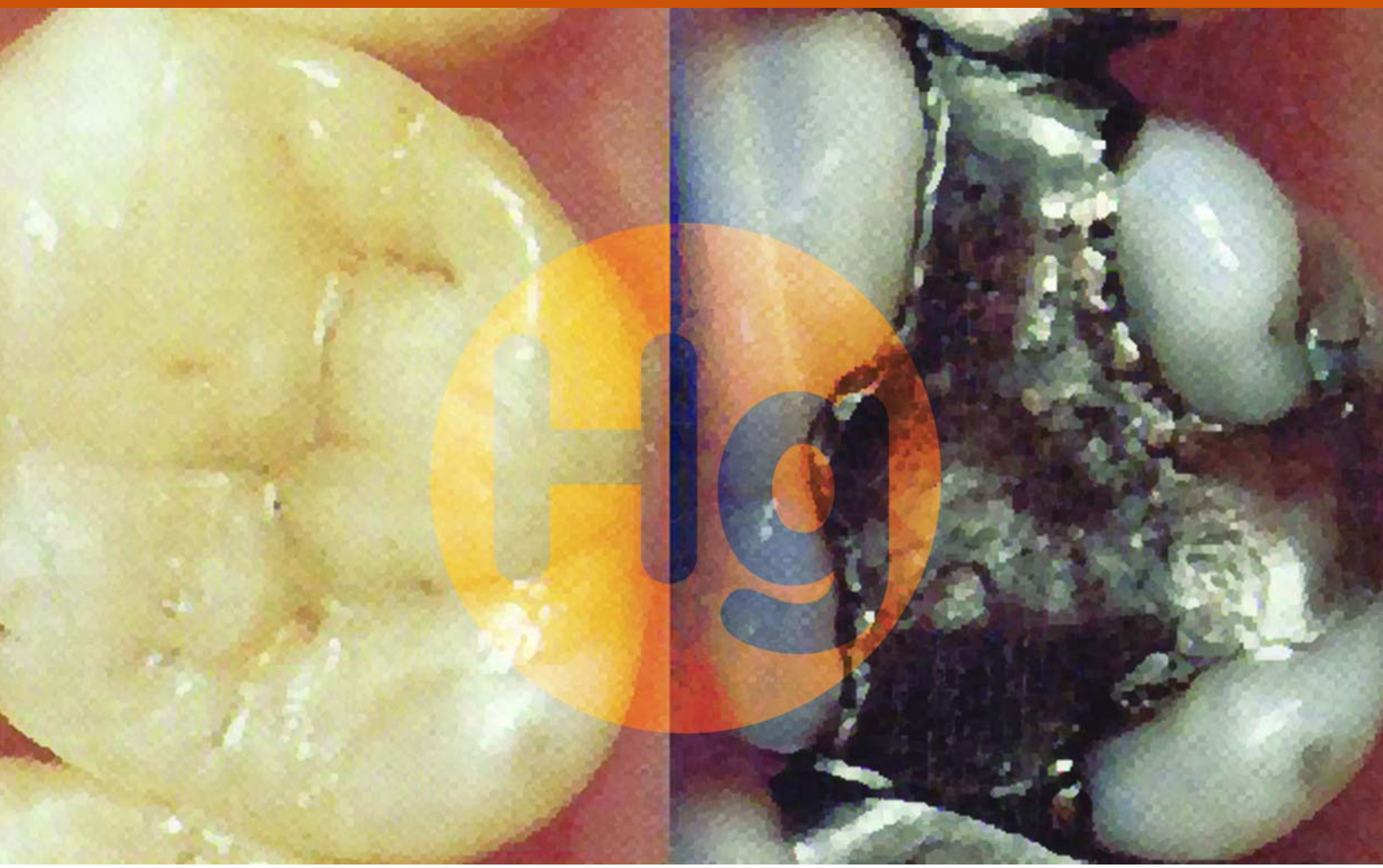

Report from the conference

Dental Sector as a Source of Mercury Contamination

Brussels, 25 May 2007

OCTOBER 2007

The European Environmental Bureau (EEB)

EEB, Europe's largest federation of environmental organisations, has over 150 environmental NGO members in 31 countries. We advocate environmental protection and sustainability by promoting ambitious EU laws and policies and their effective implementation and enforcement. We coordinate EU-focused activities with our national members around Europe. We run 13 specialised Member Working Groups, produce policy papers for the EU agenda, and represent our members in discussions with European institutions, including the Commission, Parliament, Council of Ministers and ministries in Member States. Our priority areas include agriculture, air, biodiversity, chemicals, industrial pollution, product policy, water, waste, and sustainable development. Many environmental NGOs in Accession and Candidate Countries and the Western Balkans regard EEB as their main partner on European and EU issues. Our experience, relationships and position are of great value in determining these states' role in EU enlargement and environmental-related processes. Our proactive involvement has boosted our membership from new Member States and EU applicants. In 2004, EEB, working with the Mercury Policy Project/Ban Mercury Working Group, launched the 'Zero Mercury' campaign.

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Health and Environment Alliance (HEAL)

international non-governmental organisation that aims to improve health through public policy that promotes a cleaner and safer environment. Our work draws on the findings of the environmental health science revolution, which is revealing the impact of environmental degradation on health in an ever-widening range of diseases and conditions. We represent a diverse network of more than 50 citizens', patients', women's, health professionals' academic and environmental organizations across Europe with a strong track record in bringing environmental health science and policy to an increasing number of fora. Our vision is that of a healthy planet for healthy people.

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The Zero Mercury Working Group

The Zero Mercury Working Group, is an international coalition of over 55 Public-interest non-governmental organisations from around the world formed in 2005 by the European Environmental Bureau and the Mercury Policy Project/Ban Mercury Working Group. The group's aim is to reach 'zero' emissions, demand and supply of mercury, from all sources we can control, towards eliminating mercury in the environment, at EU level and globally."

Editor responsible: John Hontelez
European Environmental Bureau (aisbl)
October 2007

The EEB gratefully acknowledges financial support from the Sigrid Rausing Trust, UK and the European Commission.

REPORT FROM THE CONFERENCE

DENTAL SECTOR AS A SOURCE OF MERCURY CONTAMINATION

BRUSSELS, 25 MAY 2007

Compiled by: **Elena Lymberidi (EEB)**
Anne Lemoine

October 2007

European Environmental Bureau

Zero Mercury Working Group

Health and Environment Alliance

Conference and report financed by the Sigrid Rausing Trust, UK.

Contents

I. Introduction

Mercury and its compounds are highly toxic to humans, ecosystems and wildlife. Initially seen as an acute local problem, mercury pollution is now also understood to be global, diffuse and chronic. High doses can be fatal to humans, but even relatively low doses can have serious adverse neuro-development impacts and have been linked with possible harmful effects on the cardiovascular, immune and reproductive systems. Mercury is persistent and can be transformed in the environment into methylmercury, its most toxic form, which readily passes through both the placenta and blood-brain barriers and can cause damage to the nervous system. It is particularly harmful to the development of unborn children. It accumulates in the bodies of humans and wildlife and can become more concentrated as it moves up the food chain, especially in certain types of fish. Mercury can drift long distances through the atmosphere, and has contaminated global food supplies at levels which represent a major risk to human health.

In the EU Strategy Concerning Mercury, adopted in January 2005, it was noted that the largest source of mercury exposure for most people in developed countries is inhalation of mercury vapour from dental amalgams[1].

Action 6 of the EU Strategy identified dental amalgams as an area of concern and decided that an opinion from the EU Scientific Committee on Health & Environmental Risks was needed before considering whether additional regulatory measures are appropriate. Following up on the strategy's actions, the European Commission prepared questions on the environmental impacts (DG Environment) and health impacts of the mercury dental amalgam and its alternatives (DG Enterprise). Both sets of questions were then sent to DG SANCO, which referred them to two of the Scientific Committees under its mandate to provide opinions[2]: the Scientific Committee on Health and Environmental Risks (SCHER)[3] and the Scientific Committee on Emerging and Newly Identified Health Risks (SCENHR)[4]. These two committees will work in parallel over the next months and intend to publish their assessment in December 2007.

In the meantime, in March 2006, the European Parliament called on the Commission to bring forward a proposal to restrict the use of mercury in dental amalgams by the end of 2007.

Given these developments in scientific assessments and policy demands on the widespread use of mercury in dental amalgams, the European Environmental Bureau (EEB), together with the Health and Environment Alliance (HEAL) and the Zero Mercury Working Group, held this conference in May 2007 to engage more stakeholders in this important debate.

The objectives of the conference were:

- To discuss the environmental impacts of dental amalgam use;
- To discuss the direct health effects caused by its use; and
- To discuss the need for the dental amalgam and potential ways forward at EU level, sharing national experiences and available tools.

[1] Community Strategy Concerning Mercury, COM(2005) 20 final, 28.1.2005, p.2
2 http://www.ec.europa.eu/health/ph_risk/committees/committees_en.htm
3 The questions on environment (DG ENV) were sent to the Scientific Committee on Health and Environment Risks (SCHER); http://www.ec.europa.eu/health/ph_risk/committees/04_scher/docs/scher_q_050.pdf
4 The questions on health (DG ENTR) were sent to the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR). http://www.ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_q_009.pdf

II. Conference Results

Clearly, for the reasons outlined in the introduction, mercury contamination poses a major threat to human health.

As noted in the introduction, as the result of a request from the EU Strategy Concerning Mercury, the environmental and health effects from the use of dental amalgams are currently being assessed by EU experts, with a report on the results of their findings expected by the end of 2007. It should also be noted that it currently seems unlikely that the Commission will produce a proposal by the end of 2007 to restrict the use of mercury in dental amalgams, as urged by the European Parliament in 2006.

Given the above developments at EU level, through this conference EEB, HEAL and the Zero Mercury Working Group offered a chance for the diverse stakeholders to assemble and express their views, providing valuable information to legislators, Member States and the European Parliament. The conference results are summarized in the following paragraphs.

- In the EU, mercury use for dental amalgams is estimated to be more than 90 tonnes, the second biggest use after mercury-cell chlor-alkali plants. Mercury use in the EU is significant in dental applications, most of which appears to eventually be deposited in the environment. Such releases are quite diffuse, and controlling them is costly. Once mercury is released, it may transform into methylmercury, its most toxic form.
- There are various pathways where mercury from dental amalgams may be released and where it can be controlled (dental clinics, waste water, crematoria, cemeteries etc.). Much mercury waste is sent into the solid waste stream, although a good amount goes into the waste water treatment stream including mercury in people's mouths released at home, while a certain amount ends up in sludge waste. Crematoria also release mercury into the atmosphere, although when people are buried it might end up in the soil or ground water.
- Approximately 500 million citizens (50-75% of individuals in the EU) have fillings in their mouths. The average mouth with fillings in the EU seems to contain 3 to 4 grams of mercury. A 'human inventory' of around 1,100 tonnes can be found in people's mouths in the EU, which is huge when one considers it will all end up in the environment.
- Experts estimate that the amount of mercury newly introduced into people's mouths in the EU is between 110 and 150 tonnes annually. However, this estimate does not include the mercury waste carved away by dentists. Yet, three grams per person are still released into the atmosphere by cremation or into the soil by burials every year. The cremation rate in the EU is also increasing by 1% a year.
- On the basis of different assumptions, it is estimated that the annual mercury releases which end up in various environmental outlets are distributed mainly into soil (30 tonnes), the atmosphere (23 tonnes), surface water (14 tonnes) and groundwater (10 tonnes). In these environmental media the mercury may be expected to continuously circulate in the biosphere, partially methylate, enter the food chain and detrimentally affect wildlife and human health.
- Amalgam separators, although they can recover quite a high percentage of dental amalgam waste, have not proven to be a real solution, since lack of maintenance or bad installation can reduce their efficiency, meaning that there will still be emissions of mercury into waste water through dental clinics. Moreover, as the presentation from the Commission made clear, the EU as a whole has a very low occurrence of separator installation in dental clinics, particularly 'retroactive' installation in existing clinics.
- Emissions from the crematoria sector increase both localised and national mercury levels through emissions and deposition. All mercury in teeth evaporates during cremation, with no traces of mercury found in the remaining ashes. Installation of filters in crematoria can be quite costly, and even then the abatement technology only removes 95% of mercury leaving the chimneys. In addition, mercury abatement is a form of end-of-pipe control and it would therefore be preferable for mercury to be controlled farther up the process chain.

- Mercury-free alternatives for dentistry exist, including composites, (resin-free) glass ionomer cements, ceramics etc. Some concerns were expressed about the potentially hazardous content of these alternatives (e.g. composites containing bisphenol-A), but hazard-free options are also available on the market. Dentists present at the conference confirmed practising amalgam-free dentistry, with the ability to restore all damaged teeth without amalgams.
- It was observed that the size of cavities could be an important factor in determining which material can be used. However, dental prevention is very important and preventing cavities is the best way to avoid the small risks that all healthcare and dental materials may entail.
- National strategies and/or advisories have been in place against the use of mercury in dental fillings (e.g. in Sweden, Denmark, Germany, Austria, France, Finland). Introduction of financial instruments (e.g. health insurance covering mercury-free amalgams only), practitioners' guidelines and awareness raising on the issue in different countries appears to have made a difference, all of which should be continued in light of the push to phase out the use of mercury in the dental sector and to stimulate a sustainable long-term solution.
- There was a call for the EU Scientific committees assessing the environment and health effects from the use of dental amalgams to have balanced representation and that their members be selected for their independence without any conflict of interest. Information upon which an assessment of independence can be made should be open to public.
- The price of an amalgam might be very low for the consumer if we compare it to the cost of alternatives; however, dental amalgams would be one of the most expensive materials if related environmental costs and (chronic) health effects caused by mercury were also taken into account. The real environmental and health costs should be included in the actual cost of the amalgams.
- Patients in Europe are not always informed about the different choices they have regarding dental fillings and what the effects or risks of one or the other material could be for their health and the environment. Some participants testified that their health deteriorated because of the use of dental amalgams and improved after their removal and detoxification therapy.
- There has been evidence that dental assistants have been seriously affected by the use of mercury while preparing dental amalgams, many reporting having children born with neurological problems. Studies presented from Norway showed dental assistants to have neurological and psychosomatic symptoms, problems with concentration, fatigue and sleep disturbance.
- There was general support for the idea that mercury use in dental amalgams can indeed be decreased or phased out in the coming years, since adequate alternatives are already available and research could provide for a wider range of even better performing materials.

  The EEB, HEAL and the Zero Mercury Working Group hope that this conference has contributed towards giving a clearer picture of the scope of the problem and how it can be handled. The EU should continue paving the way towards reducing mercury supply, demand and emissions both at a European level and globally.

Elena Lymberidi – Settimo
Project Coordinator "Zero Mercury Campaign"
European Environmental Bureau / Zero Mercury Working Group

III. Agenda

Time Schedule	Title of Presentation	Speaker
8.30	Registration	
9.00	Welcome	John Hontelez, Secretary General , EEB Moderator: Willy de Backer, EurActiv -
9.10	EC approach tackling the issue	Gernot Schnabl, European Commission, DG ENV
9.30	Overview: Mercury Releases from Amalgam to the Environment: Air, Water and Soil	Peter Maxson, Director, Concorde East/West sprl
9.50	Dental Clinics Employment of Amalgam Separators, Best Management Practices	Lars Hylander , Ass. Professor, Uppsala University, Department of Earth Sciences, Air, Water and Landscape Science.-
10.10	Requirements to Reduce Mercury Emissions from Crematoria	Colin Gillespie, Scottish Environment Protection Agency
10.30	Coffee break	
11.00	Phase out of Mercury Amalgam for Health & Environmental Reasons	Petra Ekblom, Swedish Chemicals Agency KemI, Sweden
11.20	Norway's policies on dental amalgam	Liljan Smith Aandahl, Directorate for Health and Social affairs, Norway
11.40	Discussion with all morning speakers Q & A	
12.45	Lunch Break	
13.45	Movie - Norwegian Television Broadcasting November 2005 "Burning Point" Documentary on Dental Assistants, Entitled: *"Mercury Women"* with English subtitles	Michael Bender, Mercury Policy Project
14.00	Occupational health concerns	Prof. Bjorn Hilt, St. Olav's University Hospital
14.20	Lifecycle of dental amalgam: public health concerns	Lisette van Vliet, Toxics Policy Advisor, HEAL
14.40	Coffee break	
15.10	*Panel Discussion: Mercury in dental amalgams: should we still be using it?*	
15.15 15.20 15.25 15.30 15.35	•The case for using mercury dental amalgams •Concern over health impacts of dental amalgams and latest scientific findings •Building a consensus among dentists for mercury free amalgams •Are vulnerable populations at risk for dental amalgams? Discussion	• Professor Gottfried Schmalz, The Council of European Dentists • Dr. Med. Joachim Mutter, Institute of Environmental Medicine and hospital of Epidemiology at the University Medical Centre Freiburg • Dr. Graeme Munro-Hall, International Academy of Oral Medicine and Toxicology • Jean Huss, AKUT – patient group representing environmentally sensitive patients
16.30	Summary of the day	Moderator - Willy de Backer
16.45	End of conference	

IV. Conference presentations and discussions

1. *Implementing the Mercury Strategy COM(2005)20: Dental Amalgam*

(Presentation by Mr. Gernot SCHNABL, European Commission, DG Environment)

The Commission adopted a Mercury Strategy back in January 2005. It recommended a broad range of actions, covering most aspects of the mercury lifecycle. The strategy was strongly backed by the European Parliament and the Council. At international level, there is an increased sense that further international action is needed to tackle the general mercury problem. There is now a structure since the last Governing Council of UNEP that should identify possible options and solutions.

Two of the EU Mercury Strategy's 20 actions deal more specifically with dental amalgams.

Action 4: review of implementation of Community requirements on the treatment of dental amalgam waste

Action 6: seeks a scientific opinion on the use of mercury in dental amalgam with a view to consider whether additional regulatory measures are appropriate

In relation to Action 4, the European Commission (EC) had written to Member States in 2005 asking them to report on the environmentally sound management of dental amalgam waste, with specific focus on the issue of separators. The outcome of this is not complete, because the EC has not received results from all countries. Amalgam separators are widespread in eight[5] Member States (MS). The situation is less developed in seven[6] countries (separators are installed in new facilities, but they have a backlog for old facilities; but they are taking steps to catch up. The issue is less clear in two other countries (Estonia and Latvia) in which separators are installed in new facilities, but there is no sign they will be installed in older facilities. (The) Larger countries have not given any information. Other Member States have not provided information on this subject. The EC has since sent reminders to Member States demanding the information needed; the issue will be followed up.

Following up on Action 6, the EC sent questions on the issue to two scientific committees which work for the Commission: the Scientific Committee on Health & Environmental Risks (SCHER) and the Scientific Committee on Emerging & Newly Identified Health Risks (SCENIHR). SCHER will look at the environmental effects (downstream issue of the problem). SCENIHR will see whether it is dangerous to have mercury in our mouths (the scientific community is still divided on this subject). These committees are expected to report by the end of this year (2007). But the committees' work is limited: SCHER's scientists can work on information from only three countries: Sweden, Germany and Denmark, which have fairly advanced environment control measures. If there is a problem with these countries, there will be problems in others too. If the committees do not find any problems, further investigation will be necessary. The Commission will not propose any new legislation as long as there is no clearer picture on the subject. For UNEP, dental amalgams are not an issue at all so far; mercury emissions from industry (mainly coal combustion) are much higher up the agenda.

Responding to a question, it was noted that Denmark has not given any information although it is advanced in these policies, potentially for administrative reasons, since reporting to the Commission is not a popular exercise among Member States.

5 Austria, Belgium (Walloon region), Finland, France, Germany, Netherlands, Portugal and Sweden.
6 Cyprus, the Czech Republic, Greece, Ireland, Italy, Poland and Slovakia.

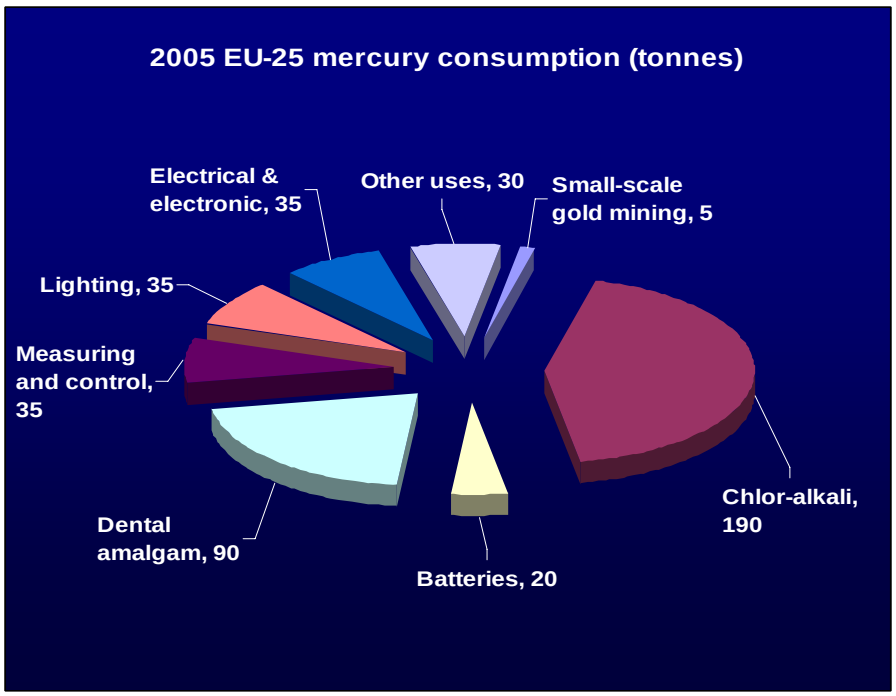
2. *Overview: Mercury releases from Dental Amalgam to the Environment*

(Presentation by Peter MAXSON, consultant, Concorde East/West, Belgium)

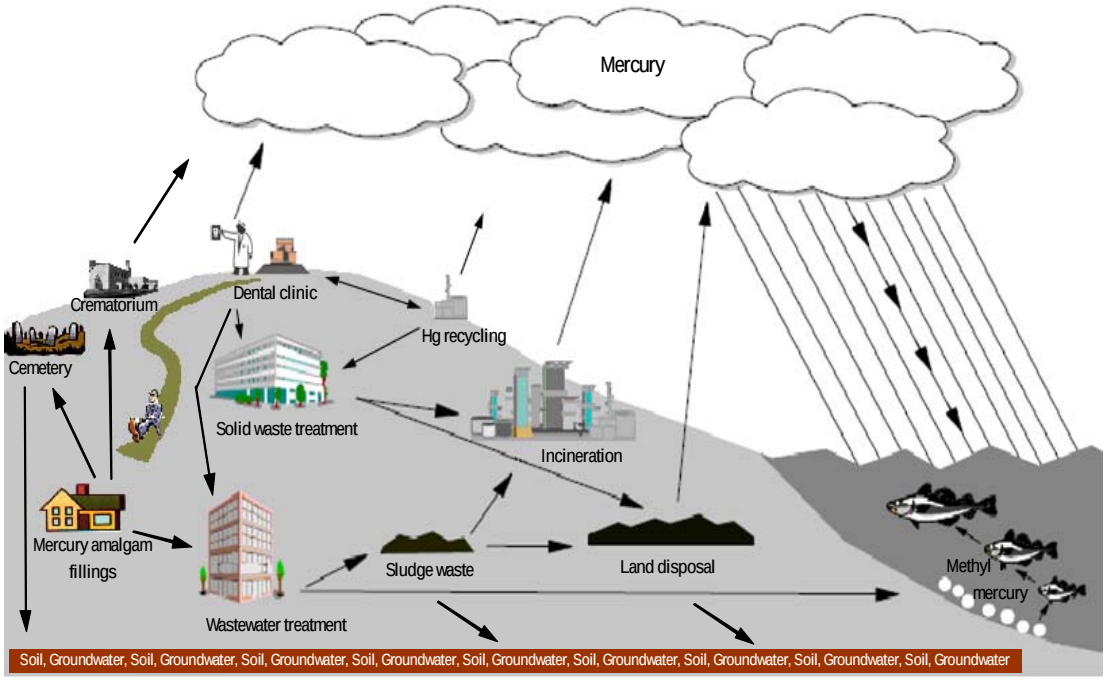
We know that there is significant mercury use in the EU in dental applications each year, and that eventually most of it appears to be lost in the environment. Releases are quite diffuse. Controlling them adequately is costly. There is evidence of transformation to methylmercury. Member States have very different policies on dental mercury use, and in some cases it is difficult to find out what these policies are, including on waste issues. Is reducing mercury use in dental applications a good focus? Should it be a priority?

Global mercury demand (2005)	Metric tonnes
Small-scale/artisanal gold mining	650-1,000
Vinyl chloride monomer (VCM) production	600-800
Chlor-alkali production	550-650
Batteries	300-600
Dental use	**240-300**
Measuring and control devices	150-350
Lighting	100-150
Electrical and electronic devices	150-350
Other (paints, laboratory, pharmaceutical, cultural/traditional uses, etc.)	30-60
Total	**3,000-3,900**
Note: In each of these sectors some mercury recycling takes place, involving the recovery of mercury from products or wastes. Therefore, "net consumption" of mercury in any of these sectors may be significantly lower than "gross consumption" indicated here.	

The top three areas above are all process uses for mercury. In terms of product uses, we have batteries and dental use (but now lower for batteries). Dental mercury use may now be at the top of the list of product uses of mercury worldwide.



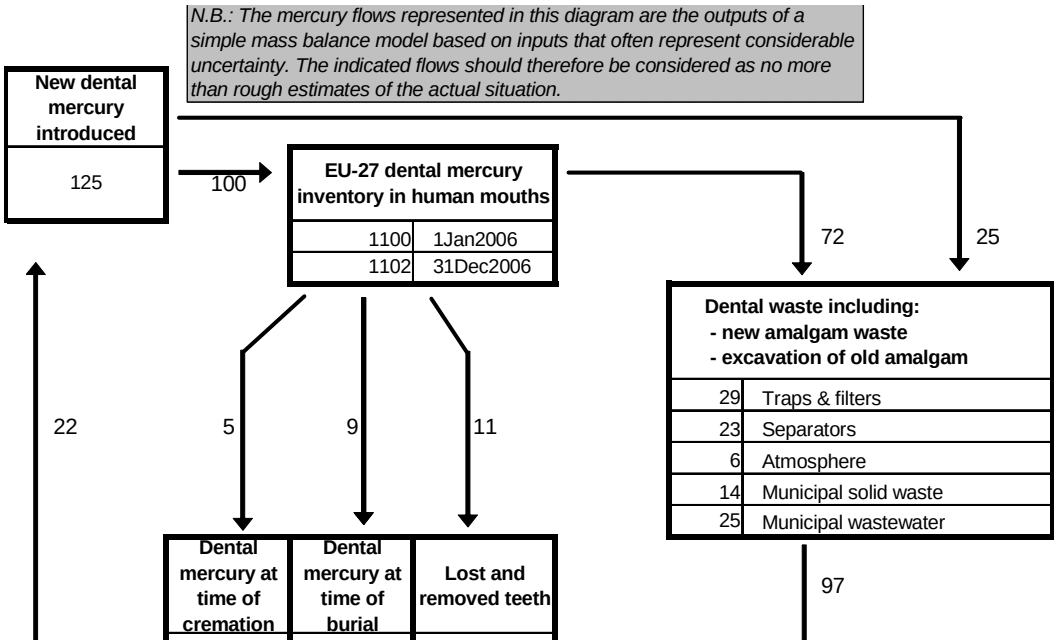
The above figure shows EU consumption of mercury. In the 'EU-25' (pre-2007 Member States), mercury use for dental amalgams was estimated at about 90 tonnes, for the EU-27, it is probably 10% higher



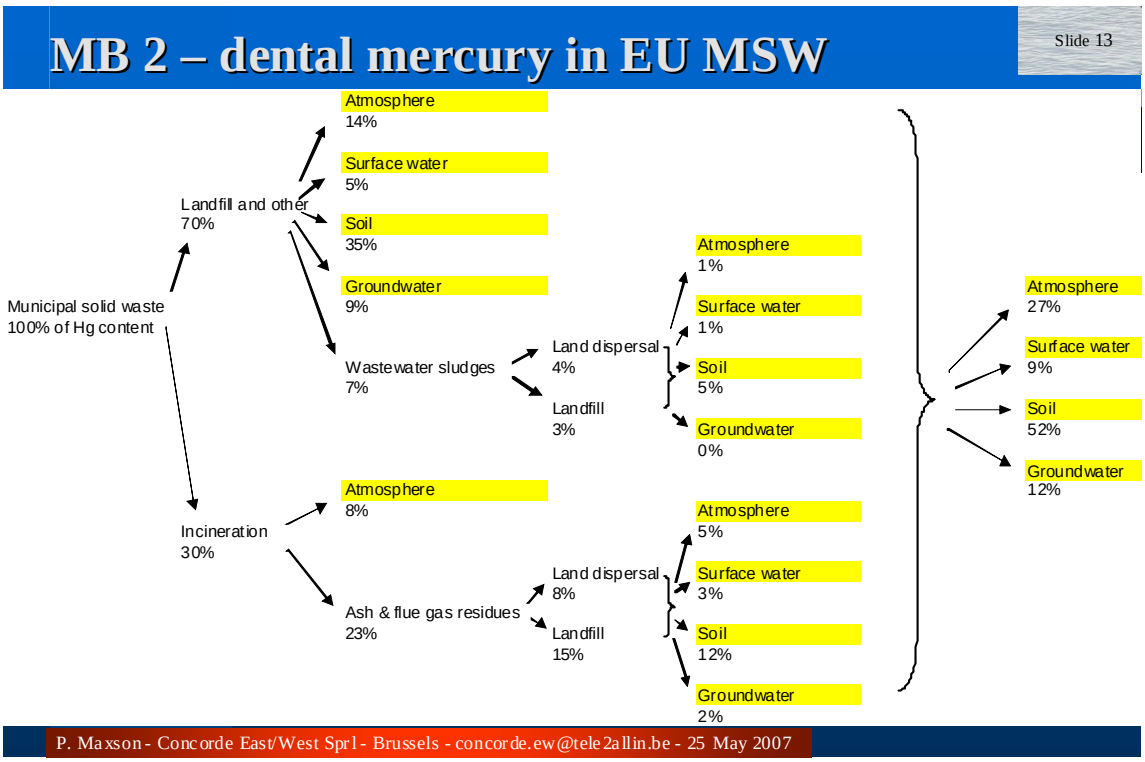
There are various places in these pathways where mercury can be controlled (traps and filters in clinics that can partly remove mercury, separators can remove more mercury, some collected mercury which can be recycled). Much waste mercury goes into the solid waste stream, a substantial amount goes into the waste water stream, some ends up in sludge waste, which can be incinerated or disposed of on the land. Mercury in people's mouths also ends up in the domestic waste water stream. Crematoria also release mercury into the atmosphere. From buried corpses it may leach into the soil or ground water.

Approximately 500 million people (50-75% of us) have fillings in their mouths. The average mouth with fillings in the EU seems to contain 3 to 4 grammes of mercury. The 'human inventory' is huge when one considers it will end up in the environment.

About 100 tonnes of mercury are put into our mouths each year, but it does not include mercury waste carved away by dentists. 125 tonnes is an estimation of the mercury introduced in people's mouths in the EU (some say it is 110 tonnes, others 150 tonnes), consistent with countries' data. Yet, 3g per person are still released into the atmosphere (cremation) or in the soil (burials). The cremation rate is increasing by 1% a year.

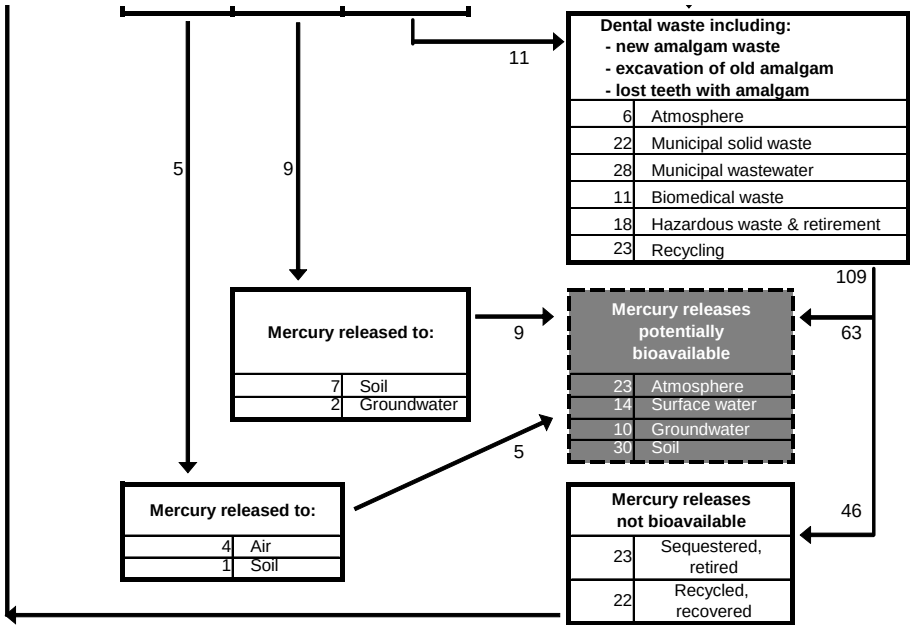


Above, part of the flow chart that was developed, shows where the 125 tonnes of mercury are going. Details are described in the report[7].



Because of specific flows of mercury, pathways are quite complicated. Determining what happens to mercury after it goes into a landfill or is incinerated is quite difficult. Various assumptions must be made, many of them based on reports from others. The above slide summarizes some of the assumptions.

7 http://www.zeromercury.org/EU_developments/Maxson%20Dental%2014May2007%20-%20A5colour.pdf



This flow diagram shows the lower part of the diagram from the previous page. The grey box: 60% of overall amount of mercury seems to be potentially bio-available and 40% appears to be recycled, recovered or perhaps going to a sophisticated hazardous waste treatment facility where it is sequestered and will not easily return to the environment.

Various studies show that dental mercury can be readily converted to methylmercury; in one study this occurred in as little as 28 days. Dental mercury which gets into the environment can be methylated in several ways and thus becomes more hazardous for humans and animals. As a result efforts are increasingly made to remove mercury from the waste stream. Such efforts can frequently cost a lot.

There is uncertainty about the precise quantity of dental mercury circulating in EU waste streams but conclusions can still be drawn. The use of mercury in dental applications is still large. Most dental mercury is eventually released into the environment. Several EU studies have shown it is very difficult to find the amount of mercury released into the atmosphere, yet all estimations are still very high. Mercury releases are very diffuse, expensive and difficult to control adequately. It is clear that transformation to methylmercury happens although we do not know exactly to what extent. It enters the food chain especially through fish consumption. There is a low level of awareness still among dental staff of the mercury hazard in the workplace. What is more, alternatives to mercury amalgams exist. So the only viable response to these problems is to phase out mercury from dentistry.

During the discussion that followed the following points were clarified:

- Once mercury enters the waste stream there are many possibilities (pathways) for its release into the atmosphere. For instance, when mercury goes into the waste water system in dental clinics, there is often an air vent system associated with the waste water system. In the dental facility or outside, there are already atmospheric emissions from this stream. Similarly, when people have mercury in their mouths, half the concentration of oral mercury enters their digestive system and eventually into the waste stream, the other half comes out of their mouths adding another source of atmospheric emissions. The bulk of atmospheric emissions from dental mercury in the EU comes from the incineration of mercury in solid waste, and likewise even when mercury is captured in waste water sludge, some of that mercury is incinerated. Even when the sludge is applied to the land, a certain quantity of mercury vaporises from the soil. There are many sources for that

mercury to be released into the atmosphere, which are not necessarily considered unless one looks carefully at the various mercury pathways. All studies show that once mercury is released into water or on land, a certain quantity continues to be volatilised.

- A percentage of the overall mercury used was taken into account (under grey box) in the study. About 40% of these 125 tonnes is either recycled or removed from the system. These data come from information provided by some Member States.

- There is even less awareness among the public than among dental staff. A US study showed that many dental assistants nevertheless continue working in ways that reveal they're unaware of the problem.

- A German dentist observed that in Germany dentists only get money for recycling gold, platinum and silver. They must pay a lot to get rid of mercury through special services.

- It was noted that waste management practices related to dental amalgam may differ greatly between EU countries. A Greek dentist said it would be interesting to know what data are available for Greece on collection and recycling of amalgams. There is currently no mercury waste collection process from Greek dental clinics. Nor is there even a special agent to turn to if a dentist wishes to dispose of mercury. Not only is it not compulsory, there is no agency to collect it and dispose of it properly even if a dentist wishes to do so.

- In Sweden, dentists must pay to dispose of amalgam waste, whether from carvings or amalgam separators. This in combination with the metal value of silver in dental amalgam waste created the bases for an illegal market, where some people acquired dental amalgam waste from Swedish dentists and brought it abroad. The waste was then smelted without mercury emission abatement equipment and the silver recovered for selling to metal brokers. This illegal market is nowadays avoided by that the authorities overlooking waste handling are demanding that the dentists can prove they have disposed of their waste to approved amalgam waste handlers.

3. *Dental Clinics' Employment of Amalgam Separators, Best Management Practices*

(by Lars HYLANDER, University of Uppsala)

Carl von Linné, a professor at Uppsala University, introduced mercury into Swedish medical care, nearly 300 years ago. People are now fighting against it and are close to succeeding.

There are five options on handling toxic heavy metals in amalgams when they end up in waste water from dental clinics: (Mercury is not the only toxic heavy metal in this waste water; silver is also very toxic for water-borne micro-organisms and will at a certain concentration hamper the biological step, where phosphorus is removed from the waste water in the treatment plants.).

i. Open-end pipe: nothing is done to fight against the pollution
ii. Best management practice recommended by American Dental Association. Very simple policy: Screen at dental chair by using a side-chair trap.
iii. Amalgam separators: the simple ones can be of three different types or a combination of sedimentary and filter types.
iv. Improved amalgam separators: Uppsala University is developing an experimental one, but there are also bark filters on the market, installed in ten Swedish dental clinics.
v. No amalgam use is the best option. It is important to realize that much more mercury is released in removing old amalgam fillings than in inserting new ones, so as long as patients with old amalgam fillings exist, mercury pollution will continue. In the end, no amalgam use will lead to no heavy metal pollution, and open-end pipe is sufficient.

In 1985, there was an agreement (not a law) about amalgam separators in all Swedish dental clinics. The amalgam separators are marketed as recovering 99% of mercury from clinic

wastewater (based on laboratory studies). To find the real situation, Uppsala University conducted two studies:

Study 1: they measured emissions from 12 dental clinics in operation belonging to the public dental health service in Uppsala County, and all equipped with the same type of amalgam separators (SRAB 99TM). These are sedimentary separators. They were installed in wet suction systems and in the actual setting preceded by a mesh (0.7 mm) at each chair to catch large pieces of amalgam as well as of gold, ceramics etc.

SRAB 99™

Lars.Hylander@hyd.uu.se

They had two different test periods. First, they determined mercury content in waste water in ordinary conditions. They went to the dental clinics and checked how the separators worked. These clinics subscribe to exchange their separator once a year. They wanted to see if the dental amalgams were removed as they were supposed to. However, there were big problems, so the research team made a thorough revision of the tubing and separator system of each clinic before starting the second phase of the evaluation.

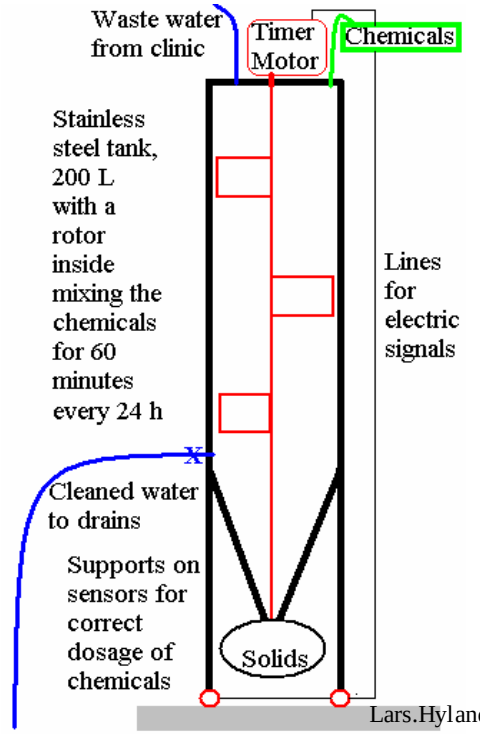
Study 2: They compared four different separators: three commercially available separators (Mercury Master II, Rasch 890, SRAB99) marketed as recovering 99% of mercury, and one prototype of an improved separator (LEX). The study was carried out in two dental clinics (LEX at one clinic).

Rasch 890

Inlet **Outlet** Lars.Hylander@hyd.uu.se

Mercury Master II (prototype)

For the samples, they collected all waste water leaving the clinics for several days, and analysed its mercury content. *See slide* below.



Low emission experimental separator, LEX

The mercury content in sediment cleared at revision of the systems was also determined. The amount and type of dental work with amalgam was registered daily.

The analytical method[8] that was followed is described below:

Mercury was determined in three fractions -
fraction 1: particulate material precipitating within 12 hours.
fraction 2: "colloids" precipitated by addition of aluminium sulphate at pH 10.5—11.
fraction 3: dissolved Hg in remaining water.

Digestion followed with 3ml acid (conc. H_2SO_4 + HNO_3, 2: 1) in sealed glass tubes with Teflon lids in stainless steel bombs in a heating block at 200 °C for 2 hours.

Mercury determined with atomic absorption cold vapour technique ($SnCl_2$ as reduction agent) followed.

Results of Study 1: The results are much better after revision of the separators.

None of the clinics had waste water that contained less than 0.0002mg mercury /litre waste water; a limit needed in case wastewater sludge should be possible to use as a fertilizer without increasing soil mercury content) They all had 0,07mg/l or more. So, there is a large discrepancy between what was performed after revision and what is needed in a sustainable context if they want to use the sludge in agriculture as a soil improver.

Table: Water flow and mercury emissions from 11 dental clinics before and after revision of the waste water systems

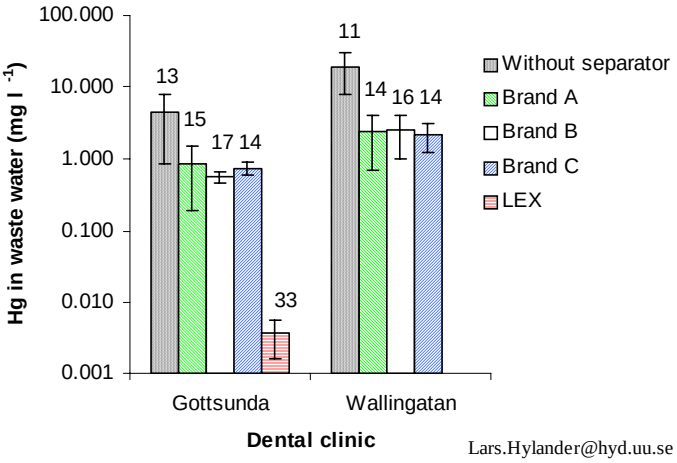
	Active chairs		Water flow l/ day		Fraction 1 mg Hg/ l		Fraction 2 mg Hg/ l		Hg discharge g/chair and y	
	Before	After	Before	After	Before	After	Before	After	Before	After
Average	**3.7**	**4.0**	**56.1**	**59.5**	**13.7**	**0.2**	**2.2**	**1.3**	**14.5**	**1.7**
SD	2.1	1.8	78.9	41.8	21.9	0.4	1.7	1.8	25.6	2.5
N	40	40	40	40	11	11	11	11	11	11

The reduction of Hg emissions after cleaning and revision was more than 500 grammes of Hg per year from the 11 clinics with 45 active chairs (units). In the twelfth clinic, settled Hg was re-suspended on cleaning, resulting in Hg in waste water being increased after cleaning. (Values not included in the average values.)

Results of Study 2: They tested the prototype at one clinic only. There is a huge difference between the market and prototype separators.

8 Further information in: Hylander, L. D., Lindvall, A., & Gahnberg, L. 2006. High mercury emissions from dental clinics despite amalgam separators. Sci. Total Environ. 362:74-84.Hylander, L. D., Lindvall, A., Uhrberg, R., Gahnberg, L., & Lindh, U. 2006. Mercury recovery in situ of four different dental amalgam separators. Sci. Total Environ. 366:320– 336

Study II. Mercury concentration in untreated wastewater and after four amalgam separators (average and 95 % confidence interval) Logarithmic scale. Numbers indicate *N* (sampled days).



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Conclusions from Study 1

Most Hg entering the waste water system originated from the removal of old amalgam fillings. Professional installation and regular maintenance of amalgam separators is most important. The currently-used amalgam separators cannot reduce the Hg content to levels needed for combating pollution in a society based on sustainability criteria. Physical laws hinder this type of amalgam separator to perform better when fed waste water at dental clinics, which contain a larger portion of finer particles than used in the laboratory tests. Other techniques, which can reduce Hg levels to levels needed should be compulsory and the costs be incorporated in the fee patients pay for inserting amalgam fillings. Changing the separators once a year only is not enough.

Conclusions from Study 2

The obtained efficiency of the three commercial amalgam separators dominating the Swedish market is in practice at the dental clinics far below what the manufacturers state. Abolishing dental amalgam use and cleaning the tubing systems is the most efficient long-term solution to reducing Hg emissions from dental clinics. Physical restrictions prohibit sedimentary type separators to recover the Hg fractions causing the greatest damage in wastewater treatment plants. This fraction is not considered in the ISO protocol for testing amalgam separators, therefore revision is needed.

Mercury emissions originating from placing, polishing or removing existing amalgam fillings, should be counteracted by using amalgam separators in conjunction with low-emission separators/filters[9].

Mercury emissions resulting from abrasion from everyday chewing (one third of total Hg emissions in Sweden) cannot be recovered by any amalgam separator.

The following points were further clarified during the discussion:

- To make an amalgam, mercury is mixed with an alloy powder which nowadays is a mixture of silver, copper, zinc and tin. During mixing, some of the mercury reacts, especially with tin. But there is always some mercury left in a metallic state, contrary to what e.g. ADA states. However microscopy studies have shown the presence of mercury drops at the surfaces of dental amalgams. Many think that mercury dissolves gold, but this is wrong. Mercury actually encapsulates gold particles. There is no real dissolution reaction between mercury and gold for example, nor between mercury and silver. According to the literature, mercury dissolves tin, but not completely. Regarding what

9 e.g. Capere dental filter , http://www.tekniskaverken.se/capere/capere_dentalfilter

emerges from the waste water system, it is mostly dental amalgams but liquid metallic mercury was also found. How the metallic mercury reaches the waste water system is still unclear. One may think that when the dentists mix liquid mercury with alloy powder, there is sometimes too much mercury, and they may have dropped it in the waste water tube. Some may come from broken clinical thermometers. But it is well-known that downstream from all dental clinics, there is always a lot of both liquid mercury and mercury amalgams in waste water pipes. It costs a lot to clean this up in a safe way.

- With respect to mercury emissions resulting from abrasion from chewing, some articles were distributed at the conference. Literature exists on this issue. The presenter mentioned that they also noticed it when analyzing saliva with different analytical equipment. They tested saliva before chewing for half an hour and afterwards. There was a dramatic difference. The saliva people swallow then emerges in the waste water system, so it is easy to prove. It has been documented in scientific literature.

4. *Mercury Abatement within the Crematoria Sector*

(by Colin GILLESPIE, Scottish Environment Protection Agency (SEPA))

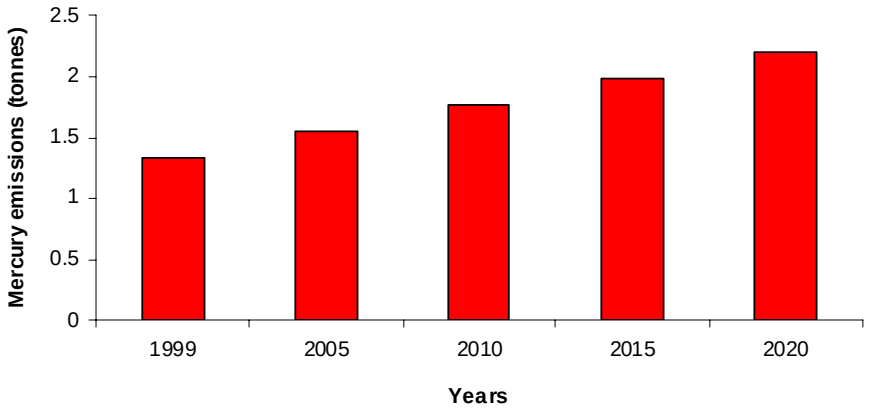
Emissions from the crematoria sector add mercury to both localised and national levels through emissions and through deposition. Deposition from emissions of mercury mainly occurs through rain, but there is also dry deposition onto soils. Once it enters the water cycle it becomes extremely toxic, changing into methylmercury through reactions with bacteria, etc. It bio-accumulates especially in the aquatic food chain. Human exposure occurs through vapour from people's dental fillings, or through contaminated food intake. The British Government produced a policy through OSPAR recommendations[10]. They looked at the key recommendations before coming up with political decisions. Best Available Techniques (BAT) are used in the crematoria sector under the IPPC[11] Directive. Most EU countries must use BAT at some point. But the level at which BAT are implemented depends very much on the crematorium. It is restricted by economic feasibility, location and the crematorium's age. Cultural and social impacts of cremation had also to be taken into account by the Government.

Table and figure: Projected emissions of mercury in the UK

	Crematoria	Primary lead/zinc	Coal/Coke: Power	Coal: industry, nonindustrial + domestic	Chloralkali	Clinical Waste Incineration	Other*	Total	named sources (ie excl 'other') as percentage of total		Crematoria as percentage of total
1999	1.34	0.29	1.56	1.42	1.41	0.37	2.16	8.55	75%		**15.7%**
2005	1.55	0.29	1.36	1.25	1.41	0.12	2.16	8.14	73%		**19.0%**
2010	1.77	0.29	1.16	1.07	0.00	0.12	2.16	6.57	67%		**26.9%**
2015	1.98	0.29	0.96	0.89	0.00	0.12	2.16	6.40	66%		**30.9%**
2020	2.20	0.29	0.76	0.71	0.00	0.12	2.16	6.24	65%		**35.3%**

In the UK, an abatement system was installed in crematoria. Because all the other sectors are reducing their mercury emissions, crematoria sector emissions will grow in importance within total mercury emissions. The bulk of emissions from individual sectors are steadily decreasing whereas crematoria emissions are steadily increasing.

10 OSPAR Recommendation 2003/4 on Controlling the Dispersal of Mercury from Crematoria, http://facultatieve-technologies.com/downloads/OSPAR_RECOMMENDATION.PDF
11 Integrated Pollution Prevention and Control Directive 96/61/EC



Emissions are predicted steadily to increase over 60% by 2020, plateau to 2035, followed by a reduction reaching 2000 levels by 2055.

The reason why crematoria emissions are increasing in the UK is that many people with fillings are particularly old, and many adults have retained their teeth remaining. Adults between 45 and 54 have the highest level of tooth retention and the highest levels of mercury in their fillings. That is why a rise in emissions is predicted.

Tables: Projected emissions linked to dental hygiene

age	Number of sound restorations in adults		
	1978	1988	1998
16-24	8	5.5	2.9
25-34	**9.8**	**10**	7.4
35-44	8.9	**11.1**	**10.1**
45-54	7.1	**9.6**	**11.1**
55-64		7.1	**9**
65-74	4.8	5.7	8.2
Over 75		3.7	6.5

age	Percentage of adults with no teeth		
	1978	1988	1998
16-24			
25-34	4	1	
35-44	13	4	1
45-54	**32**	17	6
55-64	**56**	**37**	20
65-74	**79**	**57**	**36**
0ver 75		**80**	**58**

Two consultation papers were set out by the Department of Environment, Food & Rural Affairs (DEFRA). The responses from these consultations determined the nature of British policy. They drew several conclusions:

1 Reductions should be achieved without crematoria closures.
2 New crematoria can accommodate abatement systems.
3 Older crematoria sometimes have structural problems over putting these in place. Others are located in cemeteries and there are considerations over heritage and social aspects.
4 The British Crematoria Federation suggested up to 23% of crematoria might close if the UK went for 100% abatement, which was the initial response from sources like SEPA. SEPA suggested that through the actual structural constraints there would be only 15% closures.

Another result of the consultations was the development of a fair reduction mechanism for existing crematoria. The costs of adapting to the new abatement system do not all fall on the crematoria adopting the system. The industry itself created the Crematoria Abatement Mercury Emissions Organisation (CAMEO) scheme, a crematoria abatement system scheme.

This is a burden-sharing scheme where all members pay per cremation, then receive payment per abatement. This scheme also enabled a phased approach which was not in government recommendations with targets: by 2008, 10% of cremations abated, by 2010, 20% and by 2012, 50%.

The Scottish Environment Protection Agency (SEPA) recommended the reduction programme should be spread over several years: the industry which produces gas fluid systems suggested that if everybody waited till the 2012 deadline, they would never manage to fit them on time. DEFRA set an important threshold in its policy recommendations, so bodies like SEPA must report which crematoria will fit abatements and by how much, and how much abatement is actually achieved.

Monitoring date	Indicative benchmark (proportion of cremations subject to upgrade in order to achieve the overall 50% mercury reduction*)
31 December 2006	-
31 December 2007	10%
31 December 2008	20%
31 December 2009	40%
31 December 2010	60%
31 December 2011	80%
31 December 2012	100%

*% of the cremations required to achieve the 50% reduction target

All new crematoria must install mercury abatements. The policy concludes that any crematorium having over 750 cremations per year must fit an abatement system. If they do not achieve this number of cremations, they must still fit it by the target deadline of 2012 for the 50% reduction. The final conclusion was that removing teeth prior to cremation was unacceptable in the UK.

The main aims of British regulatory approach were:

1 Implement a mercury reduction programme before expected increases in mercury emissions
2 Reduce mercury emissions by abating 50% cremations across the UK to reduce the risk of potential closures
3 Implement a form of self control for the industry by setting up an industry-based burden-sharing scheme
4 The burden-sharing scheme will be used to phase in the abatement process by the 2012 target date
5 All new crematoria (above the 750 threshold) will be required to fit abatement

Abatement technology does not scrub out all mercury (only 95%). The policy's success depends on the CAMEO scheme (the industry running their own scheme), and this does not depend on the policy itself. But DEFRA has indicated that if the CAMEO scheme did not work within the next year, they would readdress the policy. They would put in place an actual phase reduction programme based on the number of cremations per crematoria.

As an environmental agency, SEPA must consider other options. This policy has been proactive, looking at the problem before it occurs in terms of emissions. They have to consider the removal of mercury from other processes. But mercury abatement is a form of end-of pipe control, removing mercury at the end of the process – pollutants should be controlled as far up the process chain as possible

Further clarifications:

- Other countries which are also applying measures to control mercury emissions from crematoria, targeting a reduction of more than 50% (Sweden, Denmark). In the UK, because there are many old and small crematoria, they only targeted 50%. It is difficult for them to fit an abatement system.

- A participant noted that a filling's average lifespan is less than 15 years, and the UK is seeking an initial 50% emissions reduction from crematoria. If the UK had considered phasing out mercury in amalgams, it would then have a 50% reduction in five to eight years, with many other simultaneous benefits, and at a far lower cost. The presenter responded that obviously that was something the environment agencies advocated, but only the health department can say whether mercury will continue to be used in , not environment agencies. It would be much more feasible to phase it out if possible, rather than removing it at the end of somebody's life.

- SEPA had mentioned that the requirement to remove teeth before cremation was not acceptable in the UK. Deutscher Naturschutzring suggested it might be possible to have a voluntary tooth-extraction system that would work like the organ donor system. The presenter replied that this was a point raised in the consultation process. To remove teeth costs £24 per cremation, compared to £48 for the abatement system. But this is an issue many prefer not to address. The Government would not wish to force people to have their teeth removed at the time of cremation. Another issue to consider is that Scotland has a bad dental record (with 7.4 fillings per adult), compared with England (6.9 fillings). Scots should thus go to more abated crematoria but that is not the approach taken.

- Studies have measured mercury going out of chimneys. All the mercury in teeth evaporates. There are no traces of mercury in the remaining ashes. The range of mercury going up in smoke goes from .001g for those with no fillings to 6.7g for those with fillings. It can be measured but is costly. It would probably be cheaper to count the fillings before cremation.

- The number of teeth in the mouths of corpses is increasing. But the number of amalgam fillings is decreasing for cosmetic reasons. This has been taken into account in calculations for the UK. But in the UK, the number of fillings has not decreased as it has in other countries. The UK has a poor record of looking after its teeth. These data were taken directly from dental records.

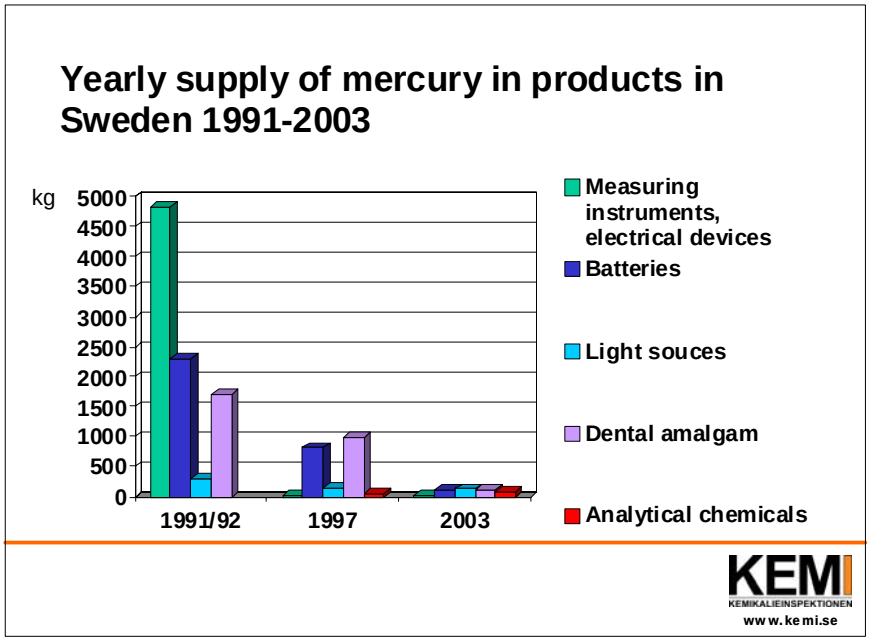
- To reduce emissions, British crematoria can choose between five types from filters to particulate removers.

- There were about 470,000 cremations in the UK each year which means that over 70% of the dead are cremated. This is important because cremations are cheaper. This is one of the main reasons why people want to be cremated. Another reason is that grave space may not be available.

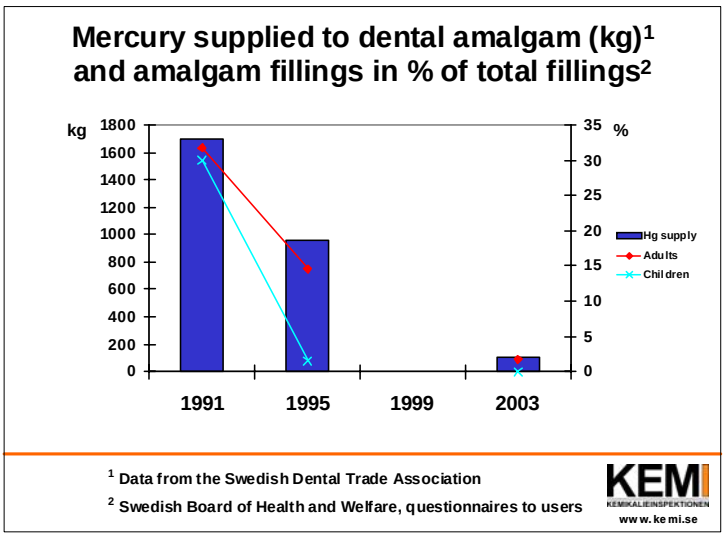
5. *Phase out Mercury Amalgam for Health and Environmental Reasons*

(by Petra EKBLOM, Swedish Chemicals Agency – KEMI)

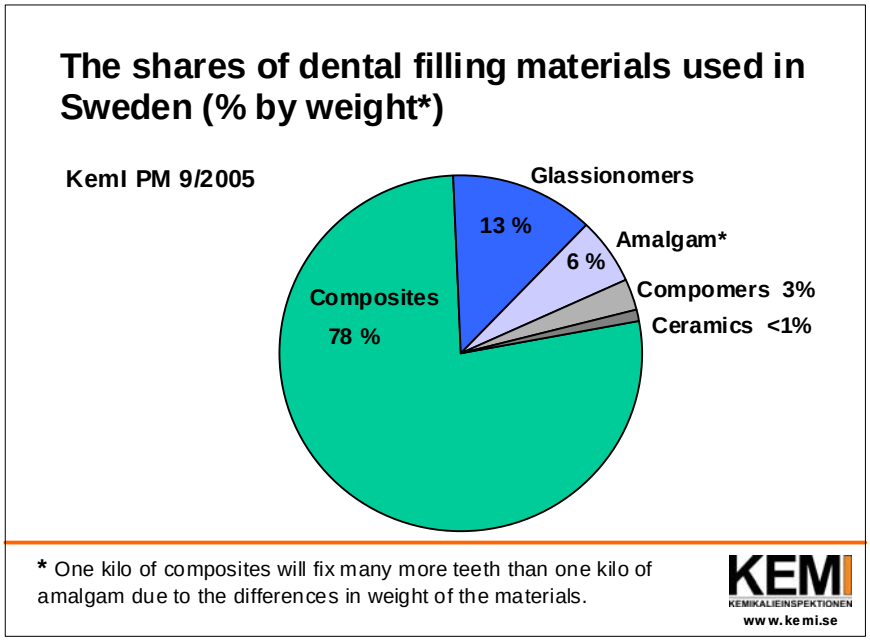
Sweden has had strategies to phase out mercury more generally since the early 1990s, by phasing out mercury products and by collecting it and safely storing it. These measures were taken to protect human health and the environment.



The above slide shows the phase-out of products in Sweden between 1991 and 2003. It has been a nearly 95% phase-out of the supply of mercury to products, mainly due to prohibitions on manufacturing and sale. Parliament decided in 1994 that the use of dental amalgams should be phased out by 1997. This goal was not reached. But some measures were taken and in 1995 there was an agreement between the state and county councils to phase out mercury amalgam use with children. This was a precautionary measure against possible health effects. In 1999, Parliament decided that patients should not get financial support for amalgam fillings. This made the costs for composites and amalgams about the same for patients.



The phase-out of dental amalgams between 1991 and 2003 can be seen in the figure above. Different ways of estimating the used amount of amalgams have been used. They all show the same trend. The supply has been reduced by 95% according to data from and the Swedish Dental Trade Association. Amalgam fillings have almost ceased for children, and for adults, it is below 2% of total fillings according to data from the Swedish Board of Health and Welfare. In 1991, it was about 30% for both children and adults.



As can be seen above (estimate from 2005), composites are the most used materials, and have replaced almost all uses of amalgams. They are used for all indications. There are allergy risks with composites and there was an increase in allergies among dental staff in the 1990s. It mostly comes from non-polymerised acrylates. Allergies decreased to a few cases a year after the improvement of information and packaging. Allergies in patients have not been a problem.

In 2004 KemI was commissioned by the government to investigate a general ban on mercury in Sweden. They wanted to know whether it was possible to ban remaining mercury use, including import and export. Concerning dental amalgams, and whether it would be possible to prohibit their remaining use, the investigation was done in cooperation with the Swedish Board of Health and Welfare. We held many consultations with different stakeholders such as the Dentist Association, Dental Trade Association, Water Companies, NGOs. The result was a strong support for a ban to eliminate mercury use for environmental reasons. But there were also diverging views on the need for an exemption for exceptional cases in hospital dentistry. All participants agreed that in normal dentistry, amalgam is not needed. Special medical reasons concern elderly people who take a lot of medication and cannot be anesthetised, but there are only a few such cases each year in Sweden.

Dental amalgams are not a controlled use of mercury and mercury is emitted throughout its life-cycle. In Sweden, cremations have been estimated as one of the largest sources of mercury emissions in the air. The same is true of sewage sludge (Amalgams is the largest source of mercury contamination of sewage sludge in Sweden). These emissions cost money. In 2005 in a small town in Sweden, they discovered a high mercury content in sewage sludge. 1200 tonnes were contaminated by about 1.5 tablespoons of mercury. Dental clinics were suspected. Sewage sludge had to be sent to landfill because it was not possible to apply it on land resulting in additional high costs (around €78,000) and extra work.

Summarising the Swedish experiences:

1 It has been possible to reduce the use of dental amalgam substantially (90% in ten years).
2 Composites have replaced virtually all types of restorations where amalgam was previously used.
3 The patients' costs for composites and amalgam are about the same.

4 Control measures are needed to achieve total phase-out.
5 A phase-out of dental amalgam is the only sustainable long-term solution

Notes from the discussion that followed:

- On whether the Swedish Parliament decided that insurance companies would refund composites - There is a public insurance system in Sweden, and the Parliament decided that it would not refund dental amalgam.
- On whether there have been studies in Sweden about the environmental effect of alternatives to dental amalgams, the presenter noted there was a brief estimate in 1996 about the methacrylates which are the main component. It showed that more information was needed. It is hoped that REACH[12] will provide more information about chemicals.
- The economic incentive in Sweden (public insurance do not cover dental amalgams) was one important factor, but not the only one. There is widespread awareness among patients and dentists in Sweden about health and environmental risks, and the alternatives have proved adequate and look better. In Sweden in was concluded that to phase out remaining use, a total ban was needed. The Water Framework Directive states that mercury emissions should be eliminated in surface water, so there is much that can still be done in this area.
- The policy in Sweden is that mercury should be phased out totally. On the investigations they did, there were diverging views on the need for exemptions and ultimately time-limited exemptions were accepted as a compromise.
- Composites - methacrylate may sometimes contain bisphenol-A, which might cause hormone disruption (Reproduction-toxicity cat. 3. in the EU classification system), meaning it can reduce fertility. The EU classification does not say anything about environmental risks/effects. This might be because of the lack of data, but the EU does not classify this substance as environmentally dangerous. It is noted that bisphenol– A - free composites do exist on the market.
- In Sweden there are no specific guidelines which dentists must follow as the presenter is aware of addressing the choice of amalgam compared to other materials –it is up to the dentist and patient to decide which material to use. The Parliament decision on phase out and the voluntary agreement may of course be seen as strong guides not to use amalgam. There are some indications as to where the different materials are used in the report "Mercury-free dental fillings – Phase out of amalgam in Sweden, KEMI, Nr.9/05, December 2005".
- A bio-dentist mentioned that dentists have nearly nothing on which they can base their choice of material. The methods of electro-acupunctures, kinesiology which are sometimes used today, are not scientifically approved. The only accepted scientific test is the epicutanious skin test to proof type IV allergy (late type, meaning reaction 24h to 48h after contact). The problem is that skin with reacting "Langerhans Cells" is tested. But those cells which have to remember the contact with heavy metals for instance rarely exist in the mucosa of the mouth. So the epicutanious test, though it is asked for, is not the correct test for proving immunological answer. Only the lymphocyte transformation test (LTT) and equivalent MELISA[13] are scientifically based tests to prove type IV allergy on heavy metals from dental materials. They are done by blood sample investigations. However, in Germany to avoid costs for restoration of dental amalgam damage after positive LTT proving mercury allergy, although the LTT is scientifically well accepted to prove allergy from medicaments, the insurance companies and political main stream deny the scientific proof by LTT. This discrepancy is not acceptable. Another scientific test from

[12] Registration, Evaluation, Authorisation and Restriction of Chemical substances. EU Regulation on chemicals and their safe use (EC 1907/2006).
[13] http://www.melisa.org/why-melisa.php (the Melisa test is not only for mercury, it can also be used with every other heavy metal)

blood samples, but only for immediate allergic reaction, is the Basophile Degranulation Test. Last but not least blood samples can be investigated for interleukin and interferon reaction from heavy metals. This proves the direct immunological answer to that material without regarding special "allergic" matters. It is hoped that in future there will be a better awareness and acknowledgement of already evaluated scientific tests proving allergic and immunologic reactions form heavy metals especially mercury containing dental amalgam.

- In Sweden during consultations, dentists said there are so many alternatives on the market they can choose a material that is good for the patient without using dental amalgams. Some patients react to different materials (metal allergies, etc.). The dentist also decides by talking to patients. There are enough other alternatives.

- Other dentists present an the conference confirmed practising amalgam-free dentistry, with no teeth which could not be restored without amalgams. Patients do not like amalgam and there are health hazards and environmental costs.

- In the UK, sewage sludge (containing mercury) must go to a special landfill that is specifically designed to contain contaminated waste, all landfills have then to be sealed.

6. *Norway's policies on dental amalgams*

(by Liljan SMITH AANDAHL , Directorate for Health and Social Affairs, Norway)

The public health perspective on the decision to phase out amalgams was presented. There are several authorities in Norway dealing with the problem of dental amalgams. The Norwegian Environment Minister would like to ban amalgams totally. The Norwegian Pollution Control Authority is assisting the Minister of Environment. The Norwegian Pollution Control Authority has proposed a ban with some exemptions for three years limits for special problems. The Directorate for Health & Social Affairs was invited to take part in the consultation. The assessment is a fairly good agreement between the health and the pollution control authorities.

As early as in 1991 the Norwegian Board of Health issued a guideline stating that the use of amalgam should be phased out.
Norway published quite an extensive report in 1998 which contains the Health Authority's recommendations that to phase out amalgam and amend possible harm already done from their use;
1. Measures for people with symptoms and reactions assumed to be related to dental restorative materials
2. Measures at population level
3. Measures to improve the quality of products and services.

The report from 1998 resulted in a National Clinical Guideline for the use of dental filling materials. The guidelines entered force in 2003. The most important recommendations here are:

- Preventive treatment should be given priority
- Dental tissue-conserving techniques shall always be chosen when dental filling therapy is necessary
- Amalgam should not normally be the first choice for any indication of dental filling therapy
- Use of amalgam should be limited as much as possible in consideration to the environment and possible adverse health effects

To the presenter's knowledge, this is the first time a health authority has stated there might be adverse health effects from amalgam use. In the literature, there is a good odontological basis for phasing out dental amalgams. There is fairly strong evidence that it is important to choose a tissue conserving technique, because in the long-term, that is what will maintain

good oral health.
Amalgams remain the most lasting fillings, but the new generation of composites is improving. Amalgam fillings contribute to people's mercury load. According to the precautionary principle, it is obvious that they should keep the level of mercury as low as possible. The substitution principle is also valid on which the Norwegian Control Act stipulates it is a duty to substitute a hazardous substance with something deemed less harmful to health or the environment. Building on those principles, they decided to phase out amalgams.
The use of amalgams substantially decreased after the 1991 recommendations. They then decided to make stronger recommendations for the 2003 guideline, but also decided to do an assessment before decisions were taken. The assessment showed that in children and teenagers, only 3% of fillings used amalgams, for the rest of the population (above 19 years old) only 11%. Five years after the 2003 guideline, they will do a new assessment, to see if they have managed to eliminate them.

In Norway they are currently working on guidelines for medical and odontological assessment for patients on whom they suspect dental filling materials may have adverse effects. The target group will be doctors and dentists working together to try to reveal if patients are harmed by any dental material. It should be completed by the end of this year. Then they suggested guidelines for reducing occupational health problems in the dental health service. This is the occupational health authorities responsibility.

Clarifications to the presentation:

- In Norway they did not use the insurance system used in Sweden; there is no refund for fillings: the patient bears the cost. Nevertheless no mercury is really used.

7. Discussion with all the morning speakers

<u>On factors which could make a difference on preferring mercury-free fillings</u>

- The fact that people prefer white fillings because they look better partly influences the outcome of non-mercury use in Norway. But a 1998 assessment showed that the public is more aware and concerned about potential adverse health effects of dental amalgams than dentists and the medical sector in general. There is a very active patient organisation in Norway.
- CED also noted that the size of cavities was an important factor in deciding which material to use. Norway, for example, has a good tradition of dental prevention, which has resulted in fewer and smaller cavities, where alternatives to amalgam may be suitable. On prevention there is still a much to do in Europe and enough is known today to largely prevent dental cavities. Preventing cavities and therefore reducing treatment needs is the best way to avoid the small risks that all healthcare and all dental materials entail.

<u>On informed choices</u>

- A Dutch participant noted there is no warning by dentists of potential adverse health effects. Even when patients are worried, dentists often tell them not to. Patients are not told of side effects as they are for drugs and even dentists are unaware of and deny the risks of mercury in dental amalgams. Dental institutions say there is no problem, dentists are not taught to tell patients about these problems. Dentists do not even think there might be a problem. If someone wants to know more before making a choice, they have to do the research themselves. The solution would be to start educating dentists on this issue.
- In Norway the Health Personnel Act states that dentists (and other health staff) have to tell people about their health status and what they can do to improve it. There is a Patient Rights Act, in which the patients have the right to information. In the guidelines, it is

compulsory for a dentist to tell the patient before any filling is inserted. The patient should be consulted, and the treatment agreed by patient and dentist. The patient should also be told of health authority recommendations. In Norway there has been some feedback from angry patients after dentists inserted a filling (amalgam) without telling them what material they would use. The Norwegian Board of Health is now expecting complaints of lack of compliance by dentists.

- A few participants also said that they had been ill owing to dental amalgams (colds and sore throats) and that since they removed them and had detoxification therapy, they felt better.

- In Belgium, informing patients is difficult, because dentists are not considered as health operators. When dentists try to tell patients, doctors say: you are a dentist, you do not have to be concerned about health. And when dentists ask doctors: "what do you know about mercury?", they answer: "everything! It's not a problem." When a dentist wants to get informed, it is also difficult, especially because they have to look for scientific evidence to support their argument.

- In Spain children get dental amalgams, and this is marketed as an advantage because it is free (thanks to the government). The journal of the American Medical Association says there is no problem with putting amalgams in children's mouths. According to a Spanish participant this is wrong. Children at least should be protected from mercury exposure from dental amalgams.

- Mercuriados said it is not only the number of amalgams, but also the conditions that make mercury more easily released. Amalgam producers should be legally obliged to warn of the risks of putting them in the mouth. If the public was told, no one would have dental amalgams.

- According to the Norwegian representative, for Norwegian and Swedish experiences to be better communicated in Europe there needs to be a health service which understands responsibility lies with improving people's health by replacing fillings. Maybe instead of working so hard to block an immediate ban, countries could progress in phases by stopping refunds for amalgams and giving more refunds for composites as the Swedes have done. In Norway, now that they have phased out amalgams, it easier to have a ban. Dentists are now used to choosing something else, not amalgams.

- The Swedish representative stressed that Europe should now examine how to reduce the impact of dental amalgams.

- The Uppsala University representative said there are two big companies producing amalgams in Sweden, which are exporting most of their production. The KemI representative clarified however that Sweden has an export ban in place since 1997. The Swedish Chemicals Agency may, in individual cases, grant exemptions from the prohibition where exceptional reasons exist thereof. The two companies have had exemptions to export dental amalgam until 31 December 2006. In 2005 KemI rejected their applications for exemptions after 2006 mainly because there are other alternatives on the market and the intention of the export ban is to protect the environment and indirect health exposure of mercury (aspects which are not covered by the Medical Devices Directive). The companies appealed to the Swedish environmental court who gave KemI right that there are no exceptional reasons to export amalgam to third countries because of environmental aspects. However, the Court said that the companies should be able to export amalgam to other EU countries. KemI then appealed to the highest level of the Swedish environmental court and asked them to send the case to European Court of Justice. The case is not settled yet.

On alternatives and costs

- A Greek dentist noted that glassionomer and ceramic materials are considered friendly materials, with no adverse effect.
- CED said that the main problem for (resin-free) glassionomer cements is that they are not mechanically stable enough for standard and big cavities. There are virtually no allergies reported for these materials. The problem of aluminium release is being discussed. Ceramics are brittle, the level of radioactivity is far below the limit values. All materials apparently have advantages and disadvantages.
- AKUT stressed that the price of amalgams might be very low for patients but it is not for society. Dental amalgams are one of the most expensive materials if the related costs to all (chronic) health effects, not just environmental effects, caused by mercury, are considered. This environmental and health cost should be included in the actual cost of amalgams.

On sources of information available and the EU Research Scientific Committees:

The European Academy for Environmental Medicine (EUROPAEM) said EU decision-makers get their information from research data, but it must be made clear who is conducting this research. The research can sometimes be one-sided, and not mention thousands of case studies that have been collected but are not researched. If research were more balanced and looked at the other side, outcomes would be different. Research is carried out using industry money (95% of research in Europe), and therefore to keep it balanced the EU has to give funds and research dental amalgam. EUROPAEM also noted there is much scientific proof in literature, many cases, related to immunology. Until now experts keep looking for toxicology values, and the scope should be widened.

The Commission representative underlined that DG Environment has no specific budget line for funding such research and no direct control on the procedures and the working of the Scientific Committees. It is however very well possible to feed existing findings from research activities into the deliberations of the Committees.

- A participant suggested research could be funded by patients' groups, or industry which is trying to promote alternatives to amalgam. There is also an important EU Research Framework Programme (FP7) which could be considered for such a purpose.
- A German bio-dentist further underlined that no dentist is really educated on the point of toxicity; they have difficulties looking beyond physics, beyond stability, and beyond the cheap cost. As a result dental teachers should be requested to show their qualifications in toxicology and immunology. The teaching of dentists should therefore look at all of these aspects.
- CED assured that there is a lot of research taking place on alternative materials. It would be good though, if new approaches to research on alternative fillings were carried out. The new generations of dentists are educated on the downsides of both amalgams and on alternative fillings.
- AKUT clarified that at the end of the year, the two EU Scientific Committees (SCHER and the SCENHIR) should give advice to the Commission on this issue, and say whether dental amalgam is safe or not. For the amalgam patient group, this is a very important question. There is a problem of transparency on who are the scientists sitting in these committees, and this is not only about their links with the industry. The problem is to know what their previous research on mercury was, if they have published articles, if they have worked in the field of mercury, if they have seen patients, etc. Patients' groups do not accept anymore that scientists take decisions behind closed doors, as it has been done until now. For instance, in France, AFSSAPS[14] said that mercury was not a problem at all.

14 French Health Products Safety Agency/ L'Agence française de sécurité sanitaire des produits de santé,

The report was not serious at all from a scientific point of vue. This question of transparency is a major one.

- EEB pointed out that the names and the CVs of the people sitting on the two committees are available on the website of DG SANCO, but there is no contact information. On the issue of information available, DG SANCO has made an open call for information, on their website. Anybody can send information to DG SANCO and these may be passed to the committees. What would be interesting is the list of documents and references that the scientists will use. To the present information this is not public but it should actually be. It would also help check whether the information sent was used in the end.

- HEAL further clarified, that the scientific committee members must have a declaration about their interests and possible conflicts of interests. Those are available. However, if the question is then taken to a working group, a special group of selected people with more expertise on the issue, they do not have the obligation to make such a declaration. Recently, DG SANCO held a stakeholder discussion session where this issue was raised, and the answer was that it was overly onerous to oblige every member of a working group to provide that declaration regarding conflict of interests, and that they should be judged on the result of their work, and not on their conflict of interests.

<u>On national experiences and the EU</u>

- Denmark had informed the conference organisers, that there is a legislation stating that amalgams should not be used except for the back molars. It was noted by the Danish Environment Protection Agency that there was no request for exemptions from industrial dentists.

- The Scottish EPA clarified that in advisory groups in the UK, information on toxicology or environmental limits as well as the material used to set these limits have to be published. It is the same for the people who sit on the groups. They were surprised the EU does not have the same approach. If the EU takes policy measures to remove mercury from dental fillings, it is not clear how and why it would prevent Member States such as Sweden or Denmark to go a stage further, no matter what legislation comes in. Environment is the key aspect.

- The Swedish representative underlined that they have agreed on a mercury strategy on the EU level and EU has to eliminate mercury use, and reduce its supply and demand, and EU has a responsibility on the global level to do that. So of course Sweden would be willing to deal with dental amalgams at an EU level.

The representative from DG Environment wrapped up this session, clarifying that his job is to oversee all the 20 actions proposed in the strategy but he is not a dental amalgam specialist. It was not surprising that the question of the scientific committees (who does what, their background and conflicts of interests…) came up in that context. This is not a brand new issue in the hazard field. There is a big hassle now on what is sound scientific evidence.

The line to take for the next steps is set in the strategy. The EC will stick to that first and foremost. It was very interesting to see that at least for the amalgam issue, there is a demand drive that goes in the right direction, away from dental amalgam.

The EC pointed out that the constant work on awareness building in Sweden and Norway appears to have made the difference. Without a full-fledged ban, they still managed an enormous reduction. To what extent financial incentives / disincentives (reimbursement schemes) can play a role, this should be checked. The training of dentists, especially in immunology and toxicology is very important if one wants to work upstream on the issue. Then there is the downstream field (collecting waste, separators, emissions from crematoria…) where there is some potential, but it will be difficult to come to zero. If there is success in the work upstream, then the troubles downstream will be much smaller in size and

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http://agmed.sante.gouv.fr/

importance. If not, work will need to be done on the downstream issues.

8. *Norwegian Public Television Broadcasting, November 2005 Documentary 'Mercury Women',*

(Introduction, Background & Context by Michael Bender, Mercury Policy Project)

There has been more than one documentary on dental assistants and exposure to mercury. This Norwegian documentary is an excerpt, seven minutes out of the original 20-minute film. The original research was conducted following a dental nurse's complaints. After the initial airing, some 400 dental assistants were called in by the television company to testify. Many of these women had serious health problems. A pattern emerged: many had worked while pregnant and were also breast feeding. There were many children reported as having children born with neurological problems

The film was shown in several countries. In Denmark, over 1,650 dental nurses called the Danish trade union, expressing concerns about their health and that of their children. In response, the trade union launched a new website (www.kviksoelv.dk). Danes are now collaborating with Parat, the Norwegian trade union (www.parat.com).

Now the Norwegian and Danish Governments are studying mercury exposure for dental personnel[15]. This includes literature research.

- A thorough literature search to create an overall survey of knowledge both nationally and internationally
- An epidemiological study to examine illnesses among dental groups/others with Hg exposure
- A clinical study to find symptoms, illnesses that may exist among a statistically randomly selected group
- A focused programme of medical examinations so each person's symptoms and illnesses can be compared to their mercury exposure

Information about the Norwegian Broadcasting documentaries can be found at[16]:

- *Mercury Girls*: http://www.tv2world.com/programmes/show/109
- *Mercury Children*: http://www.tv2world.com/programmes/show/110

9. *Exposure to metallic mercury and cognitive effects in dental personnel in central Norway*

(by Bjorn Hilt Bjørn Hilt, St. Olav's University hospital and Norwegian University of Science and Technology Trondheim, Norway)[17]

The Norwegian Government funded research to see if there were delayed effects in dental personnel, particularly regarding cognitive effects from the use of dental amalgam. Metallic mercury and occupational exposure, is a different thing from having amalgams in the teeth. This presentation was about cognitive symptoms among subjucts occupationally exposed.

The common amalgam contains 50% of mercury and an alloy of other metals. The copper amalgam contained 70% mercury, and had to be heated to 200°C to be prepared for useful amalgam from tablets. Until the late 1980s, dental staff used a Dentomat: a semi-automatic machine for mixing mercury and alloy. The problem was that it was difficult to get the right

15 English translation of a 16 February 2006 press release on the website of the Danish Employment Ministry at: http://www.bm.dk/sw5110.asp.

16 Anyone interested in airing the documentaries should contact TV2 WORLD DENMARK, www.tv2world.com Their email addresses is as follows sales@tv2.dk and tel +45 65 21 22 23

17 Study carried out by Bjorn Hilt Bjørn Hilt, Kristin Svendsen, Oddfrid Aas, Anne Marie Eggerud, Torgunn Qvenild, Pål Romundstad, Tore Syversen, Inger Melø, Helge Sletvold, St. Olav's University hospital and Norwegian University of Science and TechnologyTrondheim, Norway. The study was sponsored by the Norwegian Ministry of Labour and Social Inclusion

consistency of amalgam and it was also difficult to avoid spill from the material when the dental assistants had to fill the machine. With the more modern device, mixing takes place in a closed system that is much better with regard to exposure than the old methods.

In Norway, the National Institute of Occupational Health measured mercury excretions in the urine of dental personnel since 1955. Measurements were done on a voluntary basis and were unsystematic, but still give a good picture of the mercury exposure situation for dental staff during the last decades.

Levels of mercury in urine have fallen since 1959. However, some staff has had high values and many samples were above the recommended values. Hilt also referred to research that was also already carried out on the subject - ten studies from different countries published during the last 15 years.

The researchers from St. Olav’s University hospital and the Norwegian University of Science & Technology in Trondheim, carried out a questionnaire study among dental staff in Central Norway (near Trondheim). A total of 657 dental assistants took part in the study, in addition to 452 dentists, and 630 controls from the general population. Among the remarks on these groups were that there were more men among the dentists, and that dentists smoked less but drank more. The participants had more or less the same quantity of dental amalgams in their mouths. The researcher also asked what methods were employed at work for dental amalgams, how many patients they had, how old the dental clinic was, etc. It was found that there was probably more exposure to mercury for dental assistants than for dentists.

With regard to the outcome of the study, they used questionnaires developed in Europe (EuroQuest) for monitoring different symptoms. The questionnaire enquires about some symptom groups, like mood, neurological symptoms, psychosomatic symptoms, memory, concentration, fatigue and sleep disturbances. The assistants did not have very high symptom scores, but still significantly higher than the controls, and also higher than the dentists. The dentists, unlike the assistants, were not considered quite comparable with the control group.

Proportion (in %) of subjects who reported symptoms "often" or more frequently

Proportion of seven symptom groups	Assistants	Dentists	Controls
Three and more symptoms	5,0	1,1	2,6
Four and more symptoms	2,9	0,7	0,7
Five and more symptoms	1,1	0,7	0,4

With regard to the reported occurrence of symptoms, it may begin getting severe when you have symptoms often or more frequently. But one symptom, even often, does not necessarily as such present a big problem, while having several symptoms may be more problematic. The table shows that dental assistants more often reported to have three or more symptoms "often" or more frequently. When looking at the occurrence of symptoms in relation to reported exposure features, even for dentists, there was a relationship between the treatment of amalgam in the hand and the neurological and psychosomatic symptoms.

This study, initiated by the Norwegian Government, had to be carried out rapidly (within a year), and entitled some methodological problems, since they were asking for both outcome and exposure in the same questionnaire. Although there is wide scope for interpretation, the conclusion was that participating assistants reported more exposure to mercury and had higher urine values than the dentists. The assistants reported more cognitive symptoms than the controls, and the dentists less. For both assistants and dentists, there was a positive association between reported exposure, features and reported occurrence of cognitive symptoms. Some dental staff may have suffered long-term cognitive effects from their previous exposure to metallic mercury. This may, when certain conditions are satisfied, be recognized as an occupational disease according to Norwegian law. A second part of the study is yet to be carried out with neuropsychological investigations on 100 of the participants, 50 with assumed 'high' (>80 percentile of our total score), and 50 with 'low' (<40 percentile) exposure to metallic mercury. The results will be available in autumn 2007.

Clarifications to the presentation and discussion points:

- CED observed that the presenter compared dental assistants, dentists and controls, but with the controls did not distinguish between a group similar to the dental assistants and a group similar to the dentists. CED questioned the fact that the team did not use two controls with different educational backgrounds. The presenter clarified that they should have done that, and they are thinking of creating another control group for the dentists (in the second phase of the study). The controls have a somewhat higher education level but are comparable to the assistants, although not so much to the dentists. It was made clear that they had also ascertained from the control group that they had been economically active for at least five years.
- BBFU[18] noted that mercury is dangerous in bodily tissues. But mercury in the urine does not reflect mercury in the tissues. It may be an indicator of exposure but not intoxication. The presenter said that they had used figures with mercury concentrations in urine, because they were the only ones available. Mercury in urine, as long as someone is still exposed, can be seen as an indicator of their level of exposure. They tried to monitor exposure. A more problematic issue on this subject was that people had urine samples taken three or four times during their whole professional life. That was random, without paying attention to the day samples were taken, but it is still considered far better than nothing.

18 Bundesverband der Beratunsstellen für Umweltgifte

- However, IAOMT[19] noted that they have a problem with mercury exposure measured in urine. From an occupational point of view, they had found that it varies depending on the individual. Mercury excretion normally drops in the urine after two years, owing to impaired kidney excretion. Regarding the period, they would have problems with the true validity of such data. It may show a trend. Some people continue to excrete more while some cease to excrete mercury after a few years, and those are in fact the most affected by mercury. The urine indicators are not those one would want to look for. The presenter said urine values reflected the past four to six weeks. Other researchers have used present urine values in their studies and had found that to be more problematic.

- It was also noted that the World Dental Organization (WHO) strongly recommends using capsulated amalgams. It is thought that throughout Europe it is capsulated amalgams which are being used. If in some countries (also developing countries) amalgam is still mixed by hand, the problem may be much more important and the level of exposure in developing countries is certainly higher.

10. *Lifecycle of dental amalgam: public health concerns*
(by Lisette VAN VLIET, Health and Environment Alliance, HEAL)

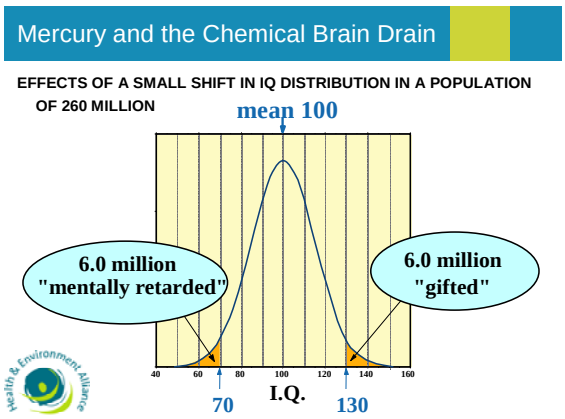
The presentation focused on the indirect health effect of dental amalgams from the release of mercury into the environment. Génon Jensen, HEAL's Executive Director, had said: "Even if we stopped all mercury production and spills and emissions today, our global food supply would still be contaminated for years to come." She is referring especially to large, old, predatory fish which have high levels of bioaccumulated methylmercury that are passed to anyone eating the fish. Methylmercury that enters women's bodies remain in their bodies for long periods and are a threat to their babies' developing brains, from fish consumption prior to as well as during pregnancy, and to a lesser extent, during breast feeding. However, breastfeeding remains the very best food for infants.

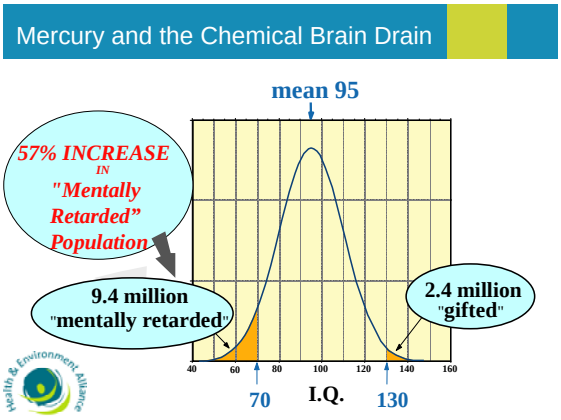
Methylmercury is a developmental neurotoxicant, both during foetal brain development and after birth.

The European Commission undertook an extended impact assessment for existing levels of mercury contamination in Europe. They estimated that between 3 and 15 million people are at the US National Research Council reference dose level, and a percentage have 10 times the reference dose level. These are fishing communities in the Arctic and Mediterranean. These are levels where there are definite impacts on the developing foetal brain. There is a potential IQ point loss of about 6. But these are only estimates and there are no sound data on the level of exposure in Europe.

In looking at the impact such methylmercury exposures can have on an entire society, we can consider a theoretical example of what happens to a 'bell curve' showing the distribution of IQ. If widespread methymercury exposure to all women bearing children shifts the mean IQ of a society approximately 5 points, this has large repercussions. While the IQ point loss may not have a big effect on an individual, on an entire population, it can increase the number of mentally retarded people by 57%, and considerably reduces the number of gifted people. This constitutes a severe public health problem.

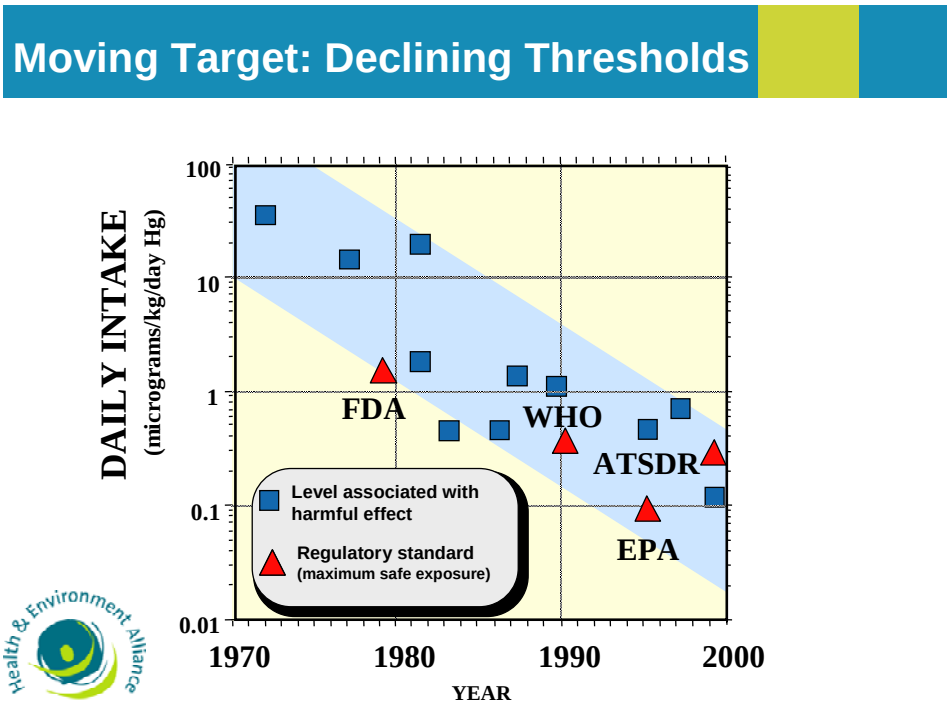
19 International Academy of Oral Medicine and Toxicology, http://www.iaomt.org/





A study in the USA on the actual cost of this IQ loss showed that with an IQ loss affecting 300,000 to 600,000 thousand children a year, the reduced intellectual capacity in the population would cost US$8.7billion in lost earnings. It affects 10 to 15% of children born. Once this IQ loss is converted into money, the figures are visibly large. Similar figures do not exist for Europe, but they might well be equivalent or perhaps greater.

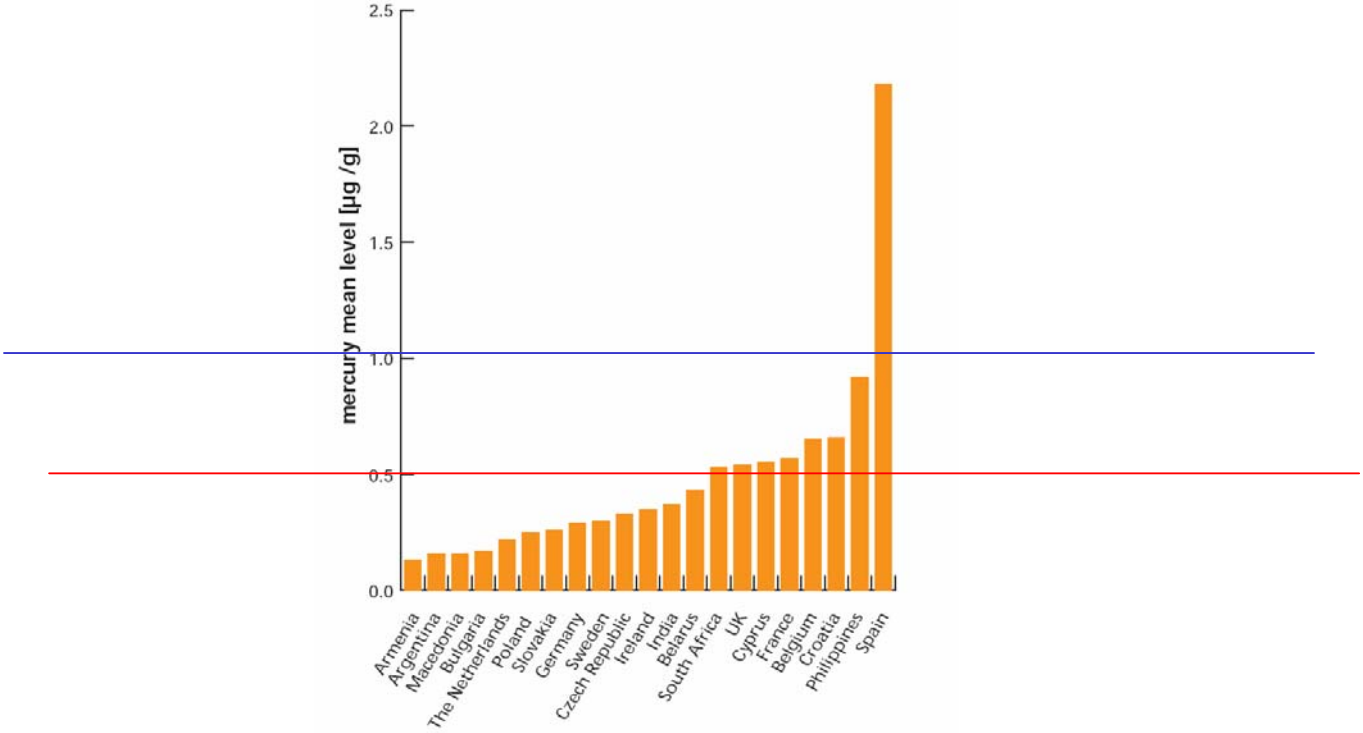
There is a constant decline in the thresholds of exposure considered safe, as knowledge about mercury advances. Safety dose thresholds will continue to drop. This represents a moving target we need to be anticipating.



A recent paper by Dr Philippe Grandjean, a specialist in mercury damage to the developing brain, has concluded that adverse effects can occur at very low levels, not only for physical coordination, but also for brain function. The current level of existing imprecise exposure assessments produce a bias towards results purporting to show no effect. However, the functional deficit that comes at these low levels of exposure appears to be permanent. The extent of the deficits depends on the interaction of toxicants and nutrients, which may explain differences between studies, depending on the population studied. Grandjean thinks that methylmercury exposure could very well be contributing to the rising level of attention deficit disorders in children witnessed in the USA and possibly Europe.

HEAL and Health Care Without Harm(HCWH)[20] have run a campaign[21] involving an illustrative hair sampling survey on women from over 21 countries between 18 and 45 years old. Some 95% of the women showed detectable levels of mercury. Some had comparatively high levels of mercury, which seems to be associated with their fish consumption. The women completed questionnaires and tried to indicate as best they could certain sources of exposure. Some 15% of these women had levels above the reference dose which the extended impact assessment also used. This is a dose that should not be exceeded in women who intend to have children.

FIGURE 3. Mean values of mercury in hair samples



The above figure shows the distribution of mercury levels found in women's' hair[22]. The top blue line, which corresponds to 1 microgram, is the reference dose level which people should not exceed. Analysis of hair samples from Spain indicate that these levels were exceeded. But if new information became available showing that the safe level was now deemed to be half a point lower, i.e. 0.5 mg, several of the countries would be at the reference level. This is shown by the red line. HEAL contends that there is absolutely no safe level of exposure for the foetus.

In relation to dental amalgam, HEAL/HCWH recommendations are moderate and could easily be met.

- There should be national advisories against the use of dental amalgams in pregnant or breastfeeding women, and in children under six.
- Amalgams should only be used, as in Denmark, in molars.
- There should be dental care reimbursement for alternatives.
- An EU advisory should be established, not just advisories at Member State level.

HEAL/HCWH may ultimately seek restrictions on the use of dental amalgams, potentially in the Medical Devices Directive.
Fact sheets have been produced by HEAL/HCWH that can be consulted.

20 Health Care Without Harm , www.noharm.org
21 http://www.env-health.org/r/145
22 http://www.env-health.org/r/145

11. *Panel Discussion: Mercury in dental amalgams: should we still be using it?*

The discussion began with comments from the panellists.

The case for using mercury dental amalgams

(by Prof. Gottfried Schmalz, Council of European Dentists)

It is said the easy way would be to get rid of dental amalgams. But the easy way may not be the best or most feasible way. There are three reasons for this. Firstly, patient risk is increased without amalgams. Northern countries have a low cavity rate among children. Other countries have different cavity rates. What is true for one EU country may not be true for others. If someone has more cavities, they also have bigger cavities. In a country like Sweden, people have on the average rather small cavities. The situation is completely different in other countries. We should be careful to avoid adopting the regulation of one Member State in another, especially if it comes to big fillings. CED doubts there could be a single solution for the entire EU.

Patient risk increased without amalgam, 12 year old

Country	**Year**	**DMFT**
Denmark	2003	0,9
Germany	2005	0,7
Estonia	1998	2,7
Finland	2000	1,2
France	1998	1,9
Greece	2000	2,2
UK (England & Wales)	2000 – 2001	0,9
Italy[2]	2003	1,2
Croatia	1999	**3,5**
Latvia	2002	**3,5**
Lithuania	2001	**3,6**
Netherlands (The Hague)	2002	0,8
Poland	2000	**3,8**
Sweden	2002	1,1
Hungary	1996	**3,8**
[2)] 11-year old		

There are many advantages to amalgams as well as disadvantages, as is the case with alternative materials. Mercury produces radical oxygen species which is responsible for cell-ageing and may be responsible for neurotoxicity. This is true for methacrylates too. Alternative materials also have adverse effects, including allergies and, in extreme cases, even anaphylactic shock. There would be higher risks for patients in these cases if they were denied the option of amalgam. Secondly, the risk of healthcare systems being destabilised if one were to restrict the use of amalgam needs to be borne in mind – alternatives may be more costly. Thirdly, whilst the environmental risks relating to the use of amalgam is an important element of the discussion, this risk can be handled. Waste management in the Member States is not as good as it could be, which indicates that better implementation of EU regulations is necessary. Amalgam separators should be installed in every clinic as part of an

EU effort.

It is essential to maintain a diversity of materials in order to best meet the needs of individual patients. It is important that decisions on treatment options should be made jointly by the dentist and the patient, because all materials have advantages and disadvantages, depending on the patient's condition. European dentists care for the environment and want to improve management of mercury waste. Above all there need to be effective programmes in every country to prevent cavities as a priority.

Concern over health impacts of dental amalgams and latest scientific findings,

(by Dr. Joachim MUTTER, Institute for Environmental Medicine and Epidemiology, University Hospital Freiburg, Germany)

Dental amalgams release continuously mercury vapour, which is considered as the most toxic, non-radioactive element in the universe. It is ten-times more toxic than lead on neurons, and even more toxic than the form of methylmercury found in fish (this is not the same toxic form of methylmercury-Chlorid or Methyl-Hg-Jodid, usually used in experiments). Mercury vapour coming off dental amalgam has not reacted with anything yet and has its full toxic potential. It is easily absorbed by body tissues (like brain) and then did react to cellular structures, which are damaged. On the other side, methylmercury in fish has already reacted with fish proteins and other protective molecules or atoms in fish tissues, like Glutathione or Selenium, which are enriched in fish and make the methylmercury less toxic. This is why the fish do not die of mercury poisoning. Mercury may have a more toxic potential when it comes from dental amalgams (as vapour) than when it comes from fish (as methylmercury-X).
Mercury shows synergistic toxicity to other metals like aluminum, iron and lead. If one give the Lethal Doses (LD1) of lead (Pb) to animals, of which only 1% die (LD1 (Pb)) together with a tenth of the Lethal Doses of mercury, of which 1% of the animals die (1/10 LD1 (Hg)), all of the animals die (!). Therefore, no safety level can be determined for mercury vapour. Also, because levels in blood, urine, saliva or hairs do not correlate with Hg-levels in brain and other tissues, a determination of a "safety level" is impossible. This was confirmed by the WHO 1991 and 2005 and several autopsy studies as well as in a new study on deceased humans [Björkman et al. 2007].

Recent studies also reveal that 1 cm^2 amalgam surface releases up to 20µg of mercury every 24 hours for years. Chewing, cleaning teeth, smoking, drinking hot beverages or grinding raises this amount dramatically (by a factor of 10-100).
It has been shown that even after 28 days of amalgam insertion in sheep and monkey teeth, several body tissues (like jaw bone, oral mucosa, brain, liver, gut, kidney and feces) contain very high levels of mercury despite "normal levels" in blood or urine.

Mercury accumulates in body tissues during time of exposure. This is because half-life of mercury in brain cells is 1 to 30 years, as studies with deceased humans have shown. Other studies have also shown that people with actual or former amalgam fillings had 2 to 12 times more mercury in their body tissues and 3 times more methylmercury in saliva. Microorganisms in the gastrointestinal tract are able to transform mercury released by amalgam fillings to organic mercury compounds (which are not bound to molecules or atoms as methyl-mercury found in fish). A new Italian study shows that people with more dental amalgams have much more mercury in their brains than others. Taken together, amalgams contribute more to mercury body burden than all other sources, including fish and vaccines together. Also, amalgam of mothers raises mercury levels in cord blood and infant body tissues (autopsy studies).

The "normal" background level in cord blood of pregnant women in Germany is 0.2 to 5.0 ng mercury per ml. But studies have shown that levels over 0.8ng mercury per ml increases the risk of neurodevelopment disorders by the factor 3.5. This level (0,8 ng/ml) is reached by a significant portion of the population and dental amalgam contributes significantly to the

mercury level in cord blood as well in foetal and infant brain tissue. It has also been shown that mothers of autistic children have more amalgam fillings during pregnancy, and that autistic children have considerably more mercury in their body tissues and have several signs of mercury toxicity. The more dental amalgams the mother has, the more mercury was found in brain of unborn and born infants (autopsy studies). Despite more mercury exposure during pregnancy, they showed abnormal low mercury levels in their first hair cut. This observation indicates that they are more sensitive to mercury exposure, because they cannot excrete mercury from their body tissues in blood, hair or urine properly. It is now known that autistics have some impaired detoxification pathways. Autistic children do not have mercury in their hair because they cannot excrete it, no matter how many amalgams the mother has. In contrast, healthy children have up to 15-times more mercury in their first hair cut than autistics and there was a correlation between amalgam counts of their mothers and mercury levels in hairs. This correlation was completely absent in autistics. Furthermore, the most severe forms of autism showed the lowest mercury levels in hair, whereas milder forms of autism showed higher mercury hair levels.

It is now known that at least 15% of the general population have increased susceptibility to mercury, e.g. due to impaired detoxifying factors in the body (e.g. polymorphism of Glutathion-S-Transverase or Brain derived neurotropic factor, Apoliprotein E4, Coproporphyrinoxidase 4, impaired transsulfuration pathways, etc.).
Given the wide-spread usage of dental amalgam, 15 % represents a significant number of people who may suffer from mercury toxicity through their dental amalgam or dental amalgam of their mothers. Some adverse health effects from mercury exposure have been described in the literature. [23] People with more than 12 amalgam fillings have on average up to 300 ng Hg/g in their brain tissues, which also increases their risk of committing suicide in a new Italian study. In experiments on brain cells and living animals, even levels of just 20 ng Hg/g, led to severe neurodegeneration, genotoxicity and immunotoxicity. This mercury level in brains and other tissues is reached by a portion of people with dental amalgam or infants, whose mothers have had dental amalgams. This additional mercury exposure together with increased susceptibilities may lead to a wide spectrum of complaints and diseases, including autoimmune, psychic or psychiatric diseases in about 1-15 % of people with dental amalgam, as were described in several studies.

Mercury vapor penetrates with great ease all body tissues like the skin, mucosa, lung alveoli and even the blood brain barrier and the cell membranes. Inside the cells, it is oxidized to the mercury-ion, which is one of the most toxic forms of mercury found inside the cells. This mercury-ion is toxic to human cells even below “safety levels”. Every atom of this mercury-ion in the body led either to consumption of protective molecules or atoms like Glutathione, Metallothionine, Selenium or to the mostly irreversible damage of biological important cell structures like tubuline, proteins, lipids, membranes, mitochondria or even chromosomes.

Some studies found raised levels of mercury in brain tissues of Alzheimer’s patients, particularly in the Nucleus Basalis Meynert, which is the first brain area to be damaged in the progress of the disease. Low levels of inorganic mercury, and not other metals, lead to all Alzheimer-typical damages in experiments with cells and animals. These mercury-typical damages (Stage I-II according to Braak, 1997) is seen already in 20% of “healthy” people in Germany aged between 20 and 30 years and rises to 50% at 50 years. Most of these people show no clinical signs of Alzheimer’s, because at least 80% of neuronal cells in this brain area must be damaged until the disease is uncovered. With increasing extent of damaged neuronal cells (stage III VI according to Braak, 1997) Alzheimer’s would be recognized clinically. This is true of half of people aged over 85 years. But still in the age group of over 85 years, a small portion (about 2-5 %) shows no signs of Alzheimer- (and mercury-) typical neuronal damage in their brain tissues (stage 0). Their brains are comparable with those of people under 20 years old. Given the fact, that 95-97% of Alzheimer’s disease is caused not by genetic but by environmental factors, together with the results from scientific research and the fact that over 95% of individuals in the over-85 age group in developed countries had have dental amalgam

23 See slide 13 , http://www.zeromercury.org/EU_developments/Bruxelles_1Mutter.pdf

in their life, dental amalgam may be one, if not the main, crucial factor for Alzheimer's Disease. It is very possible that the 2- 5% people over 85 years, who show no pathological Alzheimer- and mercury- typical changes in their brain tissues, represent the minority of the population, who have never had dental mercury fillings in their live and their mothers would had no amalgams during pregnancy. These observations are underlined by the fact that individuals with Apolipoprotein E4 (ApoE4), which may be not able to detoxify mercury from the brain, have a greatly increased risk (up to 16 times) of developing Alzheimer's. Although rural-dwelling Africans (normally without caries and therefore amalgam) having an ApoE4-Allelefrequency of 40%, they show only a very low AD-risk. In contrast, African-Americans have a higher risk of developing Alzheimer's than white Americans (with only an ApoE4-Allele-frequency of 15%). This indicates that environmental factors mainly cause this disease.

In conclusion, amalgam was and is a leading source of mercury exposure in humans and possibly also for the environment. This is because thousands of tons of mercury were used since over 170 years for dental amalgam production. And this mercury from dental amalgam was and is still released in the environment through drilling out in sewage (most countries still have no amalgam separators, or only for a short time, like Germany-since 1991), excretion through feces, urine and saliva, exhalation and even after death of individuals with amalgam (which have up to 12-times more mercury in their body tissues and/or still amalgam fillings in their teeth at the time of death) through cremation and burial. Despite amalgam usage in developed countries decrease because of health concerns of the population and some dentists, worldwide usage of dental amalgam is actually exponentially rising as a result of the caries epidemics in developing countries (caused by their increasing consumption of industrial-processed foods like isolated sugar, soft drinks, white flour, etc.), where the biggest part of the world population are living (e.g. countries in Asia, Africa and south America). This is released into the environment in the next decades.

Mercury can also be toxic far below "safety levels". The synergistic effect of other toxins on mercury toxicity makes it also impossible to define a "safe level" of mercury. It is imperative that we try to eliminate all exposure to mercury as far as possible. Removal of dental amalgam (which is acknowledged as a highly toxic waste when it is outside of humans) from dentistry is important and may be critical for human health.

Building a consensus among dentists for mercury-free amalgams

(by Dr. Graeme Munro-Hall, International Academy of Oral Medicine and Toxicology (IAOMT))

In IAOMT, they have an approach based solely on science. They collect, evaluate and fund research on the biocompatibility of all dental materials. The IAOMT has looked at all the documentation on the subject, because initially it would not believe anti-amalgam activists. When the research data they paid for came to fruition, they found, that contrary to their initial beliefs, amalgams were in fact dangerous. They went from one opinion (nothing wrong with amalgams) to the polar opposite (they are now totally against) because of scientific facts.
If mercury were banned on health grounds, there would be too many complaints from people who had received amalgams without being informed about their risks or what they were having put into their mouths. So IAOMT favours the Swedish approach of banning dental amalgams on environmental grounds. The presenter has a metal-free practice in the UK and confirmed there is no longer any need to use amalgams. There should be separators in all dental facilities, plus proper safety protocols when removing amalgams, for the safety of patients and dental staff. As dentists, they are not qualified to say whether or not mercury is toxic. They can only listen to scientists and toxicologists who speak with one voice on this matter, but they don't listen to experts. It is economically beneficial to use amalgams. They are not trained to look for the health effects of amalgams. They are afraid of legal consequences: who is responsible and who pays for it? Some 50% of patients who think they have gold in their mouths, actually have gold and amalgam, amalgam being locked under the gold. The presenter said he had tested the mercury vapour level in his practice: the vast majority of patients are above the safe limit. In August 2006 the FDA[24] issued a statement that

24 US Food and Drug Administration

"Amalgam Fillings can no longer be considered safe".

Mercury vapour is preferentially absorbed in the brain and is a neurotoxin. An average of two to four fillings have neurological risks for adults, study by Richardson for Health Canada 1996. IAOMT paid him to do the same on composites and the result was that composites are 200 times safer on the risk analysis than amalgam. Health problems from composites are isolated cases. Just because someone is poor is not a reason to put poison in their mouth. Some 90% of patients with dental amalgams will react to mercury (blood testing). There are also serious health effects for dentists (brain cancer, suicide rates, attention deficit, increased irritability, 13.9% lower motor skills, etc). The official position of dentists is opinion masquerading of science. The dentists' official associations made completely flawed studies (e.g. on the effect on children), and are thus behaving unethically. No dental authority will be the first to stand up since it would be professional suicide. If they do not take responsibility and stop using dental amalgams, damage to the profession will be tremendous.

Are vulnerable populations at risk for dental amalgams?

(by Jean Huss, AKUT – patient group representing environmentally-sensitive patients)

Vulnerable populations are at risk from dental amalgams. AKUT and many others are advocating the rapid substitution of dental amalgams in dental medicine. They more generally advocate metal-free dentistry and use of more bio-compatible and immune-compatible dental materials. According to the literature, vulnerable groups might be children, allergic patients, and above all women of child-bearing age because of foetal exposure. Vulnerable groups are chronically exposed to low-dose mercury vapours or metal ions and often are more genetically sensitive. These groups accumulate mercury more easily. Mercury release contributing to toxic body burden may address health effects in all age groups. People often complain of a metallic taste, concentration, short-term memory and nervous problems, chronic fatigue, etc. They also have increasing problems with the thyroid gland, and auto-immunity-linked health problems. In most cases, AKUT recommends several different investigations, for instance evaluating mercury release from dental amalgam (mercury triple test). Even with small, but chronic intakes, side-effects can be felt. Evaluating the immune system is also recommended. Mercury activates lymphocytes much more than other metals. The immunological investigation showed the particular sensitisation and inflammatory potential of dental mercury. Many amalgam-bearing people are at risk, and mercury fillings should be banned. Economic effects must also be considered. It is ridiculous to act at the end of the pipe at high cost. It would be better and cheaper to act upstream. AKUT hopes SCHER and SCENHIR will take these scientific facts into account. Decisions should be taken in an open and transparent way. The most important aspect for AKUT is to know who the people are sitting in these committees. They would not want to see them choosing studies they like and rejecting those critical of amalgams because they do not like them. This is a question of democracy and transparency in Europe.

Points raised during the discussion that followed:

On the effects from mercury-free alternatives

- The Association 'Non au mercure dentaire', said it is appalling that one can put so many toxic substances into people's mouths without conducting any tests (carcinogenicity, foeto-toxicity, etc) beforehand, while it is already performed for medicines. The only tests carried out before selling amalgams are corrosion tests, but these do not even have to be done for amalgams and gold. It would be good to impose these tests at EU level before amalgams are put on the market. They must also think of bisphenol-A, and endocrine disruptors.

- CED said that testing materials to go into the mouth is required by the Medical Device Directive. The question is whether there is enough testing. There is an agreement on that.

Another question is how one interprets the results. Some of the molecules in dental adhesives used to glue dental materials to the dental hard tissues have been shown to increase the radical oxygen species, to be mutagenic and allergenic. This has been tested, and the agencies in charge, which are different from one country to another, have come up with the following conclusion: 1) generally, the risk is acceptable, 2) the individual risk must be judged case by case. If one says a resin-based dental composite is bisphenol-A-free, it is basically correct, but under certain circumstances this is not yet known, since some (seldom used) monomers can be cleaved into bisphenol-A and due to contamination. Bisphenol A acts as an endocrine disruptor, but the level of concentration after exposure to resin based composites is low. Unfortunately, there is no material in the world which is risk-free.

- On another point, CED claimed that if amalgams were replaced by composites, the winners would be dentists. Dentists do not earn lots of money from mercury amalgams. The replacement of otherwise functioning amalgams by composites will increase the demand for dental treatment.

- The KEMI representative also pointed out that in a report from the Chemical Agency from 1997, there are different types of methacrylates in composites, not only bisphenol-A.

- AKUT further clarified that that Bisphenol-A is not the only endocrine disruptor. Metals can also be endocrine disruptors. A Luxembourgish laboratory has also been analysing methacrylates – where reactions to patients were rarely observed, but reactions were to mercury were shown all the time.

- The Institute of Environmental Medicine and Hospital of Epidemiology at the University Medical Centre in Freiburg reacted to a CED comment that dentists would earn more if amalgams were forbidden by noting that Dental Associations, like the world leading American Dental Association (ADA), possesses some patents for amalgam mixtures. Furthermore, if amalgams were forbidden, insurances companies would not refund for alternative materials and Dental Associations may be accused because of side effects. But CED replied that there was no evidence to support this statement. Patents on amalgams do not seem to be really an important issue, because they are old and technology is known.

<u>On cremation</u>

- CODEMA noted that in a Belgian community there are plans to build a crematorium. Many were concerned. Although waste management and amalgam separators could be part of the solution. the problem would be about the final waste. Also, even if they removed some mercury from the crematorium, in the industry's project it still represents 1kg of mercury dispersed in the air each year.

- CED said there are ways to filter mercury. The crematoria might need filters for fine particle dust anyway, so it is not just because of mercury that a crematorium would need to install a filter.

- The Institute of Environmental Medicine and Hospital of Epidemiology at the University Medical Center Freiburg noted that although amalgam fillings could be removed before cremation, people with amalgams have 2 to 12 times more mercury in body tissues which cannot be removed before burial or cremation and this amount is exhausted with the dust of graveyards and crematoria. The elimination of mercury in remains is possible but very expensive and involves much work and proper controlling. There is a rise in dental amalgams worldwide particularly in developing countries. There is no money there to put filters in crematoria to prevent mercury dust from evaporating. So if the EU does not ban dental amalgams, other countries worldwide will not do it either.

- The Scottish Environment Agency representative said that one of the big drivers in the EU

is the polluter pays principle. Why should crematoria fit abatements if they are not the ones which put the mercury in the teeth, and where would the cost go?

- CED said that today there is phasing down, not the phasing out of dental amalgams, for aesthetic reasons. In Sweden, there is still a small percentage of amalgams. The question to ask is what to do with this and whether society pays for it. But this question must be asked for any kind of medication. If amalgams are phased down, the problem will get smaller. CED said everybody agrees prevention is of the utmost importance and this is the area people should really work on.

- The representative from Uppsala University noted that dust filters do not remove all mercury. Selenium filters are hazardous waste afterwards: selenium is very toxic. Active carbon filters can also be a problem.

On caries size and prevention

- A German bio-dentist said dentists in Germany were forced to implant amalgams in almost all German patients (94%). Only a few years ago (five) they became free to talk to patients. They always have had many problems making decisions for patients in terms of intoxication. It is always said allergic tests on the skin should be made, but if someone has mercury in their brain, this cannot be seen.

- The representative from the Norwegian Department of Health, said that although many years ago in Norway they were the worst, had bad teeth, they put huge stress on prevention. That is how they succeeded in reducing cavities.

- The KEMI representative said that in a report they described a study carried out with dentists. They asked them what kind of fillings they would do with different materials. Composites are used for all kinds of indications where amalgams were used before. This was also confirmed by the Norwegian representative.

- The Uppsala University representative noted that his generation was heavily exposed to many and relatively large amalgam fillings, but amalgams cannot be used in over large cavities because the teeth crack. He added that caries is again increasing in Sweden because people drink too many soft drinks containing sugar and not enough fresh milk, which protects teeth by forming a pellicle (thin layer) of milk protein on them[25].

On the EU process

- The European Academy of Environmental Medicine said mercury is without doubt a burdening substance, since there is sufficient evidence. They fear that the Committees will not look any further than they already have.

- When asked if they would, as individuals, accept a new amalgam filling, CED said yes, but the HEAL representative said definitely not.

- On the question of how long it would take totally to phase out dental amalgams globally – CED said amalgams will for the time being not be phased out if resin is the alternative. If inorganic materials are researched, which are further improved, perhaps phase-out could be achieved. Amalgam use could drop to 10% but this might happen in different countries at different times. HEAL replied that realistically, it would be lucky to get a global amalgam ban by 2020. At UNEP level, it is not even on the radar screen.

- The representative of St. Olav's University Hospital said that from an occupational health

[25] See article: T.G. Devold et al. 2006. In vitro studies of adsorption of milk proteins onto tooth enamel. Dental Tribune, Asia Pacific Edition, December 2006, nr 12, vol. 4, page 8-9.

viewpoint, it would be possible for dental staff to handle amalgams safely if strict hygienic measures would apply. From an occupational health point of view there would therefore be no reason to ban amalgams completely.

- The Institute of Environmental Medicine & Hospital of Epidemiology at the University Medical Centre in Freiburg said in Germany, they are almost the only scientists at the university level, who have asking federal agencies for the prohibition of amalgams. The Health Minister obviously not has any interest in changing their opinion about the safety of amalgam. The advisors in Germany are mainly dentist groups or some experts, which deputize the dental position and the amalgam industry and most advisors there states since decades that amalgam is safe for humans. Dentists are legally responsible for the possible side effects of implanting mercury fillings in the human body and they and the amalgam industry could fear the possible consequences, if dental amalgam is acknowledged as toxic for humans.

- HEAL said massive awareness-raising is needed for women who will bear future generations of children, to avoid having more children with brain damage owing to mercury exposure in the womb or through breastfeeding.

- CED said it has been said that science must be considered. But the problem is that CED possesses a list of 125 papers saying amalgam is not dangerous when put in the mouth and these studies also come from toxicologists. There is no ideal material. A phase-down of amalgams is being witnessed, but patients need it, and this need varies between countries. Dentists are responsible for placing the filling. All dental materials should be assessed at the same level of expertise.

- IAOMT believed dentists would never voluntarily give up dental amalgams. They think the debate will only conclude when public opinion puts pressure on politicians. The safety record of amalgam manufacturers is quite frightening.

- AKUT reiterated that to them mercury is one of the most dangerous existing poison and should therefore not be put into people's mouths. The Swedish model should be followed and mercury should be rapidly phased out in the EU. At EU level, although it might be interesting to debate the issue, in this case, the final advice will be taken by two committees whose composition is not transparent and equally-balanced (no environmental health specialists; immunology is not taken into account). Often late lessons can be drawn from early warnings. Equally-balanced committees are needed at EU level, otherwise they will take a decision on the literature they chose to accept, although AKUT believes there is much more convincing material. AKUT admits mercury cannot be phased out tomorrow morning, but it should be done as soon as possible.

V. Pictures from the Conference

John Hontelez, EEB, Secretary General

Gernot Schabl, European Commission

(from left) Petra Ekblom (KEMI), Willy de Backer (EurActiv), Gernot Schnabl (DG ENV), Lars Hylander (Uppsala University,), Colin Gillespie (Scottish EPA), Liljan Smith Aandahl (Dir. of Health, Norway)

Peter Maxson (Concorde East/West)

Liljan Smith Aandahl (Dir. of Health, Norway)


General views of the conference room, Goethe Institut, Brussels

(from left) Michael Bender (MPP), Bjorn Hilt (St. Olavs Univ. Hospital), Willy de Backer (EurActiv), Jean Huss (AKUT), Dr. Graeme Munro-Hall (IAOMT), Prof. Gottfried Schmalz (CED), Lisette van Vliet (HEAL)

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