"The environmental risks and indirect health effects of mercury from dental amalgam (update)"

20.November 2013, Florian Schulze

Question 1: Are mercury releases caused by the use of dental amalgam a risk to the environment? The fate of mercury released from dental clinics as well as the fate of mercury released to air, water and soil from fillings placed in patients should be taken into account

SCHER noticed that nowadays dental amalgams may represent one of the major intentional uses of mercury. A mass balance of mercury emissions, in air, water and soil, from dental amalgam has been proposed by Bio Intelligence Service (2012). This type of mass balance contributes to the understanding of the magnitude and sources of mercury contamination caused by dental applications. However, it does not enable to quantitatively assess the risks of Hg in amalgam, particularly if one considers that a non-negligible risk from mercury in dental amalgam is likely to occur only at a local scale, close to relevant emission sites. For the soil and air compartment SCHER concluded that a quantitative Predicted Environmental Concentration (PEC) cannot be estimated and an assessment of local risk is not possible at the moment. Only for the aquatic environment a more quantitative assessment is considered possible. Exposure in surface water has been calculated considering three possible scenarios (worst, average and best case). The PECs calculated in the three hypotheses have been compared with the Water Framework Directive Environmental Quality Standards (Annual Average EQS and Maximum Allowable Concentration EQS) that have been set for mercury. The comparison shows that only in the worst scenario the PEC is above both AA and MAC EQS.

The report is taking the emission of methylmercury from dental practice(Point 3.2.2.4.) into acount which is not further specified.
Oral methylation can take place by sulfat reducing bacteria like Desulfomicrobium or Desulfobacter in subgingival dental plaque.[1] These genera are also the predominant sulfate-reducing bacteria in the human large intestine.[2]
In correlation with elevated concentration of total mercury in stimulated saliva[3], which was studied in individuals with multiple dental amalgam fillings, humans, especially in populated areas, could be a significant source of mercury pollution. Even more, if there would be an increase of sulfate-reducing bacteria by persistance or mutation which could have effects on

the methylation rate.
Since the only reference in the report dates from 2003, I would claim for further analysis of this aspect and to take this comment into consideration.

[1]Langendijk PS, Kulik EM, Sandmeier H, Meyer J, van der Hoeven JS. **Isolation of Desulfomicrobium orale sp. nov. and Desulfovibrio strain NY682, oral sulfate-reducing bacteria involved in human periodontal disease**. Int J Syst Evol Microbiol. 2001 May;51(Pt 3):1035-44.

[2]J. S. van der Hoeven, C. W. A. van den Kieboom, M. J. M. Schaeken **Sulfate-reducing bacteria in the periodontal pocket** 19 DEC 2007 DOI: 10.1111/j.1399 302X.1995 .tb00156.x

[3]Leistevuo J, Leistevuo T, Helenius H, Pyy L, Huovinen P, Tenovuo J. **Mercury in saliva and the risk of exceeding limits for sewage in relation to exposure to amalgam fillings.** Arch Environ Health. 2002 Jul-Aug;57(4):366-70.

Question 2: Is it scientifically justified to conclude that mercury in dental amalgam could cause serious effects on human health due to mercury releases into the environment?

Mercury coming from dental amalgam as well as from many other sources, ubiquitously distributed in the environment, can be taken up by the general human population via food, water and air. Regarding the contribution of environmental mercury coming from dental amalgam use, it can be concluded that emissions of Hg to soil are not considered as a concern regarding human health. Regarding inhalation, amalgam use will also make only a limited contribution to the overall human inhalation exposure. The contribution of amalgam use to the concentrations of methyl mercury found in fish is not known and consequently no clear conclusion on possible health risks is possible. However SCHER estimated three scenarios in fish based on five hypothetical values for the methylation rate of mercury. SCHER also noted that all additional sources which add to the methyl mercury burden in humans may increase the number of people at risk, thus respecting the more conservative WFD threshold would contribute to the prevention of human health effects.

The use of mercury must be considered not only against the background of it's elevated toxicity in the methylated form but also in interaction with other toxic elements like lead or cadmium. The inter-individual ability to eliminate methylmercury from the body, and the genetic predisposition to effects of mercury have another effect on the risk of mercury-induced disease,too.(WHO2010)
Recent studies about low-level intoxications with mercury proof long-term developmental delays (loss of IQ) in unborn and young children. Other toxic

effects include alteration of sensory functions, motor coordination, memory and attention. Mercury has been linked to diseases like myocardial infarction, heart rate variability, blood pressure, attention-deficit/hyperactivity disorder, amyotrophic lateral sclerosis, autism and Parkinson's disease.[1-9]

These serious health effects should be taken into consideration regarding the ongoing increase of Hg and MeHg levels in the environment and fish. Mercury is a chemical of global concern owing to its long-range atmospheric transport, its persistence in the environment once anthropogenically introduced, its ability to bioaccumulate in ecosystems and its significant negative effects on human health.(Minamata Konvention) It is never removed from the environment; it is just moved to other locations and eventually buried under soils and sediments. Due to anthropogenical impact the mercury level in surface water has tripled during the past century and the MeHg concentration in historical archives, such as marine bird feathers, increased of a factor of 4 for the North Atlantic during that time, supporting the assertion of a first order relationship between the pools of available inorganic Hg and MeHg formed in the upper ocean.[10,11] It has been predicted that the concentration of Hg in North Pacific intermediate waters will double by the year 2050, relative to 1995, assuming actual atmospheric Hg deposition rates[12] and according to a recent study, warmer sea surface temperatures could result in greater bioaccumulation of MeHg in fish, and consequently, increased human exposure. [13]
The Report quotes a recent study about mercury concentration in hair from mother and children which are generally below the EFSA derived TWI but not below the limit derived by US EPA. Another study (Table 4) exclusively analyses the estimated transformation of the mercury-emission of dentists into the environment to MeHg in fish and shows that in a worst case scenario the limits by the US EPA and EU could be exceeded.
This demonstrates that the contemporary exposure of MeHg is already elevated and that there is a close relation between the emission of Hg and the exposure to MeHg by the consumption of fish even if the dental emission is only a relatively small contribution to the total anthropogenic emission. From my point of view these alarming circumstances and their in fact existing health effects should not only lead to a more conservative threshold (WFD) but to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds by an unconditionally phase out of dental amalgam.

[1]Danish Ministry of the Environment **Survey of mercury and mercury compounds** LOUS-review Oct 2013

[2]Leonardo Trasande; Philip J. Landrigan; Clyde Schechter **Public Health and Economic Consequences of Methyl Mercury Toxicity to the Developing Brain** Environ Health Perspect. 2005;113(5):590-596.

[3]Environ Health Perspect. 2007 April; 115(4): 609–615 **Dose–Response Relationship of Prenatal Mercury Exposure and IQ: An Integrative Analysis of Epidemiologic Data** Daniel A. Axelrad, David C. Bellinger, Louise M. Ryan, Tracey J. Woodruff

[4]Houston MC. **The role of mercury and cadmium heavy metals in vascular disease, hypertension, coronary heart disease, and myocardial infarction.** 2007 Mar-Apr;13(2):S128-33.

[5]Wennberg M, Strömberg U, Bergdahl IA, Jansson JH, Kauhanen J, Norberg M, Salonen JT, Skerfving S, Tuomainen TP, Vessby B, Virtanen JK. **Myocardial infarction in relation to mercury and fatty acids from fish: a risk-benefit analysis based on pooled Finnish and Swedish data in men.** 2012 Oct;96(4):706-13. Epub 2012 Aug 15.

[6]Sagiv SK, Thurston SW, Bellinger DC, Amarasiriwardena C, Korrick SA. **Prenatal exposure to mercury and fish consumption during pregnancy and attention-deficit/hyperactivity disorder-related behavior in children.** Arch Pediatr Adolesc Med. 2012 Dec;166(12):1123-31. doi: 10.1001/archpediatrics.2012.1286.

[7]Johnson FO, Atchison WD.**The role of environmental mercury, lead and pesticide exposure in development of amyotrophic lateral sclerosis.** Neurotoxicology. 2009 Sep;30(5):761-5. doi: 10.1016/j.neuro.2009.07.010. Epub 2009 Jul 24.

[8]Geier DA, Geier MR.**A prospective study of mercury toxicity biomarkers in autistic spectrum disorders.** J Toxicol Environ Health A. 2007 Oct;70(20):1723-30.

[9]Dantzig PI.**Parkinson's disease, macular degeneration and cutaneous signs of mercury toxicity.** J Occup Environ Med. 2006 Jul;48(7):656.

[10] UNEP, AMAP, 2013 Technical Background Report for the Global Mercury Assessment

[11] Robert P. Mason et. al**. Mercury biogeochemical cycling in the ocean and policy implications** Environmental Research 119 (2012) 101–117

[12] Joel D. Blum, Brian N. Popp, Jeffrey C. Drazen, C. Anela Choy and Marcus W. Johnson **Methylmercury production below the mixed layer in the North Pacific Ocean** Nature Geoscience 25 AUGUST 2013 | DOI: 10.1038/NGEO1918

[13] Jennifer A. Dijkstra,Kate L. Buckman, Darren Ward, David W. Evans, Michele Dionne, Celia Y. Chen **Experimental and Natural Warming Elevates Mercury Concentrations in Estuarine Fish** Mar 12, 2013 DOI: 10.1371/journal.pone.0058401