
# Ratification of the Minamata Convention by the EU

## Complementary assessment of the mercury export ban

**9 June 2015**

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*June – 2015*

COWI bipro

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**export ban**

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**EUROPEAN COMMISSION**

Directorate-General Environment
Unit ENV.C.4 — Industrial Emissions

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2015 EUR [number] EN

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***Complementary assessment of the mercury export ban***

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Luxembourg: Publications Office of the European Union, 2015

ISBN [number]
doi:[number]



*Printed in* [Country]

PRINTED ON ELEMENTAL CHLORINE-FREE BLEACHED PAPER (ECF)

PRINTED ON TOTALLY CHLORINE-FREE BLEACHED PAPER (TCF)

PRINTED ON RECYCLED PAPER

PRINTED ON PROCESS CHLORINE-FREE RECYCLED PAPER (PCF)

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ASGM | Artisanal and Small-Scale Gold Mining |
| BAT | Best Available Techniques |
| BE | Belgium |
| BG | Bulgaria |
| CAS RN | Chemical Abstracts Service Registry Number |
| CN | Combined Nomenclature |
| CZ | Czech Republic |
| DE | Germany |
| DESA/UNSD | Department of Economic and Social Affairs/United Nations Statistics Division |
| DG TAXUD | Directorate-General for Taxation and Customs Union |
| DK | Denmark |
| EC | European Community |
| ECHA | European Chemicals Agency |
| EEB | European Environmental Bureau |
| EEC | European Economic Community |
| ES | Spain |
| EU | European Union |
| EUR | Euro |
| ePIC | Prior Informed Consent IT system |
| FI | Finland |
| Hg | Mercury |
| $Hg_2Cl_2$ | Mercury (I) chloride |
| HgO | Mercury (II) oxide |
| HR | Croatia |
| HS | Harmonised System |
| HU | Hungary |
| IE | Ireland |
| IED | Industrial Emissions Directive |
| IT | Italy |
| kg | kilogramme |
| LoW | List of Waste |
| LT | Lithuania |
| LU | Luxembourg |
| MADB | Market Access Database |
| MC | Minamata Convention |
| MCP | Medium Combustion Plant |
| MeHg | Methylmercury |
| MFSU | Manufacture, Formulation, Supply and Use |
| MEUR | Million Euro |
| MS | Member State(s) |
| n.d. | No data |
| NGO | Non-governmental organisation |
| NL | Netherlands |

| | |
|---|---|
| PCB | Polychlorinated biphenyl(s) |
| PIC | Prior Informed Consent |
| PT | Portugal |
| R&D | Research and Development |
| RO | Romania |
| SE | Sweden |
| SI | Slovenia |
| SK | Slovakia |
| t | Tonne |
| TFEU | Treaty on the Functioning of the European Union |
| UK | United Kingdom |
| UN | United Nations |
| UNEP | United Nations Environment Programme |
| USA | United States of America |
| WShipR | Waste Shipment Regulation |
| WTO | World Trade Organisation |
| y | Year |

# EXECUTIVE SUMMARY

## ABSTRACT

**Based on the results of questionnaire replies from Members States and industry as well as available statistical data on international trade, the effectiveness and efficiency of the Mercury Export Ban Regulation was assessed. It is estimated that, as a result of the export ban, approximately 650 tonnes of mercury per year are prevented from reaching the global market corresponding to approximately 20 % of the global mercury supply. Prior to the export ban, the mercury was predominantly exported to developing countries and very likely, a significant part of the exported mercury was used for artisanal gold mining in developing countries. Available data indicates that the decrease in supply may not have been replaced by increased mine production outside the EU, and a threefold increase in the price of mercury can most probably be attributed to the decreased supply of mercury from the EU and the USA. The responses to the study questionnaires indicate that the objective of the Mercury Export Ban Regulation to ensure safe storage of surplus mercury within the EU has still not been met. According to the stakeholders, specific conditions and criteria for environmentally safe permanent storage of metallic mercury are needed.**

### Study methodology

For the assessment of the effectiveness and efficiency of the Mercury Export Ban Regulation, information from Member States and relevant industry was collected using two questionnaires. Furthermore, Member State replies to a questionnaire undertaken as part of an assessment of the EU implementation of the Minamata Convention on Mercury have been included. The information collected by the questionnaires was combined with data from industry reporting under the Mercury Export Ban Regulation and international trade statistics from Eurostat and UN Comtrade, as well as export statistics reported as part of the implementation of the EU Waste Shipment Regulation and the EU PIC Regulation.

### Effectiveness in reducing the global mercury supply

The Mercury Export Ban Regulation significantly reduces the global mercury supply. The total amount of mercury prevented from reaching the global market is estimated at approximately 650 t/y for at least the next ten years, corresponding to approximately 20 % of the global mercury supply. The total prevented export of surplus mercury accumulated in the chlor-alkali sector is estimated at approximately 8,000 t, as well as any prevented recovery of mercury from gas purification and non-ferrous mining and smelting operations (in total 33 tonnes were reported as sent to storage during 2011-2013). Available data indicates that the decrease in supply may not have been replaced by increased mine production outside the EU, but the export of mercury from Switzerland has increased by an average of 100 t/y. The global prices of mercury have increased threefold over a few years, demonstrating the consequences of the decrease in the supply from the EU and later the USA (an export ban of mercury from the USA has been in effect since January 1, 2013).

The objective of preventing by-product mercury from gas purification and non-ferrous mining and smelting to enter the global market has not been fully met as the Mercury Export Ban Regulation does not prevent waste products from being exported for recovery of the mercury outside the EU. Waste statistics indicate that this takes place to some extent. Introduction of a ban on export of the waste products concerned could potentially improve the effectiveness of the Mercury Export Ban Regulation.

Only one incident of illegal export of mercury is reported in the stakeholder responses. The analysis of export data compared to import data of receiving countries indicate a few discrepancies, however, these would need specific investigation. So far, no evidence of actual illegal actions in this respect was observed, however, and there could be other reasons for the discrepancies.

**Effectiveness in ensuring safe storage of surplus mercury within the EU**
The responses to the study questionnaires indicate that the objective of the Mercury Export Ban Regulation to ensure safe storage of surplus mercury within the EU has still not been fully met. In 2013, the quantity reported to be sent to offsite storage from the chlor-alkali industry was 655 tonnes (about the same magnitude as the average prevented export), but it is not known whether the mercury was sent for temporary or permanent storage.

In general, representatives of the chlor-alkali industry consider storage capacities in the EU, both for temporary and permanent storage of mercury considered waste, as insufficient. According to the stakeholders, specific conditions and criteria for environmentally safe permanent storage of metallic mercury are needed. If conditions are clearly defined, this could be beneficial for the creation of a market for stabilising and permanently storing excess mercury. In addition to ensuring safe permanent storage, a market for stabilisation could be beneficial for the mercury recycling companies, which have been significantly affected by the introduction of the Mercury Export Ban Regulation.

**Efficiency**
The main cost elements for the implementation of the Mercury Export Ban Regulation are the costs of storage of mercury from the chlor-alkali sector and the lost revenues from sale and export of mercury from the sector. The costs are inevitable, inherent costs of the Mercury Export Ban Regulation and the costs per tonne of mercury prevented could consequently not be much smaller.

The costs to the chlor-alkali industry of storage of surplus mercury are estimated at an average of 0.6-2.0 MEUR/y while the lost revenue from sale of mercury is estimated at 3-5 MEUR/y. The stakeholder responses from the industry indicate that the industry considers the costs of disposal ranking first and the lost revenue second. Some stakeholders pointed at the lack of common criteria for environmentally safe permanent storage of metallic mercury as a cause of disproportionate costs. Introduction of clear criteria for permanent storage would be expected to improve the effectiveness (reducing costs for temporary storage) and efficiency of the Mercury Export Ban Regulation.

The most affected industry group is that of recyclers and exporters of mercury. The total lost revenues are estimated at an average of 5.0-7.0 MEUR/y i.e. of the same size as the lost revenue to the chlor-alkali sector from sale of mercury to the recyclers and exporters.

Compared to the direct costs, the administrative costs are estimated to be relatively small. The Member States estimated the time needed for the implementation of the Mercury Export Ban Regulation at on average one man-week per year per MS. It should be noted that much of the administration and enforcement is done as part of the general procedures for export of hazardous substances and hazardous waste. Most stakeholders in the chlor-alkali industry stated that the administrative burden from the implementation of the Mercury Export Ban Regulation was small compared to the total administrative burden of the industry and estimated the time needed at an average of approximately one man-week per year per company. The responding recyclers indicated that the administrative burden from the implementation of the Mercury Export Ban Regulation was significant and estimated that on average more than two man-weeks per year per company was used for administration.

The total benefits of preventing the 650 t/y in reaching the global mercury market cannot be estimated. In order to have a rough idea of the possible benefits an illustrative example can be given: Assuming that the reduced export of mercury from the EU would result in a 10 % decrease in the total global effects from lost IQ due to ingestion and inhalation of mercury (just one of the environmental and health impacts of mercury), and using available estimates of the costs of mercury impacts, the total benefits can be estimated to be at least 400 MEUR/y and more likely significantly higher. Compared to the estimated costs, the benefits in this example would likely be at least 100 times higher. This indicates strongly that the mercury export reductions achieved with the Mercury Export Ban Regulation have been efficient.

**Coherence**

The Waste Shipment Regulation, the PIC Regulation and Council Directive 2011/97/EU amending the Landfill Directive (Directive 1999/31/EC) are all important instruments for the implementation and enforcement of the Mercury Export Ban Regulation. According to MS and stakeholder feedback, overlaps or interfaces of the Mercury Export Ban Regulation exist with these instruments. The responses did, however, not specify any overlaps or contradictions with other EU legislation, and possible overlaps – e.g. in the reporting requirements – have not been identified.

The REACH Regulation restricts several mercury compounds and articles with metallic mercury (Entries 18, 18A and 62 of Annex XVII to the REACH Regulation). Entry 62 restricts the manufacture and placing on the market of five phenyl mercury compounds. As manufacture in the EU is restricted, in practice the export will be restricted as well (apart from re-export). Entry 18 restricting a number of mercury compounds and entry 18a restricting the marketing of various measuring devices with mercury do not restrict the manufacture and export of the compounds and articles. The objective of the restrictions is the protection of humans and the environment against mercury, and it seems not to cohere with the objectives of neither the REACH Regulation nor the Mercury Export Ban Regulation that these mercury compounds and articles can be exported and result in exposure of humans outside the EU and the global environment. In the context of the Mercury Export Ban Regulation, it is of particular significance that measuring devices with metallic mercury, both new and as waste, can be exported from the EU and thereby contribute to the global mercury supply.

**Requirements for permanent storage of metallic mercury considered waste**

As per the requirements of Article 3(3) of the Mercury Export Ban Regulation, criteria should be laid down in the Landfill Directive for the storage of waste mercury. Such criteria were sought to be defined in Directive 2011/97/EU (which amends the Landfill Directive). The Directive was negotiated with the aim of defining criteria for permanent storage, but an agreement on the criteria could not be reached in the technical committee at the time, and criteria were thus set for (up to five years) temporary storage only. Since then, almost five years has lapsed, and there is thus a need for resolving this issue, as also pointed out by some MS and industry stakeholders in the course of this study.

# RÉSUMÉ ANALYTIQUE


## SYNTHÈSE

**L'efficacité du Règlement relatif à l'interdiction des exportations de mercure a été évaluée sur la base des réponses des États membres et des acteurs de l'industrie aux questionnaires et des données statistiques disponibles concernant le commerce international. On estime que l'interdiction des exportations de mercure empêche environ 650 tonnes de mercure d'atteindre le marché mondial chaque année. Cela représente près de 20 % de l'offre mondiale de mercure. Avant l'entrée en vigueur de cette interdiction, le mercure était principalement exporté vers les pays en voie de développement, où il était très probablement utilisé en grande partie pour l'extraction artisanale de l'or. Les données disponibles indiquent que la baisse de l'offre n'a pas été compensée par une production minière accrue en dehors de l'UE et la multiplication par trois du prix du mercure est probablement imputable à la baisse de l'approvisionnement par l'UE et par les États-Unis. Les réponses aux questionnaires indiquent que l'objectif du Règlement relatif à l'interdiction des exportations de mercure visant à garantir le stockage sécurisé du mercure excédentaire dans l'ensemble de l'UE, n'a pas encore été atteint. D'après les parties intéressées, des critères et des conditions spécifiques pour un stockage permanent du mercure métallique sans danger pour l'environnement sont nécessaires.**

### Méthodologie de l'étude

Afin d'évaluer l'efficacité du Règlement relatif à l'interdiction des exportations de mercure, des données ont été recueillies auprès des États membres et des entreprises concernées à l'aide de deux questionnaires. En outre, les réponses des États membres à un questionnaire soumis dans le cadre de l'évaluation de la mise en œuvre de la Convention de Minamata sur le mercure au sein de l'UE ont été prises en compte. Les informations obtenues via les questionnaires ont été associées aux données de l'industrie portant sur le Règlement relatif à l'interdiction des exportations de mercure et aux statistiques du commerce international d'Eurostat et UN Comtrade, ainsi qu'aux statistiques d'exportation communiquées au titre de la mise en œuvre du Règlement de l'UE sur les transferts de déchets et du Règlement de l'UE sur le consentement informé préalable.

### Efficience de la réduction de l'offre mondiale de mercure

Le Règlement relatif à l'interdiction des exportations de mercure réduit considérablement l'offre mondiale de mercure. On estime que cette interdiction empêchera environ 650 tonnes de mercure d'atteindre le marché mondial chaque année pendant la prochaine décennie. Cela représente près de 20 % de l'offre mondiale de mercure. La quantité totale de mercure excédentaire accumulée dans le secteur du chlore et de la soude qui ne sera pas exportée grâce à ladite interdiction est estimée à environ 8 000 tonnes, sans compter la récupération de mercure évitée dans les industries de purification des gaz et d'extraction et de fonte des métaux non ferreux (au total, 33 tonnes ont été envoyées pour stockage entre 2011 et 2013). Les données disponibles indiquent que la baisse de l'offre n'a pu être compensée par une production minière accrue en dehors de l'UE, mais les exportations de mercure depuis la Suisse ont augmenté en moyenne de 100 tonnes par an. Les cours internationaux du mercure ont été multipliés par trois en quelques années en raison de la baisse de l'approvisionnement par l'UE puis par les États-Unis (l'interdiction de l'exportation du mercure est entrée en vigueur aux États-Unis le 1er janvier 2013).

L'objectif d'empêcher le mercure récupéré comme sous-produit issu des industries de purification des gaz et d'extraction et de fonte des métaux non ferreux d'atteindre le marché mondial n'a pas été complètement réalisé. Le Règlement

relatif à l'interdiction des exportations de mercure n'empêche pas l'exportation des déchets pour la récupération du mercure en dehors de l'UE. Les statistiques relatives aux déchets indiquent que ces pratiques ont lieu dans une certaine mesure. La mise en œuvre d'une mesure d'interdiction des exportations des déchets concernés pourrait renforcer l'efficacité du Règlement relatif à l'interdiction des exportations de mercure.

Seul un incident d'exportation illégale de mercure est signalé dans les réponses des parties intéressées. La comparaison des données d'exportation et des données d'importation des pays de réception indique quelques divergences qui nécessiteraient une étude plus poussée. Jusqu'à maintenant, aucune preuve de pratiques illégales à cet égard n'a été mise en évidence et d'autres raisons pourraient expliquer ces divergences.

**Efficience en matière de stockage sécurisé du mercure excédentaire au sein de l'UE**

Les réponses aux questionnaires indiquent que l'objectif du Règlement relatif à l'interdiction des exportations de mercure visant à garantir le stockage sécurisé du mercure excédentaire dans l'ensemble de l'UE, n'a pas encore été complètement atteint. La quantité de mercure signalée comme ayant été envoyée vers des lieux de stockage hors site dans le secteur du chlore et de la soude en 2013 est estimée à 655 tonnes (un volume équivalent au mercure dont l'exportation a été empêchée, en moyenne), mais rien ne permet de savoir si le mercure a été envoyé pour un stockage permanent ou provisoire.

De manière générale, les représentants du secteur du chlore et de la soude considèrent que les capacités de stockage permanent et provisoire du mercure considéré comme déchet au sein de l'UE sont insuffisantes. D'après les parties intéressées, des critères et des conditions spécifiques pour un stockage permanent du mercure métallique sans danger pour l'environnement sont nécessaires. Un cadre clairement défini pourrait favoriser la création d'un marché qui permettrait de stabiliser et de stocker de manière permanente le mercure excédentaire. En plus d'assurer un stockage permanent sécurisé, la régularisation du marché pourrait se révéler bénéfique pour les entreprises de recyclage du mercure, qui ont été significativement affectées par la mise en œuvre du Règlement relatif à l'interdiction des exportations de mercure.

**Efficacité**

Les principaux éléments de coût de la mise en œuvre du Règlement relatif à l'interdiction des exportations de mercure sont les frais de stockage du mercure issu du secteur du chlore et de la soude et la perte de revenus liés à la vente et à l'exportation du mercure au sein de cette industrie. Les coûts étant inévitables, les frais liés au Règlement relatif à l'interdiction des exportations de mercure et les coûts par tonne de mercure n'atteignant pas le marché ne peuvent pas être beaucoup réduits.

Selon les estimations, les coûts de stockage du mercure excédentaire pour le secteur du chlore et de la soude sont compris entre 0,6 et 2 millions d'euros par an, alors que la perte de revenus liée à la vente de mercure s'élève à 3,5 millions d'euros par an. Les réponses des parties intéressées œuvrant dans ce secteur indiquent que l'industrie place les frais liés à la mise au rebut avant la perte de revenus. Certaines de ces parties ont désigné le manque de critères communs pour un stockage permanent du mercure métallique comme la cause de ces coûts disproportionnés. La définition de critères précis pour le stockage permanent pourrait renforcer l'efficience (en réduisant les frais de stockage provisoire) du Règlement relatif à l'interdiction des exportations de mercure.

Les recycleurs et les exportateurs de mercure sont les acteurs les plus impactés du secteur. La perte de revenus totale est estimée entre 5 et 7 millions d'euros

par an en moyenne. Elle est du même ordre que la perte de revenus estimée relative aux ventes de mercure aux recycleurs et aux exportateurs pour le secteur du chlore et de la soude.

Par rapport aux frais directs, les coûts administratifs devraient être inférieurs relativement faibles. Selon les États membres, le temps nécessaire à la mise en œuvre du Règlement relatif à l'interdiction des exportations de mercure est en moyenne d'une semaine-personne par État membre. Une grande partie des mesures relatives à l'administration et à la mise en œuvre sont effectuées dans le cadre des procédures générales d'exportation des substances et des déchets dangereux. La majorité des parties intéressées œuvrant dans le secteur du chlore et de la soude ont affirmé que la charge administrative liée au Règlement relatif à l'interdiction des exportations de mercure n'était pas significative par rapport au fardeau administratif total que connaît le secteur. Elles ont estimé le temps nécessaire à environ une semaine-personne par année et par entreprise. Les recycleurs participant à l'étude ont déclaré que la charge liée au Règlement relatif à l'interdiction des exportations de mercure était importante. Ils ont estimé qu'environ plus de deux semaines-personne par année par entreprise étaient consacrées à l'administration.

Le total des bénéfices relatifs aux 650 tonnes de mercure qui n'atteignent pas chaque année le marché mondial du mercure ne peut pas être estimé. Voici un exemple qui permet de se faire une idée des bénéfices potentiels à titre illustratif : si on estime que la baisse des exportations de mercure depuis l'UE entraîne une diminution de 10 % du total des effets mondiaux relatifs aux points de QI perdus en raison de l'ingestion et de l'inhalation de mercure (l'un des impacts du mercure sur l'environnement et la santé, parmi d'autres), et en se basant les estimations disponibles quant aux coûts relatifs aux impacts du mercure, les bénéfices peuvent être estimés à plus de 400 millions d'euros par année, très probablement beaucoup plus. Les bénéfices illustrés par cet exemple seraient donc 100 fois plus élevés que les coûts estimés. Cela indique clairement que la diminution des exportations de mercure entraînée par le Règlement relatif à l'interdiction des exportations de mercure s'est révélée efficace.

**Cohérence**

Règlement de l'UE sur les transferts de déchets, le Règlement de l'UE sur le consentement informé préalable et la directive 2011/97/UE du Conseil modifiant la directive relative à la mise en décharge des déchets (Directive 1999/31/CE) sont des instruments importants pour la mise en œuvre et l'application du Règlement relatif à l'interdiction des exportations de mercure. Selon l'opinion des parties intéressées et des États membres, des chevauchements ou des interconnexions du Règlement relatif à l'interdiction des exportations de mercure existent avec ces instruments. Toutefois, les réponses n'indiquaient pas de chevauchement ou de contradictions spécifiques avec d'autres réglementations européennes et aucun chevauchement éventuel (par exemple, dans les obligations de déclaration) n'a été identifié.

Le Règlement REACH limite certains composés du mercure et articles comprenant du mercure métallique (dispositions 18, 18A et 62 de l'Annexe XVII du Règlement REACH). La disposition 62 restreint la fabrication et la mise sur le marché de cinq composés phénylmercuriques. La fabrication au sein de l'UE étant contrôlée, en pratique les exportations seront également réduites (à l'exception de la réexportation). La disposition 18 limite un certain nombre de composés du mercure, et la disposition 18A limitant la mise sur le marché de plusieurs équipements de mesure contenant du mercure ne restreint ni la fabrication ni l'exportation des composés et des articles. Ces restrictions ont pour but de protéger les hommes et l'environnement du mercure et le fait que ces articles et composés du mercure puissent être exportés et puissent entraîner l'exposition des hommes en dehors de l'UE et de l'environnement mondial ne semblent pas cohé-

rent avec le Règlement REACH et le Règlement relatif à l'interdiction des exportations de mercure. Dans le cadre du Règlement relatif à l'interdiction des exportations de mercure, il convient de noter tout particulièrement que les dispositifs de mesure contenant du mercure métallique (neuf ou de récupération) peuvent être exportés depuis l'UE et contribuer ainsi à l'offre mondiale de mercure.

**Exigences relatives au stockage permanent du mercure métallique considéré comme déchet**

D'après les Articles 3/3 du Règlement relatif à l'interdiction des exportations de mercure, les critères doivent être définis dans la directive relative à la mise en décharge des déchets pour le stockage des déchets de mercure. Lesdits critères ont fait l'objet d'une tentative de définition dans la directive 2011/97/UE, qui modifie la directive relative à la mise en décharge des déchets. La directive a été négociée dans le but de définir des critères de stockage permanent, mais l'accord relatif à ces critères n'a pas abouti au sein du comité technique et ils ont été appliqués à cinq ans (maximum) de stockage provisoire uniquement. Depuis, cinq années se sont presque écoulées et ce problème doit toujours être résolu, comme l'ont souligné les parties intéressées du secteur et des États membres au cours de cette étude.

# 1 INTRODUCTION

**Background**
To reduce the risk of exposure to mercury for humans and the environment Regulation 1102/2008[1] on the banning of exports of metallic mercury and mercury compounds and mixtures and the safe storage of metallic mercury (Mercury Export Ban Regulation) was adopted in the EU in 2008.

In 2013 the negotiations on a global legally binding instrument on mercury pollution were concluded in Geneva on 20 January 2013 and the resulting Minamata Convention on Mercury was opened for signature in Japan in October 2013. Currently, the EU is making preparations to ratify the Minamata Convention.

Therefore a study on the 'Assistance to the Commission in view of the European Union (EU) becoming a party to the Minamata Convention on mercury' was carried out for the European Commission. The objective of that study was to identify measures that would need to be taken at EU level, for the EU to comply with the provisions of the convention, as well as to assess the impacts of such measures.

Article 1 of the Mercury Export Ban Regulation (Regulation 1102/2008) stipulates that

1. *The export of metallic mercury (Hg, CAS RN 7439-97-6), cinnabar ore, mercury (I) chloride ($Hg_2Cl_2$, CAS RN 10112-91- 1), mercury (II) oxide (HgO, CAS RN 21908-53-2) and mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of at least 95 % weight by weight from the Community shall be prohibited from 15 March 2011.*

2. *The prohibition shall not apply to exports of compounds referred to in paragraph 1 for research and development, medical or analysis purposes.*

3. *The mixing of metallic mercury with other substances for the sole purpose of export of metallic mercury shall be prohibited from 15 March 2011.*

Articles 5 and 6 of the Regulation impose some reporting requirements on Member States and on economic actors. Information available to the Commission is, however, incomplete and does not allow for getting a clear and complete picture of transboundary shipments of mercury, or the absence of such shipments.

Obtaining more precise information on these aspects is considered necessary to complement the 2010 evaluation of the Review of the Community Strategy concerning Mercury as well as the service contract on the EU becoming a Party to the Minamata Convention on Mercury.

The European Commission contracted COWI and BiPRO to perform the current study under the contract title 'Ratification of the Minamata Convention by the EU- complementary assessment of the mercury export ban'.

1 Regulation (EC) No. 1102/2008 of the European Parliament and of the Council of 22 October 2008 on the banning of exports of metallic mercury and certain mercury compounds and mixtures and the safe storage of metallic mercury.

**Objectives**
The objectives of this study are

- to collect data on export flows of metallic mercury, compounds and mixtures as identified in Regulation 1102/2008 (the Mercury Export Ban Regulation), from the EU, in order to complement the existing data already available to the Commission and to get a more complete picture on any export of mercury

- to identify possible failures in the implementation of the export ban, e.g. the occurrence of illegal exports of these substances from the EU

- to assess the impacts of the mercury export ban on economic actors, in particular commodity traders and businesses active in the recycling/recovery of mercury, also in terms of administrative burden resulting from the associated reporting obligations (Articles 5 and 6 of the Mercury Export Ban Regulation) and to draw conclusions on its effectiveness and efficiency.

**Study team**
This study was performed by COWI A/S Denmark and BiPRO, Germany, in the period November 2014 – March 2015. The individual contributors to the study are Jakob Maag, Carsten Lassen and Ausra Sablinskiene, COWI and Elisabeth Zettl and Alexander Potrykus, BiPRO.

# 2 MERCURY EXPORTS - ANALYSIS OF STATISTICAL DATA

In order to get a more complete picture on the export of mercury and mercury compounds and to identify possible failures in the implementation of the export ban, a collection and analysis of available statistical data was carried out with the aim of describing the development of mercury export from the EU and related trends, as well as identifying inconsistencies that could perhaps indicate occurrences of illegal export.

## 2.1 Collected data types

In a first step, available quantitative information on exports of metallic mercury, mercury compounds and mixtures from the EU was collected. Different databases and literature exist with different descriptions and allocations of mercury product and waste categories.

**Considered substances - and waste codes**
To collect all relevant export data on mercury, relevant mercury codes were identified.

According to Art. 1(1) of the Mercury Export Ban Regulation, the export of metallic mercury (Hg, CAS RN 7439-97-6), cinnabar ore, mercury (I) chloride ($Hg_2Cl_2$, CAS RN 10112-91-1), mercury (II) oxide (HgO, CAS RN 21908-53-2) and mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of at least 95 % weight by weight from the Community shall be prohibited from 15 March 2011.

Art. 1(2) of the Mercury Export Ban Regulation states that the *prohibition shall not apply to exports of compounds referred to in paragraph 1 for research and development, medical or analysis purposes.*

Art. 2 of the Regulation additionally stipulates that

*(a) metallic mercury that is no longer used in the chlor-alkali industry;*

*(b) metallic mercury gained from the cleaning of natural gas;*

*(c) metallic mercury gained from non-ferrous mining and smelting operations; and*

*(d) metallic mercury extracted from cinnabar ore in the Community as from 15 March 2011*

*shall be considered as waste and be disposed of in accordance with Directive 2006/12/EC on waste[2] in a way that is safe for human health and the environment.*

In legislation and databases different descriptions and codes exist for metallic mercury, mixtures and mercury compounds. They are specifically addressed by the PIC Regulation[3], Regulation (EEC) No 2658/87 on the tariff and statistical

[2] Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste.

[3] Regulation (EU) No. 649/2012 of the European Parliament and of the Council of 4 July 2012 concerning the export and import of hazardous chemicals (replacing Regulation

nomenclature and its implementing acts[4] and the Prodcom Regulation on the establishment of a Community survey of industrial production[5].

Relevant codes for metallic mercury, mixtures and mercury compounds are shown in Table 2-1. The codes include mercury compounds which are still allowed to be exported (allocated to the same code as mercury compounds which are addressed by the export ban). Separate codes do not exist for the cinnabar ore and the two restricted mercury compounds.

Although amalgams with less than 95 % mercury are not directly addressed by the export ban, the export data for amalgam was considered for the analysis. Dental amalgam capsules are not amalgams, but the capsules contain metallic mercury, which at the time of application of the filling is mixed with other components to form an amalgam. They may, however, to some extent be traded as amalgams and registered as amalgams in the import/export statistics.

(EC) No. 689/2008 of the European Parliament and of the Council of 17 June 2008 concerning the export and import of dangerous chemicals replacing Regulation (EC) No. 304/2003 of the European Parliament and of the Council of 28 January 2003 concerning the export and import of dangerous chemicals).

[4] Council Regulation (EEC) No. 2658/87 on the tariff and statistical nomenclature and on the Common Customs Tariff and the implementing Regulations annually amending Annex I.

[5] Council Regulation (EEC) No. 3924/91 of 19 December 1991 on the establishment of a Community survey of industrial production.

***Table 2-1 Codes considered for metallic mercury, mixtures and mercury compounds addressed by the Mercury Export Ban Regulation***

| Substances addressed by Mercury Export Ban Regulation | CAS Number | HS code * | HS code description | CN code ** | CN code description | Prodcom code *** | Prodcom code description |
|---|---|---|---|---|---|---|---|
| Metallic mercury and mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of at least 95 % weight by weight | 7439-97-6 | 280540 | Mercury | 2805 4010 | Mercury<br>- in flasks of a net content of 34.5 kg (standard weight), of a fob value, per flask, not exceeding EUR 224) | 20.13.23.00* | Alkali or alkaline-earth metals; rare earth metals, scandium and yttrium; mercury |
| | | | | 2805 4090 | Mercury<br>- other | | |
| Cinnabar ore | | 2852 | Inorganic or organic compounds of mercury, whether or not chemically defined, excluding amalgams.<br>- chemically defined<br>- other | Introduced in 2007: 2852<br><br>Introduced in 2012:<br><br>2852 1000<br>2852 9000 | Inorganic or organic compounds of mercury, whether or not chemically defined, excluding amalgams,<br>-chemically defined<br>- other | 20.13<br><br>20.13.52.70<br><br>20.13.52.75 | Compounds, inorganic or organic, of mercury (excluding amalgams)<br>..chemically defined as mercury<br>..not chemically defined as mercury |
| Mercury (I) chloride ($Hg_2Cl_2$) | 10112-91-1 | | | | | | |
| Mercury (II) oxide (HgO) | 21908-53-2 | | | | | | |
| | | 2852 10<br>2852 90 | | | | | |
| Amalgams (not addressed)**** | | 284390 | -Other compounds; amalgams | 28439010 | Amalgams of precious metals | 20.13.51.85 | Colloidal precious metals; compounds and amalgams of precious metals (excluding silver nitrate) |

*: International harmonised (HS) codes used e.g. for UN international trade statistics (Comtrade) **: Combined nomenclature (CN) used for EU international trade statistics (Council Regulation (EEC) No 2658/87): ***: Prodcom codes used for EU production statistics (Council Regulation (EEC) No 3924/91); ****Some capsules for dental amalgams may be registered as amalgams.

Specific waste codes are addressed by the European list of waste[6], the Basel Convention[7] and the Waste Shipment Regulation[8]. After the analysis of these waste codes and other relevant literature on mercury (e.g. COWI and Concord East/West, 2008), codes shown in Table 2-2 were considered relevant for further analysis. These codes all relate to mercury but the mercury share, which is often small, cannot be determined. Mercury can also be contained in waste streams allocated to other waste codes which do not mention mercury specifically, but this amount is considered low.

***Table 2-2 Relevant codes from the Basel Convention and the European list of waste for waste streams including mercury, status 2014***

| Waste codes | Addressed by | Description |
|---|---|---|
| Y29 | Annex I of Basel Convention | Wastes having as constituents: mercury; mercury compounds |
| A1010 | Annex VIII of Basel Convention | Metal wastes and waste consisting of alloys of any of the following (but excluding such wastes specifically listed on list B):<br>• Antimony<br>• Arsenic<br>• Beryllium<br>• Cadmium<br>• Lead<br>• Mercury<br>• Selenium<br>• Tellurium<br>• Thallium |
| A1030 | Annex VIII of Basel Convention | Wastes having as constituents or contaminants any of the following:<br>• Arsenic; arsenic compounds<br>• Mercury; mercury compounds<br>• Thallium; thallium compounds |
| A1180 | Annex VIII of Basel Convention | Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB capacitors, or contaminated with Annex I constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annex III (note the related entry on list B B1110)10 |
| 05 07 01* | European list of waste | wastes from natural gas purification and transportation - wastes containing mercury |

[6] Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste including amendments.

[7] Basel Convention on the control of transboundary movements of hazardous wastes and their disposal.

[8] Regulation (EC) No. 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste.

| Waste codes | Addressed by | Description |
|---|---|---|
| 06 04 04* | European list of waste | metal-containing wastes other than those mentioned in 06 03 - wastes containing mercury |
| 06 07 03* | European list of waste | wastes from the MFSU of halogens and halogen chemical processes - barium sulphate sludge containing mercury |
| 10 14 01* | European list of waste | waste from crematoria - waste from gas cleaning containing mercury |
| 16 01 08* | European list of waste | end-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08) - components containing mercury |
| 16 03 07* | European list of waste | metallic mercury** |
| 16 06 03* | European list of waste | batteries and accumulators - mercury-containing batteries |
| 17 09 01* | European list of waste | other construction and demolition wastes – construction and demolition wastes containing mercury |
| 18 01 10* | European list of waste | wastes from natal care, diagnosis, treatment or prevention of disease in humans – amalgam waste from dental care |
| 19 03 08* | European list of waste | partially stabilised mercury** |
| 20 01 21* | European list of waste | separately collected fractions (except 15 01) - fluorescent tubes and other mercury-containing waste |

* Hazardous

** New waste codes introduced in Commission Decision 2014/955/EU amending Decision 2000/532/EC on the list of waste

**Data sources**

After definition of the relevant mercury and mercury waste codes, relevant data sources were identified.

**Eurostat database[9]**

According to Regulation (EC) No 471/2009 on Community statistics relating to external trade with non-member countries[10] MS are required to record annually any export or import in the event that goods leave or enter the statistical territory of the Community. The quantities of these goods reported are allocated to the relevant CN codes and are listed in the database of internal trade from Eurostat, the statistical office of the European Union providing the EU with statistics at European level. The database enables comparisons between countries and regions. It includes the CN code description, reporting country, partner country, type of trade flow, year and reporting unit.

[9] http://epp.eurostat.ec.europa.eu/newxtweb/submitformatselect.do

[10] Regulation (EC) No 471/2009 of the European Parliament and of the Council of 6 May 2009 on Community statistics relating to external trade with non-member countries and repealing Council Regulation (EC) No 1172/95

**Market Access Database**[11]
The Market Access Database (MADB) provides information to companies exporting from the EU about import conditions in third country markets. It also provides an overview of trade flows of goods between EU and non-EU countries for specific products. The source for these data is the database on international trade from Eurostat.

**Prodcom database**[12]
Council Regulation (EEC) No 3924/91 on the establishment of a Community survey of industrial production requires the MS to collect and annually report data on the volume and value of manufactured goods as defined in the Prodcom list. The list is regularly up-dated. The data are listed in the Prodcom database from Eurostat. For completeness, imports and exports are also indicated, including year, reporting country and partner country for the respective Prodcom codes, which reflect single CN codes or groups of CN codes. The import and export data are retrieved from the database on internal trade from Eurostat.

**UN Comtrade database**[13]
The UN Comtrade is a repository of official global trade statistics and relevant analytical tables. It contains annual trade statistics starting from 1962. It receives the statistical data on imports and exports from the national statistical offices of the involved countries (139 countries (areas), representing 93.1 % of world trade; status 2012). For each of the involved countries imports and exports are reported (on the one hand from the importing countries and on the other hand from the exporting countries), as well as the corresponding HS code, the partner country, the year and the reporting unit.

**The PIC Regulation and MS Chemical Reports**
Regulation 649/2012 concerning the export and import of hazardous chemicals (PIC Regulation) administers the export and import of certain hazardous chemicals and places obligations on companies who wish to export/import these chemicals to/from non-EU countries. Article 10 of the PIC Regulation stipulates that exporters and importers of hazardous chemicals listed in Annex I of the Regulation, during the first quarter of each year, have to inform the designated national authority of the exporter's Member State regarding the quantity of the chemical, as a substance and as contained in mixtures or in articles, shipped to each Party or other country during the preceding year. That information shall be given together with a list of the names and addresses of each natural or legal person importing the chemical into a Party or other country to which shipment took place during the same period. Each importer within the Union shall provide the equivalent information for the quantities imported into the Union. The reported information is handled in the Prior Informed Consent IT system (ePIC) (maintained by ECHA) which allows information to be securely exchanged between industry users, authority users and customs users.

The hazardous chemicals subject to export notification procedure are listed in Annex I, Part 1 which covers one entry covering all mercury compounds*: 'Mercury compounds, including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds except mercury compounds listed in Annex V'.* Annex V, in which chemicals/article(s) subject to the export ban are listed, includes the substances addressed by the Mercury Export Ban Regulation: cinnabar ore, mercury (I) chloride ($Hg_2Cl_2$, CAS No 10112-91-1) and mercury (II) oxide (HgO, CAS No 21908-53-2) except compounds exported for research and development, medical or analysis purposes as well as metallic mercury and mixtures of metallic mercury with other sub-

[11] http://madb.europa.eu/madb/statistical_form.htm

[12] http://epp.eurostat.ec.europa.eu/newxtweb/submitformatselect.do

[13] http://comtrade.un.org/data/

stances, including alloys of mercury, with a mercury concentration of at least 95 % weight by weight. Addressed mercury compounds reported as substance are allocated to HS code 285200.

Annex I, Part 3 includes the list of chemicals subject to the PIC procedure. This annex includes '*Mercury compounds, including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds*' used as pesticides. Mercury compounds reported as mixtures in Part 3 are allocated to HS code 380850 (insecticides, rodenticides, fungicides, herbicides, anti-sprouting products and plant-growth regulators, disinfectants and similar products, put up in forms or packings for retail sale or as preparations or articles, containing one or more of the following substances: i.a. mercury compounds).The PIC Regulation does not apply to chemicals exported for the purpose of research or analysis in quantities that are unlikely to affect human health or the environment and that in any event do not exceed 10 kg from each exporter to each importing country per calendar year. Article 10 of the PIC Regulation, 'Information on export and import of chemicals' includes no specific requirements to provide information on the intended use and type of mercury compound exported. The chemical reports from the MS are collected by the European Commission and used to draft annual summary reports. The reported data include information on the type of chemical exported/imported, the year, the exporter, the importing country, the importer and the quantity.

**Waste shipment data**[14]
The Waste Shipment Regulation (WShipR), which implements the Basel Convention, governs transboundary shipments of waste and requires all hazardous waste movements to be notified in advance to the authorities. Some non-hazardous types of waste are also covered. Member States report annually on the waste that is shipped across their borders. Data are allocated to Y-codes and A-codes as defined in the Basel Convention as well as to waste codes as defined in the European list of waste. They include inter alia the reporting year, the reporting country, the importing/exporting country, the reported quantity and the disposal method.

**Direct contacts to MS and other stakeholders**
National authorities from the EU28 MS and other relevant stakeholders were asked via questionnaires whether they could provide additional data not yet reported due to above mentioned requirements (see Appendices 1 and 2).

**Literature**
Relevant literature on the mercury issue in the EU context were evaluated in regard to specific mercury export data. Relevant reports are BIO IS (2010 and 2012), COWI (2012, 2014), Concord East (2006), COWI and Concord East (2008) and BiPRO (2010), internal draft final report COWI/BiPRO/ICF (2015).

[14] http://ec.europa.eu/eurostat/web/waste/transboundary-waste-shipments

*Table 2-3 EU28-extra import and export of mercury, mercury compounds and amalgams. Source: Eurostat database: 'International trade detailed data'.*

| CN code | Type of commodity | Export in tonnes | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| 2805 4010 | Mercury In flasks of a net content of 34,5 kg (standard weight), of a fob value, per flask, not exceeding EUR 224 | 83.8 | 139.5 | 191.4 | 75.1 | 514.4 | 462.5 | 66.2 | 0.9 | 68.9 | n.a. |
| 2805 4090 | Mercury - other | 319.3 | 125.8 | 406.6 | 523.9 | 694.4 | 503.8 | 242.4 | 20.3 | 17.7 | n.a. |
| 2852 0000 | Compounds, inorganic or organic, of mercury, excluding amalgams * | - | - | 1663.7 | 257.4 | 126.6 | 107.6 | 54.0 | - | - | - |
| 2852 1000 | Inorganic or organic compounds of mercury, excluding amalgams - chemically defined | - | - | - | - | - | - | - | 114.3 | 89.6 | n.a. |
| 2852 9000 | Inorganic or organic compounds of mercury, excluding amalgams, - not chemically defined | - | - | - | - | - | - | - | 45.2 | 123.0 | n.a. |
| 2843 9010 | Amalgams of precious metals | 7.7 | 15.7 | 15.9 | 51.3 | 9.6 | 5.9 | 10.1 | 11.0 | 13.2 | n.a. |
| | | Import in tonnes | | | | | | | | | |
| 2805 4010 | Mercury In flasks of a net content of 34.5 kg (standard weight), of a fob value, per flask, not exceeding EUR 224 | 3.4 | 3.1 | 27.5 | 10.8 | 18.8 | 0.0 | 7.8 | n.a. | n.a. | n.a. |
| 2805 4090 | Mercury - other | 272.1 | 254.4 | 247.5 | 239.8 | 376.8 | 97.1 | 31.7 | 28.7 | 49.9 | n.a. |
| 2852 0000 | Compounds, inorganic or organic, of mercury, excluding amalgams * | - | - | 611.7 | 514.6 | 127.4 | 138.2 | 43.1 | | | |
| 2852 1000 | Inorganic or organic compounds of mercury, excluding amalgams, - chemically defined | - | - | - | - | - | - | - | 3.1 | 19.6 | n.a. |
| 2852 9000 | Inorganic or organic compounds of mercury, excluding amalgams, - not chemically defined | - | - | - | - | - | - | - | 35.5 | 34.1 | n.a. |
| 2843 9010 | Amalgams of precious metals | 8.1 | 3.9 | 4.5 | 7.8 | 6.8 | 16.6 | 8.3 | 25.0 | 8.7 | n.a. |

* Before 2007, mercury compounds were registered in a group 'other' with various other compounds. The CN code 28520000 was in 2012 split into two codes.

### *2.1.1 Metallic mercury*

The exports of metallic mercury from EU28 are divided into the time periods before and after the mercury export ban which is in place since 15 March 2011. Since reporting year 2012, it is fully in place.

In order to analyse the export data, the data on export from EU28, as reported in the Eurostat database, are compared with the data on imports from EU reported by non-EU importing countries to the UN Comtrade database. In principle, the reported exports by the MS should be the same as the reported imports from MS by non-EU importing countries.

In Table 2-4 exports of mercury (CN code 28054010 + 28054090) from EU28 are shown by import country during the period 2005-2011 (before the mercury export ban entered into force) and compared with import data by importing countries provided in the UN Comtrade database. The main import countries were Vietnam, Singapore, India, Peru, Colombia and Iran.

***Table 2-4 Export of mercury from EU28 by importing country 2005-2011 Sources: Eurostat database: 'international trade detailed data'; DESA/UNSD, United Nations Comtrade database***

| Country | Export of mercury from EU28 Total 2005-2011 Eurostat tonnes * | Percent of total exports indicated in Eurostat database | Import of mercury from EU28 2005-2011 UN Comtrade tonnes** |
|---|---|---|---|
| Vietnam | 556.4 | 13% | no quantity provided |
| Singapore | 544.6 | 13% | 751.2 |
| India | 426.5 | 10% | 580.5 |
| Peru | 338.2 | 8% | 390.2 |
| Colombia | 234.3 | 5% | 381.2 |
| Iran | 205.4 | 5% | 155.8 |
| Thailand | 186.5 | 4% | 36.7 |
| United States | 147.8 | 3% | 82.2 |
| Guyana | 132.2 | 3% | 103.0 |
| Panama | 128.5 | 3% | 119.5 |
| Morocco | 126.8 | 3% | 28.6 |
| Philippines | 104.7 | 2% | 141.2 |
| Togo | 79.2 | 2% | 62.3 |
| Brazil | 70.5 | 2% | 108.5 |
| Hong Kong | 70.3 | 2% | 118.2 |
| Argentina | 67.0 | 2% | 103.9 |
| Pakistan | 55.8 | 1% | 108.2 |
| Indonesia | 54.4 | 1% | 63.2 |
| Ecuador | 50.2 | 1% | 80.5 |

| Country | Export of mercury from EU28 Total 2005-2011 Eurostat tonnes * | Percent of total exports indicated in Eurostat database | Import of mercury from EU28 2005-2011 UN Comtrade tonnes** |
|---|---|---|---|
| China (People's Republic of) | 46.1 | 1% | 0 |
| Ghana | 46.0 | 1% | 59.9 |
| Korea, Republic of (South Korea) | 42.2 | 1% | 46.7 |
| Burkina Faso | 38.7 | 1% | 4.0 |
| Sudan | 35.8 | 1% | 0 |
| Other, or not specified | 561 | 13% | no data |

* Total of CN codes: 2805 4010 and 2805 4090

** CN code: 280540 (which is the sum of CN codes 2805 4010 and 2805 4090)

The data provided in the UN Comtrade database for non-EU countries importing mercury from EU Member States are often higher than the export data from Eurostat; in general within a deviation of ±50 %. In some cases data provided in the Comtrade database are significantly higher and in four cases data are significantly lower.

In the Eurostat database from 2012 onwards, when the export ban was already in place, the pattern has changed significantly. The USA and Norway represented 92.7 tonnes accounting for 86% of the exports from EU28[15]. These data were also compared with data provided in the UN Comtrade database from importing countries (see Table 2-5).

***Table 2-5 Export of mercury from EU28 by importing country 2012-2013; Sources: Eurostat database: 'international trade detailed data'; DESA/UNSD, United Nations Comtrade database***

| Country | Export of mercury from EU28 by importing country Total 2012-2013 Eurostat * tonnes | Percent of total exports from EU28 indicated in Eurostat database | Import of mercury from EU28 Total 2012-2013 UN Comtrade ** tonnes |
|---|---|---|---|
| Norway | 68.9 *** | 64 % | 0 |
| United States | 23.8 | 22 % | 19.7 |
| Israel | 5.0 | 5 % | 10.7 |
| Brazil | 4.2 | 4 % | 8.3 |
| United Arab Emir- | 1.4 | 1 % | 0 |

[15] After correction of the export to Norway from Denmark, no export to Norway was carried out, which means that the United States with 23.8 tonnes represents 61.2 % of the export from EU28.

| Country | Export of mercury from EU28 by importing country Total 2012-2013 Eurostat * tonnes | Percent of total exports from EU28 indicated in Eurostat database | Import of mercury from EU28 Total 2012-2013 UN Comtrade ** tonnes |
|---|---|---|---|
| ates | | | |
| Malaysia | 1.2 | 1 % | 2.6 |
| Singapore | 1.1 | 1% | 3.5 |
| Iran | 0.7 | 1% | 0 |
| Mexico | 0.6 | 1% | 0.7 |
| Switzerland | 0.3 | 0.3% | 5.2 |
| India | 0.2 | 0.2% | 52.1 |
| Morocco | 0.1 | 0.1% | 0.4 |
| Turkey | 0.1 | 0.1% | 3.4 |
| Tanzania, United Republic of | 0.1 | 0.1% | 1.1 |
| Algeria | 0.1 | 0.1% | 0.1 |
| Other, not specified | 0.0 | | 153.4 |
| **Sum (total exports)** | **107.8 (38.9)****** | | **261.2** |

* Total of CN codes: 2805 4010 and 2805 4090.

** Comtrade code: 280540 (which is the sum of CN codes 28054010 and 28054090).

*** This export from Denmark was specifically checked by Statistics Denmark for this study with the result that no metallic mercury had been exported to Norway at all from the EU (reporting companies had used wrong CN codes; Statistics Denmark, 2015).

**** After correction of the export to Norway the sum amounts to 38.9 tonnes (in brackets).

In the comparison for the time period 2012-2013, only for a few MS export data are in the same range, in particular the data regarding Norway and India differ significantly. In the UN Comtrade database, no import data are reported from Norway (Eurostat database: 68.9 tonnes export to Norway)[16] and 52.1 tonnes of mercury are reported to be imported by India from EU28 (Eurostat database: 0.2 tonnes export to India). According to Eurostat the main importing countries were Norway and the United States, whereas considering importing countries in the UN Comtrade database, India, the United States, Israel and Brazil are indicated as main importing countries from the ones listed in Eurostat. In the UN Comtrade database a lot of imports to non-EU countries from EU28 were indicated, which were not listed in Eurostat.

Additionally a comparison was made for the countries, which, according to the Eurostat database, exported mercury in the time period 2005-2011 (those listed in Table

[16] After correction of the export to Norway from Denmark no export to Norway was carried out. This will be adjusted in the Eurostat database in October 2015.

2-4), for the time period 2012-2013 when the export ban was already in place (see Table 2-6).

*Table 2-6 Comparison of mercury exports from EU28 MS, which exported mercury in the time period 2005-2011, by importing country 2012-2013 Sources: Eurostat database: 'International trade detailed data'; DESA/UNSD, United Nations Comtrade database.*

| Country | Export of mercury from EU28 Total 2012-2013 Eurostat database tonnes * | Import of mercury from EU28 Total 2012-2013 UN Comtrade database tonnes** |
|---|---|---|
| Vietnam | 0.0 | 0.03 |
| Singapore | 1.1 | 3.5 |
| India | 0.2 | 52.1 |
| Peru | 0.0 | 0.0 |
| Colombia | 0.0 | 13.6 |
| Iran | 0.7 | n.d. |
| Thailand | 0.0 | 0.0 |
| United States | 23.8 | 19.7 |
| Guyana | 0.0 | 45.0 |
| Panama | 0.0 | 0.0 |
| Morocco | 0.1 | 0.4 |
| Philippines | 0.0 | 0 |
| Togo | 0.0 | 2.2 |
| Brazil | 4.2 | 8.3 |
| Hong Kong | 0.0 | 42.4 |
| Argentina | 0.0 | 2.4 |
| Pakistan | 0.0 | 0.2 |
| Indonesia | 0.0 | 0.1 |
| Ecuador | 0.0 | 0.0 |
| China (People's Republic of) | 0.0 | 0.0 |
| Ghana | 0.0 | 0.01 |
| Korea, Republic of (South Korea) | 0.0 | 0.004 |
| Burkina Faso | 0.0 | 0.0 |
| Sudan | 0.0 | 13.2 |
| **Sum** | **30.1** | **203.1** |

According to Eurostat only small amounts were exported from EU28 to these countries in the time period 2012-2013 after the Mercury Export Ban Regulation entered into force (in total 30.1 tonnes). In the UN Comtrade database however, some importing countries still indicated significant imports from the EU28, although the export ban

was already in place (in total 203.1 tonnes) (see Table 2-6). The main importing countries are India, Guyana and Hong Kong. The main exporting countries for these importing countries are Finland, the Netherlands, Spain and the UK.

India imports are reported to come mainly from Finland (14.5 tonnes in 2012), the Netherlands (25.9 tonnes in 2013) and Spain (3.1 tonnes in 2012, 8.3 tonnes in 2013). Guyana imports are reported to come from Spain (37 t in 2012) and the UK (7.98 tonnes in 2012). According to the Natural Resources Defense Council (2015), Hong Kong imports were coming from the Netherlands (5.1 tonnes in 2012) and from Italy (37.3 tonnes in 2013). This was also shown in the summary sheet of mercury imports into Hong Kong from 2009-2014 from environmental officials in Hong Kong.

Observing overall imports from EU28 to non-EU countries reported by non-EU importing countries, the total export in the period 2012-2013 amounted to 261 tonnes according to the UN Comtrade database (see Table 2-5). The main importing countries are India, Guyana, Hong Kong, South Africa, USA, Colombia, Sudan, Israel, Brazil and Zimbabwe; each importing more than seven tonnes in the time period 2012-2013. Germany, the Netherlands, Spain and the UK were indicated as main exporting countries. According to the Eurostat database 107.8 tonnes of mercury in total were exported from EU28 in the time period 2012-2013, mainly to Norway and the USA, from Denmark and Germany.

According to the Mercury Export Ban Regulation, metallic mercury is forbidden without exemptions to be exported since 15$^{th}$ March 2011. Therefore, the national authorities of MS for which significant exports were reported in the Eurostat database since 2012 (Germany, Denmark) as well as of MS for which significant inconsistencies were identified (Germany, Netherlands, Spain and the UK), were contacted. They were informed about the data identified in the Eurostat and the Prodcom database for the time period 2012-2013 and were asked for possible explanations.

One possible explanation received so far regarding inconsistencies, is that most importing countries indicate the country of origin as partner country, which could be a country other than the country of dispatch, in the Comtrade database. If for example a non-EU country imports mercury of German origin not directly from Germany, but from another country, it will indicate Germany as a partner country in the Comtrade database, whereas in Germany the country will be indicated as partner country, to which the mercury was initially exported as e.g. at the time of export the final country of destination was possibly not yet known. Further explanations could be different or wrong CN code allocations (as was the case with exports from Denmark to Norway), errors in exporters or importers reporting to customs (including common reporting of mixed shipments), time lags in data reporting between exporting and importing country and statistical confidentiality of data differentiating in exporting and importing country (National authorities ES, DE, 2015). Additionally, intentional misreporting by EU exporters, meaning illegal export, cannot be ruled out as a possible explanation.

The statistical bureau of Denmark checked the metallic mercury export data reported for Denmark for this study with the specific reporting companies and was able to clarify this issue: The companies allocated their exports to the wrong CN codes; no metallic mercury was exported from Denmark since 2011 (Statistics Denmark, 2015). Therewith the total export of metallic mercury from the EU since 2012 has to be adjusted to 38.9 tonnes.

The exports of mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of less than 95 % weight by weight are still allowed. If such mixtures were exported and allocated to the CN code 285040 (metallic mercury) this could also explain the continued export.

From the questionnaire replies and other contact to MS, the impression arose that Article 1 of the Mercury Export Ban Regulation can be misinterpreted. In Article 1 (1) it reads that export of metallic mercury (Hg, CAS RN 7439-97-6), cinnabar ore, mercury (I) chloride ($Hg_2Cl_2$, CAS RN 10112-91-1), mercury (II) oxide (HgO, CAS RN 21908-53-2) and mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of at least 95 % weight by weight from the Community shall be prohibited from 15 March 2011 without mentioning the word compounds. Article 1 (2) stipulates that the prohibition shall not apply to exports of compounds referred to in paragraph 1 for research and development, medical or analysis purposes. It seems not totally clear that the exemptions for export do not refer to metallic mercury but only to mercury compounds. This could also result in unintentionally illegal export. Therefore Article 1 could be amended to state clearly that the exemptions do only refer to mercury compounds and include the wording 'mercury compounds' already in Article 1(1).

The background for the indicated exports in the Comtrade database could be further investigated to establish if in fact illegal exports are taking place. If illegal exports do take place, the Mercury Export Ban Regulation may need to be better enforced.

### *2.1.2 Mercury compounds*

Considering the data on exports of mercury compounds provided in the Eurostat database, it can be observed that exports decreased over the years from 2005-2011. With the implementation of the Mercury Export Ban Regulation the exports seem to increase again (see Table 2-3). According to the Mercury Export Ban Regulation, the mercury compounds cinnabar ore, mercury (I) chloride and mercury (II) oxide are forbidden to be exported with the exemption for research and development, medical or analysis purposes. The other compounds can still be exported without restrictions under the Mercury Export Ban Regulation.

The exported amounts of mercury compounds addressed by Regulation 649/2012 are reported in chemical reports from Member States to the European Commission (see Table 2-7). The data from this table is extracted from the summary reports on exports and imports published by the European Commission for 2005 to 2009 (European Commission, 2005-2009). For the years 2010 to 2013 data were directly extracted from the chemical reports of the MS28 provided to the European Commission and were compared with the data from the summary reports for these years (for quality control) (European Commission, 2010-2012).

***Table 2-7 EU-extra imports and exports of mercury compounds as defined in Annex I of Regulation 689/2008 and from 2012 onwards in Annex I of Regulation 649/2012; Sources: European Commission (2005 – 2012), summary of chemical reports from MS received by European Commission.***

| Export in tonnes | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| 63.4 | 104.7 | 97.0 | 318.0 | 110.0 | 70.9 | 42.7 | 64.6 | 88.2 | n.a. |
| **Import in tonnes** | | | | | | | | | |
| 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| n.a.* | n.a.* | 422.7** | 53*** | 160.4**** | 3.3 | 7.2 | 2.5 | 3.2 | n.a. |

* Not published due to limited import data; ** Pesticides (2): Fenitrothion, Fenthion, Diazinon, Endosulfan and Mercury compounds; *** Pesticides (3): Amitraz, Chlordimeform, Chlorfenapyr, Iminoctadine, Mercury compounds and Omethoate; *** Pesticides (4): Amethryn, Carbaryl, Chlorfenvinphos, Dichlorvos, Fenthion and Mercury compounds

The data reported due to Art. 10 of Regulation 649/2012 as substance are contained in the CN code 28520000 'Inorganic or organic compounds of mercury, excluding amalgams' (since 2012 sum of codes 28521000 and 28529000) in the Eurostat database. In practice MS also report exports of mixtures of metallic mercury. Except for the year 2008, the figures reported in the chemical reports are always below the figures reported in the Eurostat database for the CN code 285 20000 (or sum of 28521000 and 28529000). The reasons that the figures reported in the chemical reports are lower than the figures indicated by Eurostat could be that in the chemical reports only the weight of the relevant substances is indicated whereas the data in the Eurostat database could also include the packaging or the solution/mixture in which the relevant substance is included.

In Regulation 649/2012 there is no specific reporting requirement under Art. 10 to indicate which specific mercury compound is exported or imported and for what kind of use. In the chemical reports, most MS did not indicate the specific compounds but just reported export quantities for 'mercury compounds', no information about intended uses was provided. Some MS still use the description 'mercury and its compounds'. It is unclear whether mercury is still exported for research and development, medical or analysis purposes. In those cases, where specific mercury compounds were indicated, exported amounts are usually very small (not higher than 70 kg). Only in one case an export of nine tonnes of mercury (II) sulphate is reported. Mercury compounds, which are specifically mentioned in the reports, are: dipotassium tetraiodomercurate, mercury (II) chloride, mercury (II) sulphate, mercury (I) nitrate dehydrate, mercury (II) bromide, mercury (I) chloride, mercury (II) acetate, mercury (II) iodide, mercury (II) nitrate and mercury (II) oxide, which is only allowed to be exported for exempted uses.

In 2010 and 2011, countries importing more than five tonnes of mercury compounds each were Indonesia, Singapore, Taiwan, the United States and Australia. In 2012 and 2013, the main importing countries were Indonesia, Mexico, the United States, Philippines, Taiwan and Australia.

Comparing these data with the export data of metallic mercury (CN code 28054000) from Eurostat it can be seen that exports of metallic mercury from EU28 to Indonesia and Philippines decreased drastically (from 54 and 105 tonnes respectively to 0 tonnes) whereas exports of mercury compounds increased for these countries (from a total of 28 tonnes in the period 2005-2011 to a total of 70 tonnes in the period 2012-2013 for Indonesia and from 0 tonnes to 9 tonnes for the Philippines). Also for Mexico the export of mercury compounds increased (from 0 tonnes in the period 2005-2011 to a total of 16 tonnes in the period 2012-2013) whereas the export of pure mercury increased only slightly (0 tonnes in the period 2005-2011 to a total of 0.6 tonnes in the period 2012-2013).

The considered time period is too short to derive significant trends, but exports to Indonesia, Mexico and Philippines of metallic mercury drastically decreased or only very slightly increased. These could be countries to investigate more thoroughly in regard to the type and use of mercury compounds and whether the declaration of mercury compounds is correct.

As the specific mercury compound and the application of the exported compounds do not have to be indicated in the chemical reports, it is difficult to evaluate 1) which amounts of the restricted mercury compounds are still exported for research and development, medical or analysis purposes, 2) which other compounds are exported, as well as 3) the trend in amounts of these compounds. Therefore it cannot be evaluated whether the observed exports of mercury compounds are in compliance with the Mercury Export Ban Regulation. For further investigation exporters could be obliged to provide information on the exact compound exported as well as on the intended use

for export. More detailed information already has to be provided by exporting and importing countries in the ePIC database, where planned exports have to be indicated, including CAS number and type of use for quantities greater than 10 kg, and declarations of end use have to be delivered by the importing non-EU countries. For research or analysis and quantities of less than 10 kg, a simplified procedure applies, not requesting declarations of end use by the importing country.

In the ePIC database, summaries on export notifications for all chemicals, mixtures or articles that contain one or more chemicals subject to PIC are provided[17]. They include information on the chemical and/or mixture name and type of chemical, the number of export notifications by year, the exporting EU member state and the importing country. Export notifications were issued for at least 40 different mercury compounds or specifications, whereas also entries for 'mercury compound' and 'Mercury compounds, including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds' exist. The number of notifications regarding all chemicals which can be directly allocated to mercury compounds seems to rise over the years (about 30 notifications per year in the first reporting years up to about 80 notification per year in the last years; considered time period: 2003 to 2015). No significant increase can be seen since the Mercury Export Ban Regulation entered into force. But the number of notifications does not allow a conclusion on the amount of mercury exported. Export quantities are not reported in these export summaries. Mercury compounds, for which most notifications were issued for the years 2012 to 2015 are mercury sulphate (97 notifications) and mercury dichloride (100 notifications).

Exports of mercury compounds from EU28 were extracted from the Eurostat database for all countries which exported mercury in the time period 2005-2011 and 2012-2013 to see whether the export since 2012 decreased to countries which imported significant amounts of mercury, before the export ban entered into force (see Table 2-8). This could only be seen for Indonesia. The exported amount of nine tonnes to the Philippines in the period 2012-2013 is not reported in the Eurostat database. In the other cases, analogously to the decrease of mercury also the export of mercury compounds decreased.

Data on exports of mercury compounds from the Eurostat database were also compared with data reported by non-EU countries on imports from EU28 provided in the UN Comtrade database (see Table 2-9). Main differences can be seen for the United States, Pakistan, Peru, Thailand, Indonesia and Singapore. But as exports of many mercury compounds are still allowed, these inconsistencies do not necessarily relate to illegal exports.

[17] http://echa.europa.eu/information-on-chemicals/pic/export-notifications; accessed on 4th March 2015

*Table 2-8 Export of mercury compounds from EU28 MS which exported mercury in the time period 2005-2011, by importing country 2012-2013; Source: Eurostat database: 'international trade detailed data'*

| Country | Total 2005-2011, tonnes | | Total 2012-2013, tonnes | |
|---|---|---|---|---|
| | Export of mercury from EU28 | Export of mercury compounds* from EU28 | Export of mercury from EU28 | Export of mercury compounds* from EU28 |
| Vietnam | 556.4 | 1.1 | 0.0 | 0 |
| Singapore | 544.6 | 4.7 | 1.1 | 0 |
| India | 426.5 | 67.2 | 0.2 | 0.3 |
| Peru | 338.2 | 2.6 | 0.0 | 3 |
| Colombia | 234.3 | 60.5 | 0.0 | 0 |
| Iran | 205.4 | 9.1 | 0.7 | 0 |
| Thailand | 186.5 | 3.6 | 0.0 | 0.4 |
| United States | 147.8 | 302.3 | 23.8 | 16.3 |
| Guyana | 132.2 | 0 | 0.0 | 0 |
| Panama | 128.5 | 0.1 | 0.0 | 0 |
| Morocco | 126.8 | 70.8 | 0.1 | 0 |
| Philippines | 104.7 | 0 | 0.0 | 0 |
| Togo | 79.2 | 100 | 0.0 | 0 |
| Brazil | 70.5 | 51.4 | 4.2 | 2.9 |
| Hong Kong | 70.3 | 44.4 | 0.0 | 0 |
| Argentina | 67.0 | 1.4 | 0.0 | 0 |
| Pakistan | 55.8 | 119.5 | 0.0 | 0 |
| Indonesia | 54.4 | 1.1 | 0.0 | 83.7 |
| Ecuador | 50.2 | 20 | 0.0 | 0 |
| China (People's Republic of) | 46.1 | 296.7 | 0.0 | 0.4 |
| Ghana | 46.0 | 25.1 | 0.0 | 0.4 |
| Korea, Republic of (South Korea) | 42.2 | 31.2 | 0.0 | 22 |
| Burkina Faso | 38.7 | No data | 0.0 | 0 |
| Sudan | 35.8 | 0 | 0.0 | 0 |
| Other, or not specified | 561.0 | 996.2 | 77.7 | 242.7 |
| **Sum** | **4,350** | **2,209** | **107.8 (38.9)**** | **372.1** |

* CN code: 28520000.

** After correction of the export to Norway the sum amounts to 38.9 tonnes.

*Table 2-9 Comparison of export data of mercury compounds from EU28 MS which exported mercury in the time period 2005-2011, by importing country for the time period 2012-2013; Sources: Eurostat database: 'international trade detailed data'; DESA/UNSD, United Nations Comtrade database.*

| Country | Chemically defined * | | Not chemically defined ** | |
|---|---|---|---|---|
| | Export from EU28 Eurostat tonnes | Import from EU28 UN Comtrade tonnes | Export from EU28 Eurostat tonnes | Import from EU28 UN Comtrade tonnes |
| Argentina | 0 | 0.02 | 0 | n.d. |
| Brazil | 1.7 | 2.0 | 1.2 | 0 |
| Burkina Faso | n.d. | 0 | n.d. | 0 |
| China (People's Republic of) | 0.3 | 0 | 0.1 | 0 |
| Colombia | 0 | 0.1 | 0 | 0 |
| Ecuador | 0 | 0.01 | 0 | 0 |
| Ghana | 0.4 | 0.06 | 0 | 0 |
| Guyana | 0 | 0 | 0 | 0 |
| Hong Kong | 0 | 0 | 0 | 3.3 |
| India | 0.3 | 0.02 | 0 | 0.5 |
| Indonesia | 0.3 | 1.6 | 83.4 | 22.8 |
| Iran | 0 | 0 | 0 | 0 |
| Korea, Republic of (South Korea) | 0.1 | 0.06 | 21.9 | 6.5 |
| Morocco | 0 | 0 | 0 | 0 |
| Pakistan | 0 | 40.7 | 0 | 59.1 |
| Panama | 0 | 0.02 | 0 | 0 |
| Peru | 0 | 0.1 | 3 | 18 |
| Philippines | 0 | 0 | 0 | 0 |
| Singapore | 0 | n.d. | 0 | 16.6 |
| Sudan | 0 | 0 | 0 | 0 |
| Thailand | 0.4 | n.d. | 0 | 21.1 |
| Togo | 0 | 0 | 0 | 0 |
| United States | 6.3 | 15.6 | 10 | 1,951.3 |
| Vietnam | 0 | n.d. | 0 | 5.8 |
| **Sum** | **9.8** | **60.3** | **119.6** | **2,105** |

* Mercury compounds, chemically defined, CN and HS code 2852 1000.

** Mercury compounds, not chemically defined, CN and HS code 2852 9000.

### *2.1.3 Amalgams of precious metals*

The export of amalgams of precious metals highly fluctuates between 2005 and 2012 (see Table 2-3 in section **Error! Reference source not found.**). For the year 2008 a high export of 51.3 tonnes was reported, in the other years, the export varied between 6 and 16 tonnes. In the period 2010-2013 the export increased but was still lower than in the period 2006 to 2008 some years the import exceeded the export. In the UN Comtrade database data for amalgams (CN code: 28439010) are reported together with data for the CN code 28439090 (Colloidal precious metals; inorganic or organic compounds of precious metals, whether or not chemically defined; amalgams of precious metals: Other compounds; amalgams: other). Therefore it is not possible to compare export data with import data from importing countries for amalgam. Alloys of mercury (amalgams) with less than 95 % mercury may still be exported and, in accordance with this, the data do not indicate any decrease in the quantities exported. The observed increase in the period 2010-2013 was so slight that it does not obviously point at deliberately wrong declaration or allocation of mercury to other CN codes.

As mentioned, dental amalgam capsules may to some extent be traded as amalgams (and registered by the CN code for amalgams), even though the content is not an amalgam before the constituents are mixed[18]. No data are available for assessing to what extent the reported export of amalgams is in fact exported dental amalgam capsules.

### *2.1.4 Waste data*

Data on exports and imports of mercury waste were extracted for the years 2010 to 2012 from the table on waste shipments provided by Eurostat[19] (see Table 2-10). In regard to exports, data were also extracted for the year 2009 to get a better picture of trends. All waste data were considered, which were indicated with relevant Y-codes[20], A-codes[21] or waste codes[22] (for relevant codes, see Table 2-2). Waste exports, where the origin was not specified, were not considered. It has to be considered that the retrieved codes refer to waste containing hazardous substances, inter alia mercury. The concentration of mercury in the waste streams cannot be determined. Furthermore, waste streams which include mercury to a certain content, but are allocated to other waste categories due to predominant substances, are not included.

[18] The capsules generally consist of one chamber with pure mercury and another chamber with the other metal ingredients. When prepared, the thin wall between the chambers is broken, and the amalgam is formed.

[19] http://ec.europa.eu/eurostat/web/waste/transboundary-waste-shipments, Excel table downloaded on the 5th of February, 2015.

[20] Y-code according to the Basel Convention.

[21] A-codes according to the Basel Convention.

[22] Waste codes according to the European list of waste.

*Table 2-10 EU-extra import and export of waste containing mercury, 2009 to 2012. Source: Eurostat, Environmental Data Centre on Waste*[19]

| Exports (tonnes) | | | |
|---|---|---|---|
| **2009** | **2010** | **2011** | **2012** |
| 10,284 | 206 | 6,567 | 3,399 |
| **Imports (tonnes)** | | | |
| **2009** | **2010** | **2011** | **2012** |
| - | 5,131 | 1,259 | 4,985 |

Most exports refer to 'soil and stones containing dangerous substances and/or mercury' allocated to Y29 code, from Sweden to Norway (10,284 tonnes in 2009, 6,305 tonnes in 2011 and 1,935 tonnes in 2012) (see Table 2-11). In 2012 also Denmark exported 1,176 tonnes of EWC 070413* (wastes from the MFSU of organic plant protection products (except 02 01 08 and 02 01 09), wood preserving agents (except 03 02) and other biocides - solid wastes containing hazardous substances), allocated to Y29 code, to Norway.

Smaller amounts between 1 and 120 tonnes of waste containing mercury were carried out mainly to Switzerland and the United States. Since 2011 most of the Member States also indicate the waste category. Most of the exports of mercury between 1 and 120 tonnes were allocated to categories 050701* 'waste from natural gas purification and transportation containing mercury' and 060404* 'metal-containing wastes other than those mentioned in 06 03 containing mercury (06 03: wastes from the MFSU of salts and their solutions and metallic oxides)'. As for former years no waste categories had to be reported, a clear trend for these waste streams cannot be derived. The data available, undetailed as it is, does not give any indications of illegal exports or of missing reporting of such exports.

There still seem to exist interpretation problems regarding waste containing mercury and mercury itself. Metallic mercury should be reported under CN code 28054010 and CN code 28054090 and its export is prohibited. However, it is expected, that in practice it is sometimes reported as waste containing mercury and as such it could still be exported outside the EU. Metallic mercury considered as waste shall, according to the Mercury Export Ban Regulation, be disposed of. But if exported outside the EU and not controlled thoroughly, it could happen that it ends up on the market again, as was the case for the illegal export incident from Germany to Switzerland (DELA, described in section 3.7.1).

Also some answers from industry stakeholders demonstrate that reporting of mercury amounts is still not clear and readers' interpretations of Article 2 of the Mercury Export Ban Regulation differ. This concerns e.g. Article 2 (a) which refers to 'metallic mercury that is no longer used in the chlor-alkali industry' and Article 2 (b) which refers to 'metallic mercury gained from the cleaning of natural gas' (waste category 050701*). It is not clear to all addressed stakeholders whether mercury in waste streams such as non-ferrous metal sludge, scraps, dust or other waste products that originate from the chlor-alkali industry or from cleaning of natural gas has to be regarded as mercury or as mercury waste. These uncertainties in interpretation also result in different reporting and treatment of metallic mercury.

For waste category 050701* 41.2 tonnes are indicated to be exported from the UK to Switzerland in 2011 and 62.1 tonnes from the UK and NL to Switzerland in 2012. As for the former years, no waste category was provided and no clear data or trends pointing at wrongly declared exports can be observed.

*Table 2-11 Export of waste containing mercury from EU 28 from 2009 – 2012; source: Eurostat, Environmental Data Centre on Waste*[19]

| Year | MS | Quantity in tonnes | To or from country | R/D code *7 | Y code | Category of waste | A-code |
|---|---|---|---|---|---|---|---|
| 2009 | SE | 10,263 | Norway | D5 | Y29 *1 | | |
| 2009 | SE | 13.0 | Norway | D9 | Y29 *2 | | |
| 2009 | SE | 8.0 | Norway | D9 | Y29 *1 | | |
| 2010 | PT | 1.0 | Australia | R4 | Y29 | | |
| 2010 | IT | 60.0 | Switzerland | R4 | Y29 | | |
| 2010 | SE | 30.0 | Switzerland | R4 | Y29 | | |
| 2010 | UK | 115.0 | United States | R4 | Y29 | Mercury-containing batteries | A1010 |
| 2011 | SE | 6,305 | Norway | Mix | Y29 *3 | Mix | |
| 2011 | UK | 41.2 | Switzerland | R4 | Mix | 050701* | A2030 |
| 2011 | DE | 103.6 | Switzerland | R4 | Y29 | 060404* | A1030 |
| 2011 | UK[6] | 116.8 | United States | R4 | Y29 | 060404* | A1010 |
| 2012 | DK | 1,176 | Norway | D12 | Y29 | 070413*[5] | A4030 |
| 2012 | SE | 1,935 | Norway | Mix | Y29 *4 | Mix | |
| 2012 | UK | 48.4 | Switzerland | R4 | Mix | 050701* | A2030 |
| 2012 | NL | 13.7 | Switzerland | R4 | Y22 | 050701* | A2030 |
| 2012 | DE | 112.1 | Switzerland | R4 | Y29 | 060404* | A1030 |
| 2012 | UK[6] | 113.6 | United States | R4 | Y29 | 060404* | A1010 |

* Hazardous

*1 Soil and stones containing dangerous substances.

*2 Construction and demolition wastes containing mercury.

*3 Construction and demolition wastes containing mercury, soil and stones.

*4 Soil and stones containing dangerous substances, construction and demolition wastes containing mercury.

*5 Solid wastes containing dangerous substances.

*6 According to MS information 135.1 tonnes of waste containing mercury were exported to the United States in 2011 and 210.5 tonnes were exported to the United States in 2012.

*7 Disposal and recovery operations as defined in Annex I and Annex II of Directive 2008/98/EC on waste.

**Additional information**

Further data and information from stakeholders and literature were evaluated additionally in search of inconsistencies, such as data from answered questionnaires and mercury related reports. Except for the DELA case, no peculiarities pointing at illegal exports were found.

Relevant national authorities, industry stakeholders as well as NGOs were asked whether they have observed illegal exports of mercury and mercury compounds.

A lot of information was provided on the DELA case, in which significant amounts of mercury were illegally exported from Germany (internal feedback EEB, AT, DE, two industry stakeholders). The illegal exports in this case were detected in 2014 and the responsible persons sanctioned. DELA declared insolvency and was taken over by Remondis. Part of the mercury was exported to Switzerland, disguised as waste containing mercury. This case shows that a possibility for circumventing the export ban could be to declare mercury as waste containing mercury. Therefore, during controls of shipments, specific attention could be paid to waste streams containing mercury as well as to mercury compounds.

In its statement to the evaluation of the Mercury Export Ban Regulation, EEB mentioned possible illegal exports from Netherlands and Italy to Hong Kong. The exports were confirmed to be indicated on the summary sheet of mercury imports into Hong Kong from 2009-2014 by officials of the Hong Kong Environmental Protection Department (Natural Resources Defense Council, 2015). In the frame of this project, MS officials were asked whether they investigated the case and can explain these data. It is not clear yet whether mercury was exported illegally or whether there are simple explanations for it e.g. reporting of country of origin instead of reporting of country of dispatch.

# 3 IMPACTS OF THE EXPORT BAN ON KEY STAKEHOLDERS

The assessment of impacts focuses on impacts on Member States and specific economic actors, namely the EU chlor-alkali industry, mercury commodity traders and mercury recycling and recovery businesses within the EU, of the Mercury Export Ban Regulation. It is based on the main findings from the previous chapter as well as on the analysis of feedback from MS and other relevant stakeholders to the questionnaires on impacts of the Mercury Export Ban Regulation (for summaries of received questionnaires see Appendices 2 and 3). The questionnaires aimed at gathering more detailed information on the industry and MS perspective on the Mercury Export Ban Regulation.

Additionally, relevant answers to the questions concerning the Mercury Export Ban Regulation from the questionnaires on EU implementation of the Minamata Convention on Mercury from a former project (COWI/BiPRO/ICF, 2015) were evaluated (for summaries of received questionnaires see Appendix 1).

Other information from the mentioned former study on EU implementation of the Minamata Convention on Mercury and other relevant studies were taken into account, as appropriate.

## 3.1 Evaluation of feedback from questionnaires

Different questionnaires were elaborated for MS and for relevant industry stakeholders within this project for the evaluation of the Mercury Export Ban Regulation. In total, all 28 MS, 20 representatives of the chlor-alkali industry, and 36 companies dealing with mercury or mercury compounds, among them five key mercury recyclers, were contacted.

Additionally, the MS, which did not answer the questionnaires in the former project on the EU implementation of the Minamata Convention on Mercury, were asked again to answer that questionnaire.

Regarding the questionnaire on impacts of the mercury export ban, 18 MS submitted responses, of which 17 sent back an answered questionnaire. One additional questionnaire on the EU implementation of the Minamata Convention on Mercury was received. In total, 17 such answers to the questionnaire on EU implementation of the Minamata Convention on Mercury could be used for evaluation of relevant questions addressing the Mercury Export Ban Regulation.

A total of 18 contributions were received from the contacted industry stakeholders, 13 of which are active in chlor-alkali production, four in mercury recycling/recovery and mercury commodity trade and one in research on mercury treatment as waste as well as on storage (allocated to the category 'other'). Eight contacted trading companies stated that they are not dealing with mercury. All of the contacted stakeholders who answered the questionnaire indicated that they had been well aware of the existence of Regulation 1102/2008 before receiving the questionnaire. However, one stakeholder reported that he made the experience, that the Mercury Export Ban Regulation is still unknown in other parts of the world as well as in Europe itself.

Appendix 3 includes a list of contacted companies.

## 3.2 Direct costs for stakeholders

In the context of this project, direct costs for the different stakeholders include one-off costs resulting from the implementation of the Mercury Export Ban Regulation as well as various other costs due to the Mercury Export Ban Regulation's provisions.

### *3.2.1 Member States*

In general, MS have to implement procedures to ensure that the requirements of the Mercury Export Ban Regulation are complied with. As stipulated in Article 7 of the Regulation, MS specifically have to lay down rules on effective, proportionate and dissuasive penalties applicable to infringements of the provisions of the Regulation.

According to the feedback of MS, the one-off costs resulting from the implementation of the Regulation's requirements for the national authorities had in average only marginal budgetary consequences (approximately one man-week of work). However, as no information on budget lines was revealed or could be revealed, no specific implementation costs could be determined.

Other costs for the MS resulting from the implementation of the Mercury Export Ban Regulation are connected with controls of exports and treatments of mercury to ensure that the requirements of Article 1 and Article 2 are complied with. Controls are usually carried out by the customs. Such controls are often of a general character, checking compliance for many issues at the same time. Direct allocation to mercury is therefore difficult. The costs for specific controls regarding mercury depend directly on the number of controls carried out and indirectly on the activities carried out related with mercury. No specific costs for controls are available.

### *3.2.2 Industry stakeholders*

**Implementation costs**

Industry stakeholders have to change their individual procedures once to ensure that the requirements of the Mercury Export Ban Regulation are complied with. Industry stakeholders are mainly affected by Article 1 and Article 2 as well as by reporting obligations (Articles 5 and 6).

**Chlor-alkali industry**

According to the feedback of the stakeholders from the chlor-alkali industry one-off costs resulting from the implementation of the Mercury Export Ban Regulation's requirements were in average moderate (two to five man-days). None of the companies provided information on specific costs.

**Mercury waste management and trade**

Mercury waste management and trade companies seem to have made greater efforts in relation to the implementation of the Mercury Export Ban Regulation, as two out of three companies, who indicated costs, reported significant one-time efforts (more than two man-weeks). None of the companies provided information on specific costs.

**Other industry stakeholders**

The company allocated to the category 'other', which was formerly active in mercury trade, stated to have made significant efforts due to the implementation of the Mercury Export Ban Regulation. No specific values for these one-off costs were provided to determine specific implementation costs.

**Other costs**

In addition, according to the results of the stakeholder consultation, the provisions of the Mercury Export Ban Regulation are sources of other additional annual costs and burdens.

**Chlor-alkali industry**
One third of the industry stakeholders experienced additional relevant costs related to the implementation of the Mercury Export Ban Regulation. Costs for storage of metallic mercury and mercury compounds considered as waste appear to be one important factor in this industry sector, including provision or upgrade of appropriate storage facilities and packaging of the respective metallic mercury or mercury compounds. The classification of those substances as waste also requires other measures connected with financial burdens, such as additional treatment of mercury, which can no longer be sold as a commodity (e.g. stabilization of metallic mercury as mercury sulphide). Another important factor is the lost profits from sales of metallic mercury or restricted mercury compounds. No further indications on specific costs or profit losses were made to further estimate the exact impacts.

One UK company mentioned that the different interpretations of Article 2 (a) (metallic mercury that is no longer used in the chlor-alkali industry) lead to competitive disadvantages for their company. According to their statement, most national competent authorities have decided that Article 2 (a) applies to the metallic mercury in cells or metallic mercury stored at the plant, but not to metallic mercury recovered by treating waste streams that originate from the chlor-alkali industry. The UK competent authority considers metallic mercury recovered by treating waste streams that originate from the chlor-alkali industry also as waste, which has to be disposed of. Therefore, the company is in competitive disadvantage in comparison to companies from other MS with the other way of interpretation. They propose a clear statement in the Mercury Export Ban Regulation that Article 2 (a) only refers to large tonnages of metallic mercury in use or stored at chlor-alkali plants and not to metallic mercury recovered from waste treatment activities. This should, according to their opinion, be considered a commodity in the same manner as other recovered mercury (e.g. from dentistry). Another company sees the costs for temporary storage and for stabilization of waste as disproportionate costs and mentions missing decisions on how to handle the waste (underground storage or stabilization as mercury sulfide or both) in the Mercury Export Ban Regulation.

In general, representatives of the chlor-alkali industry consider storage capacities in the EU, both for temporary and permanent storage of mercury considered as waste, as insufficient and therefore as a source of disproportionate efforts and costs.

**Mercury waste management and trade**
All companies trading mercury experienced significant profit losses due to the export ban. Two mention yearly profit losses in the range of 200,000 to 500,000 EUR. Additional costs were mentioned for non-paid invoices (after further mercury deliveries had to be stopped) and the write off for a costly machine to produce so-called mercury pillows (a semi-manufacture) for dental amalgam capsules for export.

One company also mentioned costs of approximately 500,000 Euros for the construction of a warehouse to store 500 tonnes of metallic mercury. Some mercury waste management facilities mentioned that there is still no solution defined as regards final storage of mercury (EU storage criteria) as well as insufficient capacity to transform mercury into a disposable compound e.g. mercury sulphide and that this results in uncertainties and additional costs for them.

According to the mercury waste management and trade companies there are some ambiguities and sources of disproportionate costs in the Mercury Export Ban Regulation. Regarding ambiguities they mention Article 2 (mercury gained from specific processes has to be regarded as waste and be disposed of) and Article 2 (b) (metallic mercury gained from the cleaning of natural gas shall be considered as waste and be disposed of) in particular. It is not clear for them whether Article 2 refers only to mercury which can be obtained as metallic mercury in the mentioned processes without any further treatment (like metallic mercury in the cells of chlorine-alkali-plants or

metallic mercury which drops out during gas production) or also to mercury still contained in sludge, scraps, dusts and other waste products of those industries, which is recovered by recycling processes in recycling companies.

Also regarding disproportionate costs, the companies dealing with metallic mercury for dental amalgam have the opinion that metallic mercury strictly determined for production of dental amalgam (outside the EU) should be also exempted from the mercury export ban.

In this respect, it can be mentioned that according to the authors' background knowledge, mercury used illegally in small scale gold mining (ASGM) has been reportedly traded as dental amalgam.

Another company mentions, in addition to the exemption for the production of dental amalgam, other use exemptions, such as for the production of chlorine and caustic soda, the production of fluorescent tubes and the production of energy saving bulbs.

## 3.3 Administrative burden

In the context of this project, administrative costs were evaluated for MS and relevant industry stakeholders.

### *3.3.1 Member States*

In general, MS have to ensure that the requirements of the Mercury Export Ban Regulation are complied with.

Administrative burden resulting from the provisions of the Mercury Export Ban Regulation mainly refer to Article 5. Article 5 (1) stipulates that '*Member States shall submit to the Commission a copy of any permit issued for a facility designated to store metallic mercury temporarily or permanently (disposal operations D 15 or D 12 respectively, as defined in Annex II A of Directive 2006/12/EC), accompanied by the respective safety assessment pursuant to Article 4(1) of this Regulation*.

According to Article 5(2), '*by 1 July 2012, Member States shall inform the Commission on the application and market effects of this Regulation in their respective territories. Member States shall, upon request from the Commission, submit that information earlier than that date*.'

Furthermore, according to Article 7 of the Mercury Export Ban Regulation, MS have to take measures to ensure that penalties applicable to infringements of the provisions of this Regulation are applied. If they conduct amendments regarding their penalties, which they had to report by 4 December 2009 once, they have to inform the Commission.

According to the feedback of MS, the resulting estimated annual incremental budgetary consequences are on average marginal (less than one man-week work). No specific information on budget lines was revealed or could be revealed.

### *3.3.2 Industry stakeholders*

In general, industry stakeholders have to ensure that they comply with the requirements of the Mercury Export Ban Regulation.

According to Article 5 (3), '*by 1 July 2012, importers, exporters and operators of*

*activities referred to in Article 2, as appropriate, shall send to the Commission and to the competent authorities the following data:*

*(a) volumes, prices, originating country and destination country as well as the intended use of metallic mercury entering the Community;*

*(b) volumes, originating country and destination country of metallic mercury considered as waste that is traded cross-border within the Community.'*

Article 6 (1) stipulates that *'the companies concerned in the chlor-alkali industry shall send the following data related to the decommissioning of mercury in a given year to the Commission and the competent authorities of the Member States concerned:*

*(a) best estimate of total amount of mercury still in use in chlor-alkali cell;*

*(b) total amount of mercury stored in the facility;*

*(c) amount of waste mercury sent to individual temporary or permanent storage facilities, location and contact details of these facilities.'*

Article 6 (2) reads: '*The companies concerned in the industry sectors that gain mercury from the cleaning of natural gas or as a by-product from non-ferrous mining and smelting operations shall send the following data related to mercury gained in a given year to the Commission and the competent authorities of the Member States concerned:*

*(a) amount of mercury gained;*

*(b) amount of mercury sent to individual temporary or permanent storage facilities as well as location and contact details of these facilities.'*

Article 6 (3) stipulates that *'the companies concerned shall send the data referred to in paragraphs 1 and 2, as applicable, for the first time by 4 December 2009, and thereafter each year by 31 May'.*

**Chlor-alkali industry**
According to the feedback of the stakeholders from the chlor-alkali industry, their average administrative burden related to the relevant provisions from the Mercury Export Ban Regulation is marginal to moderate (less than two man-days of work input/y to 5 man-days/y). In general they indicate that their company's annual administrative burden is minimal compared to the other administrative work in their company. No specific information on budget lines was revealed or could be revealed.

**Mercury waste management and trade**
According to the feedback from the stakeholders from the mercury trade companies, the administrative burden related to the relevant provisions from the Mercury Export Ban Regulation, as far as information is available, is substantial to significant (one man-week to more than two man-weeks). They disagreed that their company's annual administrative burden is minimal compared to the other administrative work in their company. The company dealing only with mercury waste treatment and recovery indicated, that their administrative burden in connection with the Mercury Export Ban

Regulation is minimal. However, as no information on budget lines was revealed or could be revealed, no specific implementation costs could be determined.

**Other**
The company active in research on mercury treatment as waste and in storage also indicated, that their administrative burden in connection with the Mercury Export Ban Regulation is minimal.

## 3.4 Social impacts

Social impacts are expected to correlate strongly with the projected economic impacts outlined in the sections above. Changes in employment resulting from the implementation of the mercury export ban are estimated to be minimal as well as to be offset to some degree by additional administrative burdens arising from reporting, treatment and storage requirements in relation with the Mercury Export Ban Regulation.

### *3.4.1 Member States*

According to the feedback from MS, the additional administrative burden associated with the implementation of the Mercury Export Ban Regulation is marginal or negligible for the majority of the competent authorities. Reporting obligations and control mechanisms seem to be feasible within the limits of current capacities. The average additional workload at competent authorities in relation with the Mercury Export Ban Regulation is therefore considered minimal and unlikely to create any notable social impact.

### *3.4.2 Industry stakeholders*

As to industry stakeholders, potential negative social impacts could be ascribed to the constraints on exports and the resulting decrease in sales of mercury or mercury compounds and related forgone profits. Especially mercury commodity traders and mercury waste management companies are confronted with decreased exports and additional drawbacks such as lost investments in expensive machinery or additional costs for treatment or storage of mercury or mercury compounds considered as waste under the Mercury Export Ban Regulation. Those economic impacts may lead to minor job losses in the concerned sectors.

These consequences might be compensated by different positive social impacts. Mercury traders contacted for stakeholder consultation indicated quite significant additional administrative burdens arising from the Mercury Export Ban Regulation, which implies an increase of the administrative workload for companies operating in mercury commodity trade.

Moreover, new employment might possibly be generated through required storage, treatment and disposal operations. As an example, one of the industry respondents pointed out that there is high demand in treatment operations, such as the stabilisation of mercury as mercury sulphide in order to generate disposable compounds. The current lack of capacity for stabilisation could create new jobs in waste treatment companies.

## 3.5 Functioning of the reporting requirements of the Mercury Export Ban Regulation

One element in effective regulation is that the required reporting system is implemented in practice. Therefore it has been evaluated in the frame of this study whether

the addressed MS authorities and industry stakeholders comply with the reporting requirements included in the Mercury Export Ban Regulation.

### *3.5.1 Member States*

According to Article 5, MS have to

- *submit of a copy of any permit issued for a facility designated to store metallic mercury temporarily or permanently (disposal operations D 15 or D 12 respectively, as defined in Annex II A of Directive 2006/12/EC), accompanied by the respective safety assessment pursuant to Article 4(1) of this Regulation to the Commission (Article 5 (1))*

- *inform the Commission on the application and market effects of this Regulation in their respective territories by 1 July 2012. Member States shall, upon request from the Commission, submit that information earlier than that date (Article 5 (2))*

No information was provided to the Commission by 1 July 2012. Eighteen MS reported information regarding these requirements in their answers to the questionnaire on EU implementation of the Minamata Convention on Mercury within the project COWI/BiPRO/ICF, 2015) in 2014. Only two MS stated that they issued permits as addressed under Article 5 (1) and only four MS indicated that the Mercury Export Ban Regulation found any application in their country.

The other MS, which did not answer the questionnaire, still did not report on the application and market effects of this Regulation or any permits issued for a facility designated to store metallic mercury temporary or permanently.

Article 7 stipulates that Member States shall notify rules on penalties applicable to infringements of the provisions of the Mercury Export Ban Regulation *to the Commission by 4 December 2009 and shall notify it without delay of any subsequent amendment affecting them.*

As regards Article 7, most MS have provided information on rules and penalties applicable to infringements of the provisions of the Mercury Export Ban Regulation upon several requests from the Commission by end of 2009 and during 2010. Since then, most Member States have up-dated their legislative acts. Information on whether they also made amendments affecting the rules on penalties and whether they have notified the Commission without delay of any subsequent amendment affecting them is not available.

### *3.5.2 Relevant industry stakeholders*

According to Article 5 (3), *by 1 July 2012, importers, exporters and operators of activities referred to in Article 2, as appropriate, shall send to the Commission and to the competent authorities the following data:*

- *volumes, prices, originating country and destination country as well as the intended use of metallic mercury entering the Community;*

- *volumes, originating country and destination country of metallic mercury considered as waste that is traded cross-border within the Community*

No data have been submitted directly to the Commission so far. MS were asked in the questionnaire on EU implementation of the Minamata Convention on Mercury within the project COWI/BiPRO/ICF (2015) in 2014, whether they received required data from the addressed companies. Only two MS answered that they received such submissions, whereas one referred to metallic mercury entering the EU and the other referred to metallic mercury considered as waste that is traded cross-border within the EU. It can be concluded that most of the producers, importers and exporters of activities referred to in Article 2 did not comply with their reporting duties under the Mercury Export Ban Regulation.

Article 6 (1) stipulates that the companies concerned in the chlor-alkali industry shall send the following data related to the decommissioning of mercury in a given year to the Commission and the competent authorities of the Member States concerned:

*(a) best estimate of total amount of mercury still in use in chlor-alkali cell;*

*(b) total amount of mercury stored in the facility;*

*(c) amount of waste mercury sent to individual temporary or permanent storage facilities, location and contact details of these facilities.*

This information has been provided by the chlor-alkali industry, submitted either directly to the Commission or via Euro Chlor[23]. This industry has also submitted data for facilities with no immediate activities related to decommissioning (with reference to '*data related to the decommissioning of mercury…* '). Therewith, regarding reporting to the European Commission, the requirements of Article 6 are fulfilled. Whether industry also reports the data to the competent authorities of the MS is not known.

In Article 6 (2) companies concerned in the industry sectors that gain mercury from the cleaning of natural gas or as a by-product from non-ferrous mining and smelting operations are required to *send the following data related to mercury gained in a given year to the Commission and the competent authorities of the Member States concerned:*

(a) *amount of mercury gained*;

(b) *amount of mercury sent to individual temporary or permanent storage facilities as well as location and contact details of these facilities.*

According to Article 6 (3), 'the companies concerned shall send the data referred to in paragraphs 1 and 2, as applicable, for the first time by 4 December 2009, and thereafter each year by 31 May'.

The Commission has received information from five companies involved in natural gas production and one company in the non-ferrous mining and smelting sector. The data are presented in Table 3-2.

In conclusion, the reporting systems under the Mercury Export Ban Regulation, in so much as reporting from the companies is concerned, seems to work well.

[23] Data are published at http://ec.europa.eu/environment/chemicals/mercury/ ).

## 3.6 Impacts on trade

**Trends in import and export of mercury**

The trends in export and import of mercury and mercury compounds as reported by the Eurostat database: 'international trade detailed data' are shown in Table 2-3. The same data are illustrated in the charts below.

The export of mercury increased significantly during 2009 and 2010 prior to the export ban entry into force on 15 March 2011. Figure 3-1 (A) shows the total export of mercury divided by mercury in flask and mercury - other. The increase in 2009 and 2010 was most pronounced for mercury in flasks. Figure 3-1 (B) shows the total (mercury in flasks and other) export and import and the calculated net export (export minus import). The import of mercury decreased markedly after 2009. The data may indicate that the mercury imported for use in the EU after the export ban went into force has been replaced by mercury placed on the market within the EU. Alternatively, the data may be interpreted in the way that a part of the import before 2010 was actually re-exported (e.g. after a purification) and as consequence of the export ban the incentives for the import have ceased.

The total export during the period 2005-2011 was 4,300 tonnes while the net export was 2,758 tonnes. The average annual export decreased from 673 t/y for the period 2005-2011 to 54 t/y for the period 2012-2013. Until 2011, the majority of the mercury was mainly exported to developing countries as further discussed in section 2.1.1.

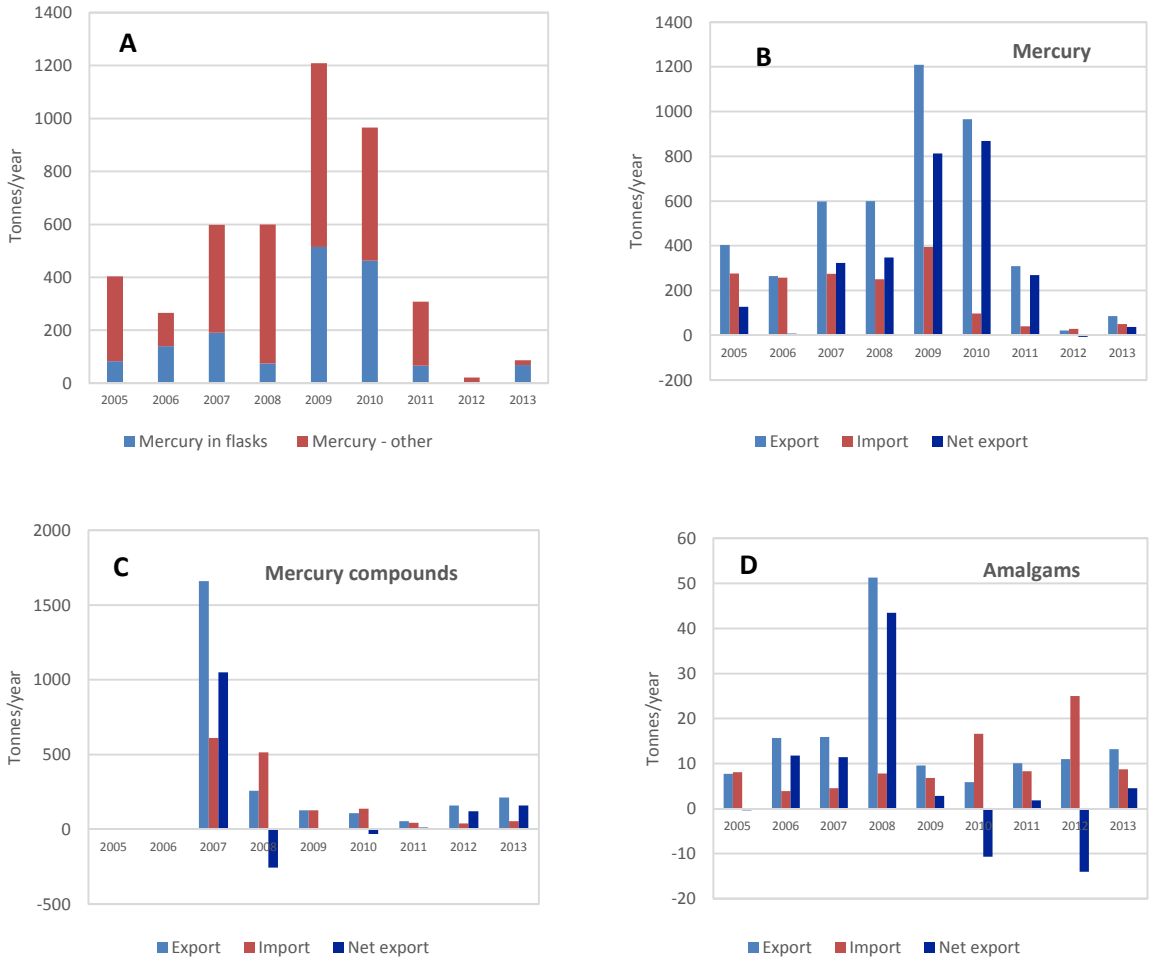


***Figure 3-1 Import, export and net export of mercury, mercury compounds and amalgams. Mercury compounds were not reported separately before 2007. Source: Eurostat database: 'international trade detailed data'.***

While the EU28-extra exports have decreased markedly as a consequence of the ban after its entry into force, the EU internal mercury trade has increased. In 2013, in total more than 1,200 tonnes mercury was exported from one Member State to another. Some of the exports may be re-exported to another Member State within the same year, but still the statistical data indicate a clear change in the EU internal trade of mercury after entry of force of the Mercury Export Ban Regulation.

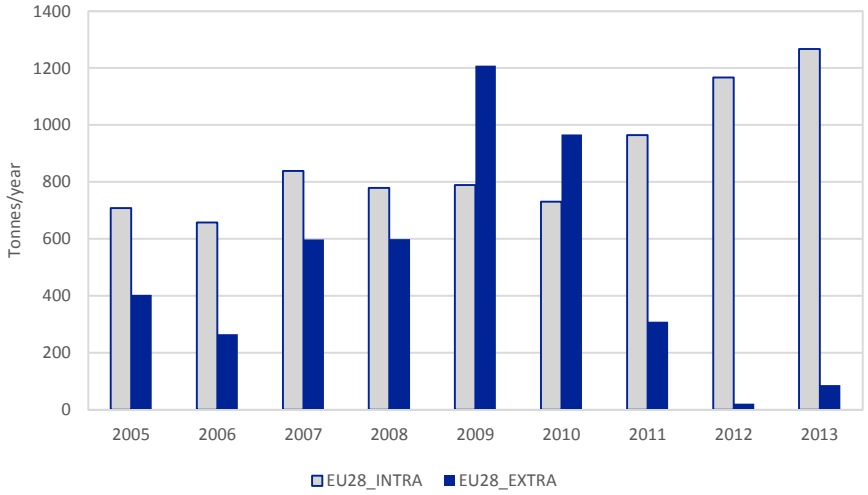


*Figure 3-2 Trends in EU28-extra and E28-intra export during the period 2005-2013. The EU28-intra export represent the total export from one EU Member State to another. Source: Eurostat database: 'international trade detailed data'.*

**Mercury from chlor-alkali plants**

A summary of changes in the mercury on site at the chlor-alkali plants in the EU and sent for storage for the period 31 December 2009 to 31 December 2013 are shown in Table 3-1. The data are reported to the European Commission by the companies and posted at the website of the Commission[24]. Certain companies report the data through Eurochlor, their trade organisation. A dataset designated 'December 2009' is posted at the website as well but the exact date for the inventory is not indicated. During the period 31 December 2009 to 31 December 2013, the total number of sites decreased from 41 to 34 and the total mercury at the sites (in cells and on-site storage) decreased by 1,954 tonnes. Of this, 990 tonnes decreased at sites still in operation by 31 December 2013, while the remaining decrease was due to decommissioning of plants. In the reporting for the Commission, it is not specifically indicated that sites with no reported mercury on site is due to the decommissioning of the sites, but the decrease in number of sites is in accordance with information on total number of sites per Member State and decommissioning reported to the UNEP Global Mercury Partnership (WCC, 2014).

From 31 December 2009 to 31 December 2013, 1,954 tonnes mercury was reportedly removed from the sites; of this 1,026 tonnes was reported as sent for storage. The resulting difference of 928 tonnes can be compared to the total EU-extra export for the period 2010-2013 of 1,383 tonnes. The data indicate that the majority of the mercury, which was not sent for storage, was exported to countries outside the EU prior to the export ban entry into force.

[24] http://ec.europa.eu/environment/chemicals/mercury/regulation_en.htm

*Table 3-1 Mercury on site and sent for storage reported for all chlor-alkali plants within the EU from December 2009 to 31 December 2013*

| | Mercury, tonnes | | | | | | |
|---|---|---|---|---|---|---|---|
| | Dec 2009 * | 31 Dec 2009 | 31 Dec 2010 | 31 Dec 2011 | 31 Dec 2012 | 31 Dec 2013 | Total period *** |
| Number of reporting companies | 41 | 41 | 36 | 34 | 34 | 34 | |
| In the cells | 8,201 | 6,949 | 6,931 | 6,795 | 6,053 | 5,617 | |
| Stored at site | 606 | 1,103 | 924 | 593 | 1,005 | 481 | |
| Total on site | 8,807 | 8,052 | 7,855 | 7,388 | 7,059 | 6,098 | |
| Removed of total since previous year | | 755 ** | 197 | 467 | 329 | 960 | 1,954 |
| Sent for storage the year concerned | 1 | - | 1 | 171 | 199 | 655 | 1,026 |

* The date is not specified.

** Difference compared to the inventory indicated as 'Dec 2009' not included in total.

*** Data are here represented by rounded figures, totals are based on actual figures.

Whereas the reporting from the chlor-alkali sector shown above include very specific data on the mercury quantities in use in the cells and stored on-site, previous assessments have been based on information on chlorine capacity and some assumptions regarding the mercury to chlorine capacity ratio. The COWI/Concorde report from 2008 estimated the total quantity accumulated in 45 production facilities at 13,100 tonnes in 2006 (Lassen et al., 2008). According to the assessment, the quantity of mercury held by the electrolytic cells at any one time was estimated by industry to average about 1.8 tonnes mercury per 1000 tonnes chlorine capacity, which would give about 10,000 accumulated in the cells in 2006. The remaining part (3,100 tonnes) was assumed to be stored on-site, accumulated in the plants as wastes or accumulated in building materials, steelworks, etc. Maxson (2004) indicates that, apart from the 1.8 tonnes per 1000 tonnes chlorine capacity, at least another 10-15 % percent is easily recoverable mercury stored at the plants.

Maxson estimated the easily recoverable mercury in Western European mercury cell chlor-alkali plants at 12,000 tonnes in 2001. With the total indicated chlorine capacity of 5,746,000 tonnes for the EU, this corresponds to 2.08 tonnes mercury per 1000 tonnes chlorine capacity.

Data for the total mercury-cell chlorine capacity in Europe is available for the period 2002-2013 from UNEP global chlor-alkali mercury partnership as reported by the World Chlorine Council (WCC, 2014). The data concern the entire European capacity. In 2010 and 2012, sites in the EU28 represented 99 % of the capacity while the remaining 1% was represented by sites in Serbia and Switzerland with total capacity of approximately 38,000 tonnes chlorine. Data for the capacity in non-EU countries have not been identified for all years but the mercury-cell capacity have at least remained at the same level from 2005 to 2013, whereas for 2001 the mercury-cell capacity in Switzerland was reported at 104,000 tonnes chlorine, corresponding to approximately 2 % of the EU capacity.

From the data reported for the period 31 December 2010 to 31 December 2013 it appears that on average 91 % of the mercury on the sites was held in the electrolytic cells (please note that the inventory concerns easily recoverable mercury only). The

total mercury on the sites per 1,000 tonnes of chlorine capacity can be estimated from the data in Table 3-1 and data on chlorine capacity from UNEP global chlor-alkali mercury partnership (WCC, 2014). The ratio varies during the period from 1.90 to 2.16 tonnes mercury per 1,000 tonnes of chlorine capacity (this may partly be due to small time shifts in the reporting), with an average of 2.0. This is well in accordance with previous estimates by Maxson (2004).

In order to estimate the changes in the total quantity of mercury in the chlor-alkali facilities in the EU28[25] over time, it is assumed that EU28 accounted for 99% of the total European capacity during the period and on average the sites had 2.0 tonnes mercury per 1,000 tonnes of chlorine capacity. The estimated easily recoverable mercury on-site for the period 2002-2009 on the basis of these assumptions are shown in Figure 3-3 (in grey bars) together with the reported quantities for the period 2009-2013 (in blue bars).

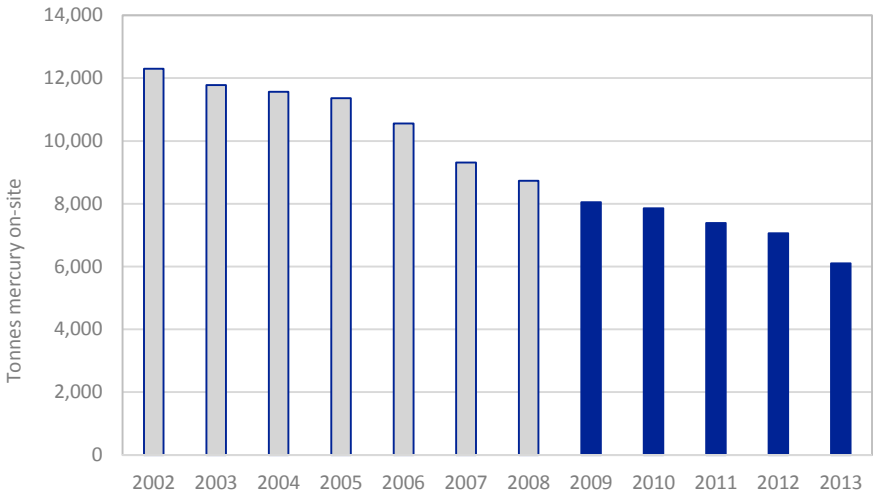


***Figure 3-3 Estimated trends in mercury on-site in chlor-alkali facilities in EU-28. Data indicated with blue bars are identical to the data presented in Table 3-1. Grey bars represent figures based on reporting on chlorine capacity to the UNEP global partnership as discussed in the main text (WCC, 2014; UNEP, 2013).***

Figure 3-4 illustrates the accumulated estimated quantity of mercury removed from chlor-alkali sites and the accumulated export + quantity sent for storage. The data are based on data in Figure 3-3 (quantities removed), Table 3-1 (quantities sent for storage) and Table 2-3 (EU-extra export) supplemented with 2004 export data from Eurostat. The quantities removed from the sites correlate well to the total export + quantity sent for storage. The differences between the two bars for the individual years may be due to some uncertainties regarding the exact year the mercury is removed from the sites as the estimates on mercury on-sites is based on the reported change in chlorine capacity, external stockpiling of mercury, import and other sources of mercury. The data indicates that the peak in export in 2009 and 2010 could partly be due to mercury accumulated from the decommissioning of sites the previous years.

The data shows that the mercury from the decommissioning of mercury-cell chlor-alkali plants or from chlor-alkali plants still in operation (as indicated by the decrease in mercury-cell chlorine capacity) quite well balance the export and quantities sent for

[25] EU28 designates the 28 Member States in 2014 although some of the countries were not members at the reporting time.

storage. The actual picture is, however, more complex as some of the mercury from decommissioned plants may have been reused within the EU, and some of the exported mercury may originate from other sources.

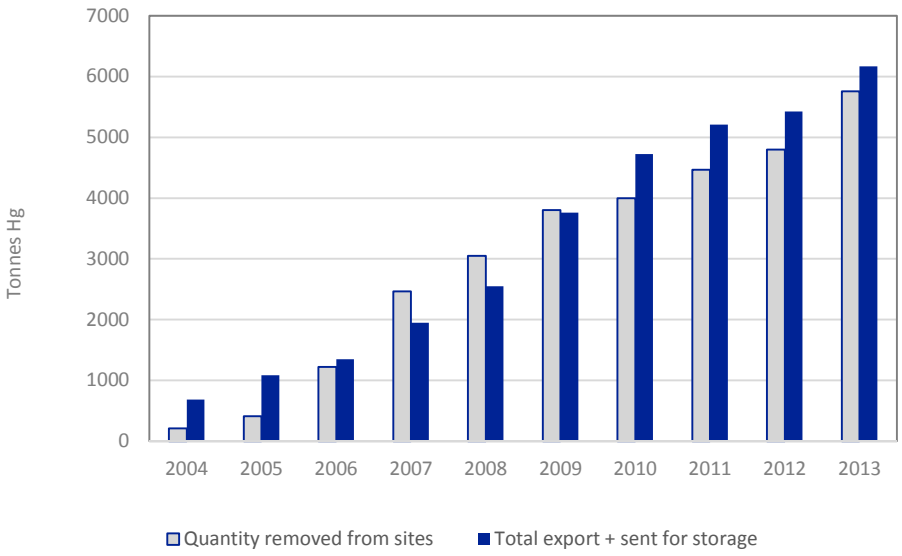


*Figure 3-4 Accumulated estimated quantity 'removed from chlor-alkali sites' and accumulated export + quantity sent for storage in EU28*

**Mercury from natural gas production and non-ferrous mining and smelting**
Data for mercury extracted and sent for storage from natural gas production and non-ferrous mining and smelting is shown in Table 3-2. The data are reported to the European Commission by the companies and posted at the website of the Commission[26]. Certain companies send their reports to the European Commission through Euro Chlor, their trade association.

The reported extraction in 2009 before the Mercury Export Ban Regulation entered into effect, was 12 tonnes from five companies in the natural gas sector and 6.2 tonnes from one company in the non-ferrous mining and smelting sector.

The total reported quantity sent for storage from the natural gas sector decreased from an average of 11 tonnes during 2009-2010 to 1.8 tonnes in 2013. The data indicates that some of the mercury-containing wastes from the sector in recent years is either disposed of at landfills without recovery of the mercury or is exported for recovery abroad. As mentioned elsewhere, export of sludge from natural gas purification has been reported. In its communication with the Commission on this issue, the sector has indicated that, in their view, the Mercury Export Ban Regulation concerns metallic mercury, and not the mercury-containing sludge or other waste types.

[26] http://ec.europa.eu/environment/chemicals/mercury/regulation_en.htm

*Table 3-2 Mercury extracted and sent to storage from natural gas production and non-ferrous mining and smelting during December 2009 to 31 December 2013*

| Year* | Mercury, tonnes | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | From natural gas production | | | From non-ferrous mining and smelting | | | Total | |
| | Extract-ed | Sent for storage | No of reporters | Ex-tracted | Sent for storage | No of reporters | Extract-ed | Sent for storage |
| 2009 | 12 | 2.1 | 5 | 6.2 | 0 | 1 | 18.2 | 2.1 |
| 2010 | 10 | 10 | 3 | 0 | 0 | 0 | 10 | 10 |
| 2011 | 6.6 | 6.4 | 5 | 12.4 | 12.4 | 1 | 19 | 18.8 |
| 2012 | 6.4 | 6.3 | 5 | 2.2 | 2.2 | 1 | 8.6 | 8.5 |
| 2013 | 2.2 | 1.8 | 2 | 4 | 4 | 1 | 6.2 | 5.8 |
| 2011-2013 | 15.2 | 14.5 | | 18.6 | 18.6 | | 33.8 | 33.1 |

* As reported by 31 December the indicated year. For 2009 the data combine the quantities reported by December 2009 (for the year 2009; most companies) and reported by May 2010 (for the year 2009; only one company reporting).

**Prevention of mercury**

**Hg selling trends/changes as reported by MS and stakeholders**

Two Member States – Spain and the Czech Republic – had observed market effects in their countries as a result of the Mercury Export Ban Regulation, though this was largely confined to sub-regions and sectors. Some negative economic impacts had been felt regionally in Spain since 2001 with the closure of mercury mining operations. Nevertheless, the affected region has since been able to shift its focus to culture and tourism with the opening of a regional mining park and to the research of environmentally sound management solutions of mercury through the National Technological Centre for Mercury Decontamination. Impacts on the chlor-alkali sector were also noted in Spain. Czech Republic highlighted some adverse trade impacts resulting from the cessation of exports of dental mercury outside the EU (this related specifically to trade with Turkey – a key partner for a major Czech mercury production and waste recollection firm – BOME).

According to information from some industry stakeholders, the prices for mercury increased since the mercury ban entered into force, due to reduced availability on the world market and limited use of mercury. Within Europe, a reduced demand could be observed due to limited use and the decreasing application of mercury electrolysis whereas outside EU, there is still high demand for mercury. Also a change in the trade patterns could be observed as shown in decreased export of mercury and mercury compounds due to Art. 2(a) and 2(b) of the Mercury Export Ban Regulation.

**Other factors influencing Hg export/selling trends (question 9 to stakeholders)**

Experienced changes in the possibilities of selling metallic mercury and its compounds were attributed also to factors going beyond the Mercury Export Ban Regulation. Potential causes are:

- a general decrease in the application of mercury electrolysis.

- the Best Available Techniques (BAT) Reference Document for the Production of Chlor-alkali, with BAT conclusion[27] stating mercury-cells as non-BAT under the IE Directive (Directive 2010/75/EU).

- according to the IE Directive local permits have to be updated before December 2017 and installations will have to comply with the new BAT requirements. As the mercury cell technology is not considered BAT, this technology *de facto* has to be phased out by this deadline.

## 3.7 Evaluation of illegal trade, possible loopholes, and penalty regimes

One aspect of the overall evaluation of the effectiveness of the Mercury Export Ban Regulation was to evaluate if despite the ban, restricted metallic mercury and mercury compounds are still exported to non-EU countries. Additionally, it was to evaluate if possible loopholes of the Regulation allowing a circumvention of the export ban were identified. A further aspect was to evaluate if uncertainties with specific provisions were identified.

### *3.7.1 Illegal trade*

Statistical data on exports of mercury from the EU28 still show exports of mercury to countries outside the EU for the years 2012-2013 when the export ban was already in force. Additionally inconsistencies in data reporting of exporting MS from EU and importing MS from outside the EU were detected, which indicate possible illegal exports. One reason for ongoing exports of metallic mercury in the statistics, could be the fact that mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of less than 95 % weight by weight, which are still allowed to be exported, are allocated to the CN code 280540 (mercury).

To identify whether actual illegal exports have taken place, each single entry in the databases would have to be checked for correctness with the customs authorities or national competent authorities. In the frame of this project, six MS were asked to provide possible explanations for reported exports. Two of these MS were asked due to significant mercury exports still being reported in the Eurostat database. The other four MS, were asked due to significant inconsistencies identified between data reporting of exporting and importing countries.

The most relevant possible explanations received so far regarding inconsistencies are (1) the indication of the country of origin instead of the country of dispatch by importing countries in the Comtrade database (the major reason as explained in section 2.1.1), (2) different or wrong code allocations, (3) errors in exporters or importers reporting to customs (including common reporting of mixed shipments), (4) time lags in data reporting between exporting and importing country and statistical secrecy of data differentiating in exporting and importing country. Another reason could be intentional misreporting by EU exporters meaning illegal export (National authorities ES, DE, 2015).

Relevant stakeholders were asked whether they have information about illegal exports of mercury and mercury compounds.

[27]COMMISSION IMPLEMENTING DECISION of 9 December 2013 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions, for the production of chlor-alkali.

A lot of information was provided on the DELA case. Significant amounts of mercury were illegally exported from Germany (feedback EEB, AT, DE, two stakeholders). The illegal exports in this case were detected in 2014 and the responsible persons were prosecuted. DELA declared insolvency and was taken over by Remondis. Part of the mercury was exported to Switzerland, disguised as waste containing mercury.

In its statement to the evaluation of the Mercury Export Ban Regulation EEB mentioned also illegal exports from the Netherlands (5.2 tonnes in 2012) and Italy (37.3 tonnes in 2013) to Hong Kong. This was confirmed to be indicated in the summary sheet of mercury imports into Hong Kong from 2009-2014 from environmental officials in Hong Kong (Natural Resources Defense Council, 2015). These entries were also shown in the Comtrade database for Hong Kong, but not in the Eurostat database for the Netherlands and Italy. In the Comtrade database it is indicated that Hong Kong reports the country of consignment and not of origin for their imports. Whether actual illegal exports had taken place still has to be further investigated.

### *3.7.2 Possible loopholes*

Loopholes are understood in this project as gaps in the Mercury Export Ban Regulation, which can be used to circumvent the intent of the Regulation.

By evaluating the statistical data, relevant literature, the feedback of the questionnaires as well as additional information, possible loopholes and uncertainties with provisions of the Mercury Export Ban Regulation were identified. Possible loopholes are described in this chapter. Specific recommendations are provided in the boxes below for each possible loophole or uncertainty.

As the DELA case shows, a possibility to circumvent the export ban is to disguise and declare mercury as waste containing mercury, export it as waste to later place it as product on the market. FI pointed out another possibility, that operators could simply not purify the residues from non-ferrous mining and smelting operations (Article 2 (c)) in order to gain mercury-containing sludge instead of metallic mercury. This sludge might be exported as waste and the contained mercury could possibly be placed on the market.

During controls of shipment, specific attention could be made to waste streams containing mercury as well as to mercury compounds. The waste streams defined in Article 2 of the Mercury Export Ban Regulation should be further specified. It could be considered to specify that waste with mercury concentrations above certain thresholds should be disposed of, and not be exported as waste from which mercury can be recovered and recycled to the market.

According to DE, it is expected that mercury waste declared as used mercury products could be an illegal transboundary movement from developed countries, where mercury-free products are available and most mercury-containing products are phased out, to developing countries and countries with economies in transition. In these countries, ASGM activities or other activities relating to mercury are possibly managed in an environmentally unsound manner. Raw mercury or mercury in used mercury products, such as thermometers, is the important mercury source for artisanal and small-scale gold mining (ASGM) in developing countries and countries with economies in transition.[28]

[28] ASGM experts report that mercury for ASGM is often illegally imported in developing countries as registered for dental use (dental amalgam).

The export ban could therefore be expanded to mercury containing products (with free metal mercury) and mixtures with a lower mercury content.

It was also observed during this project that the waste streams defined in Art. 2 are interpreted differently. This concerns e.g. Article 2 (a) which refers to 'metallic mercury that is no longer used in the chlor-alkali industry' and Article 2 (b) which refers to 'metallic mercury gained from the cleaning of natural gas' (waste category 050701*). It is not clear to all addressed stakeholders whether mercury recovered from treating waste streams such as sludge, scrap, dust or other waste products that originate from the chlor-alkali industry or from cleaning of natural gas has to be regarded as mercury waste or can be considered as commodity. This shows that the wording in the Mercury Export Ban Regulation leaves room for interpretation and could lead to unwanted exports.

The waste streams defined in Article 2 of the Mercury Export Ban Regulation should be further specified with a clear statement, what is covered by these waste streams.

During the stakeholder consultation the impression arose that Article 1 of the Mercury Export Ban Regulation can be misinterpreted. In Article 1 (1) it reads that export of metallic mercury (Hg, CAS RN 7439-97-6), cinnabar ore, mercury (I) chloride (Hg2Cl2, CAS RN 10112-91-1), mercury (II) oxide (HgO, CAS RN 21908-53-2) and mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of at least 95 % weight by weight from the Community shall be prohibited from 15 March 2011 without specifically mentioning the word 'compounds'. Article 1 (2) stipulates that the prohibition shall not apply to exports of 'compounds' referred to in paragraph 1 for research and development, medical or analysis purposes. It seems not totally clear that the exemptions for export do not refer to metallic mercury but only to its compounds. This could also result in unintentional illegal export.

Therefore Article 1 should be amended stating clearly that the exemptions do only refer to compounds and mentioning the word 'compounds' already in Article 1(1).

BE addressed the intentional mixing of mercury with other substances, so that the mixture gets a lower mercury concentration than the 95 % mentioned in Article 1(1), as a possible loophole and believes that this exemption is not proportionate.

BE recommends to change the threshold concentration in mixtures and alloys in Article 1 to 5 % of metallic mercury, and therewith to ban the export of mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration above 5 % weight by weight from the EU.

Currently, for the exportation of compounds of metallic mercury to non-EU countries below 10 kg per country and year for the purpose of research or analysis, no declaration of end use is required under the PIC procedure from the non-EU importing countries as done for quantities of more than 10 kg. This is seen, by BE authorities, as a potential loophole for exporting restricted mercury compounds.

It is recommended to introduce a declaration of end use for exports of mercury compounds for research and development, medical or analysis purposes in the EU PIC procedure. In this case the importing customer must sign a form to confirm the type of use indicated by the exporter and only with the signed form the export can be carried out. This procedure is already introduced in BE.

The Mercury Export Ban Regulation does not specifically indicate that export also includes re-export. DG TAXUD has indicated that since the Mercury Export Ban Regulation does not mention re-exports, these are not targeted by this Regulation. Contrary to this, export is in the PIC Regulation defined as: *(a) the permanent or temporary export of a chemical meeting the conditions of Article 28(2) TFEU29; (b) the re-export of a chemical not meeting the conditions of Article 28(2) TFEU which is placed under a customs procedure other than the external Union transit procedure for movement of goods through the customs territory of the Union*;

Therefore, re-exports should be specifically mentioned in the Mercury Export Ban Regulation. Regarding waste containing mercury, a solution would be to resort to the wording of the Minamata Convention on Mercury and thus require 'operations that do not lead to recovery, recycling, reclamation, direct re-use or alternative uses' for the disposal of metallic mercury considered as waste.

Moreover, it was criticised that the CN codes do not allow distinguishing between the restricted compounds and the other compounds. The lack of specific CN codes for each individual compound means that investigations are required to clarify which actual compound is being exported. This obviously requires additional resources just to enforce the Mercury Export Ban Regulation.

Therefore it is proposed to introduce CAS numbers or specific CN codes for the restricted mercury compounds in the customs declaration forms. Belgium suggested to manage PIC and custom export data at the EU level and to link the databases in order to identify illegal movements and to improve monitoring.

BE also emphasized difficulties in identifying companies that do not declare goods as substances targeted by PIC because customs do not perform physical controls on dangerous chemicals for safety reasons and due to a lack of appropriate expertise.

More physical controls should be carried out and specific trainings should be offered to the personnel responsible for carrying out the controls.

Uncertainties were also mentioned by industry stakeholders regarding temporary storage and final disposal. Decisions on how to handle waste (underground disposal, stabilization as mercury sulphide or both) are missed in the Mercury Export Ban Regulation. One MS stated that permanent above-ground storage (disposal) of mercury and mercury compounds (mercury sulphide) is not environmentally sound and should be banned, as there is a risk of mercury being released when stored above ground. The risk is especially pronounced in case of fires at landfills due to the thermal instability of mercury sulphide. Above-ground disposal furthermore poses the risk of the biological conversion of elemental mercury to methyl mercury.

Decisions on how to handle waste (underground disposal, stabilization as mercury sulphide or both) should be included in the Mercury Export Ban Regulation. Mercury sulphide as well as metallic mercury should only be allowed to be disposed of in underground landfills.

[29] Treaty on the Functioning of the European Union (TFEU), Official Journal of the European Union, October 2012.

### *3.7.3 Penalty regimes*

According to Article 7 of the Mercury Export Ban Regulation MS are required to lay down rules on effective, proportionate and dissuasive penalties applicable to infringements of the provisions of this Regulation. They shall take all measures necessary to ensure that they are applied.

**Penalties**

Most of the MS reported their rules on effective, proportionate and dissuasive penalties applicable to infringements of the provisions of the Mercury Export Ban Regulation between 2009 and 2010 upon several requests from the Commission. In the questionnaire on impacts of the mercury export ban MS were asked again whether penalties are foreseen in their national legislation. According to the feedback from the 17 MS, which answered the questionnaire, the majority has introduced penalties. Only MT, HU and SK answered that they did not introduce such systems. However, in the answers to the Commission in 2010 HU and SK stated that penalty systems were introduced in their national legislation. Penalties address Article 1 (export ban), Article 2 (waste) and Article 5-6 (data reporting).

Most MS included the penalties in their legislative acts addressing chemicals (penalties for infringements addressing Article 1 of the Regulation) and waste (penalties for infringements addressing Article 2 of the Regulation). Some included the penalties in other acts like the Environmental Protection Act or elaborated specific acts. The penalties, if described, include fines from max. 5,000 up to max.500,000 Euros or imprisonment from max one month up to max. three years.

**Monitoring systems**

According to the feedback from the majority of the MS having responded to the questionnaire, monitoring arrangements are in place. Customs and different national and regional authorities are responsible for monitoring and ensuring compliance with the Mercury Export Ban Regulation. The arrangements include regular transport/company inspections (AT, BE), harbour and border controls (DK, HU), checks on documentation relating to exports (UK, IE) and close cooperation of customs, authorities and police in order to detect breaches of the Regulation (DK, HU, SK). Lithuania's response included information on monitoring requirements set for temporary storage sites containing metallic mercury. In addition, Belgium provided information referring to its custom declaration database (PLDA database) which includes a control mechanism that identifies Regulation 1102/2008 (PIC), also applying to metallic mercury and compounds and mixtures. Information on the quantity of controls carried out in practice is not available.

Except for Belgium and Ireland, the MS had no recommendations for improved/effective penalty regimes or monitoring systems. Belgium suggested to manage PIC and custom export data at EU level and to link the databases in order to identify illegal movements and to improve monitoring. Moreover, custom declaration forms were criticised, as no CAS number is given in order to identify the substances, meaning that the restricted compounds listed in the export ban cannot be distinguished comparatively to other compounds. This fact was also criticized by Ireland. BE emphasized also the difficulties in identifying companies that do not declare goods as substances targeted by PIC because customs do not perform physical controls on dangerous chemicals for safety reasons and due to a lack of appropriate expertise.

**Conclusions**

Only in Germany, one case is known where penalties were applied because of infringement of the export ban. Whether the penalties are effective is difficult to say as there is no comparison before and after the introduction of penalties and the dimension of illegal trade is not known. The proposal to introduce CAS numbers or specific CN codes for the restricted mercury compounds seems reasonable to simplify the control and detection of illegal exports, but just in case, that the now restricted compounds remain the only restricted ones under the Mercury Export Ban Regulation.

# 4 UNCERTAINTIES, DIFFICULTIES, COHERENCE WITH OTHER EU POLICY AND POSSIBLE AMENDMENTS

During the evaluation of statistical data, relevant literature, the feedback to the questionnaires as well as additional information, uncertainties of the Mercury Export Ban Regulation and difficulties in meeting the objectives were identified and described in this chapter. Additional information was provided by the feedback of the public consultation regarding the ratification of the Minamata Convention on the question whether amendments to the existing EU legal framework on mercury and (in particular to the Mercury Export Ban Regulation) with a view to simplifying it and/or improving its effectiveness could be proposed (European Commission, 2014).

Specific recommendations for clarifications or amendments are provided in boxes in the following sections.

## 4.1 Difficulties in the implementation of the Mercury Export Ban Regulation

**Difficulties in control whether a mixture contains more than 95 % metallic mercury**

Exports of mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of less than 95 % weight by weight are still allowed. It has been mentioned that it is difficult to control whether a mixture contains more or less than 95 % of metallic mercury and, although the mixing of metallic mercury with other substances for the sole purpose of export of metallic mercury is forbidden, this is difficult to control. BE specifically mentions that mercury could be mixed with more than 5% 'impurities' for export and believes that this exemption is not proportionate. To the knowledge of the authors of this report, no cases are officially known so far, in which mercury was mixed with impurities and declared as mixture containing metallic mercury for export. However, as mentioned above it would be difficult to control.

As mentioned previously, it is recommended to thoroughly assess, whether the limit of 95 % of metallic mercury is appropriate or should be adjusted to avoid exports of metallic mercury. BE recommends to change it to 5 % of metallic mercury and therewith to ban the export of mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of above 5 % weight by weight from the EU. Also other MS replied to the questionnaire on EU implementation of the Minamata Convention on Mercury that there is a need to extend the export ban on mixtures with a lower mercury threshold (AT, DK, DE, LT, SE, HU). No further specifications were made.

**Other difficulties in control of fulfilment of the export ban**

Certain controls are possible during the PIC procedure under the PIC Regulation, which also includes the ban of metallic mercury, cinnabar ore, mercury (I) chloride, mercury (II) oxide and mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of at least 95 % by weight from the EU. To apply for a PIC notification, the indication of the intended use is mandatory. However, the PIC Regulation does not apply for chemicals exported for the purpose of research or analysis in quantities that are unlikely to affect human health or the environment

and that in any event do not exceed 10 kg from each exporter to each importing country per calendar year. Currently, for exporting restricted mercury compounds to non-EU countries not exceeding 10 kg per country and year, a simplified procedure is applied, which does not require a 'declaration of end use' from the non-EU importing countries as is done for quantities exceeding 10 kg. BE considers this a weak point in the Regulation which could lead to illegal exports of small amounts of banned mercury by indicating the wrong intended use (but in total 10 kg from each exporter per year).

It is recommended by BE to introduce a 'declaration of end use' for exports of mercury compounds not exceeding 10 kg from each exporter to each importing country per calendar year for research and development, medical or analysis purposes in the EU PIC procedure. In this case, the importing customer must sign a form to confirm the type of use indicated by the exporter and only with the signed form the export can be carried out. This procedure is already introduced in BE. It could also be considered for the PIC Regulation. However, as there are already restrictions on the number of exports per importing country and year it is not expected that huge amounts of restricted mercury could be illegally exported in this way.

During the evaluation of the statistical data for illegal activities and for trends resulting from the export ban it was observed that it is difficult to control whether restricted mercury compounds are still exported after the Mercury Export Ban Regulation entry into force. In the Country Reports submitted to the Commission by the Member States under the PIC Regulation, it is not obvious for which kind of uses the mercury compounds are exported.

In the PIC procedure, the identity of the substances as well as the intended use of the substances should be specified in the export notification (the information required is listed in Annex II to the restriction). The data for evaluation of whether the exported mercury compounds and the intended uses are in accordance with the Mercury Export Ban Regulation should consequently be available to the competent authorities and customs services through the ePIC database tool.

The CN codes used for EU international trade statistics only allow for distinction between chemically defined mercury compounds (2852 10 00: Inorganic or organic compounds of mercury, whether or not chemically defined, excluding amalgams: chemically defined) and not chemically defined mercury compounds (2852 90 00: Inorganic or organic compounds of mercury, whether or not chemically defined, excluding amalgams: other) 30. This distinction was introduced in 2012. No allocation is made to specific mercury compounds such as mercury (II) chloride or mercury (II) sulphate. The lack of specific CN codes for mercury compounds was also criticised by BE and IE.

A solution for this problem would be to introduce CAS numbers or specific CN codes for the restricted mercury compounds in the customs declaration forms. Another solution suggested by Belgium is to manage customs export data together with PIC export data at EU level and to link the databases in order to see which kind of mercury compounds are exported for what kind of uses and to identify illegal movements and to improve monitoring.

[30] **Commission Implementing Regulation (EU) No 1101/2014 of 16 October 2014 amending Annex I to Council Regulation (EEC) No 2658/87 on the tariff and statistical nomenclature and on the Common Customs Tariff**

It was also proposed by some NGOs during the public consultation of the Ratification of the Minamata Convention to set up a trade tracking system to record information on exports and imports of mercury between MS and between EU and external countries and also within the industry sector to ease controls and reduce possibilities for illegal exports.

**Difficulties in the physical control of goods**
BE emphasized difficulties in identifying companies that do not declare goods as substances targeted by the PIC Regulation, because customs services do not perform physical controls on dangerous chemicals for safety reasons and due to a lack of appropriate expertise.

It could be considered whether controls on dangerous chemicals could be carried out after specific trainings of concerned personnel (however, this is outside the scope of the Mercury Export Ban Regulation).

Another possibility for illegal export of restricted mercury, mentioned by DE is the declaration of mercury waste such as used mercury products. With this declaration, mercury waste could be exported from developed countries, where mercury-free products are available and most mercury-containing products are phased out, to developing countries and countries with economies in transition (The Waste Shipment Regulation does only allow export of mercury-containing waste to OECD Decision countries). In developing countries, ASGM activities or other activities relating to mercury are possibly managed in an environmentally unsound manner. Raw mercury or mercury in used mercury products, such as thermometers, is according to stakeholders important mercury source for artisanal and small-scale gold mining (ASGM) in developing countries and countries with economies in transition.

To avoid such illegal exports, the scope of the export ban could therefore be expanded to mercury-containing products and mixtures with a lower mercury content (suggested by DE). This was already recommended by some MS in replies to questionnaires on the EU implementation of the Minamata Convention on Mercury (AT, DK, DE, SE, HU). They indicated a need for the extension of the export ban to include all mercury compounds, mixtures containing mercury as well as specific products containing mercury. Some other MS did not see a specific need, but were partly open for discussion and wished an impact assessment carried out on this issue.

## 4.2 Coherence with other EU policy

It is important to ensure coherence between different EU legislations for an overall good functioning policy. Therefore, one aspect of the evaluation of the Mercury Export Ban Regulation was the evaluation of any overlaps, discrepancies, contradictions or similar issues with other EU legislations.

According to MS feedback (Appendix 2), overlaps of the Mercury Export Ban Regulation exist with the following other legislations:

- Regulation (EC) No 1907/2006 concerning the registration, evaluation, authorisation and restriction of chemicals (REACH-Regulation).
- Regulation (EC) No 1013/2006 on shipments of waste (Waste Shipment Regulation).

- Council Directive 2011/97/EU of 5 December 2011 amending Directive 1999/31/EC in regard to specific criteria for the storage of metallic mercury considered as waste.

- Regulation (EU) No 649/2012 concerning the export and import of hazardous chemicals (PIC Regulation).

One representative of the chlor-alkali industry mentioned further (Appendix 3):

- Directive 2010/75/EU on industrial emissions[31] (IED).

- Reference Document on Best Available Techniques in the Chlor-Alkali Manufacturing industry.

- One MS (LT) suggested to merge and streamline the existing EU legislation and forthcoming requirements on mercury.

The responses, however, did not specify any overlaps or contradictions with other EU legislation and the 'overlaps' reported in the responses are rather to be considered interfaces with the other legislation.

The Waste Shipment Regulation, the PIC Regulation and Council Directive 2011/97/EU amending Directive 1999/31/EC (the Landfill Directive) are all important for the implementation and enforcement of the Mercury Export Ban Regulation. Possible overlaps e.g. in the reporting requirements have not been identified. It has been mentioned by some MS that specific requirements on substance identity and information on application of exported substances are missing in the PIC regulation reporting requirements. This seems to be due to improper implementation, as the PIC Regulation requires such information, which should be available to the competent authorities and customs services via the ePIC web-tool. As mentioned in chapter 2.1, the PIC Regulation clearly indicates that metallic mercury, mixtures and alloys are not addressed by the exemption in Article 1 (2) of the Mercury Export Ban Regulation, but this cannot be considered an inconsistency, but instead a clarification of the exemption.

The REACH Regulation restricts several mercury compounds and articles with metallic mercury (Entry 18, 18A and 62 of Annex XVII to the REACH Regulation). Entry 62 restricts the manufacture and placing on the market of five phenyl mercury compounds. As manufacture in the EU is restricted, in practice the export will be restricted as well (apart from re-export). Entry 18 which restricts a number of mercury compounds and Entry 18a which restricts the marketing of various measuring devices with mercury, do not restrict the manufacture of compounds or articles. The objective of the restrictions is the protection of humans and the environment against mercury, and it seems not to be in coherence with the objectives of neither the REACH Regulation nor the Mercury Export Ban Regulation that the compounds and articles can be exported. In the context of the Mercury Export Ban Regulation, it is of particular significance that measuring devices containing metallic mercury, both new and as waste, can be exported from the EU and thereby contribute to the global mercury supply.

[31] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions

## 4.3 Other aspects with regard to the Mercury Export Ban Regulation

During the public consultation regarding the ratification of the Minamata Convention and in the replies to the questionnaire on EU implementation of the Minamata Convention on Mercury, further recommendations were made by MS and organisations.

**Requirements for permanent storage of metallic mercury considered waste**
As per the requirements of Article 3(3) of the Mercury Export Ban Regulation, criteria should be laid down in amended Annexes I, II and III of Directive 1999/31/EC (the Landfill Directive) for the storage of waste mercury. Such criteria were sought defined in Directive 2011/97/EU, which amends the Landfill Directive. Directive 2011/97/EU was negotiated with the aim of defining criteria for permanent storage, but an agreement on the criteria could not be formed in the technical committee at the time, and criteria were thus set for (up to five years) temporary storage only. Since then, almost five years has lapsed, and there is thus a need for resolving this issue, as also pointed out by some MS and industry stakeholders in the course of this study; see below.

COWI/BiPRO/ICF (2015) summarises the findings of two recent studies pertaining to possible criteria for permanent storage of waste mercury as described in Appendix 4. Based on the findings of the studies, they conclude that permanent storage of liquid mercury in salt mines is considered the most favourable option both from an environmental and economic perspective. Stabilisation and permanent storage in salt rock, and stabilisation and permanent storage in hard rock, are considered to be environmentally sound disposal options. Solidification of liquid mercury should be mandatory prior to final disposal in hard rock formations. Permanent storage of stabilised mercury in above ground facilities is considered to have significant environmental disadvantages.

Industry stakeholders have in the stakeholder consultation for the current study called for clear decisions on how to handle waste (underground disposal, stabilization as mercury sulphide or both). If waste has to be stabilized for underground storage in salt mines, mercury needs to be stabilized because liquid waste is not accepted. However, hardly any treatment facilities exist so far to commercially stabilize mercury (only Dela GmbH in Germany existed which went bankrupt and is now overtaken by Remondis). According to one industry stakeholder, there are many formality obstacles by local authorities for the immobilisation of mercury waste.

One MS stated that permanent above-ground storage (disposal) of mercury and mercury compounds (mercury sulphide) is not environmentally sound and should be banned, as there is a risk of mercury being released when stored above ground. The risk is especially pronounced in case of fires at landfills due to the thermal instability of mercury sulphide. Above-ground disposal furthermore poses the risk of the biological conversion of elemental mercury to methyl mercury.

It is recommended by DE, that mercury sulphide as well as metallic mercury should only be allowed to be disposed of in underground landfills. Some organisations, which contributed to the public consultation, state that metallic mercury considered as waste should not be allowed to be stored permanently without prior transformation. By keeping the mercury in metallic form, illegal traffic is eased. Consequently, by imposing transformation (solidification/stabilization) of metallic mercury into more stable and less dangerous components, any illegal use is also more difficult or even impossible. Some MS further find that there is a need to extend the storage obligations to metallic mercury from other sources (BE, DK, LT, SE, HU). However, this should be based on a comprehensive impact assessment.

Regarding the definition of time limits, two MS, which replied to the questionnaire on EU implementation of the Minamata Convention on Mercury, find that there is a need

to define time limits concerning temporary storage of metallic mercury (DE, SE). The time limit should be about 5 to 10 years (DE), to be further discussed. The setting of time limits is also requested by some organisations, which contributed to the public consultation. However, many MS answered that they do not see a need for time limits. For definition of specific time limits and other storage regulations, a comprehensive impact assessment should be carried out according to these MS.

Specific conditions and criteria for environmentally safe permanent storage of metallic mercury are needed. If conditions are clearly defined this could also be beneficial for the creation of a market to treat mercury before final disposal if required.

If criteria for permanent storage cannot be reached in the near future, it could be considered to set further time limits for the temporary storage in order to prevent accidents and unintentional releases of mercury to the environment.

**Introduction of an import ban**
Some MS (AT, DK, SE, HU, BG) indicated, that they consider a need to introduce an import ban in order to phase out mercury in the long term, provided that it is compatible with WTO and any other trade rules. Import for sound final disposal (underground disposal) within Europe should be allowed. This was specifically mentioned by DE, which has the view, that a general import ban would unduly restrict countries from exporting waste mercury to safe underground storage and disposal facilities that were presently only available in some Member States. The import ban for metallic mercury was also requested by some organisations which contributed to the public consultation regarding the ratification of the Minamata Convention.

**Extension of the export ban to include all mercury compounds**
Some MS stated in the replies to the questionnaire on EU implementation of the Minamata Convention on Mercury that the export ban should be extended to all mercury compounds, mixtures containing mercury as well as specific products containing mercury. Some MS were open for discussion but wished that an impact assessment be carried out on this issue. The extension of the export ban to other compounds, mixtures containing mercury as well as specific products containing mercury was also requested by many organisations, which contributed to the public consultation regarding the ratification of the Minamata Convention.

**Extension of the ban on manufacture, import and export of products**
Many addressed organisations also requested specific provisions prohibiting the manufacture, import and export of mercury added products (including those listed in Annex A, Part I of the MC) as well as the mercury use in processes (listed in Annex B, Part I of the MC) during the public consultation, as well as the recycling and eventual phase out of mercury used in porosimetry and pycnometry. These provisions, however, may perhaps rather be within the scope of the REACH Regulation than the Mercury Export Ban Regulation.

**Separate collection of used products containing mercury**
Another proposal from addressed organisation is to introduce requirements for the separate collection of used products containing mercury (thermostats, thermometers, blood pressure devices, etc.) and a better labelling of these products to facilitate the separate collection.

# 5 OVERALL EVALUATION OF THE EXPORT BAN

This chapter includes an overall evaluation of the Mercury Export Ban Regulation. With reference to the draft Commission Guidelines for Evaluation (European Commission. 2013), this chapter address the effectiveness, efficiency and coherence of the Regulation:

- Effectiveness – To what extent did the intervention cause the observed changes/effects? To what extent can these changes/effects be credited to the intervention? To what extent do the observed effects correspond to the objectives?
- Efficiency – Were the costs involved justified, given the changes/effects which have been achieved? What factors influenced the achievements observed?
- Coherence – To what extent is this intervention coherent with other interventions which have related objectives? To what extent is the intervention coherent internally?

The European Commission Impact Assessment of the proposal of the Mercury Export Ban Regulation from 2006 (European Commission, 2006b) estimated the remaining mercury amounts accumulated in the cells in the chlor-alkali sector at that time at 12,000 tonnes which could be placed on the market by the phase-out of mercury-cell chlor-alkali production before 2020. The mercury demand seen over the period 2005-2015 for uses other than the chlor-alkali industry was estimated at about 190 tonnes/y and consequently significant surplus mercury would enter the global market. It was expected that the majority of the surplus mercury was exported from the EU which was in accordance with international trade statistics, showing that 824 tonnes of mercury was exported from the EU in 2004. The Mercury Export Ban Regulation was proposed as an intervention with the aim of avoiding that this mercury was exported and used e.g. in developing countries for artisanal and small-scale gold mining, where significant mercury releases to the local and global environment take place.

The overall objectives of the Mercury Export Ban Regulation, as specified in the preamble to the Regulation, are:

- To significantly reduce the global mercury supply.
- Ensure safe storage of surplus mercury within the EU.

## 5.1 Effectiveness

### *5.1.1 Impact on the global and the EU mercury supplies*

**Changes in export and import of metallic mercury and global mercury supply**

During the period 2005-2010, prior to the Regulation entry into force, the annual export of metallic mercury averaged 673 tonnes. After the Regulation entered into force, the export of mercury had decreased to 19 t/y (average for 2012-2013 corrected for some misreporting in the trade statistics). The annual decrease in export can be estimated at approximately 650 t/y. As discussed in section 3.6, the annual export varies considerably and increased significantly prior to the Regulation entering into force. A likely explanation is that stockpiled surplus mercury was exported before the ban. The average export for a period before the Mercury Export Ban Regulation entering into force, however, still indicates the quantities of surplus mercury that likely would have been exported.

In the absence of the Regulation, the export of mercury from the EU would most probably have lasted for many years, mainly due to the large quantities accumulated in the EU chlor-alkali sector. The European Commission's Impact Assessment of the proposal for the Regulation foresaw that surplus mercury from the chlor-alkali sector could enter the world market. This has been confirmed by the actual figures. The total quantity of metallic mercury removed from the chlor-alkali sector during the period 2004-2013 is estimated at 5,800 tonnes (average 880 t/y). The total quantity of mercury exported outside the EU or sent to storage from the chlor-alkali sector (in 2011-2013 in accordance with the Regulation) adds up to 6,200 tonnes. Even if some of the mercury from decommissioned chlor-alkali plants may have been reused within the EU, and some of the exported mercury may originate from other sources, the data illustrate the overall impact on the export of the surplus mercury.

The total quantity of mercury accumulated in the cells and stored on-site as metallic mercury in the chlor-alkali sector by 31 December 2010 (latest reporting from industry before the Mercury Export Ban Regulation entering into force) was 8,252 tonnes.

A part of this may be used within the sector in the coming years. According to the reporting for the UNEP Mercury Chlor-alkali Partnership, the total consumption during 2010-2013 of the chlor-alkali sector in Europe (of this 99 % in the EU) was 92 tonnes (average: 23 t/y) (WCC, 2014). If it is assumed that the consumption remains at that level for eight years from when the Mercury Export Ban Regulation entered into force, the total used in the sector can be estimated at approximately 180 tonnes. Most likely, the total consumption will be lower, as more chlor-alkali plants may be decommissioned in the period.

Subtracting the internal consumption, the total impact of the Regulation as concerns the mercury accumulated in the chlor-alkali sector is anticipated to be the prevention of approximately 8,000 tonnes of mercury entering the global market for mercury.

If it is assumed that the majority of this in a business-as-usual scenario would have been exported over a period of ten years (2011-2020), the annual export would have been 800 t/y. This is well in line with the observed decrease in the export after the Mercury Export Ban Regulation entered into force, and the observed decrease will be used as a best estimate of the annual impact of the Regulation on the export of mercury. It should be noted that after 2020, the export would have decreased also in a business-as-usual scenario.

Consequently, the decrease in the global mercury supply will be estimated at 650 t/y as a best estimate. The global mercury supply in 2007 has been estimated at 3000-3900+ t/y [32] (Maxson as cited in COWI, 2012) and the decrease in the export from EU correspond to approximately 20 % of the supply. No newer data are available.

Analyses of trade statistics demonstrate that the majority of the mercury prior to the Mercury Export Ban Regulation was exported to developing countries. For many of the countries it is known that mercury is used for artisanal gold mining either within the importing country or in the region.

Besides the decrease in export from the EU, the Regulation in principle may have affected the global mercury market by an increased import of mercury into the EU. No data are available from the trade statistics regarding the import of metallic mercury under the CN code 'mercury, in flasks' for 2012 and 2013 and it is consequently not possible to evaluate the consequences for the mercury import in detail. During the

[32] The + refers to mercury from commercially available mercury stocks which were not known and not included in the estimate.

period 2004-2010, the total import of metallic mercury averaged 259 t/y; of this 95 % was reported under the CN code 'mercury-other'. In 2011 the reported total import was 43 tonnes (of this, 8 tonnes in flask). The quantity reported as 'mercury-other' for the period 2012-2013 was 39 t/y on average. The available data indicate a clear decrease in the import of mercury to the EU as compared to the import during the period 2005-2010. Unless the import of mercury in flasks has increased massively (as mentioned, data are not available from the statistics), the available data indicate that changes in the import would have a small impact on global mercury market and changes in import have not been taken into account in the assessment of the impact on the global mercury market.

**Changes in the export and import of mercury compounds**

As the international trade statistics do not include specific CN codes for the mercury compounds addressed by the Regulation, it is not possible to undertake a detailed assessment of the impact of the Regulation on the export or import of these substances. The export of mercury compounds as reported by the international trade statistics decrease during the period 2007-2011 (data before 2005 are not available), but increased from a level of 54 tonnes in 2011 to 212 tonnes in 2013. A similar trend, although less pronounced, was observed in the data reported under the PIC Regulation (MS chemical reports). The available data consequently do not indicate any positive impact on the global trade of mercury compounds from the implementation of the Regulation. It should, however, be noted that the main intention of the inclusion of the mercury (II) chloride and mercury (II) oxide was to prevent these substances being used as a loophole for continued export of mercury, by the subsequent conversion of the substances into metallic mercury abroad.

As discussed elsewhere, it cannot be ruled out that the increase in the export of mercury compounds is the consequence of some metallic mercury being exported under incorrect CN codes.

**Safe storage of mercury from sources targeted by the Regulation**

**Chlor-alkali sector**: During the period 2011-2013, in total 1,025 tonnes mercury from the chlor-alkali sector was sent for off-site storage (average: 341 t/y). The quantities sent for storage increased from 171 tonnes in 2011 and 199 tonnes in 2012 to 655 tonnes in 2013. The data may indicate some delay in the quantities sent for storage due to shortages in temporary and final storage capacity highlighted by several stakeholders. The total annual quantities removed from the chlor-alkali sector during the period 2004-2013 average 880 t/y, i.e. significantly higher than the quantities sent for storage during the period 2011-2013. Based on the reporting from the industry[33], 1,954 tonnes of mercury was removed from the facilities during 2010-2013 (estimated from the differences between the years in total mercury in the cells plus stored on-site), while the reported quantity sent for off-site storage during the same period was 1,025 tonnes. The resulting difference of 929 tonnes can be compared with the total EU-extra export for the period 2010-2013, which was 1,383 tonnes, while the reported net-export was 1,168 tonnes (data for import of mercury in flasks for 2012-2013 are not available and the actual net-export may consequently be somewhat lower). The data indicate that the majority of the mercury, which was not sent for storage, may have been exported to countries outside the EU prior to the export ban entry into force.

A part of the decrease in the amounts at the facilities may be attributed to mercury removed from the sites in solid waste (sludge), by emissions, accumulated in buildings, etc. A proxy for this is the total quantity of mercury reported as consumption/use

[33] Available at the European Commission's website ay:
http://ec.europa.eu/environment/chemicals/mercury/regulation_en.htm

of mercury in the sector. According to the reporting for the UNEP Mercury Chlor-alkali Partnership, the total consumption during 2010-2013 in the chlor-alkali sector in Europe (of this 99 % in the EU) was 92 tonnes corresponding to 23 t/y (WCC, 2014). Of this, about half was reportedly removed as solid waste (12 t/y). Compared to the total quantities being available from the decommissioning of plants, the reported consumption within the sector is very small.

**Gas purification and nonferrous metal production**: An assessment of mercury gained from gas purification and nonferrous metal production estimated a total production of by-product mercury in the EU of 65-90 t/y in 2008 (COWI/Concorde, 2008). The potential total recoverable mercury in these waste types was estimated at 350-410 t/y. According to the Mercury Export Ban Regulation, the companies in the sectors that gain metallic mercury from these waste types should report to the Commission and MS competent authorities on the mercury amounts gained. The recovery of mercury from waste as reported by five companies in the natural gas sectors and one company in the non-ferrous mining and smelting sector in 2009 was 18.2 tonnes (Table 3-2). It is not clear if the difference between the 65-90 t/y estimated by COWI/Concorde (2008) and the 18 tonnes reported in 2009 is due to actual decreases in the quantities recovered, non-comprehensive reporting in 2009, or that the quantities were overestimated by COWI/Concorde (2008). The reported recovery decreased to 6.2 tonnes in 2013. An explanation for this decrease may be that the companies have no incentives for gaining the metallic mercury from the wastes and the mercury-containing waste is either disposed of untreated or exported for treatment outside the EU[34]. Data reported under the Waste Shipment Regulation demonstrates that at least mercury-containing waste from gas purification is exported for treatment abroad. In 2012, the reported export of such waste to Switzerland was 62 tonnes (no data available for 2013-2014).

The total export of mercury from Switzerland has increased significantly after the EU Mercury Export Ban Regulation entered into force. According to the UN Comtrade data, the export from Switzerland increased from an average export during 2007-2010 of 25 t/y to an average of 128 t/y for the period 2012-2014; a change of a magnitude similar to the 2008 by-product mercury production in the EU (as described above). This could indicate that the recovery of mercury from waste products (including those imported from the EU) has increased significantly; as a consequence of increased mercury prices or a consequence of increased import of mercury waste from the EU, or both. It may, however, also be a consequence of export of mercury from decommissioned mercury-cells from chlor-alkali plants in Switzerland.

The impact of the Regulation on the global supply of mercury recovered from waste from cleaning of gas and from non-ferrous metal production is thus made less efficient by the export of the waste for recovery of mercury outside the EU.

**Changes in the EU market for mercury**

Current mercury consumption in the EU is estimated at 260-400 t/y; of this 160-190 t/y is estimated as used in the chlor-alkali sector (COWI/BiPRO/IC, 2015). The consumption within the chlor-alkali sector is reported by the sector to be lower (WCC, 2014): on average 23 t/y for the period 2010-2013. The current mercury demand for the sector in the EU is most probably met by the surplus mercury from decommissioned plants.

The supply sources of the remaining 100-210 t/y used in other sectors would be the recovery of mercury from other wastes than those addressed by the Regulation, and

[34] Provided an interpretation of the Mercury Export Ban Regulation that the provisions concern metallic mercury recovered from the sludge and other waste products; further discussed under uncertainties.

the import of mercury. The most recent detailed assessment of mercury recovered from other wastes from 2008 estimated the total recovered quantities at 102 t/y (COWI/Concorde, 2008). The main sources were mercury sludge from chlor-alkali production and dental amalgams. The current annual supply from the recycling of waste excluding waste from chlor-alkali production is assumed to amount to approximately 100 tonnes (COWI/BiPRO/ICF, 2015). This is roughly in line with information obtained for the COWI/BiPRO/ICF study from 'Hazardous Waste Europe'. Currently there are five facilities in the EU for the treatment of mercury containing waste. According to Hazardous Waste Europe, they produce between 50 and 120 t/y of mercury in total. In its submission to that study, Hazardous Waste Europe explained that the real production was below 100 t/y and that only one plant was equipped with triple distillation to produce very high quality mercury.

The quantities recycled from solid waste from the chlor-alkali sector would today be no more than 12 t/y, as the total mercury in solid waste from the sector is reported to be on average 12 t/y (WCC, 2014). As discussed below, there are currently some uncertainties as to whether mercury recovery from sludge from chlor-alkali production is still allowed. Including the waste from the chlor-alkali sector, the total quantity recovered would likely be 100-110 t/y on average.

The data indicate that for a period some mercury should still be imported in order to meet the demand, which is in accordance with trade data demonstrating that the import of mercury is at least 39 t/y. If the import of mercury is banned in the short term, it may be challenging to meet the current demand of mercury by the recovery of mercury from those waste products not addressed by the Regulation. The available data do not allow for a precise assessment of the impacts of an implementation of an import ban in the near future.

**Observation regarding changes in prices**

According to information from some industry stakeholders, the prices for mercury increased since the mercury ban entered into force, due to reduced availability on the world market.

The following description of the changes in the market prices is largely based on the description in a recent assessment for the European Commission (COWI/BiPRO/ICF, 2015).

The effects on mercury prices of reductions in supply are not well described in the literature. COWI (2012) illustrates that the world market price for mercury has varied extensively over the last decades. In the period 2002-2010 annual average import prices ranged from 67 to 687 EUR/flask[35] , based on EU trade statistics, with an average price for the period of 221 EUR/flask. The annual average export prices ranged from 207 to 739 EUR/flask, with an average export price of 457 EUR/flask.

World market prices for mercury between 2006 and 2013 are shown in Table 5-1. From 2009 to 2011 the price increased steeply from 600 USD/t to 1,850 EUR/t, but has been stable at 1850 EUR/t during 2011-2013. The value of exported mercury as reported by Eurostat international trade statistics varies considerably, but averages for more years may still indicate the trend. The average value per tonne of mercury was for the period 2008-2010 at 14,563 EUR/t. For the period 2011-2013 the average had increased to 37,631 EUR/t. These increases are quite well in accordance with the world market prices shown in Table 5-1.

[35] 1 flask = 34.5 kg mercury

The increase in prices is most likely an effect of the decrease in supply of mercury from the EU and the USA. In the USA, an export ban went into force on January 1, 2013 (USGS, 2014). During the period 2008-2010, the average export from the USA was 651 t/y and the net export was 433 t/y. Already in the last years before the US export ban, the exports decreased significantly. The effect of the US export ban on the global supply of mercury is thus of the same order of magnitude as the effect of the EU export ban.

World mine production has remained stable between 2009 and 2013 at around 1,900 t/y (exclusive of production in the USA) (USGS, 2014) and the available data indicate that the decreased supply from the EU and the USA, has not resulted in increased mine production. This supports the assumption that the increase in prices can be attributed to the decreased supply of mercury from the EU and the USA.

For the calculations of impacts in different groups of stakeholders in section 5.2, the average price for the last three years before the Mercury Export Ban Regulation entered into force (2008-2010) of 15,900 EUR/t is applied (based on data Table 5-1), as they are deemed reasonably descriptive for the business-as-usual situation, should the EU Export Ban Regulation not have been implemented.

***Table 5-1 World market prices for mercury 2006-2013, based on USD/Hg flask prices.****

| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|
| Average price, USD/flask * | 670 | 530 | 600 | 600 | 1076 | 1850 | 1850 | 1850 |
| Exchange rate EUR/USD | 1.2558 | 1.3704 | 1.4709 | 1.3942 | 1.3275 | 1.3924 | 1.2585 | 1.3280 |
| Calculated price in EUR/t | 15,464 | 11,210 | 11,824 | 12,474 | 23,494 | 38,511 | 42,609 | 40,379 |

* Source for 2006 to 2012: USGS (2011, 2012, 2014) citing Platts Metals Week.

### *5.1.2 Impact on the safe storage of surplus mercury within the EU*

During the period 2011-2013 in total 1,025 tonnes of mercury from the chlor-alkali sector was sent for off-site storage (average: 341 t/y). The quantities sent for storage increased from 171 tonnes in 2011 and 199 tonnes in 2012 to 655 tonnes in 2013. The total quantity sent for storage from natural gas production and non-ferrous mining and smelting during the period 2011-2013 was 33 tonnes (average 11 t/year) with a decreasing trend. It is not indicated how much of the reported quantities sent for storage is temporarily stored as metallic mercury.

In general, responding representatives of the chlor-alkali industry consider storage capacities in the EU, both for temporary and permanent storage of mercury considered as waste, as insufficient and therefore as a source of disproportionate efforts and costs. The small capacity is also indicated by the fact that only two MS (HU, HR) have issued permits for facilities designated to store metallic mercury.

Industry stakeholders have in the stakeholder consultation called for clear decisions on how to handle the waste (underground disposal, stabilization as mercury sulphide or both). Currently waste has to be stabilized for underground storage in salt mines, because liquid waste is not accepted according to Article 5, 3(a) of the Landfill Directive (Council Directive 1999/31/EC). However, hardly any treatment facilities exist so far

to commercially stabilize mercury[36]. According to one industry stakeholder there are a lot of formality obstacles by local authorities for the immobilisation of mercury waste.

The responses to the stakeholder consultation indicate that the objective of the Regulation to ensure safe storage of surplus mercury within the EU has still not been met. Specific conditions and criteria for environmentally safe permanent storage of metallic mercury could be introduced (see section 4.3 above). If conditions are clearly defined this could be beneficial for the creation of a market to treat mercury before final disposal if required.

### *5.1.3 Difficulties in the implementation of the Regulation*

**Reporting on the import of mercury and cross-border trade of mercury considered waste within the EU**

The stakeholder consultation and assessment of the available data have pointed at several difficulties in the implementation of the Regulation in particular with regard to the control of metallic mercury entering the EU, cross-border trade within the EU and export of mercury compounds.

Only one MS (UK) reports that the authorities have received documentation of activities referred to in Article 2 of the Mercury Export Ban Regulation (as requested in Article 5 (3) of this Regulation), which indicates that most importers and exporters did not submit the required information.

The international trade statistics from Eurostat demonstrates that metallic mercury is imported into at least three other MS (in addition, no statistical data are available for import of mercury in flasks, so it may be more MS).

Data from Eurostat demonstrates that the cross-border trade of metallic mercury has increased after the Mercury Export Ban Regulation entered into force (section 3.6). The total reached more than 1,200 tonnes in 2013, indicating an extensive trade between the MS which probably also includes mercury from decommissioning of chlor-alkali plants. With the wording used in Article (2) of the Regulation '*metallic mercury that is no longer used in the chlor-alkali industry*' (our underlining), mercury from decommissioned sites may in principle be used elsewhere in the industry and would consequently not be mercury considered as waste. As Article 5,3 (b) only concerns mercury considered as waste (i.e. traded cross-border for temporary or permanent storage) no documentation would be required for cross-border trade of mercury from one chlor-alkali site to another. Several stakeholders have pointed out the shortcomings in storage capacity and this may be an explanation for the very limited reporting on cross-border trade of mercury considered waste.

The missing reporting requirements for mercury from decommissioned chlor-alkali sites not considered waste may hamper the control of whether the mercury is actually reused in accordance with the Regulation.

**Export of mercury compounds**

Several MS have pointed at difficulties in the control of exported mercury compounds. Due to the hazardousness of the substances, the possibility of compliance control by actual analyses of the substances by the customs authorities are limited. One Member State commented that the MS have no actual effective means to prove an intention to circumvent the export obligations. Several MS have pointed at the need for specific CN codes in the international trade statistics for substances covered by the export ban,

[36] Stabilisation was commercially offered by DELA, which went bankrupt, and we are not aware if the new owner Remondis offers the service currently.

and more specific requirements in the PIC Regulation for providing information on the specific mercury compound (indicated by CAS number) and the intended use. This would ease the control at least for banned substances exported by operators not deliberately involved in illegal export. However, the PIC regulation already requires that substance identity and intended use are specified in the export notification.

**Illegal export or use of metallic mercury**
One example of illegal export of mercury, the DELA case where mercury metal was illegally exported from Germany to Switzerland, was mentioned by several stakeholders. One incident in Spain has been mentioned by stakeholders, but according to the questionnaire response from Spain, the investigation showed that no illegal activity had taken place. Besides this, no examples of illegal export or illegal reuse of metallic mercury from the chlor-alkali sector were reported. Comparison of EU export data and data on import from the EU MS as reported by the importing countries to the EU Comtrade statistics indicate some irregularities where mercury indicated as imported from EU MS is not reported as exported. Based on the current knowledge, it cannot be considered a clear indication of illegal export, but may indicate a need for further investigation.

### *5.1.4 Proposed clarifications of uncertainties and possible extension of the scope*

**Clarifications**
Clarifications of several points may extend the effectiveness of the regulation by preventing unintended activities.

Depending on the interpretation and intention of the current text, changes may be considered either a clarification (in accordance with the actual intention of the Regulation) or an extension of the scope of the Regulation.

Uncertainties identified as part of the stakeholder consultation and the assessment of available data are listed in Table 5-2. The table includes two interpretations indicated as 'least wide-reaching' and 'most wide-reaching', but in fact some interpretations in-between may exist.

*Table 5-2 Uncertainties identified on the basis of the stakeholder consultation*

| Article | Interpretation 1 (least wide-reaching) | Interpretation 2 (most wide-reaching) | Remark |
|---|---|---|---|
| Art 1 (2)<br>The prohibition shall not apply to exports of compounds referred to in paragraph 1 for research and development, medical or analysis purposes. | The article refers to all listed substances<br>(according to the REACH definition a substances is '*a chemical element and its compounds in the natural state or obtained by any manufacturing process*' (ECHA, 2011) i.e. it includes metallic mercury, cinnabar and mixtures of metallic mercury). | The article refers to the listed compounds only i.e. mercury (I) chloride, mercury (II) oxide.<br>Unclear whether cinnabar ore is included in the definition of a compound | The PIC Regulation Annex V, part 2 specifically indicates that the export ban applies to all exports of metallic mercury and mixtures of metallic mercury and alloys, i.e. the PIC Regulation is in accordance with interpretation two.<br>The PIC Regulation includes the cinnabar ore in the list of compounds, even if it may not exactly meet the definition of a compound.<br>A rephrasing would be needed in order to be chemically consistent. |
| Art 1 (1)<br>The export of metallic mercury.... | The export ban does not include mercury in semi-manufactures ("mercury pillows"[37]) for capsules for dental amalgams.<br><br>At least one stakeholder has raised the question whether these semi-manufactures are included in the ban. | The export ban includes mercury in semi-manufactures ("mercury pillows") for capsules for dental amalgams.<br>The companies and MS addressing this issue in the stakeholder responses seem to apply this interpretation. | It is a common understanding that the Regulation does not concern mercury in articles such as thermometers and barometers.<br>These mercury pillows most probably cannot be considered an article using the REACH Regulation definition of articles [38]. It is thus on the borderline and it may be relevant to clarify whether it is covered. |

[37] Mercury in a small polyethylene bag, that is intended for incorporating in a dental amalgam filling capsule.

[38] Article 3(3) of the REACH Regulation defines an article as "an object which during production is given a special shape, surface or design which determines its function to a greater degree than its chemical composition".

| Article | Interpretation 1 (least wide-reaching) | Interpretation 2 (most wide-reaching) | Remark |
|---|---|---|---|
| Art 1<br>1. The export of.... | The article concerns export only. | The article concerns both export and re-export. | One MS mentioned at the stakeholder consultation that the PIC Regulation specifically indicated that export means both export and re-export, which is not mentioned in the Mercury Export Ban Regulation.<br>In order to be coherent with the PIC regulation, and to increase clarity, it may be considered to specifically indicate that the Regulation concerns re-export also. |
| Art 2<br>(a) metallic mercury that is no longer used in the chlor-alkali industry. | The article refers to metallic mercury in a pure form which can be placed on the market without recovery.<br>According to the stakeholder consultation this interpretation is applied by some MS. | The article refers to metallic mercury in any form, also metallic mercury (elemental mercury) gained from solid waste from the industry which needs recovery/refining before it can be marketed.<br>This interpretation is applied at least by the UK. | The article needs a rephrasing in order to clarify if metallic mercury gained from waste of the chlor-alkali industry has also to be considered as waste or can be used as commodity again. |
| | The article refers to metallic mercury that is no longer used in the chlor-alkali industry i.e. the mercury from one site can be reused in another site within the industry sector. | The article refers to metallic mercury that is no longer used by the individual companies in the industry i.e. when removed from a site, the mercury is considered waste. | Interpretation one seems the most literal, but it is unclear whether this is the intention. |

| Article | Interpretation 1 (least wide-reaching) | Interpretation 2 (most wide-reaching) | Remark |
|---|---|---|---|
| Art 2 (b) metallic mercury gained from the cleaning of natural gas; Art 2 (c) metallic mercury gained from non-ferrous mining and smelting operations; | The article refers to metallic mercury gained from the addressed processes without further treatment. This interpretation is at least used by some stakeholders and MS | The article refers to metallic mercury in any form, also metallic mercury (elemental mercury) gained from solid waste from the concerned industries which needs to be recovered before it can be marketed. Applying this interpretation, the use of the recovered mercury as commodity would be banned. | The article needs a rephrasing in order to clarify if metallic mercury gained from waste of the addressed industrial activities has also to be considered as waste or can be used as commodity again. |
| Article 5 (3, b) volumes, originating country and destination country of metallic mercury considered waste that is traded cross-border within the EU. | The article refers (as stated) to mercury considered as waste and sent for temporary or permanent storage, i.e. the article does not refer to mercury removed from one chlor-alkali site for reuse within the sector. | The article includes all mercury removed from chlor-alkali sites irrespective of the destination. | The uncertainty is linked to an uncertainty about the wording of Article 2 (a): 'metallic mercury that is no longer used in the chlor-alkali industry' mentioned above. |

### *5.1.5 Extending the scope of the Regulation*

As mentioned above, the discussion regarding the extension of the scope is linked to the discussion of uncertainties.

The most wide-reaching interpretations indicated in the Table 5-2 may by some stakeholders and MS be considered a clarification of the existing legislation, whereas by others it may be considered as extensions.

**Further reducing the global mercury supply**

As part of the consultation for the study on the EU implementation of the Minamata Convention (COWI/BiPRO/ICF, 2015), MS have indicated their support to widening the scope of the EU legislation on mercury as summarised below.

The answers to the possible additions with regard to export and import of mercury are summarised below.

| Possible extension | Number of Member States (out of 17 responses) | | |
|---|---|---|---|
| | Yes | No | Undecided |
| Extending the export ban to other mercury compounds, mixtures with a lower mercury content and products containing mercury, in particular thermometers, barometers and sphygmomanometers. | 6 (AT, DK, DE, LT, SE, HU) | 6 (HR, FI, RO, ES, BG, LU) | 3 (BE, IE, UK) |
| An import ban on metallic mercury, mercury compounds and products containing mercury. | 5 (AT, DK, SE, HU, BG) | 6 (HR, DE, FI, RO, ES, LU) | 4 (BE, LT, IE, UK) |
| Extending the storage obligation to metallic mercury from other sources. | 5 (BE, DK, LT, SE, HU) | 6 (HR, FI, RO, ES, BG, LU) | 2 (IE, UK) |

Support for additional legislation varied across the MS. For the three mentioned possible additions, support was evenly split between the MS that had formed a position on the issue. Concerning the extension of export bans to products and compounds with lower mercury content, countries in favour had either already put in place further restrictions, or were broadly supportive of stricter regulations given the environmental risks involved. Where specified, the objections of the MS were raised on the basis that there were insufficient assessments.

Specific concern was raised about the shipment of mercury wastes from measuring instruments to developing countries where it is an important source for small-scale and artisanal gold mining. In some cases, lack of data and research made it difficult for countries to form clear positions.

Where objections to import bans were raised, it was partly on the basis of the need for specific exemptions such as for the import for safe underground storage and disposal, as this is only available in some MS.

The intention of Article Art 2 (b) and Art 2 (c) is to prevent that mercury recovered from wastes from the cleaning of natural gas and non-ferrous mining and smelting operations reaches the global market for metallic mercury. The export of the wastes for recovery of the mercury outside the EU is clearly contrary to the intention of the Regulation, but not necessarily a violation of the Regulation (depending on the interpretation). An extension of the Regulation with a specific ban of export of the addressed mercury-containing wastes for recovery (or export of mercury containing waste in total) would certainly increase the effectiveness of the Regulation.

**Ensure safe storage of surplus mercury within the EU**

Temporary storage of metallic mercury involves a risk of accidents and environmental releases of the stored mercury. The MS consultation results regarding a possible time limit concerning temporary storage of metallic mercury is shown below (Cowi;BiPRO;ICF, 2015).

| Possible extension | Number of Member States (out of 17 responses) | | |
|---|---|---|---|
| | Yes | No | Undecided |
| Time limits concerning temporary storage of metallic mercury. | 2 (DK, SE) | 8 (HR, DE, FI, LT, RO, HU, BG, LU) | 3 (BE, IE, UK) |

Two MS expressed a need to set clear limits on temporary storage. One MS highlighted a specific need for additional assessments on the long-term behaviour of metallic mercury in underground storage to determine sound, knowledge-based requirements for permanent storage, though felt that present regulations were appropriate in the context of temporary storage (up to five years) and represented the best available techniques.

### *5.1.6 Current and future environmental and health benefits of the Regulation*

The total amount of mercury prevented to reach the global market is estimated at approximately 650 t/y at least the next years. The total prevented export of surplus mercury in the chlor-alkali sector is estimated at 8,000 t/y, and to this should be added any prevented recovery of mercury from gas purification and non-ferrous mining and smelting operations. If the reported data on recovery in 2009 are used as an indication of the recovery before the ban entered into force, the prevented recovery from these sectors would be some 18 t/y.

The annual decrease in export corresponds to approximately 20 % of the global supply of mercury (see section 5.1.1). The environmental impact of the export of mercury will depend on the actual uses of the exported mercury, which is not known. If used for ASGM, the majority of the mercury will be lost to the environment. Considering that most of the mercury was exported to developing countries, it seems likely that a significant part of the exported mercury was indeed used for ASGM.

The significant increases in the global prices of mercury indicates that the decrease in mercury export from the EU may not have been compensated for by mercury supplied from other sources, but may actually have resulted in a decrease of (legal) supply of mercury on the global market. There is anecdotal reports of illegal mercury recovery from old mining sites, etc., but the extent of such activities are of course unknown.

In order to indicate the order of magnitude of the health benefits, some rough estimates are provided below.

Intentional use of mercury in 2010 accounted for 44 % of the total global anthropogenic[39] mercury emissions; with ASGM as the main source accounting for 37 % of the total mercury emissions (UNEP, 2013). This indicates that intentional use of mercury would also contribute significantly to the total human exposure to mercury from ingestion and inhalation.

The societal benefits in terms of reduced damage costs from IQ (intelligence) reductions caused by mercury intake from indirect sources (marine diets, etc.) have been assessed in several studies. The studies do not include the less tangible advantages of protecting brain development against neurotoxicity or any other of mercury's many adverse effects on health and environment. The estimated benefits consequently underestimate the actual benefits, which are not known.

[39] Other contributions come from natural mercury release sources and re-emission of mercury from previous anthropogenic pollution.

Pacyna et al. (2010) estimated the global damage costs of loss of IQ due to intake of mercury from ingestion and inhalation. They estimated the damage cost in a 'Status quo' mercury release scenario for 2020. This was a 'business as usual' scenario with no additional mercury reduction measures implemented, but anticipating an increasing economic activity. The global damage costs assuming a value of IQ loss as in Europe was estimated at 22 billion EUR/y, while the same results adjusted for lower life income and other parameters, in other parts of the world yielded an adjusted damage cost of 8 billion EUR/y. The benefits of preventing the exposure would correspond to those costs.

A more recent study based on measurements of mercury concentrations in human hair from most EU Member States (indicating the exposure levels), estimated the lost IQ points in the EU due to mercury exposure and use (Bellanger et al., 2013). The total benefits of mercury exposure prevention in the EU were estimated to be 8-9 billion EUR/y. i.e. significantly higher than the potential benefits estimated by Pacyna et al. (2010). Values about four times higher were obtained when using the logarithmic response function, while adjustment for productivity resulted in slightly lower total benefits.

If it was assumed, as an illustrative example, that the reduced export of mercury from the EU would result in a 10 % decrease in the total global effects from lost IQ due to ingestion and inhalation of mercury, the total benefits can be estimated to be at least 400 MEUR/y (lower estimate from Pacyna et al., 2010) and more likely significantly higher. Compared to the estimated costs (see section 5.2 below), the benefits would consequently be at least be 100 times higher in this example, and therefore likely also with a good margin higher than the associated reduction costs in the actual prevailing situation.

## 5.2 Efficiency

### *5.2.1 Administrative costs and burden*

An overview of time used for administration of the Regulation based on questionnaire responses is provided in Table 5-3.

The majority of the MS classified the direct budgetary consequences resulting from the implementation of the Regulation as marginal or moderate. Only one MS (SK) reported substantial budgetary consequences. The one-off time input used by the MS for implementation of the Regulation ranges from less than one man-week to 2-4 man-weeks with an average of approximately one week. The situation is the same in regard to annual time consumption. The implementation of the export ban under the Mercury Export Ban Regulation is mainly organized in MS on the basis of the general reporting requirements under the PIC Regulation.

Most respondents within the chlor-alkali sector agreed or agreed partly with the statement that the company's annual administrative burden related to complying with the Regulation was minimal compared to the other required administrative work. Only one company disagreed. The annual time consumption is approximately one man-week per company. The total costs of administration of the Regulation ranked lower than the costs of safe disposal and the lost revenue from sale of mercury.

Two out of three responding recycling companies (involved in trade as well) indicated that the administrative burden related to complying with the Regulation was significant compared to the other required administrative work and reported the annual time consumption at more than two man-weeks per year.

In order to have a rough indication of the costs of administration as compared with other costs, the total costs of the 28 MS is calculated assuming that the average time consumption for administration is one-man weeks per year for each MS. With an average weekly rate of 1,137 EUR, the total annual cost for all MS can be estimated at approximately 31,000 EUR[40]. Compared to the costs of disposal and lost revenues from the sale of mercury of several million EUR, the estimate indicates that the administrative costs are very small.

***Table 5-3 Overview of time used for administration of the Regulation based on questionnaire responses (detailed data in Appendix 2 and 3)***

| | No of respondents | No of affected | One-off time consumption Average (range) Man-weeks | Annual time consumption Average (range) Man-weeks/year |
|---|---|---|---|---|
| Member States | 17 | 28 | ~0.8 (<1 to 2-4) | ~0.9 (<1 to 2-4) |
| Chlor-alkali | 13 | ~ 23 | ~0.8 (0 to >2) | ~0.7 (0 to >2) |
| Recycling (involved in trade as well) | 3 | 5-10 (with significant activity) | >2 (<0.2 to >2) | >2 (0 to >2) |
| Trade (not involved in recycling) | 0 | 10-30 * | No data | No data |

* Estimated.

### *5.2.2 Costs to chlor-alkali sector for safe disposal of mercury*

The estimated cost to the chlor-alkali sector due to lost revenue from the sale of mercury and costs of final storage is indicated in Table 5-4. The costs estimated do not include costs of temporary storage prior to the final storage. Some uncertainties exist as to the actual prices for the final storage, primarily because experience with the processes in full scale is still limited and because the actual requirements are still not defined. In any case, the table clearly indicates that the cost of final storage is smaller than the lost revenue from the sale of the mercury. For the estimate of lost revenue, a price of 30-50 % of the market price is applied in accordance with previous assessments (European Commission, 2006a).

For the study questionnaire, the responding chlor-alkali companies indicated the cost for the storage of mercury considered as waste was the main cost type whereas lost revenue ranked second. It should be noted that the lost revenue will not be realised until the mercury is actually disposed of for storage.

Among the costs for storage, one company indicated additional costs for the upgrading of temporary storage sites. No actual costs were indicated and it must be expected that the costs of temporary storage of the metallic mercury vary considerably among

[40] Based on an average of 24.12 EUR/hour from Eurostat statistics, 37 hours a week, 3 % extra for public administration and 25 % extra for overhead. Statitiscs: http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Hourly_labour_costs_by_selection_of_NACE_industries_compared_to_the_national_level_-_LCS_2012.png

the companies. Consequently, it has not been possible to estimate the total costs of temporary storage, but in total they are assumed to be small compared with the costs of final storage and the lost revenue from mercury sales.

***Table 5-4 Estimated costs to the chlor-alkali sector due to lost revenue and final storage***

| | Tonnes mercury | Lost revenue (2015 prices)* | | Final storage (2015 prices) ** | |
|---|---|---|---|---|---|
| | | EUR/kg | Million EUR | EUR/tonne | Million EUR |
| Annual average | 650 | 5-8 | 3-5 | 900-3,000 | 0.6-2.0 |
| Total (from when the Regulation entered into force) | 8,000 | 5-8 | 40-64 | 900-3,000 | 7.2-24 |

* Fluctuations in mercury market prices are shown in section **5.1.1**. Based on this an average price of mercury in flasks during 2008-2010 of 15,900 EUR/t is applied in this study, reflecting the expected world market prices if the Regulation had not been introduced. According to the European Commission's impact assessment of the Mercury Export Ban Regulation (2006), the price of the mercury when sold by the chlor-alkali companies to the recycler/trader (at that time the Almaden in Spain) was 30-50% of the market price. The same percentages are in the absence of newer data used for this study combined with a market price of 15,900 EUR/t.

** Costs of different disposal options are reviewed in COWI/BiPRO/ICF (2015). The study estimates the costs of storage of liquid mercury in salt mines at 900-2,000 EUR/t. The costs of stabilisation and permanent storage in salt rock formations or hard rock is in the study estimated to be at least 2000 EUR/t. A price of 3,000 EUR/t is used as a rough maximum, considering the current requirements for storage. The costs of deposition of stabilised mercury in deep rock may be significantly higher, but is not required by the current EU regulation.

### *5.2.3 Costs to mercury waste recyclers and traders*

The costs to mercury recyclers and traders results from:

- lost revenue from the export of mercury.
- lost revenue from the marketing of recovered mercury from waste from cleaning of natural gas and from non-ferrous metal production.
- lost investment in machinery for manufacture of capsules for dental amalgams (as indicated in a questionnaire response)

**Lost revenues from the pre-treatment and export of mercury**

Two companies involved in recovery and export of mercury reported lost profits from sales of mercury of 500,000 EUR/y and 200,000 EUR/y, respectively, in their questionnaire responses.

The total impact on the trade of mercury can be indicated from the changes in values of the EU28-extra export of mercury (Figure 5-1). The annual average decreased from 10.2 MEUR/year for the period 2005-2011 to 1.6 MEUR/year for the period 2012-2013 corresponding to a decrease of 8.6 MEUR/year. As shown in section 5.1.1, the world market price of mercury has increased significantly in recent years, probably due to the impact of the EU mercury export ban on the global mercury market.

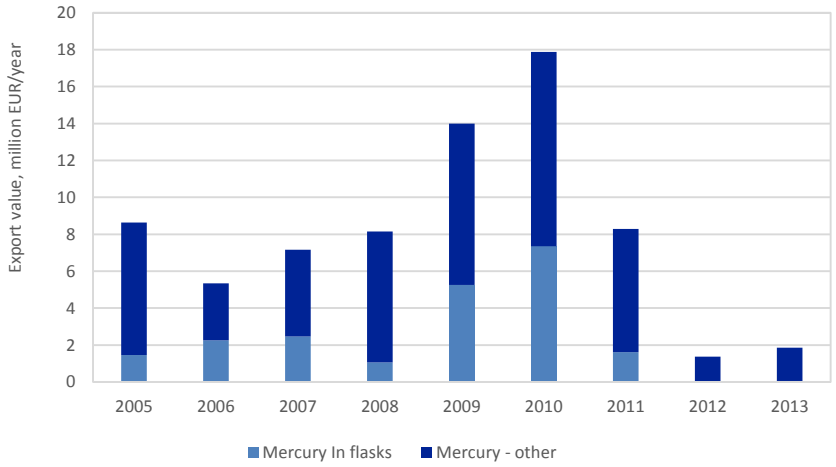


*Figure 5-1 Changes in total value of EU28-extra export of metallic mercury. Source: Eurostat international trade database*

If the lost value of export is estimated from an annual decrease of 650 t/y of a price of 15,900 EUR/t based on recent world market prices (see section 5.1.1), the lost value in 2015 prices would correspond to 10 MEUR/y. If it is assumed that the exported mercury is sold to the recyclers/traders at a price of 30-50 % of the market value (see section 5.2.2), the lost revenue by the recyclers/traders could be in the range of 5.0-7.0 MEUR/y.

**Lost revenue from the recovery of mercury from waste from cleaning of natural gas and from non-ferrous metal production.**
The most recent assessment of mercury gained from gas purification and nonferrous metal production estimated a total production of by-product mercury of 65-90 t/y (COWI/Concorde, 2008) but the reported recovery in 2009 was 18.2 tonnes, of this 2.1 tonnes was sent for storage. As discussed in section 5.1.1, a part of the wastes may now be exported for recovery abroad. If a market price of 15,900 EUR/t is applied (see section 5.1.1), and it is estimated that 16 t/y was recovered and placed on the market before the Regulation entered into force, the lost revenue from the recovery of mercury from these sectors can be estimated at 0.3 MEUR/y. This lost revenue is included as part of the lost revenue from export of metallic mercury estimated above.

The lost revenue may to some extent be compensated for by the increased recovery of mercury from other waste sources. World market prices have within five years increased fourfold, which makes recycling of mercury from waste sources with lower concentrations profitable.

Furthermore, as indicated by many stakeholders, the capacity for temporary and final storage and stabilisation of mercury is insufficient, indicating a possible market potential for companies involved in mercury waste management.

**Lost investment in machinery**
Two respondents indicated the write off of investments in machinery for capsules for dental amalgams for export. One of the companies indicated a lost investment of 260,000 EUR. Details are not available, and it is difficult to estimate how much can be allocated to losses due to the implementation of the Regulation (dental capsules can still be sold on the EU market).

**Other costs**
One respondent indicated the investment of 500,000 EUR in an appropriate warehouse for metallic mercury with a capacity of 500 tonnes. If linked to the Mercury Export Ban Regulation, these costs are expected to be allocated to the costs borne by the chlor-alkali industry.

## 5.3 Coherence

### *5.3.1 Coherence with other EU policy*

The Waste Shipment Regulation, the PIC Regulation and Council Directive 2011/97/EU amending the Landfill Directive (Directive 1999/31/EC) are all important instruments for the implementation and enforcement of the Mercury Export Ban Regulation. According to MS and stakeholder feedback, overlaps or interfaces of the Mercury Export Ban Regulation exist with these instruments. The responses did, however, not specify any overlaps or contradictions with other EU legislation and possible overlaps e.g. in the reporting requirements have not been identified.

It was mentioned by some MS that specific requirements on substance identity and information on application of exported substances are missing in the PIC regulation reporting requirements, but this seems rather to be due to improper implementation, as the PIC Regulation requires such information, which should be available to the competent authorities and customs services via the ePIC web-tool.

The REACH Regulation restricts several mercury compounds and articles with metallic mercury (Entry 18, 18A and 62 of Annex XVII to the REACH Regulation). Entry 62 restricts the manufacture and placing on the market of five phenyl mercury compounds. As the manufacture of these in the EU is restricted, in practice the export will be restricted as well (apart from re-export). Entry 18 restricting a number of mercury compounds and Entry 18a restricting the marketing of various measuring devices with mercury do not restrict the manufacture of the compounds and articles. The objective of the restrictions is the protection of humans and the environment against mercury, and it seems not to be in coherence with the objectives of neither the REACH Regulation nor the Mercury Export Ban Regulation that these mercury compounds and articles can be exported. In the context of the Mercury Export Ban Regulation, it is of particular importance that measuring devises with metallic mercury, both new and as waste, can be exported from the EU and thereby contribute to the global mercury supply.

### *5.3.2 Coherence internally*

The stakeholder consultation did not point at any internal inconsistences with the Mercury Export Ban Regulation.

One inconsistency noted by the authors of this report, is the reporting requirement for mercury entering the EU, whereas the requirements for mercury trade cross-border concern mercury considered as waste only. Mercury reused within the chlor-alkali industry can be traded without reporting, which restricts the possibilities of control of the use of the mercury. It should be noted that this is only an inconsistency if Article 2 (a) is interpreted in the way that mercury from the chlor-alkali industry can be traded and reused within the industry as a whole.

Furthermore, it seems to the authors of this report inconsistent that the Regulation stipulates requirements to mercury gained from the cleaning of natural gas and non-ferrous mining and smelting operations, but does not prevent the export of the mercury-containing wastes from these operations for recovery abroad.

### *5.3.3 Coherence with trade restriction measures taken outside EU*

The EU export ban is well in coherence with measures of other countries and the provisions of the Minamata Convention

**The Minamata Convention**
The EU Export Ban Regulation is in close coherence with the (later defined) wording of the Minamata Convention. With its global perspective, the Minamata Convention thus contributes to the intentions of the Mercury Export Ban Regulation.

**USA**
The Mercury Export Ban Act in the USA (Public Law 110–414) was signed into law on October 14, 2008. The Act's three main provisions are the following:

- Federal agencies are prohibited from conveying, selling or distributing elemental mercury that is under their control or jurisdiction. This includes stockpiles held by the Departments of Energy and Defense.
- Export of elemental mercury is prohibited from the United States beginning January 1, 2013.
- The Department of Energy (DOE) should designate one or more DOE facilities for long-term management and storage of elemental mercury generated within the U.S. This designation should occur no later than January 1, 2010 (US EPA, 2015).

The US export ban includes some exemptions export of mercury for 'essential uses'. As a result of the ban, the export of mercury decreased from an average of 651 t/y during the period 2008-2010, to less than 0.5 tonne in 2013 (USGS, 2014b).

**Norway**
In 2008, Norway introduced a general ban on the use of mercury in new products, with only a few time-limited exceptions (Klif, 2010). These rules are set out in the Product Regulations. According to the Product Regulations, export of metallic mercury and mercury compounds is prohibited.

## 5.4 Conclusions

**Objective: To significantly reduce the global mercury supply**
The Mercury Export Ban Regulation significantly reduces the global mercury supply. The total amount of mercury prevented to reach the global market is estimated at approximately 650 t/y at least for the next years, corresponding to approximately 20 % of the global mercury supply. The total prevented export of surplus mercury from the chlor-alkali sector is estimated at 8,000 t/y, added to this should also be any prevented recovery of mercury from gas purification and non-ferrous mining and smelting operations. Available data indicates that the decrease in supply has not been replaced by increased mine production outside the EU, but the export of mercury from Switzerland has increased by on average 100 t/y. The global prices of mercury have increased threefold over a few years, demonstrating the consequences of the decrease in the supply from the EU and later the USA (export ban of mercury from the USA effective from January 1, 2013). One example of illegal export is known, but even though some uncertainties regarding other illegal export exist, the total illegal export is considered small as compared to the prevented export of 650 t/y.

The objective of preventing by-product mercury from gas purification and nonferrous mining and smelting from entering the global market has not been fully met as the waste products can still be exported for the recovery of mercury outside the EU.

Waste statistics indicates that this takes place to some extent and Swiss mercury export data may indicate that mercury is actually recovered from the mercury-containing waste from the EU.

**Objective: Ensure safe storage of surplus mercury within the EU**
The responses to the study questionnaires indicate that the objective of the Regulation to ensure safe storage of surplus mercury within the EU has still not been met. In 2013, the quantities reported to be sent for off-site storage from the chlor-alkali industry was 655 tonnes (of the same magnitude as the average prevented export), but it is not known whether the mercury was sent for temporary or permanent storage.

In general, representatives of the chlor-alkali industry consider storage capacities in the EU, both for temporary and permanent storage of mercury considered as waste, as insufficient. According to the stakeholders, specific conditions and criteria for environmentally safe permanent storage of metallic mercury are needed. If conditions are clearly defined, this could be beneficial for the creation of a market for stabilising and permanently storing excess mercury. In addition to ensuring safe permanent storage, a market for stabilisation could be beneficial for the mercury recycling companies, which have been negatively affected by the introduction of the Mercury Export Ban Regulation.

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# APPENDIX 1 SUMMARY OF MEMBER STATE REPLIES TO QUESTIONNAIRE ON EU IMPLEMENTATION OF THE MINAMATA CONVENTION ON MERCURY

As part of the study on EU implementation on the Minamata Convention on Mercury (Cowi/BiPRO/ICF, 2015), a questionnaire was sent to all Members States. It addressed specific issues relevant to the assessment as well as the planned review of Regulation 1102/2008 on the mercury export ban and safe disposal. This appendix provides a summary of the responses.

**1. Which countries responded to the survey?**

| | Member States |
|---|---|
| Yes | 17 (AT, BE, BG, CZ, DE, DK, ES, FI, HR, HU, IE, LT, LU, PT, RO, SE, UK) |

17 Member States have responded to the survey. One country confirmed that it would not participate.

**2. Member State legislation going beyond the EU law**

**Has your country implemented or proposed new legislation or other national initiatives since 2010 which go beyond the EU legislation on mercury?**

| | Member States |
|---|---|
| Yes | 4 (DK, ES, LT, SE) |
| No | 13 (AT, BE, HR, FI, DE, IE, RO, LU, PT, UK, HU, BG, CZ) |

The majority of countries that responded (three-quarters) had not implemented or proposed new mercury legislation/initiatives going beyond those already in place under EU law. Only four countries stated that they had. Additional mercury restrictions imposed by these countries, typically pertained to specific sectors and types of mercury compounds e.g. statutory prohibition of import, sale and export of mercury and mercury-containing products with specified exemptions; a phased ban on dental amalgams (SE); limits on mercury emissions from crematoria not covered under EU law (LT); lower occupational exposure limit values for mercury alkyl compounds (LT); stricter mercury migration limits in toys, electrical and electronic equipment (ES); tighter requirements around temporary storage of metallic mercury (ES); environmental quality standards for mercury in water (ES); methods and criteria for evaluation of mercury concentration in air (ES).

These countries also highlighted other non-legislative initiatives, mostly awareness raising campaigns e.g. risk warnings to vulnerable groups associated with consumption of certain sea foods with potentially high mercury content (SE); use and disposal of broken energy saving light bulbs with mercury content (DK), as well as green public sector procurement initiatives which included provisions on mercury (LT).

## 3. Sectors affected by the Minamata Convention provisions in your country

**To your knowledge, do any of the sectors/activities targeted by the Minamata Convention listed below exist in your country?**

| | No. Member States |
|---|---|
| Yes | 16 (AT, BE, DK, FI, DE, IE, LT, LU, RO, ES, SE, PT, UK, HU, BG[41], CZ) |
| No | 1 (HR) |

| Sector | No. Member States |
|---|---|
| Button cell batteries | |
| Switches and relays | 2 (FI, UK) |
| Fluorescent lamps/ high pressure vapour lamps (HPMV) | 2 (UK, HU) |
| Barometers | 3 (BE[42], DK[43], UK) |
| Hygrometers | 3 (BE[42], DK[43], UK) |
| Manometers | 1 (DK[43]) |
| Thermometers | 2 (BE[42], DK[43], UK[44]) |
| Sphygmomanometers | 2 (UK) |
| Dental amalgams/filling materials | 6 (AT, DK, ES, SE, CZ) |
| Acetaldehyde with Hg catalyst | |
| Vinyl chloride monomer (VCM) with Hg catalyst | 3 (BE, RO[45], HU) |
| Sodium or potassium methylate/ ethylate with Hg catalyst/feedstock | 2 (DE -production, UK -end-use) |
| Polyurethane using mercury containing catalysts | |
| Artisanal and small-scale gold mining | |
| Primary production of lead, zinc, copper or industrial gold with smelting and roasting processes | 5 (BE, FI, ES, SE, HU)[46] |
| Waste incineration | 11 (AT, BE, FI, IE, LT, ES, SE, PT, CZ, HU, LU) |

[41] Further details of domestic sectors targeted by the Minamata Convention were not provided by Bulgaria.

[42] Belgium's response indicates that one company was identified in barometer, hygrometer and thermometer sectors, though it is not known whether mercury is used in production.

[43] Denmark's response indicates that there may be production of barometers, hygrometers and manometers taking place in Denmark, although these in any case will be alternatives to traditional instruments and so will not contain mercury.

[44] One company producing thermometers was identified in the UK, although mercury is unlikely to be used in production.

[45] There are no VCM installations currently in operation in Romania, although there are some quantities of mercury still present from a facility that is no longer in operation.

[46] Zinc and lead concentrates are produced at two major mines in Ireland although these operations do not involve smelting or roasting of ores.

| Sector | No. Member States |
|---|---|
| Cement clinker | 10 (AT, DK, FI, IE, LT, ES, SE, PT, CZ, LU) |
| Large scale commercial Hg stocks (above 50 tonnes stored) | 1 (DE) |
| Recycling of mercury | 5 (BE, IE, CZ, UK, HU) |
| Commercial disposal of hazardous Hg waste | 1 (HU) |

All but one of the Member States which responded had domestic sectors targeted by the Minamata Convention. Cement clinker production and waste incineration were the most prevalent sectors stated by countries (around three-fifths of respondents), and to a less extent the production of dental amalgams and filling materials (a third of respondents). This is not surprising given that these sectors were relatively mainstream in comparison to more specialised uses of mercury. The use of mercury in the manufacture of scientific instruments, electrical components and industrial components was restricted in each case to a few countries with specialised operations. Almost all countries responding were also able to provide examples of companies operating within these sectors. A few countries also specified domestic studies used to assess sectoral impacts (UK, SE, DK). The UK referred widely to a domestic study – 'An Assessment of the Future Levels of Demand for Mercury in the UK' (2009). Denmark highlighted a study looking at alternatives to mercury-containing measuring devices. Sweden drew on four domestic studies on the effects of amalgam use on different population cohorts, which formed the basis of its national ban.

## 4. Review of the Mercury Export Ban Regulation

### 4.1. Article 5 (1): 'Member States shall submit to the Commission a copy of any permit issued for a facility designated to store metallic mercury temporarily or permanently (disposal operations D 15 or D 12 respectively, as defined in Annex II A of Directive 2006/ 12/EC), accompanied by the respective safety assessment pursuant to Article 4(1) of this Regulation.'

**Has your country issued any such permits?**

| | No. Member States |
|---|---|
| Yes | 2 (HU, HR) |
| No | 13 (AT, DK, FI, DE, IE, LT, ES, SE, PT, UK, BG, CZ, LU) |
| Not answered / No information available at present | 2 (BE, RO) |

The overwhelming majority of countries had not issued permits for mercury storage facilities. Only two countries – Hungary and Croatia – had issued permits. Both of these were able to provide a list of permits issued. A total of 7 permits were issued in Hungary, and 63 permits were issued across 44 different companies in Croatia.

**4.2. Article 5 (2): 'By 1 July 2012, Member States shall inform the Commission on the application and market effects of this Regulation in their respective territories.'**

**Has this Regulation found any application in your country?**

| | No. Member States |
|---|---|
| Yes | 4 (IE, ES, SE, HU) |
| No | 12 (AT, HR, DK, FI, DE, LT, RO, PT, UK, BG, CZ; LU) |
| Not answered | 1 (BE) |

The vast majority of respondents did not find that the Article 5(2) of the Regulation had any application in their countries. Only four countries – Hungary, Ireland, Spain and Sweden – noted any concrete application of the laws, mostly in the storage, disposal and waste export sectors.

**Has any market effects of the Regulation been observed in your country?**

| | No. Member States |
|---|---|
| Yes | 2 (ES, CZ) |
| No | 12 (AT, HR, DK, FI, DE, IE, LT, RO, SE, PT, BG, LU) |
| Not answered | 3 (BE, UK, HU) |

Two Member States – Spain and the Czech Republic – had observed market effects in their countries as a result of the regulation, though this was largely confined to sub-regions and sectors. Some negative economic impacts had been felt regionally in Spain since 2001 with the closure of mercury mining operations. Nevertheless, the affected region has since been able to shift its focus to culture and tourism with the opening of a regional mining park and to the research of environmentally sound management solutions of mercury through the National Technological Centre for Mercury Decontamination. Impacts on the chlor-alkali sector were also noted in Spain. The Czech Republic highlighted some adverse trade impacts resulting from the cessation of exports of dental mercury outside the EU (this related specifically to trade with Turkey – a key partner for a major Czech mercury production and waste recollection firm – BOME).

**4.3. Article 5(3): 'By 1 July 2012, importers, exporters and operators of activities referred to in Article 2, as appropriate, shall send to the Commission and to the competent authorities the following data:**

**(a) volumes, prices, originating country and destination country as well as the intended use of metallic mercury entering the Community;**
**(b) volumes, originating country and destination country of metallic mercury considered as waste that is traded cross-border within the Community.'**

**Has your country received submissions of the following types of data from importers, exporters and operators of activities referred to in Article 2 of Reg. 1102/2008: (a) volumes, prices, originating country and destination country as well as the intended use of metallic mercury entering the Community?**

| | No. Member States |
|---|---|
| Yes | 1 (UK) |
| No | 15 (AT, HR, DK, FI, DE, IE, LT, RO, ES, SE, PT, HU, BG, CZ, LU) |
| No information available at present | 1 (BE) |

Almost no respondents had received data submissions from relevant operators. The UK was the only country stating that it had received submissions of this kind. This comprised a submission from one company on the volumes and destinations of metallic mercury extracted from the cleaning of natural gas. This was transported for treatment in Switzerland and long-term storage and disposal in Germany.

**Has your country received submissions of the following types of data from importers, exporters and operators of activities referred to in Article 2 of Reg. 1102/2008: (b) Volumes, originating country and destination country of metallic mercury considered as waste that is traded cross-border within the Community?**

| | No. Member States |
|---|---|
| Yes | 1 (BG) |
| No | 13 (AT, HR, DK, FI, DE, IE, RO, SE, PT, HU, CZ, UK, LU) |
| Not answered | 3 (BE, ES, LT) |

Almost none of the respondents received data submissions from relevant operators. Bulgaria was the only country that had received submissions of this kind. This pertained to waste from mercury containing lamps.

**4.4 Does your country find that there is a need for each of the following additions to EU legislation?**

| | No. Member States | | | |
|---|---|---|---|---|
| | Yes | No | Undecided | Not answered |
| (a) extending the export ban to other mercury compounds, mixtures with a lower mercury content and products containing mercury, in particular thermometers, barometers and sphygmomanometers | 6 (AT, DK, DE, LT, SE, HU) | 6 (HR, FI, RO, ES, BG, LU) | 3 (BE, IE, UK) | 3 (RO, ES, PT) |
| (b) an import ban of metallic mercury, mercury compounds and products containing mercury | 5 (AT, DK, SE, HU, BG) | 5 (CZ, HR, DE, FI, LU) | 4 (BE, LT, IE, UK) | 3 (RO, ES, PT) |
| (c) extending the storage obligation to metallic mercury from other sources | 5 (BE, DK, LT, SE, HU) | 5 (CZ, HR, FI, BG, LU) | 2 (IE, UK) | 5 (DE, RO, ES, PT, AT) |
| (d) time limits concerning temporary storage of metallic mercury | 2 (DK, SE) | 8 (CZ, HR, DE, FI, LT, , HU, BG, LU) | 3 (BE, IE, UK) | 4 (RO, ES, PT, AT) |

Support for additional legislation varied across the Member States. There were marginally more countries in favour of the proposed additions than were opposed, though most countries were opposed to time limits to temporary storage of metallic mercury. Where specified, objection was raised on the basis that there were insufficient assessments undertaken as yet to provide a clear case for stricter regulation, rather than any fundamental opposition (LT). Bulgaria suggested that storage regulations should only be extended on the basis of a comprehensive impact assessment so as not to jeopardise the competitiveness of EU industry. Both Germany and Sweden concurred in principle on the need to set clear limits on temporary storage. Sweden was open as to the precise length of the limitations. Germany highlighted a specific need for additional assessments on the long-term behaviour of metallic mercury in underground storage to determine sound, knowledge-based requirements for permanent storage, though felt that present regulations were appropriate in the context of temporary storage (up to five years) and represented the best available techniques. In the remainder of cases, countries responding did not state the reasons for their position.

Concerning the extension of export bans to products and compounds with lower mercury content, countries in favour had either already put in place further restrictions or were broadly supportive of stricter regulations given the environmental risks involved (SE, DK). Specific concern was raised around the shipment of mercury wastes from scientific instruments to developing countries where it is an important source for small-scale and artisanal gold mining (DE). Lack of data and research also, in some cases, made it difficult for countries to form clear positions. Germany was opposed to an import ban. Its view was that such a ban would unduly restrict countries from exporting waste mercury to safe underground storage and disposal facilities that were presently only available in some Member States.

**4.5 Does your country have new research (since 2008) regarding the safe disposal of mercury waste?**

| | No. Member States |
|---|---|
| Yes | 2 (ES, DE) |
| No | 13 (AT, BE, HR, DK, FI, IE, LT, UK, BG, HU, CZ, RO; LU) |
| Not answered | 2 (SE, PT) |

Two countries – Germany and Spain – mentioned new research they had undertaken on the safe disposal of mercury waste. A German study (the results of which have been provided to the European Commission), examined the risks of permanent disposal of metallic mercury and mercury sulphide in underground landfills in salt rock, drawing up a basis for establishing criteria and requirements to determine the feasibility of these options. Spain highlighted two studies looking at stabilisation and solidification processes/technologies to treat mercury-contaminated soil and waste with sulphur micro-cements.

# APPENDIX 2 SUMMARY OF MEMBER STATE REPLIES TO QUESTIONNAIRE ON IMPACTS OF THE MERCURY EXPORT BAN REGULATION

A questionnaire focusing on the impacts of the Mercury Export Ban Regulation and elaborated for the sole purpose of this study was sent to all Member States in order to draw conclusions on its effectiveness and efficiency, and to get a more complete picture on any exports of mercury. This appendix provides a summary of the responses.

## 1. Which countries responded to the survey?

| | Member States |
|---|---|
| Yes | 17 (AT, BE, BG, DE, DK, ES, FI, HU, IE, LT, LU, MT, NL, PT, SE, SK, UK) |

17 Member States have responded to the survey.

## 2. Statistical data on exports of mercury and mercury compounds

### 2.1 Data on exports of mercury and mercury compounds addressed under Regulation (EU) No 649/2012 (former: Regulation 689/2008)

We extracted the data related to exports of mercury compounds for the period 2011 to 2013 from the reports your country sent to the European Commission pursuant to Article 10 of Regulation (EU) No 649/2012. In case you have any additional data or information regarding exports of mercury or mercury compounds could you please provide them (you can also provide additional data as attachment)?

| | No. of Member States |
|---|---|
| Yes | 5 (AT, BG, IE, NL, UK) |
| No | 12 (BE, DE, DK, ES, FI, HU, LT, LU, MT, PT, SE, SK) |

The majority of the responding countries did not provide any further information regarding exports of mercury or mercury compounds. Five countries included additional information, however mostly of rather general nature and referring to information already submitted. Bulgaria accentuated that no mercury has been exported from the country since 2011, and that there are no facilities or activities which might result in the generation of mercury as a product or by-product. Two countries (IE, NL) referred to the information already submitted in the context of their reporting obligations, whereas Austria pointed out that there are regular notifications by exporters concerning Article 2 paragraph 3* of Regulation (EU) No. 649/2012. The United Kingdom stated that 2014 tonnages are not yet available.

### 2.2 Data on exports of metallic mercury considered as waste

**According to Article 5 of Regulation 1102/2008 exporters with activities referred to in Article 2 (concerning specified mercury wastes) have to report volumes, originating country and destination country of metallic mercury**

**considered as waste that is traded cross-border within the Community (an issue that was covered in the previous mercury questionnaire). Do you, in addition, have data on exports of metallic mercury considered as waste, which is exported outside the EU?**

| | No. Member States |
|---|---|
| Yes | 1 (UK) |
| No | 16 (AT, BE, BG, DE, DK, ES, FI, HU, IE, LT, LU, MT, NL, PT, SE, SK) |

Only the United Kingdom provided further information on metallic mercury classified as waste being exported out of the EU. It indicated that in 2012, 135.1 tonnes and in 2011, 210.5 tonnes of waste containing metallic mercury were shipped to the United States. It was emphasized that these tonnages were for the total waste and did not necessarily equate to the tonnage of mercury.

### 2.3 Data on exports of waste containing mercury as required in the Basel Convention

**We extracted the data related to exports of waste containing mercury reported by your country pursuant to Article 51(2) and Annex IX of Regulation 1013/2006 from the CIRCA webpage for the time period 2010 to 2012. In case you have any additional/newer data or information regarding exports of mercury or mercury compounds could you please provide them (you can also provide additional/newer data as attachment)?**

| | No. Member States |
|---|---|
| Yes | 6 (BE, BG, DE, FI, HU, IE) |
| No | 11 (AT, DK, ES, LT, LU, MT, NL, PT, SE, SK, UK) |

About one third of the Member States' responses to the questionnaire contained additional information regarding exports of mercury compounds under the Basel Convention.

Belgium indicated that exports of mercury containing waste from chlor-alkali installations in the Flemish region to other chlor-alkali plants and to DE for disposal took place and in the latter case will continue to take place in the future. Both Bulgaria and Hungary included data on mercury containing fluorescent tubes shipped to Germany and Romania. Moreover Finland, Germany and Ireland added information on other mercury-containing waste categories shipped from the respective country. All additional information provided refers to waste exported to other EU MS.

# 3. Complementary questions regarding the efficiency and effectiveness of Regulation 1102/2008

### 3.1 Has any illegal export of mercury and mercury compounds been observed?

| | No. Member States |
|---|---|
| Yes | 2 (AT, DE) |
| No | 14 (BE, BG, DK, ES, FI, HU, IE, LT, LU, MT, NL, SE, SK, UK) |
| Not answered | 1 (PT) |

The vast majority of the respondents have not observed any illegal exports of mercury or mercury compounds. The two MS reporting such cases (AT, DE) both referred to illegal shipments of mercury from Dela GmbH in Germany to companies in Switzerland, the Netherlands and Greece between 2011 and 2014.

### 3.2 Have you experienced that the exemptions for research and development, medical and analytical purposes have acted as a loophole for actual exports of regulated mercury and mercury compounds?

| | No. Member States |
|---|---|
| Yes | 0 |
| No | 15 (AT, BG, DE, DK, ES, FI, HU, IE, LT, LU, MT, NL, SE, SK, UK) |
| Not answered | 2 (BE, PT) |

So far, none of the MS have experienced that exemptions for research and development, medical and analytical purposes granted by the Mercury Export Ban Regulation served as loopholes for any actual exports of regulated mercury and mercury compounds. However, the Belgian response included recommendations on a supplementary obligation in case of an application for export for the uses exempted by the export ban for quantities below 10 kg per year and exporter, namely a 'declaration of end-use' required from the importer. For further information on these recommendations please refer to question 10 of this appendix.

### 3.3 Have you experienced that the allowed export of mercury and compounds (other than cinnabar ore, mercury (I) chloride, mercury (II) oxide and mixtures with at least 95 % mercury) has acted as loophole for actual exports of regulated mercury and mercury compounds?

| | No. Member States |
|---|---|
| Yes | 0 |
| No | 15 (AT, BG, DE, DK, ES, FI, HU, IE, LT, LU, MT, NL, SE, SK, UK) |
| Not answered | 2 (BE, PT) |

So far, none of the MS have witnessed that the allowed export of mercury compounds has served as a loophole for the export of restricted mercury compounds. Again, Belgium included a comment indicating that no data on this issue is available and that there are no actual effective means to prove an intention to circumvent the export

obligations (i.e. via transformation or mixture). Nonetheless the exclusion of mixtures containing less than 95 % mercury is regarded not proportionate and an exemption for mixtures with contents up to 5% of mercury is proposed instead. Moreover it is highlighted that there was no PIC specific entry for 'mixtures with at least 95 % mercury' until 2014, meaning that it is not clear, which code was used by industry before that time.

**3.4 Have you experienced other loopholes regarding the exports of mercury and mercury compounds?**

| | No. Member States |
|---|---|
| Yes | 1 (FI) |
| No | 13 (AT, BG, DK, ES, HU, IE, LT, LU, MT, NL, SE, SK, UK) |
| Not answered/ No information available | 3 (BE, DE, PT) |

None of the responding MS has actually experienced any other loopholes for exports of mercury and mercury compounds in practice. However, Finland ticked 'Yes' in the questionnaire and indicated that for them a potential loophole in theory could be the export of mercury containing sludge. It was pointed out that operators could simply not purify the residues from non-ferrous mining and smelting operations to gain metallic mercury for disposal but to receive mercury containing sludge instead which might be exported as waste and could possibly end up on the market. Belgium justified its abstention with a lack of information on this point.

**3.5. In case of illegal export activities, are any penalties foreseen in your national legislation (relating to the Mercury Export Ban Regulation's Article 7)?**

**If yes, please specify the kind (and extent) of penalties foreseen.**

| | No. Member States |
|---|---|
| Yes | 10 (AT, BE, BG, DK, FI, IE, LT, LU, SE, UK) |
| No | 3 (HU, MT, SK) |
| Not answered | 4 (DE, PT, NL, ES) |

More than half of the respondents indicated that penalties were foreseen in their national legislation for illegal export activities, including fines and imprisonment of different extents. Two countries (HU, MT) have no penalties foreseen, whereas Slovakia indicated that there were no penalties in direct relation with Article 7 of the Regulation, but that other legislation covered the prosecution of threats or damages to human health and the environment. The Spanish response contained a reference to the Spanish Organic Law 12/1995 applying to the substances for which export has been banned by Regulations (EC) No 1102/2008 and No 649/2012. The penalties, if described, include fines from 1,500 up to 50,000 Euros or imprisonment from one month up to two years.

### 3.5.1 What kind of monitoring arrangements are established to ensure that illegal exports and storages are detected?

| | No. Member States |
|---|---|
| Arrangements included | 12 (AT, BE, DK, ES, FI, HU, IE, LT, MT, SE, SK, UK) |
| No arrangements included | 5 (BG, DE, LU, NL, PT) |

The majority of the respondents provided information on monitoring arrangements in place in the respective MS. In all of these MS, customs and different national and municipal authorities are responsible for monitoring and ensuring compliance with the Mercury Export Ban Regulation. The arrangements include the implementation of national legislation (namely mentioned by SE, FI, ES), regular transport/company inspections (AT, BE), harbour and border controls (DK, HU), checks on documentation relating to exports (UK, IE) and in general close cooperation of customs, authorities and police in order to detect breaches with the Regulation (DK, HU, SK). Lithuania's response included information on monitoring requirements set for temporary storage sites containing metallic mercury. In addition, Belgium provided information referring to its custom declaration database (PLDA database) which includes a control mechanism that identifies the PIC Regulation, also applying to metallic mercury and compounds and mixtures.

### 3.5.2 Do you have any recommendations for an improved/effective penalty regime or monitoring arrangement?

| | No. Member States |
|---|---|
| Yes | 1 (BE) |
| No | 12 (BG, DK, ES, FI, HU, IE, LT, LU, MT, SE, SK, UK) |
| Not answered | 4 (AT, DE, NL, PT) |

Most of the respondents had no recommendations on this point. Suggestions for improved penalty regimes were not made at all. Two MS (BE, IE) provided additional input on monitoring arrangements. Belgium suggested to manage PIC and custom export data at EU level and to link the databases in order to identify illegal movements and to improve monitoring. Moreover, custom declaration forms were criticised, as no CAS number is given in order to identify the substances, meaning that the restricted compounds listed in the Mercury Export Ban Regulation cannot be distinguished comparatively to other compounds. Emphasis was also put on the difficulties in identifying companies that do not declare goods as substances targeted by PIC because customs do not perform physical controls on dangerous chemicals for safety reasons and due to a lack of appropriate expertise. Ireland ticked 'No' in the questionnaire, however stated that the lack of specific CN codes for each individual compound required investigations to identify the actual compounds being exported. The additional resource needs resulting from this enforcement of the Regulation were highlighted.

**3.6. What is your estimate of the direct budgetary consequences your national competent authorities had regarding the implementation of the Regulation (one-time input)?**

| | No. Member States |
|---|---|
| No costs/input | 2 (BG, LT) |
| Marginal (less than 1 man-week of work) | 6 (BE, DK, LU, MT, SE, UK) |
| Moderate (1-2 man-weeks) | 4 (AT, ES, FI, IE) |
| Substantial (2-4 man-weeks) | 1 (SK) |
| Significant (more than 1 man-month) | 0 |
| Don't know | 2 (HU, NL) |
| Not answered | 2 (DE, PT) |

The majority of the respondents (ten MS) classified the direct budgetary consequences resulting from the implementation of the Regulation as marginal or moderate. Only one country (SK) reported substantial budgetary consequences whereas significant consequences were indicated by no MS at all.

No MS could provide information on specific costs from separate budget lines.

Belgium added as a comment that the implementation of the export ban under the Mercury Export Ban Regulation is organized on basis of the PIC regulation general process considering a few specific arrangements (substance banned similarly as it is the case for the POPs regulation and specific exemption). It is a major asset for BE to keep on the same basis for ensuring the fulfilment of the export ban as already established for the treatment of the overall PIC provisions.

**3.7. What is your estimate of the incremental budgetary consequences your national competent authorities have annually (on average) in relation to the Regulation?**

| | No. Member States |
|---|---|
| No costs/input | 3 (BG, LT, SE) |
| Marginal (less than 1 man-week of work) | 6 (AT, BE, DK, IE, LU, MT, UK) |
| Moderate (1-2 man-weeks) | 2 (ES, FI) |
| Substantial (2-4 man-weeks) | 1 (SK) |
| Significant (more than 1 man-month) | 0 |
| Don't know | 2 (HU, NL) |
| Not answered | 3 (DE, PT) |

Estimations of the incremental costs in relation with the Regulation were diverse with the majority of the MS estimating no (three MS) or marginal costs (seven MS). Two MS indicated moderate costs and only one respondent (SK) assessed significant costs. The remaining respondents either couldn't estimate the financial consequences or didn't provide any answer at all. Both Belgium and Denmark referred to answer six for additional information. Again, no country provided specific information on costs. This lack of precise information was justified by Denmark with uncertainties and case-by-case influences, making it impossible to estimate annual costs.

**3.8. Have you experienced that any provision of the Regulation has been inefficient or a disproportionate source of costs (relatively)?**

| | No. Member States |
|---|---|
| Yes | 1 (BE) |
| No | 13 (AT, BG, DK, ES, FI, HU, IE, LT, LU, MT, SE, SK, UK) |
| Not answered | 3 (DE, NL, PT) |

Apart from Belgium, no other MS stated, that it considers provisions of the Regulation resulting in inefficiency or disproportionate costs. The Belgian response emphasized once again the reduced effectiveness due to potential loopholes such as the above mentioned mixtures of mercury with mercury concentrations of at least 95 % and suggested the improvement of data coherence in order to enhance the effectiveness of the Regulation. For further proposals and recommendations, reference to the previous questions is made.

**3.9. Have you experienced any overlaps, discrepancies, contradictions or similar issues of the Regulation with other EU legislation?**

| | No. Member States |
|---|---|
| Yes | 5 (AT, DK, IE, LT, MT) |
| No | 8 (BE, BG, FI, HU, LU, SE, SK, UK) |
| Not answered | 4 (DE, ES, NL, PT) |

About one third of the respondents included information on this question. Two countries (DK and MT) pointed to overlaps of the mercury export ban with Regulation (EC) No. 1907/2006 concerning the registration, evaluation, authorisation and restriction of chemicals (REACH-Regulation). Austria addressed overlaps with Regulation (EC) No. 1013/2006 on shipments of waste. The Irish response made reference to question 5.2, stressing again the fact that in all substance/compound trade controls across different pieces of EU legislation, the lack of specific CN codes creates problems and additional efforts for investigations. Lithuania emphasised the fact that with the requirements for the export of mercury and mercury compounds and for the storage of metallic mercury considered as waste being scattered in several legal acts (namely Regulation No. 1102/2008, Council Directive 2011/97/EU on specific criteria for the storage of metallic mercury considered as waste, Regulation No. 649/2012), the implementation was troublesome. It was suggested to merge and streamline the existing EU legislation and forthcoming requirements on mercury.

**3.10. If you have any additional comments regarding the efficiency and effectiveness of the Regulation, please comment here.**

| | No. Member States |
|---|---|
| Comments included | 3 (BE, ES, SE) |
| No comments included | 14 (AT, BG, DE, DK, FI, HU, IE, LT, LU, MT, NL, PT, SK, UK) |

Three of the contacted MS made use of the opportunity to include further comments regarding the Regulation and its implementation. Throughout the whole questionnaire,

Belgium suggested additional provisions going beyond the current EU legislation, especially concerning end uses and specific identification of exported mercury compounds. Belgian PIC competent authority has introduced simplified procedures for quantities below 10 kg per year, exporter, and importing country, obligating importers to declare the end use a mercury compound is directed to. Moreover it is criticised that customs use CN codes which allow no distinction between individual mercury compounds, meaning that banned compounds cannot be clearly identified. Obligatory declaration of the substances' CAS number would allow identification of illegal movements and facilitate monitoring. Moreover, an additional provision on the EU import of mercury is suggested, including an obligation of explicit consent (as required for chemicals included in parts two and three of Annex I to the PIC Regulation) also for the import of mercury and mercury compounds and clear identification of the intended use by the industry sector or other activity. This recommendation provided by Belgium was explained to be motivated by the needs related to the implementation of the Minamata Convention. The suggestion aims at the identification of remaining uses in EU and the respective consumption, in order to achieve further reduction of emissions of mercury, and at simplified identification of potential uncompliant uses.

Spain remarked that EU legislation should resort to the wording of the Minamata Convention on Mercury and thus require 'operations that do not lead to recovery, recycling, reclamation, direct re-use or alternative uses' for the disposal of metallic mercury considered as waste. Otherwise re-export of mercury wastes could result in mercury wastes re-entering the market. This observation was also included in one of the comments contained in the Belgian response.

# APPENDIX 3 SUMMARY OF STAKEHOLDER REPLIES TO QUESTIONNAIRE ON IMPACTS OF THE MERCURY EXPORT BAN

A separate questionnaire was sent to specific stakeholders who may have been affected by the implementation of the EU mercury export ban. Companies involved in mercury commodity trade (36 companies identified earlier as mercury traders), recovery/recycling of mercury (the 5 key companies involved in this activity in the EU) and chlor-alkali production (23 companies) have been contacted[47]. This appendix provides a summary of the responses received as well as a list of companies contacted (see at the end of this appendix).

**1. Which companies responded to the survey?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Yes | 13 | 4 | 1 |

18 companies responded to the survey by returning answered questionnaires. 13 of the respondents are active in chlor-alkali production, four either in mercury waste management or trade with mercury commodities or both, and one company does research on mercury treatment as waste as well as storage (hereinafter allocated to category 'other'). In addition, eight companies did not submit a questionnaire response, but replied by e-mail that they did not trade or otherwise deal with mercury.

**2. Questions regarding the efficiency and effectiveness of Regulation 1102/2008**

**2.1 Before receiving this questionnaire, were you aware of the existence of the Mercury Export Ban Regulation?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Yes | 13 | 4 | 1 |
| No | 0 | 0 | 0 |

Without exemption, all responding stakeholders of all sectors had already been aware of the existence of the Regulation. Nevertheless, one mercury trade and waste treatment company stated that a lot of inquiries for mercury deliveries are still received

[47] Potential mercury trading companies were identified with the help from Peter Maxson of Concorde East/West, who have made surveys on this issue in earlier studies. The key mercury recyclers were identified in earlier studies performed by COWI and BiPRO. The chlor-alkali companies were contacted initially via Euro Chlor. Follow-up contacts were made by COWI/BiPRO.

both from European and international side, which indicates that the company's clients are not yet fully aware of the Regulation.

**2.2 In case your company is affected by the Regulation, how do you estimate the (one-time) effort you made regarding the implementation of the Regulation in your company procedures?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Not affected | 2 | 0 | 0 |
| Marginal (less than 2 man-days of work input) | 4 | 1 | 0 |
| Moderate (2-5 man-days) | 3 | 0 | 0 |
| Substantial (1-2 man-weeks) | 2 | 0 | 0 |
| Significant (more than 2 man-weeks) | 2 | 2 | 1 |
| Don't know | 0 | 1 | 0 |

Among the companies active in chlor-alkali industry, responses to this question were quite evenly distributed with a slight peak for marginal (four companies) and moderate (three companies) estimated one-time effort. Two respondents each indicated substantial, significant and no effects at all. Only one company added a further comment, indicating that the implementation of the Regulation had caused no one-off costs (0 EUR).

Waste management and trade companies seem to have made greater efforts in relation to the implementation of the Regulation, as two out of four companies reported significant one-time effort. This could possibly be connected with the market potential for final disposal required in the Mercury Export Ban Regulation or the additional requirements regarding mercury trade. One company active in waste treatment estimated only marginal efforts. None of the companies provided information on specific costs.

Also, the company responding in the category 'other' activities stated that they have made significant efforts due to the implementation of the Regulation. No specific values for these one-off costs were provided.

**2.3 In case your company is affected by the Regulation, to what extent do you agree that your company's annual administrative burden related to complying with the Regulation is minimal compared to the other administrative work in your company?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Not affected | 3 | 0 | 0 |
| Agree | 6 | 1 | 1 |
| Agree partly | 2 | 0 | 0 |
| Don't know | 0 | 1 | 0 |
| Disagree partly | 0 | 1 | 0 |
| Disagree | 1 | 1 | 0 |
| Not answered | 1 | 0 | 0 |

More than half of the stakeholders involved in chlor-alkali production agreed (six companies) or agreed partly (two companies) with the statement that the company's annual administrative burden related to complying with the Regulation was minimal compared to the other required administrative work. Only one company disagreed, whereas the remaining ones did not answer the question or stated not to be affected.

The four waste management and mercury trade companies responding to the questionnaire all replied differently, ranging from agreement to disagreement. Therefore no general tendency can be determined.

The company operating in research agreed on the statement that, in comparison to other administrative work, the annual administrative burden related to complying with the Regulation is minimal.

**2.4 In case your company is affected by the Regulation, what is your estimate of the annual administrative burden your company has because of the Regulation?**

| | **No. Chlor-alkali industry** | **No. Mercury waste management and trade** | **No. Other** |
|---|---|---|---|
| Not affected | 2 | 1 | 0 |
| Marginal (less than 2 man-days of work input/y) | 5 | 0 | 1 |
| Moderate (2-5 man-days/y) | 4 | 0 | 0 |
| Substantial (1-2 man-weeks/y) | 0 | 0 | 0 |
| Significant (more than 2 man-weeks/y) | 2 | 2 | 0 |
| Don't know | 0 | 1 | 0 |

Among the companies belonging to the chlor-alkali sector, a majority of nine respondents reported marginal (five companies) or moderate (four companies) annual administrative consequences from the Regulation. Two companies each stated that they were not affected at all or that, on the contrary, significant administrative burden had to be dealt with because of the Regulation. Again, one company included a value of zero EUR for the resulting annual cost. The response of another company pointed out that arrangements were still being set up meaning that time requirements were still uncertain.

As to the waste management and mercury trade business, two out of four companies reported significant annual administrative burden. Response patterns suggest that increased administrative efforts apply especially for trade companies dealing with mercury and mercury compounds rather than for waste treatment companies recycling/recovering mercury. None of the respondents included information on specific costs.

The remaining company stated to have experienced marginal additional administrative burdens due to the Regulation. Specific values were not provided.

**2.5 In case your company is affected by the Regulation, have you experienced other relevant costs related to the implementation of the Regulation?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Yes | 5 | 3 | 0 |
| No | 7 | 1 | 1 |
| Not answered | 1 | 0 | 0 |

Five of the thirteen respondents from the chlor-alkali industry stated that they had experienced other relevant costs resulting from the implementation of the Regulation; see details below.

Three out of four companies active in waste treatment and mercury trade indicated to have dealt with other costs due to the implementation of the Regulation.

The company belonging to the category 'other' indicated not to have experienced further costs.

Cost types:

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Cost for storage of mercury and compounds (…) | 4 | 1 | 0 |
| Lost profits from sales of mercury or compounds | 3 | 3 | 0 |
| Other costs | 2 | 2 | 0 |

Regarding the types of costs, costs for storage of mercury and compounds considered as waste in the Regulation played the most important role for the representatives of the chlor-alkali sector (indicated by four companies). In this context, one company stated that corresponding costs resulted from material and man-hours for packaging of the mercury waste, whereas another company ascribed the additional costs to the upgrading of temporary storage sites. Lost profits from sales of mercury or compounds ranked second (three companies), whereas two companies stated that these costs were difficult to determine. In addition, two companies indicated other costs related to the implementation of the Regulation, however only one of them specified these costs, namely as treatment/disposal costs for metallic mercury which can no longer be sold as commodity.

Among the representatives from waste management and mercury trade, lost profits from sales of mercury or mercury compounds were reported most frequently. They were specified to amount to at least 500,000 EUR/y by one company previously mostly exporting to African countries, whereas another company indicated lost profits of approximately 200,000 EUR/y. Moreover, one company stated to have made storage investments of approximately 500,000 EUR for the construction of an appropriate warehouse offering capacity for 500 tonnes of metallic mercury. In addition, different other types of costs were experienced by the responding companies of these sectors, such as lost investments made earlier for special machines in relation with the production of capsules for dental amalgam (stated by two companies). One respondent specified such lost investments at a cost of approximately 260,000 EUR. Moreover, one company had to deal with unpaid invoices from customers after further mercury deliveries had to be stopped (creating a loss of 92,046 EUR). They had with attorney costs arising from issues with the competent authorities concerning Article 2 of the Regulation, regarding the issue whether mercury gained from sludge, scraps, dust and other waste products from chlor-alkali industry or natural gas cleaning recovered by recycling companies has to be considered as waste or commodity.

**2.6 In case your company is affected, have you experienced that any provisions of the Regulation have been unclear, inefficient, or sources of disproportionate costs (relatively) from your point of view?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Yes | 2 | 3 | 0 |
| No | 9 | 1 | 1 |
| Not answered | 2 | 0 | 0 |

Only two of the contacted chlor-alkali producers provided further information on provisions of the Regulation which have been unclear, inefficient, or sources of disproportionate costs. One company highlighted final storage of mercury, lacking decisions concerning the handling of mercury and costs for temporary storage and stabilization as problematic provisions of the Regulation; however, specific proposals for simplification were not given. The response provided by the other company indicated that UK companies suffer from competitive disadvantages due to the national authorities' decision to classify mercury recovered from the treatment of waste streams that originate from the chlor-alkali industry as waste. They stated that according to their infor-

mation, competent authorities of other MS regard this type of mercury as a commodity which is not covered by Article 2(a) of the Regulation. It is therefore recommended in the company's response to clearly define whether Article 2(a) applies to metallic mercury in use or stored in plants only, or also to mercury recovered from waste treatment activities.

Two representatives of the waste management and mercury trade sector again criticized Article 2 of the Regulation, stating that it is not clear which substances are covered by this provision. They state that it is required to clarify whether mercury still contained in sludge, scraps, dust or other waste products is to be considered as waste. Disparate interpretation of this provision in the different MS is criticized as well. Two other companies emphasized the fact that from their point of view, mercury for dental use in amalgams should be excluded from the ban. One respondent questioned the entire export ban, arguing the fact that mercury is still used in many applications within and outside the EU and whether foreign authorities are not regarded able to enforce reasonable use of mercury. The same respondent also added that many inquiries from international and European clients for the delivery of mercury are still received, showing the so-far insufficient awareness of the Regulation both globally and in Europe.

**2.7 Have you experienced any overlaps, discrepancies, contradictions or similar issues between the Regulation and other EU legislation?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Yes | 1 | 3 | 0 |
| No | 11 | 1 | 1 |
| Not answered | 1 | 0 | 0 |

Only one stakeholder of the chlor-alkali industry provided information regarding this question. It reported the Industrial Emissions Directive and the Best Available Techniques (BAT) Reference Document for the Production of Chlor-alkali as potential sources of overlaps, discrepancies or contradictions without mentioning further explanations.

Three of the four representatives from waste management and mercury trade companies stated that the Regulation interfered with other EU legislation. However, the corresponding legislation was not specified.

The remaining company did not share any experiences on this point.

**2.8 Have you experienced changes in the possibilities of selling mercury and mercury compounds (apart from the specifically banned substances/materials) since the Regulation entered into force (for example changes in the trade patterns, in the demand, in the type of mercury compounds sold, etc.)?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Yes | 2 | 3 | 0 |
| No | 10 | 1 | 1 |
| Not answered | 1 | 0 | 0 |

Among the chlor-alkali producing stakeholders, only two companies have witnessed changes in the possibilities of selling mercury and mercury compounds since the Regulation entered into force, see details below.

Three out of four respondents operating in waste management recycling/recovering mercury or in trade of mercury and its compounds stated to have experienced such changes.

The company allocated to the category 'other' reported not to have noticed changes.

| | **No. Chlor-alkali industry** | **No. Mercury waste management and trade** | **No. Other** |
|---|---|---|---|
| Change in prices | 2 | 2 | 0 |
| Change in demand | 2 | 2 | 0 |
| Change in trade patterns | 1 | 1 | 0 |
| Change in types of mercury compounds sold | 0 | 1 | 0 |
| Other changes | 0 | 2 | 0 |

Regarding the types of changes, changes in prices (reported by two companies), in demand (two companies) and in trade patterns (one company) have been experienced by two chlor-alkali producing firms. One company attributed changes in prices to limited use of mercury, changes in demands to decreasing application of mercury electrolysis and changes in trade patterns to the export ban in general and the transition of mercury from product to waste. Change in types of mercury compounds sold or other changes were not reported from the chlor-alkali sector in the scope of this survey.

Among waste management and mercury trade companies, increasing price of mercury due to reduced availability of mercury on the world market has been noticed as a consequence of the export ban. As far as changes in demand are concerned, two companies stated that the demand for mercury is decreasing in Europe, but that it is still considerable outside the EU (one company). In particular the demand for dental amalgam capsules seems to have increased in non-EU countries according to one representative of the sector, resulting in an increased demand for so-called mercury pillows (a semi-manufacture) used for the production of dental amalgam capsules. The reason for the increased demand is the decreased production of dental amalgam capsules by European manufacturers due to the mercury export ban. The same respondent stated that the ban might restrict the access of socially weak citizens to dental treatment and that studies do not prove harmful effects of dental amalgam on human health. Moreover, one respondent indicated other changes due to the Regulation. A change he specified is the production of Hg outside the EU and the fact that products of non-EU origin are still sold to non-EU countries in the same quantities as before the mercury export ban.

**2.9 In case you experienced changes as mentioned above, have you experienced other factors than the Regulation that may have caused these changes?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Yes | 2 | 0 | 0 |
| No | 7 | 4 | 1 |
| Not answered | 4 | 0 | 0 |

The two respondents of the chlor-alkali sector which had experienced changes in the possibilities of selling mercury and its compounds both attributed those changes also to factors going beyond the Regulation. Whereas one company referred to the Best Available Techniques (BAT) Reference Document for the Production of Chlor-alkali, another company identified a general decrease in the application of mercury electrolysis as well as the upcoming phase-out date for mercury in the chlor-alkali production (closure or conversion of mercury cell plants no later than 2017) as potential causes.

None of the other industry representatives identified further causes for the experienced changes.

**2.10 In case you have needed to store mercury or mercury compounds considered as waste in the Regulation after its entry into force, is it your experience that there is sufficient storage capacity in the EU?**

| | | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|---|
| For temporary storage | Yes | 2 | 1 | 0 |
| | No | 6 | 0 | 0 |
| For final storage | Yes | 2 | 0 | 0 |
| | No | 6 | 1 | 0 |
| Not answered | | 5 | 3 | 1 |

The majority of the chlor-alkali producers answering the question on storage capacity in the EU believe that there is neither enough temporary (six companies answered with 'No') nor final storage capacity (again six companies ticked 'No'). Also in the comment section related to this question, several companies emphasized the fact that, from their point of view, available storage and treatment facilities were insufficient.

Three out of four companies involved in mercury trade and waste management activities did not answer this question. However, two of them justified their abstention with a lack of experience on these issues. One respondent highlighted the fact that there seems to be insufficient capacity for the transformation of mercury into a disposable compound such as mercury sulphide, as many inquiries concerning this measure were received. According to the one company answering the question, capacity for temporary storage is sufficient, but final storage of mercury waste is a huge problem and needs to be solved. It was added that local authorities set up all sorts of formal hurdles, and that they should 'combine forces' in order to get things organised swiftly.

**2.11 Does your company export out of the EU mercury compounds mentioned in the Regulation as exempted uses (R&D, medical uses, analysis), or other mercury compounds or mixtures of metallic mercury not banned according to the Regulation?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Yes | 1 | 0 | 0 |
| No | 12 | 4 | 1 |
| Not answered | 0 | 0 | 0 |

Among the companies active in the chlor-alkali sector, only one company stated to export other mercury compounds or mixtures of metallic mercury not banned according to the Regulation out of the EU. Again, the response emphasized the fact that the

company would like to export mercury containing waste to treatment facilities outside the EU, as already explained in question 3.6.

None of the companies belonging to the other sectors indicated corresponding export activities.

**2.12 Has any export of mercury and mercury compounds been observed, which is illegal according to the Regulation?**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Yes | 1 | 1 | 1 |
| No | 11 | 2 | 0 |
| Not answered | 1 | 1 | 0 |

Only one chlor-alkali producing company provided information on illegal exporting activities of mercury or mercury compounds, referring to the well-known case of Dela in Germany.

Also one representative of the waste management and mercury trading companies cited this example, stating that some 500 tonnes of liquid mercury have been shipped from Dela in Germany to Batrec in Switzerland.

**2.13 If you have any further comments to the Regulation or to this questionnaire, please insert them here.**

| | No. Chlor-alkali industry | No. Mercury waste management and trade | No. Other |
|---|---|---|---|
| Comments included | 4 | 4 | 0 |
| No comments included | 9 | 0 | 1 |

Four of the respondents belonging to the chlor-alkali industry added further comments regarding the Regulation and its implementation. One company once again made reference to the uncertainties in relation with the interpretation of Article 2(a) of the Regulation. Also another company addressed legal uncertainties in Switzerland concerning the import and export of mercury between Swiss and EU chlor-alkali plants. Two other companies commented on the fact that with Dela GmbH in Germany, the only company authorized to treat mercury was shut down, resulting in a lack of adequate treatment facilities. The offer of appropriate alternatives for chlor-alkali producers wishing to dispose of or treat mercury is requested.

Comments added by companies operating in mercury waste management or trade include criticism concerning the Regulation in general, which is even regarded partially illegal by one representative, and concerning the ban of mercury exports for the use in dental amalgam outside EU in particular. In addition, one comment included the rec-

ommendation that Switzerland should commit itself to complying with EU legislation concerning mercury, in order to prevent further illegal exports of mercury, as those observed in the case of Dela GmbH in Germany.

***Contacted companies***

| Company | Country | Trade | Recy-cling/Re-covery | Chlor-alkali | Other | Quest-ion-naire retur-ned | Not/no longer in-volved in activities related to mercury |
|---|---|---|---|---|---|---|---|
| A&M Minerals & Met-als | UK | x | | | | | x |
| A.H.Knight | UK | x | | | | | |
| Acros Organics BVBA | BE | x | | | | | |
| AkzoNobel | NL | | | x | | x | |
| Alex Stewart International | UK | x | | | | | |
| Ampere Alloys | FR | x | | | | | |
| Arkema France | FR | | | x | | x | |
| BASF SA | DE | | | x | | x | |
| Bayer MaterialScience AG | DE | | | x | | x | |
| BMT Begemann Milieu-techniek BV - Dord-recht | NL | x | x | | | x | |
| BOME, s.r.o. | CZ | x | x | | | x | |
| BorsodChem RT | HU | | | x | | x | |
| BRGM | FR | x | | | | | |
| BSI Inspectorate | - | x | | | | | |
| CABB AG | CH | | | x | | x | |
| Cfm Oskar Tropitzsch GmbH | DE | x | | | | x | |
| Chemos GmbH | DE | x | | | | | |
| Dragten Metaux | FR | x | | | | | |
| Ercros SA | ES | | | x | | x | |
| Euro-Rijn | NL | x | | | | | |
| Evonik Industries AG | DE | | | x | | x | |
| Floridienne SA | BE | x | | | | | x |
| Fox Chemicals | DE | x | | | | | |
| Gimat S.A.S | IT | x | | | | | |
| GMR Gesellschaft für Metallrecycling mbH | DE | x | x | | | x | |

| Company | Country | Trade | Recy-cling/Re-covery | Chlor-alkali | Other | Quest-ion-naire retur-ned | Not/no longer in-volved in activities related to mercury |
|---|---|---|---|---|---|---|---|
| Gomensoro Instru-mentación Científica | ES | x | | | | | |
| Hellenic Petroleum SA | EL | | | x | | | |
| Hollands Veem BV | NL | x | | | | | x |
| HydroChem Italia Srl | IT | | | x | | x | |
| INEOS ChlorVinyls Ltd | BE | | | x | | x | |
| INEOS ChlorVinyls Ltd | UK | | | x | | x | |
| INEOSCHLOR | DE | | | x | | | |
| INEOSCHLOR | SE | | | x | | | |
| Johnson Matthey Ltd. | UK | x | | | | | x |
| Kem One | FR | | | x | | x | |
| Lambert Metals Inter-national Ltd. | UK | x | | | | | |
| Lippmann Walton | UK | x | | | | | x |
| M&R Claushuis | NL | x | x | | | | |
| METALLUM Metal Trading AG | UK | x | | | | | |
| MINAS DE ALMADÉN Y ARRAYANES, S.A. – COMMERCIAL AREA MAYASA | ES | x | | | x | x | |
| OltChim SA | RO | | | x | | x | |
| Panreac Quimica | ES | x | | | | | |
| Remondis NQR | DE | x | x | | | | |
| RJH Trading | UK | x | | | | | x |
| Rokita SA | PL | | | x | | | |
| Sanab Ltd | UK | x | | | | | |
| Schartab SL | ES | x | | | | | |
| SFP Metals (UK) Ltd | UK | x | | | | | x |
| Sigma-Aldrich Chemie Gmbh | DE | x | | | | | |
| Solvay SA | BE | | | x | | | |
| Spolana as | CZ | | | x | | | |
| Spolchemie AS | CZ | | | x | | x | |
| Syndicat Halogènes & Dérivés Chimie Miné-rale | FR | | | x | | | |

| Company | Country | Trade | Recy-cling/Re-covery | Chlor-alkali | Other | Quest-ion-naire retur-ned | Not/no longer in-volved in activities related to mercury |
|---|---|---|---|---|---|---|---|
| Tessenderlo | BE | | | x | | | |
| Tessenderlo | IT | | | x | | | |
| THOR GROUP LIMITED | UK | x | | | | | |
| Trademet UK (Trade-met SA) | UK | x | | | | | |
| Vertellus Chemicals SA | BE | x | | | | | |
| Wogen Resources | UK | x | | | | | x |

# APPENDIX 4 CONSIDERATIONS ON FINAL DISPOSAL OF METALLIC MERCURY

The following is a summary performed by COWI/BiPRO/ICF (2015) of two recent studies on the final disposal of metallic mercury.

**Technical considerations**
BiPRO (2010) evaluated four options for the final disposal of metallic mercury. The study concluded that three out of the four options can be recommended for environmentally sound final disposal of metallic mercury:

- Pre-treatment (sulphur stabilisation) of metallic mercury and subsequent permanent disposal in salt mines (highest level of environmental protection, acceptable costs).
- Pre-treatment (sulphur stabilisation) of metallic mercury and subsequent permanent disposal in a hard rock underground formation (high level of environmental protection, acceptable costs).
- Permanent disposal of metallic mercury in salt mines (high level of environmental protection, most cost effective option).

The recommended options are all underground disposal options of stabilised or liquid mercury. Above-ground disposal was not recommended.

The environmental assessment identified uncertainty relating to the underground disposal of liquid mercury in salt rock formations. The storage of liquid mercury in salt rock is generally seen as a safe storage option providing the waste mercury is safely encapsulated. However, it was stated that (1) "... *compared to the disposal of stabilised mercury lower safety margins apply in case of an unforeseen severe incident like flooding of the salt mine – due to the significantly higher solubility of metallic mercury in water compared to stabilised mercury*." and (2) "...*little is known about the long-term behaviour of liquid mercury in the salt rock formation*." (BiPRO, 2010).

Disposal options involving stabilisation of metallic mercury prior to final disposal are associated with reduced risks of mercury releases due in particular to the low solubility of the stabilised waste (see BiPRO, 2011). Against this background the question arises of whether metallic mercury should be stabilised prior to final disposal.

Hageman et al. (2014) investigated the risks for operational and long-term safety of underground storages of metallic mercury for the German EPA. Measures were derived to reduce the risks to an acceptable level. A similar analysis was undertaken for mercury sulphide, which results from most procedures for the stabilisation of metallic mercury. Relevant risks and measures derived are described in the study report (see Hagemann et al., 2014).

The study concluded that, "...*neither elemental mercury nor mercury sulphide exhibit properties that threaten the long-term safety of an underground landfill*" (see Hagemann et al., 2014).

Considering an unforeseen severe incident, like flooding of the final disposal site in salt rock, Hagemann et al. (2014) concluded, "*In the hypothetical event of a failure of the technical barriers, from a geochemical perspective, both elemental mercury and mercury sulphide are suitable for deposition in salt mines. In the hypothetical event of a solution inflow, the low solubility of elemental mercury and mercury sulphide acts as an internal barrier*."

BiPRO (2010) did not recommend final disposal of mercury in above ground disposal sites because of possible releases of mercury to the environment. Hagemann et al. (2014) confirmed this assessment. They expect that the surface sealing of above ground facilities will be permeable to air in the long term. Mercury sulphide can then come into contact with atmospheric oxygen and become oxidised to elemental mercury and sulphate. The formation of methylmercury may occur under suitable geochemical conditions. A landfill with mercury sulphide would inevitably become a local source of mercury emissions. Both elemental mercury as well as methylmercury can leave the landfill via off-gassing (landfill gas). Hagemann et al. (2014) conclude that the deposit of mercury sulphide as well as of other high-concentration mercury waste should be prohibited in above-ground landfills. Further technical details can be found in the corresponding studies of BiPRO (2010) and Hagemann et al. (2014).

Concerning final above ground disposal, Spain's contributions under the current study should be taken into consideration. In Spain's reply to the questionnaire, a technology for the environmental sound disposal of low concentration wastes is described (stabilization and solidification technology to treat mercury-contaminated soil and waste with sulphur micro-cements). According to the information provided, the technology is applicable and has been already tested in soils and wastes with low mercury contamination levels (Hg ≤ 2% by weight). In its stakeholder contribution, Spain specifies that the leaching behaviour of final products of a stabilisation process of mercury in a polymeric sulphur matrix via mercury sulphide was tested in both monolithic and crushed samples using the EU standard (CEN/TS 14405:2004 and UNE-EN-12457) and the US EPA Toxicity Characteristic Leaching Procedure (TCLP), Method 1311. The leaching values lead to concentrations well below 0.01 mg/kg. Thus, the products meet the EU acceptance criteria for landfills for inert wastes (<0.01 mg/kg, as per Decision 2003/33/EC). Spain has provided specific information on mercury stabilization and solidification technologies and specific information on two technologies used in Spain (sulphur polymer stabilization/solidification (SPSS) and stabilization and solidification with sulphur microcements). Reference is made to López et al. (2010) and López-Delgado et al. (2012) [48]. However, a long term assessment of possible risks of above ground landfilling should be considered, according to Spain.

BiPRO (2010) described waste acceptance criteria and facility related requirements for the temporary and permanent storage of mercury specifying requirements on:

- Composition of the mercury
- Containments
- Acceptance procedures
- Certificates
- Record keeping
- Facility related requirements
- Monitoring inspection and emergency

Many of these requirements have been taken over in Directive 2011/97/EU amending Directive 1999/31/EC as regards specific criteria for the storage of metallic mercury considered as waste. However, at that time additional assessments of the long-term behaviour of metallic mercury in underground storage were not available for the determination of sound and knowledge-based requirements for permanent storage. The requirements laid down in Directive 2011/97/EU are therefore limited to temporary storage and are considered as appropriate and representing the best available techniques for the safe storage of metallic mercury for a time span of up to 5 years (see recital 10 of Directive 2011/97/EU).

[48] See stakeholder contribution Spain 31.7.2014 (available at http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm)

Hagemann et al. (2014) investigated the risks for operational and long-term safety of underground storage that result from the specific properties of metallic mercury and for mercury sulphide, which results from most procedures for the stabilisation of metallic mercury. On this basis, measures were derived, which may help to reduce the risks to an acceptable level. Measures are related to the operation of an underground storage (1) for metallic mercury (such as specific criteria for the mercury to be disposed of, transport and storage containers, storage areas and conditions) as well as (2) for mercury sulphide (compared to metallic mercury, fewer additional measures are required). Hagemann et al. (2014) propose the following requirements:

***Table A4-1 Recommended additional requirements for the permanent storage of metallic mercury and mercury sulphide (from Hagemann et al., 2014).***

| Process / Event | Recommended requirement for the permanent storage of metallic mercury | Recommended requirement for the permanent storage of mercury sulphide |
|---|---|---|
| Certification / Labelling | Permanent labelling of inner and outer containers, certificate of producers, amount, and test results similar to Directive 2011/97EU, additional test result of the independent expert. | Permanent labelling of inner and outer containers, certificate of producers, amount, and test results similar to Directive 2011/97EU. |
| Acceptance control | Advanced acceptance control (purity, identity) by an independent expert and an accredited testing laboratory. No open handling of mercury in the underground storage. | - |
| Container corrosion | Minimum purity of mercury 99.9% by weight, absence of aqueous, oily, or solid phases. Containers should be corrosion-proof with respect to storage conditions. | - |
| Underground mechanical impact | Use of containers from which no mercury leaks during mechanical impacts (impact, crash) which cannot technically be excluded.<br>For multi-walled containers: increase in geo-mechanical stability due to pressure-resistant elements, e.g. concrete. | For multi-walled containers: avoidance of cavities to increase geo-mechanical stability. |
| Thermal impact | Use of containers from which no mercury leaks during mechanical and subsequent thermal impacts (vehicle fire) which cannot technically be excluded. Example: multiple-walled containers with thermal insulation. | Use of containers from which no mercury leaks during mechanical and subsequent thermal impacts which cannot technically be excluded. Example: multiple-walled containers with thermal insulation. |
| Storage area | Facility separate from storage areas for other types of waste<br>Storage in stages<br>Immediate backfilling and closure<br>Lower floor level. | Facility separate from storage areas for other types of waste<br>Storage in stages<br>Immediate backfilling and closure. |

| Process / Event | Recommended requirement for the permanent storage of metallic mercury | Recommended requirement for the permanent storage of mercury sulphide |
|---|---|---|
| Occupational safety | Multiple daily concentration measurement in open storage sections in which work is being done<br>Visual inspection of open storage sections at least once a month<br>Providing personal protective equipment. | Providing personal protective equipment. |
| Fire protection | Minimising fire loads and ignition sources in the storage area.<br>Avoiding oncoming traffic and overtaking on transport routes. Setting a maximum speed and avoiding above-ground and underground interim storage<br>Storage area can be separated from the remaining mine operation by ventilation structures. | Minimising fire loads and ignition sources in the storage area.<br>Avoiding oncoming traffic and overtaking on transport routes. Setting a maximum speed.<br>Storage area can be separated from the remaining mine operation by ventilation structures. |
| Emergency planning | Preparation of plans and measures for the event that a release of mercury has occurred (e.g. leakage or fire). | Preparation of plans and measures for the event that a release of mercury has occurred (e.g. fire). |
| Emergency planning | Preparation of plans and measures for the event that a release of mercury has occurred (e.g. leakage or fire). | Preparation of plans and measures for the event that a release of mercury has occurred (e.g. fire). |

These requirements could be taken into consideration in any supplement to or adjustment of the criteria for the storage of metallic mercury as laid down in Directive 2011/97/EU in order to target permanent disposal of metallic mercury.

A submission received from Hazardous Waste Europe (HWE), a representative body for operators of hazardous waste treatment installations, voiced doubts that the conclusions on above ground landfill of Hagemann et al. 2014 are correct because of the assumptions concerning the engineering and operational conditions of dedicated landfills for stabilised mercury containing waste. HWE deems solidification / stabilisation necessary for any type of disposal (above or underground) in dedicated cells/areas for the storage with specific monitoring requirements[49].

**Economic impacts**
BiPRO (2010) provided an economic assessment of (among other) final disposal options.

A summary of the findings is provided for the following disposal options:

1 Permanent storage of liquid mercury in salt mines

[49] Stakeholder Contribution Hazardous Waste Europe 28.7.2014 (available at http://ec.europa.eu/environment/chemicals/mercury/)

2 Pre-treatment (stabilisation) + permanent storage of stabilised mercury in salt mines

3 Pre-treatment (stabilisation) + permanent storage of stabilised mercury in deep underground hard rock formations

4 Pre-treatment (stabilisation) + permanent storage of stabilised mercury in above ground facilities

The following costs were estimated and evaluated:

- Permanent storage costs (incl. engineering and construction costs if necessary)
- Costs of a temporary storage of metallic mercury
- Costs for maintaining, monitoring and inspection of the permanent storage site before its final closure (time period depends on the expected closure time of the storage site)
- Transportation costs
- Capital costs for the pre-treatment facility
- Operating and maintenance costs for the pre-treatment process

The assessment was based on information available. For several parameters only estimates are available as no specific quantification is available.

Each option is more cost intensive when it involves pre-treatment, as additional handling, processing and transports is required. Storage costs charged for the disposal in salt mines are 260-900 EUR per tonne. Storage costs at hard rock formations are in general low but highly depend on the necessary engineering and construction measures which have to be implemented for the specific waste and/or location.

Specific containers are only required for the storage of metallic mercury. Costs for these containers are 600-1,100 EUR per tonne of metallic mercury. For stabilised products, bags or drums are used which are significantly cheaper (~ 10 EUR/t).

Transport costs are in particular relevant for options including pre-treatment and subsequent permanent storage. Transport costs are estimated to amount to approximately 140 EUR/t metallic mercury.

The number of available storage sites only plays a minor role in case of metallic mercury. The main producers of metallic mercury waste (chlor-alkali plants) are spread around Europe. The existence of several storage options for metallic mercury would not significantly reduce the costs but would require additional costs for the preparation of storage sites for a relatively low volume of waste (due to the high density of mercury).

With pre-treatment (stabilisation) the costs will increase significantly as additional transport (from the pre-treatment site to the final disposal site) is necessary. The pre-treatment results in a product with higher volume and higher total weight than metallic mercury. For the sulphur stabilisation, an elevation of the weight (at least 16%) and volume (up to 500%) has to be considered. As a consequence, transport costs significantly increase. Therefore it is advantageous to have short distances from the pre-treatment site to the storage site. As for pre-treated products different types of disposal sites (salt rock, hard rock) are possible, the transport costs might be reduced by selecting the nearest appropriate disposal site.

Specific cost estimates were available for the sulphur stabilisation process. Pre-treatment including transport costs and final disposal is around 2,000 EUR/t metallic mercury. These costs also include the capital costs and the operational costs for the

plant. Only one company offered this price (in 2010). The German facility previously owned by DELA was not in operation for a period[50]. The facility has been taken over by another company and is again operational. All other technologies seemed to be more expensive. However, COWI (2012) gave examples of similar price levels for other comparable waste types.

Costs for inspections, monitoring and surveillance are considered comparatively low.

Hagemann et al. (2014) did not provide additional relevant information for the economic assessment. Against this background the above listed options were evaluated as follows:

**Option (1): Permanent storage of liquid mercury in salt mines**
This option is considered to be the most economic disposal solution. Storage costs range between 300 and 900 EUR/t metallic mercury plus the costs for the container with around 600 – 1,100 EUR/t metallic mercury. The transport costs are relatively low as only one transport from the waste generator to the salt mines is required. The total cost thus range between 900 and 2,000 EUR/t metallic mercury.

**Option (2): Stabilisation and permanent storage in salt rock**
The pre-treatment process is the most cost intensive part of this option. The costs for the stabilisation, the transport to the disposal site and the final disposal costs are at least 2,000 EUR/t metallic mercury. No specific container is required. The stabilized product can be disposed in relatively cheap big bags or drums.

Storage costs increase significantly due to the increased amount of waste which has to be stored. Storage costs are typically charged per tonne of waste. Each stabilisation process results in higher volume as well as increased total weight compared to metallic mercury.

The transport costs are higher compared to option (1) as additional transports are required. The transport costs from the pre-treatment site to the final disposal site depend on the distance and the number of available storage sites.

**Option (3): Stabilisation and permanent storage in hard rock**
The economics of option (3) are very similar to option (2). The disposal costs of pre-treated mercury in hard rock or salt rock formations are relatively low compared to the other costs. No information was available on the number of sites fulfilling the requirements for the storage of stabilised mercury in hard rock formations.

**Ranking**
In conclusion, option (1) was considered the most economic option. Options (2) and (3) have similar costs which are higher compared to option (1).

**Environmental impacts**
BiPRO (2010) also contains an environmental assessment of the four options listed above. The following aspects were considered in the evaluation:

- Level of protection of the environment in case of permanent storage
- Protection of the ground water against mercury
- Protection of the biosphere
- Hg-emissions during storage and handling
- $CO_2$ emissions resulting from transport
- Energy consumption

[50] Comment Germany 29.8.2014

- Reversibility (in case of temporary and permanent storage)
- Safety of workers
- Removal of mercury from the biosphere
- Prevention against natural events
- Monitoring possibility
- Possibility of corrective actions with or without incidents
- Safety margins in case of incidents

The level of protection of the environment and human health is the most important criterion of the environmental assessment. Independently of which type of waste is stored - metallic or stabilised - the release of mercury or mercury compounds into the environment should be prevented as far as possible.

Underground storage sites provide generally a higher level of protection of the environment against mercury releases compared to above ground storage sites. Each underground storage facility needs a site specific risk assessment which provides the long term safety of the stored waste in the facility.

Mercury emissions might occur during the transport, handling but also storage of the metallic mercury. It is obvious that the number of handling processes will increase the probability of mercury emissions/releases. Therefore single permanent storage solutions were considered environmentally more favourable concerning possible mercury releases than options including pre-treatment.

Transportation generates $CO_2$ emissions so options requiring several transport moves are assessed as less environmentally favourable than options with only one. Options for which there are several storage sites distributed around Europe are seen as more beneficial (with respect to transport-related $CO_2$ emissions) due to the shorter distances involved. The risk of mercury emissions during the transport of stabilised products is considered negligible.

The transportation of metallic mercury is subject to the regulations applying to transport of hazardous wastes. The risk of an incident was considered very low but in case it happens the consequences for the environment were considered significantly higher than those of transport of stabilised mercury.

Little energy is consumed in permanent storage without prior treatment. Energy consumption is a more relevant concern for options with pre-treatment processes. Stabilisation of the metallic mercury requires energy. The sulphur stabilisation process is slightly exothermic so the energy consumption is moderate. However, energy is required elsewhere in the operation, e.g. to provide vacuum conditions or for mixing.

Only storage in hard rock formations and above ground storage would allow the retrieval of the permanently stored waste. Due to the creeping potential of salt rock, the retrieval of permanently stored waste in salt mines is only possible for a certain time period.

Worker safety concerns include possible exposure to mercury and mercury vapour. The probability of an exposure increases with pre-treatment. However, permanent storage in salt mines might also entail risk of exposure to mercury e.g. in case of leaking containment or any other incident.

A permanent storage providing the highest degree of removal of the mercury from the biosphere is environmentally more favourable. Permanent underground storage facilities are constructed and designed in a way to remove the waste from the biosphere.

Permanent above ground storages have the disadvantage that interaction with the environment and emission of the waste to the environment are more likely compared

to underground options. Also the consequences of natural catastrophes were considered to have a stronger impact in case of above ground storage compared to underground storage options.

These disadvantages might be compensated by the easier access to the waste in case of any incidents. The monitoring and the possibility of interventions are easier for above ground facilities.

Against this background and in the light of relevant additional information from Hagemann et al. (2014), the above listed options were assessed as follows:

**Option (1): Permanent storage of liquid mercury in salt mines**
Storage in salt rock is generally seen as a safe storage option. Under the pre-condition that a safe encapsulation of the waste mercury is ensured, a high level of protection of the biosphere is provided.

This evaluation is supported by the conclusions from Hagemann et al. (2014) (see above):

- concerning an unforeseen severe incident like flooding of the final disposal site in salt rock it is stated that even in the hypothetical event of a failure of the technical barriers both elemental mercury and mercury sulphide are suitable for deposition in salt mines.

- concerning the long term safety in salt rock it is stated that neither elemental mercury nor mercury sulphide exhibit properties that threaten the long-term safety of an underground landfill (in salt rock formations).

After the closure of the salt mine, the possibility of corrective actions with or without an incident is low or not given.

Once the facility is closed, the retrieval of the waste is very difficult or even not possible without major risks for the whole storage site.

**Option (2): Stabilisation and permanent storage in salt rock**
The solid pre-treated product should, in a long term, be encapsulated within the salt rock formation. Even in case the pre-treated product gets in contact with water due to unforeseeable circumstances, the low solubility of the product keeps the environmental pollution limited, and releases are distributed over a very long time period. Due to this, a rapid release of mercury to the environment resulting in acute local contamination can be considered unlikely.

Possible mercury emissions during handling, stabilisation and transport have to be taken into consideration. Further transportation is required to bring the stabilised product to the storage site. From an environmental point of view the increased $CO_2$ emissions from the transport are negligible compared to the higher protection level of the environment. Mercury emissions during the stabilisation processes are highly dependent on the established emission control measures. Applying state-of-the art equipment significantly reduces mercury emissions during the handling and stabilisation process.

BiPRO (2010) considered option (2) to be the most beneficial solution from an environmental point of view. In the light of the new information provided by Hagemann et al. (2014) option (1) is now considered equally beneficial for the environment or even slightly more beneficial due to possibly lower mercury emissions (less handling), reduced transport costs and less energy demand.

**Option (3): Stabilisation and permanent storage in hard rock**
Underground hard rock formation storage facilities are seen as a safe storage option by applying adequate multi-barrier systems. A total encapsulation of the waste is not possible as it is the case in salt rock formations and which is an additional environmental safety factor.

Option (3) is comparable to option (2) but in hard rock formations a total encapsulation is not possible and the presence of water cannot be completely excluded. The risk of mercury entering the biosphere via water flows over the long term has been assessed as being slightly higher than for salt mines. Due to these risks the solidification of liquid mercury prior to final disposal in hard rock formations was recommended.

Hard rock formations with stable cavities allow corrective measures over a long time period. For worker safety there are no differences between salt mines and hard rock formations. The stored material can be retrieved, should this be needed.

**Option (4) Stabilisation and permanent above ground storage**
Permanent above-ground storage of stabilised mercury was considered to be less favourable than the underground storage options. The risk of an interaction with the environment (e.g. penetrating rain water, floods) with a subsequent release of mercury from the storage site was considered to be higher than with underground storage. Although in case of unforeseen incidents potential emissions can be detected and counter measures could be applied, the risk of mercury entering the environment is still very high. Once the protection barrier of the site is destroyed the prospects for stopping mercury from entering the environment are very limited.

This assessment was confirmed by Hagemann et al. (2014) who concluded that the deposit of mercury sulphide and other highly contaminated mercury waste should be prohibited in above-ground landfills because these will become a source of mercury releases in the long term (see above).

The stored material can be retrieved, should this be needed, but the risk of unauthorised retrieval of the stabilised waste is higher compared to underground storage.

**Ranking**
In conclusion, based on the literature cited, option (1) was considered the environmentally most advantageous option. Options (2) and (3) are slightly less beneficial from an environmental perspective due to the possibility of higher mercury emissions (increased handling required), higher transport efforts and higher energy demand. Option (4) was considered to have significant environmental disadvantages.

**Conclusion**
Based on the findings of the two authoritative studies reviewed, permanent storage of liquid mercury in salt mines (option (1)) was considered the most favourable option both from an environmental and economic perspective. Stabilisation and permanent storage in salt rock (options (2)) and stabilisation and permanent storage in hard rock (option 3) were considered to be environmentally sound disposal options. Solidification of liquid mercury should be mandatory prior to final disposal in hard rock formations.

[Catalogue num

Publications Office
doi:[number]