



# Mercury

Issue 16

September 2009

## Safeguarding human health from the effects of mercury

Mercury is widely considered to be among the highest priority environmental pollutants of concern on the global scale. Although occupational exposure to inorganic mercury is a continuous problem, possible effects on broader sections of the population resulting from widespread dispersal of mercury in the environment has become a major concern in recent years.

Mercury has been targeted by agencies and organisations worldwide for possible emission control. For example, the EU has called for a ban on mercury exports by 2011<sup>1</sup>, while the United Nations Environment Programme (UNEP) coordinates intense scientific and policy debate on how best to deal with mercury on a global level. In February 2009, the Governing Council of UNEP took the decision to begin negotiations towards an international treaty on mercury that would significantly reduce the use of this dangerous chemical<sup>2</sup>.

This thematic issue reports on research which explores the impacts of mercury emissions and contaminants, and how they may be traced, controlled and reduced.

The use of mercury in industrial processes is a key policy concern. The manufacture of chlorine in chlor-alkali plants represents one such process. A pan-European project has assessed mercury exposure levels for communities living near chlor-alkali plants and considered whether this could cause kidney damage. Read the results in the article **'Impact of mercury exposure from chlor-alkali plants'**.

The consequences of mercury exposure are still not fully understood. To develop effective strategies for preventing any toxic consequences, we first need a precise medical understanding of what mercury does to our bodies, and how. **'Does mercury damage genes?'** discusses mechanisms for DNA damage.

While dental amalgam is not widely believed to pose a health risk in itself, there is concern that it could contribute to more harmful levels of accumulated mercury in the body, by adding to deposits derived from air pollution and contaminated food. However, its exact contribution is not clear. Researchers have recently shed new light on this matter by highlighting another mechanism of exposure to mercury from dental fillings. For more details, see **'Can mercury from dental fillings travel through teeth?'**

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We must look for ways to control and reduce exposure to mercury, including finding alternatives to mercury in industrial processes. Artisanal gold mining can be a lifeline for many communities in the developing world, in terms of income, but the use of mercury in processing the gold ore poses a toxic threat. **'Finding alternatives to mercury in small-scale gold mining'** suggests 'mill-leaching' with cyanide could substitute mercury.

Mercury in landfill waste must be tightly controlled to avoid potential harmful emissions. The effectiveness of several commercial forms of 'activated carbon', used to stabilise industrial mercury emissions before disposal in landfill, is evaluated in **'Activated carbon: effective at locking away mercury'**.

Air pollution can be a significant source of exposure to mercury. Research can inform improved policies by revealing how mercury moves around the atmosphere and how we can track down its origin. **'Understanding the movement of mercury in the atmosphere'** calls for intensive global monitoring of mercury and **"Chemical fingerprints" could reveal source of mercury pollution'** explains how the potentially unique chemistry of coal deposits from around the world provides crucial clues as to where the pollution came from.

Although mercury pollution has received much attention and is placed high on the political agenda, it is clear that many concerning aspects of this mysterious toxic element are still not fully understood. The development of cost-effective, clean technologies for removing mercury from gaseous and liquid streams are behind current needs, particularly in fast developing economies.

The socioeconomic and health effects of mercury pollution and its effects on the world's fisheries and wildlife are still some of the biggest concerns. However, much uncertainty still surrounds safe and recommended levels. While sound, legally binding instruments on mercury combined with voluntary approaches will reduce the extent of the problem, it will be a long time before scientists can adequately answer some key questions, particularly related to long-term, low-level mercury exposure and effects on susceptible population groups.

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<sup>1</sup> For more details of the EU's regulation on the banning of exports of metallic mercury and certain mercury compounds and mixtures and the safe storage of metallic mercury, see: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008R1102:EN:NOT>

<sup>2</sup> For more details of UNEP's guidelines for a suitable approach to regulating mercury, see the Governing Council's decision 25/5 III Chemicals management, including mercury. Mercury (2009): [http://www.chem.unep.ch/mercury/GC25/GC25Report\\_English\\_25\\_5.pdf](http://www.chem.unep.ch/mercury/GC25/GC25Report_English_25_5.pdf)



## Impact of mercury exposure from chlor-alkali plants

An EU project, EMECAP<sup>1</sup>, has investigated levels of mercury exposure to populations living near chlor-alkali plants and the impact on human health. It found that the overall health risk was low, but was higher for some workers at the plants and for those who consumed contaminated fish or had mercury dental fillings.

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Theme(s): Chemicals, Environment and health

“The overall health risk for those living near a chlor-alkali plant was low, but was higher for some workers at the plants and for those who consumed contaminated fish or had mercury dental fillings.”

Mercury is a natural element but human activities, such as mining and coal-combustion in power plants, add to environmental levels. It usually occurs in combination with other chemicals, forming salts or compounds such as methylmercury. A major anthropogenic source of mercury is the manufacture of chlorine, (a chemical used as a disinfectant, among many other uses), by the mercury cell chlor-alkali (MCCA) process. In Europe this method is being replaced with alternative processes that do not use mercury.

Mercury is highly toxic and can affect a number of organs, including the kidneys. It can be inhaled from the air, but it is primarily taken in through diet, especially through fish and seafood consumption.

The researchers studied an area around a large MCCA plant in Tuscany, Italy, which discharges waste directly into the Mediterranean Sea. They sampled the local air, soil, vegetables and fish to assess exposure to mercury in adults living in the vicinity of the plant. The samples were compared to a reference area 20 kilometres away.

In general, the impact of mercury was in the immediate vicinity of the plant. Increased levels of mercury in the atmosphere were found close to the plant - 8.0–8.7 ng/m<sup>3</sup> (nanograms per cubic metre) in summer and 2.8–4.2 ng/m<sup>3</sup> in winter. Peaks of up to 100 ng/m<sup>3</sup> were observed under particular meteorological conditions. However, three kilometres away, the mercury dropped to the background level (typical level) of 2 ng/m<sup>3</sup>. Total emissions of mercury to the air were around 285 kilograms per year. Of this, only 14 per cent is deposited within 5 kilometres from the plant. 86 per cent is transported away from the area, highlighting the contribution of local sources of mercury to global pollution.

Levels of inhaled mercury from the air were approximately 18 times higher around the MCCA plant (0.06–2.0 µg/day (micrograms per day)) compared with the reference area. However, this is still relatively low and is only 50 per cent of the 4 µg/day level recommended by the WHO<sup>2</sup>. However, exposure is increased for those with mercury dental fillings. For some of those in the area with mercury dental fillings, the overall level of exposure was estimated to be over 4 µg/day.

Relatively low concentrations of total mercury and methylmercury were found in soil samples and in vegetables taken from around the MCCA plant, at levels only slightly higher than in the reference area. Total mercury concentrations in local fish varied: 39 per cent of samples exceeded the 0.5 mg/kg (fresh weight) limit<sup>3</sup> set by the EU for all marine species (other than marine tuna, swordfish and shark). However, there are many other sources of mercury in the Mediterranean Sea and these levels could not be directly related to the MCCA plant.

Sources: Gibičar, D., Horvat, M., Logar, M. et al. (2009) Human exposure to mercury in the vicinity of chlor-alkali plant. *Environmental Research*. 109:355–367.

Jarosińska, D., Horvat, M., Sällsten, G. et al. (2008). Urinary mercury biomarkers of early renal dysfunction in environmentally and occupationally exposed adults: A three-country study. *Environmental Research*. 108:224–232.

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Intake of mercury from fish, vegetables, other foods and drinking water appeared to be similar to the intake of those living in the reference area and was well below the limit of 2µg inorganic mercury per kg body weight per day set by the WHO, showing no unacceptable risk to human health, again, except for those who have a higher number of mercury dental fillings.

In contrast, mercury in the form of methylmercury could pose a real health risk: daily exposure to methylmercury, primarily through the consumption of local fish and vegetables, ranged up to 474 per cent of the daily tolerable dose set by the Joint WHO/FAO Expert Committee on Food Additives<sup>2</sup>.

The project also looked to see if actual health impacts on local residents could be identified. The researchers questioned residents about lifestyle and took urine samples to see if there was a link between early signs of kidney damage and high levels of mercury in the urine. In addition to the Italian plant, they also studied populations living near MCCA plants in Poland and Sweden. The participants included staff from the MCCA plants who were compared with residents who lived far away from the plants.

No association between mercury levels in the urine and signs of early kidney dysfunction was found for residents living close to the MCCA plants. In general, mercury levels were low. The highest levels of mercury (measured as 1.2µg per gram of creatinine (C), a natural chemical found in urine) were found in the Italian participants, with lower levels in the Polish (0.22µg/gC) and Swedish (0.21µg/gC) groups. However, urinary mercury levels were not significantly different between people living near MCCA plants and those living further away. They did find that urinary mercury levels were higher in individuals who had mercury dental fillings and in those who ate fish.

Similar levels of mercury in urine were detected for workers in the MCCA plants in all three countries: 3.8µg/gC for Swedish, 4.6µg/gC for Italian and 6.0µg/gC for Polish employees. Compared with earlier studies on MCCA workers, these levels are lower, which indicates that more recent safety measures to protect workers have been effective.

However, in cases where MCCA workers had been highly exposed, as shown by very high mercury levels in urine (greater than 35µg/gC), there was some indication of early kidney damage, especially among the Swedish men.

Exposure to low levels of mercury over an extended period of time remains a concern, especially when the effects are combined with exposure to other toxic substances, such as lead and cadmium.

<sup>1</sup> EMECAP (European Mercury Emission from Chlor-alkali Plants) was supported by the European Commission under the Fifth Framework Programme. See: [www.emecap.com](http://www.emecap.com)

<sup>2</sup> See: <ftp://ftp.fao.org/es/esn/jecfa/jecfa61sc.pdf>

<sup>3</sup> See: [http://eur-lex.europa.eu/LexUriServ/site/en/oj/2006/l\\_364/l\\_36420061220en00050024.pdf](http://eur-lex.europa.eu/LexUriServ/site/en/oj/2006/l_364/l_36420061220en00050024.pdf)



## Does mercury damage genes?

Mercury has many uses but its toxic properties are a health concern. A recent analysis explored the effects of mercury exposure on human genes. They identify four possible processes that could lead to genetic damage and suggest that international safety limits may need reviewing.

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Theme(s): Chemicals, Environment and health

“The carcinogenic effects of mercury are controversial since there are mixed results on its toxicity to genes.”

Mercury is versatile and this means it is used in areas ranging from industry to dentistry and from pharmacology to mining. However, the consequences of mercury intoxication are not fully understood.

Some mercury compounds cause developmental defects in embryos. For example, methylmercury is directly transferred to the foetus through the placenta and affects the central nervous system. The most well-known exposure to methylmercury is through the consumption of fish. Exposure to other mercury containing compounds through diet and occupation is thought to cause tumours. However, the carcinogenic effects of mercury are controversial since there are mixed results on its toxicity to genes (or ‘genotoxicity’).

As part of the review, indicators of DNA damage used in research were evaluated. This suggests that chromosome abnormality is the best indicator because it is sensitive to low concentrations of mercury. From the research four mechanisms of mercury genotoxicity were identified:

- DNA damage by free radicals generated by mercury, such as hydrogen peroxide and nitric oxide.
- Changes to the microtubules (tiny fibres involved with cell division)
- Effects on DNA’s ability to repair itself
- Direct interaction with DNA

Among the mercury compounds studied, methylmercury is the most genotoxic. The lowest concentration of methylmercury needed to cause significant damage to DNA is below the safety limit set by the WHO for mercury exposure, which suggests that tolerance levels need to be reviewed.

If the relationship between genotoxic mechanisms and exposure to mercury is understood more accurately, strategies can be developed to prevent and avoid toxic consequences. The EU’s ban on mercury exports from 2011 and its restrictions on mercury use will reduce exposure<sup>1</sup>. However, guidance on methylmercury through diet is not as simple since recent research has demonstrated that the nutritional benefits of fish consumption must also be considered.

Source: Crespo-López, M.E, Macedo, G.L, Pereira, S.I.D. *et al.* (2009) Mercury and human genotoxicity: Critical considerations and possible mercury mechanisms. *Pharmacological Research*. doi: 10.1016/j.phrs.2009.02.011.

<sup>1</sup> See: <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/05/114&format=HTML&aged=0&language=EN&guiLanguage=en>



## Can mercury from dental fillings travel through teeth?

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Theme(s): Chemicals, Environment and health

“The researchers detected small ‘hotspots’ of mercury in the teeth up to several millimeters from where the amalgam filling had been.”

Dental amalgam fillings made with mercury have been used for many years, but there are concerns about the risk to human health. A recent study suggests that mercury can travel through the tooth and enter the tooth's active bloodstream. This is another route of exposure to mercury in addition to the release of the toxin from the surface of the filling.

It is known that biting and chewing can erode the surface of amalgam fillings, releasing mercury in the mouth that can be inhaled or ingested. Mercury affects the nervous tissue and organs, such as the kidneys, although concentrations from amalgams are not thought to be high enough to have serious health effects, except in a few susceptible people. However, accumulated mercury exposure, from sources including air pollution and food, in addition to amalgam fillings, has caused concern for some. A report on the potential health and environmental risks of dental fillings has been prepared by a scientific committee of the European Union<sup>1</sup>.

In this particular study, the researchers used x-ray techniques to examine cross sections of teeth that had been extracted from patients. The amalgam fillings and linings around the fillings had been removed.

They detected small ‘hotspots’ of mercury of up to 10 mg g<sup>-1</sup> (milligrams of mercury per gram of tooth) and higher concentrations of zinc (greater than 100 mg g<sup>-1</sup>) up to several millimeters from where the amalgam filling had been. Zinc is a major component of the lining applied to teeth before filling with amalgam. The researchers suggest that zinc and mercury had migrated from the filling and lining through to the pulp (or nerve tissue) of the tooth where mercury could be released directly into the pulp bloodstream.

The zinc appeared to be evenly distributed, whereas the mercury was concentrated in the tiny tubes that run through dentine in teeth (dentine is the central layer of a tooth, between the enamel and the pulp). The difference in the way that the mercury and zinc are distributed suggests that there are different mechanisms for their movement.

Fillings are applied under pressure, when the amalgam is soft to remove excess mercury, which then results in the amalgam hardening. The researchers suggest that mercury may have initially moved physically through the tooth at this point, especially as copper and silver were also found with the mercury hotspots; these metals are also in the dental amalgam. They suggest that zinc is likely to have moved through the tooth through a series of chemical reactions. In time, the chemical form of mercury will have changed and it is possible that it may have migrated again through chemical reactions.

Significant amounts of mercury were also detected in the calculus (the hard deposit that forms on teeth from accumulated food, bacteria and minerals from saliva). This indicates that mercury can also migrate from the surface of the fillings to the calculus. Therefore, care should be taken to avoid ingesting any calculus that has been loosened from the teeth.

This study was not able to tell how much mercury migrating through teeth would be released into the bloodstream on a daily basis. However, it appears that significant amounts could enter the body via these two different mechanisms of migration, through the tooth as well as ingestion of calculus.

Source: Harris, H.H., Vogt, S., Eastgate, H. *et al.* (2008). Migration of mercury from dental amalgam through human teeth. *Journal of Synchrotron Radiation*. 15:123-128

<sup>1</sup> See: <http://ec.europa.eu/health/opinions/en/dental-amalgam>



## Finding alternatives to mercury in small-scale gold mining

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Themes: Chemicals, Sustainable consumption and production

Artisanal small-scale gold mining (ASM), largely practised in Asia, South America and Africa, contributes significantly to mercury emissions, both in the developing world and globally. A recent study investigates an alternative to using mercury in ASM.

“The results indicate that mill-leaching with cyanide is a superior technique to amalgamation. It is simple, inexpensive and well-accepted by local miners.”

The EU Mercury Strategy<sup>1</sup> recognises the need for global action to reduce mercury in the environment. This includes actions to help other countries reduce their mercury use and support of the UN Environment Programme mercury programme<sup>2</sup>. In ASM practice, gold is often extracted by amalgamating (‘blending’) it with mercury. However, it is estimated that 30 per cent of the mercury used in the process is lost to the atmosphere. Furthermore, amalgamation is inefficient and recovers less than 30 per cent of the gold.

Most artisanal miners come from extremely poor backgrounds and turn to mining to escape poverty. They cannot afford to process gold themselves and so take the ore to processing centres. These centres use amalgamation - the cheapest but least efficient process. In return miners leave their tailings (residue) and the centres extract any remaining gold by cyanidation. In this process, cyanide dissolves both gold and any residual mercury, forming mercury cyanide. Mercury cyanide easily turns into methylmercury, a highly toxic mercury compound that readily makes its way into rivers and consequently fish consumed by humans.

Although cyanidation of tailings is environmentally unsound, cyanidation of the gold ore itself may be a better alternative to amalgamation. This is done by grinding the gold in cyanide, known as ‘mill-leaching’.

The researchers examined the potential of mill-leaching with cyanide in a laboratory test with an Indonesian ore sample and in a field test in Ecuador. In the laboratory test, mill-leaching extracted 93 per cent of the gold in six hours. This was better than other procedures, such as magnetic methods, which recovered just 8 per cent. In the field test in Ecuador, a traditional mill-leaching technique using a mill called a “chanchas” recovered 95 per cent of gold after eight hours.

The results indicate that mill-leaching with cyanide is a superior technique to amalgamation, both in terms of its efficiency and its reduced environmental risk. It is simple, inexpensive and well-accepted by local miners. However, processing centres may be reluctant to adopt it because they have already invested in cyanidation tanks to extract gold from tailings.

The authors recommend further analysis of the socio-economic and environmental impacts of mill-leaching with cyanide. Cyanide is also toxic and miners must be educated to understand the associated risks if this process is introduced.

Source: Veiga, M.M., Nunes, D., Klein, B. *et al.* (2009). Mill leaching: a viable substitute for mercury amalgamation in the artisanal gold mining sector? *Journal of Cleaner Production*. doi:10.1016/j.jclepro.2009.03.012

<sup>1</sup> See <http://ec.europa.eu/environment/chemicals/mercury>

<sup>2</sup> See <http://www.chem.unep.ch/MERCURY/>



## 'Activated carbon': effective at locking away mercury

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Themes: Chemicals, Waste

"Activated carbon can immobilise mercury via two different mechanisms. While the mechanisms are different, the mercury is highly stable in both cases."

Mercury is often removed from industrial emissions with 'activated carbon' which is then disposed of. A recent study assesses the adsorption of mercury by four types of activated carbon and demonstrates that they all provide a permanent means of locking away mercury.

As part of the EU Mercury Strategy<sup>1</sup> emissions of mercury from major industrial sources are subject to the EU legislation on air quality<sup>2</sup>. One of the main strategies for controlling mercury emissions from combustion processes is to inject activated carbon into the gas as it is emitted from the flue.

Activated carbon is powdered and porous (lots of small holes), giving it a large surface area available for adsorption. Once it adsorbs gaseous mercury, it is captured with fly ash and then typically disposed of in ash ponds or landfills. This study assessed the stability of mercury adsorbed by activated carbon.

Two commercial activated carbons were studied, one of which was impregnated with a minimum of 10 per cent gaseous sulphur at low temperature. Two other activated carbons were impregnated with sulphur by reactions with sulphur dioxide at relatively high temperatures.

Each activated carbon was exposed to a level of mercury that was similar to that experienced in flue gas. The stability of the adsorbed mercury was assessed using a standard method called the Toxicity Characteristic Leaching Procedure (TCLP) which simulates the conditions of landfill. The steps of mercury release were also investigated.

For all forms of activated carbon, the TCLP demonstrated that very little mercury is released. This indicates that the adsorption was stable and would provide permanent sequestration after disposal.

The study also found that there are two forms in which mercury is sequestered or stored. In the activated carbon impregnated by sulphur dioxide, at least 75 per cent of mercury is bound in its elemental form, i.e. it remains pure and does not react with other elements. However, for the activated carbon impregnated with gaseous sulphur at low temperatures, the mercury reacts with the sulphur and nearly 60 per cent is bound as mercury sulphide.

The study demonstrates that activated carbon can immobilise mercury via two different mechanisms: binding in its elemental form and binding as a sulfide. While the mechanisms are different, the mercury is highly stable in both cases, and will remain permanently sequestered after disposal.

Source: Graydon, J.W., Zhang, X., Kirk, D.W. & Jia, C.Q. (2009). Sorption and stability of mercury on activated carbon for emission control. *Journal of Hazardous Materials*. 168: 978-982.

<sup>1</sup> See: <http://ec.europa.eu/environment/chemicals/mercury>

<sup>2</sup> See: <http://ec.europa.eu/environment/air/legis.htm>



## Understanding the movement of mercury in the atmosphere

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Themes: Air pollution, Chemicals

“About two thirds of mercury emitted from natural processes has an anthropogenic origin – it is ‘recycled’ mercury that has previously been deposited from industrial sources.”

In order to reduce mercury pollution, we need to understand its movement in the global atmosphere. A UN report summarises current information on mercury transport in the atmosphere and indicates that intensive global monitoring is needed to inform and evaluate policy.

As a result of EU policy<sup>1</sup>, European emissions of mercury have dropped considerably in recent decades, decreasing by about 60 per cent between 1990 and 2000. However, global emissions continue to rise. This report from the UN Environment Programme<sup>2</sup>, more recently published as a book, evaluated research on the distribution of mercury emissions and on models to predict future levels.

2503 tonnes of mercury emitted to the atmosphere each year comes directly from anthropogenic sources. This is about a third of all mercury emitted to the atmosphere. Fossil fuel power plant emissions contribute 1422 tonnes per year. China and India account for 62 per cent of mercury emissions from fossil fuel burning whilst Europe and USA account for 23 per cent. Small-scale gold mining produces the second largest amount of direct anthropogenic emissions at 400 tonnes per year.

Natural sources of mercury, such as oceans, rocks, volcanoes and forest fires, release about 5207 tonnes of mercury per year. Oceans account for over half of this (2682 tonnes per year) and the second largest source is burning biomass, such as forest fires (675 tonnes per year).

However, burning biomass is a mixture of natural processes and burning by humans. In fact, about two thirds of mercury emitted from natural processes has an anthropogenic origin – it is ‘recycled’ mercury that has previously been deposited from industrial sources.

Changes in global levels of mercury should be reflected in changes in background mercury concentration, but estimating global trends is difficult due to variations in area and time. The general consensus is that the southern hemisphere has a lower concentration at 1.1 to 1.3 nanograms (10<sup>-9</sup> of a gram) per cubic metre than the northern hemisphere (1.5 to 1.7 nanograms per cubic metre). In the USA and Europe, trends vary according to region and for Asia there is a lack of data.

The report proposes that a global monitoring network is needed to assess progress on mandated reductions of anthropogenic mercury. It also recommends continued research on the processes of mercury movement and the development of models.

Little is known about the processes involved in the exchange of mercury between the air and the sea or the land and the air, or about the reactions of mercury with oxygen in the air. This information is needed to develop models which can accurately predict future mercury concentrations and the influence of human activity and climate change on mercury.

Source: Pirrone, N. & Mason, R. (2009). Mercury Fate and Transport in the Global Atmosphere.: Measurements, models and policy implications. Publisher: SPVU. ISBN-13: 9780387939575 ISBN-10: 0387939571.

<sup>1</sup> See: <http://ec.europa.eu/environment/chemicals/mercury>

<sup>2</sup> See: [http://www.chem.unep.ch/mercury/Sector-Specific-Information/Fate\\_and\\_Transport.htm](http://www.chem.unep.ch/mercury/Sector-Specific-Information/Fate_and_Transport.htm)



## 'Chemical fingerprints' could reveal source of mercury pollution

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Themes: Air pollution, Chemicals

Scientists have described a new method for tracking down the source of mercury pollution from burning coal. By analysing the chemistry of the pollution, it is possible to identify which region the coal was originally from.

"The mercury fingerprint for coal from each of the regions is different. Even coal deposits in the same country can differ quite considerably and may even be globally unique."

Mercury pollution in the atmosphere comes mainly from coal-fired power stations and chemical plants. Mercury is naturally present in coal and is emitted when it is burned as fuel. If deposited in soil or water, mercury can eventually reach toxic concentrations which may pose a health risk to humans through accumulation in food chains.

The dangers of mercury pollution prompted the EU to launch a mercury strategy in 2005, which aims to protect against exposure<sup>1</sup>. The United Nations is considering what further action should be taken to reduce global emissions.

New research suggests that the source of atmospheric mercury could be traced by analysing mercury 'isotopes', which are already used to study other forms of chemical pollution, such as nitrate pollution. Elements, such as mercury, have a number of variants which differ according to atomic composition, for example, the number of neutrons may differ. Each one of these variants is an 'isotope'.

Environmental factors, such as specific atmospheric and river conditions at the prehistoric point in time when the coal was originally formed, will have influenced the concentrations of specific mercury isotopes. This variation means that isotopes can be used as chemical signatures or "fingerprints" for the various sources. Isotopes can be detected by analysing samples containing the pollutants in question.

Emissions from power stations are distributed globally and are difficult to attribute to their original source. The research explains how isotopes could be used as tracers for atmospheric mercury pollution. By burning 30 coal samples from across the United States, China and Russia-Kazakhstan, the researchers produced emissions which could then be analysed to identify the mercury fingerprint.

The researchers found that the mercury fingerprint for coal from each of the three regions is different. Even coal deposits in the same country can differ quite considerably and may even be globally unique. This means it could be possible to distinguish between emissions from different sources within a relatively small region.

This method could help us understand the global mercury budget as well as help scientists learn more about how mercury behaves in the environment. Many different processes, such as exposure to light or bacteria, can affect the way mercury is cycled and stored. A better understanding of these processes could lead to new ways of reducing mercury's impact on the environment and human health.

Source: Biswas, A., Blum, J.D., Bergquist, B.A. *et al.* (2008). Natural Mercury Isotope Variation on Coal Deposits and Organic Soils. *Environmental Science and Technology*. 42(22): 8303-8309.

<sup>1</sup> See: <http://ec.europa.eu/environment/chemicals/mercury>



## **A selection of articles on mercury from the *Science for Environment Policy News Alert***

### **Forest fires increase mercury emissions (18/6/09)**

Mercury is a global pollutant arising from many sources, including biomass burning (BMB), which includes both wildfires and intentional fires to clear land. A recent study estimates that mercury emissions from BMB make up 8 per cent of total global mercury emissions.

### **Managing mercury risks from energy-saving light bulbs (13/11/08)**

Compact fluorescent light bulbs (CFLs) use up to two-thirds less energy than standard incandescent bulbs. But CFLs contain mercury, a neurotoxin that can cause serious health problems. A global study calls for a strategic policy to address the risks associated with mercury emissions from CFLs.

### **Better detection of mercury contamination (30/10/08)**

Mercury contamination has a negative impact on both the environment and human health. Researchers have developed a simple visual technique that will make detecting mercury pollution much easier.

### **Mercury and Lead Pollution: still a Critical Issue in Europe (06/12/07)**

Human activities release heavy metals into the atmosphere where they are also transported across national boundaries. This results in air, soil and water pollution through the deposition of heavy metals in environments that are located far away from the actual emission sources. Atmospheric deposition of mercury and lead in particular are calculated to be too high, affecting respectively 51.2% and 7.5% of EU-25 ecosystems respectively in 2000.

### **Mercury Accumulation and Persistence in River Ecosystems (24/05/07)**

Slovenian researchers have recently investigated the mercury content in aquatic organisms in a river located next to a former mine. They have shown that the accumulation of toxic mercury increases with the position in the food chain of the studied organisms. This study also highlights the great persistence of mercury in the aquatic environment, as the mining activities ceased more than 10 years ago. The findings of this study enhance our understanding of mercury cycles in river ecosystems.

To view any of these articles in full, please visit:

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