New method measures mercury vapour for the first time

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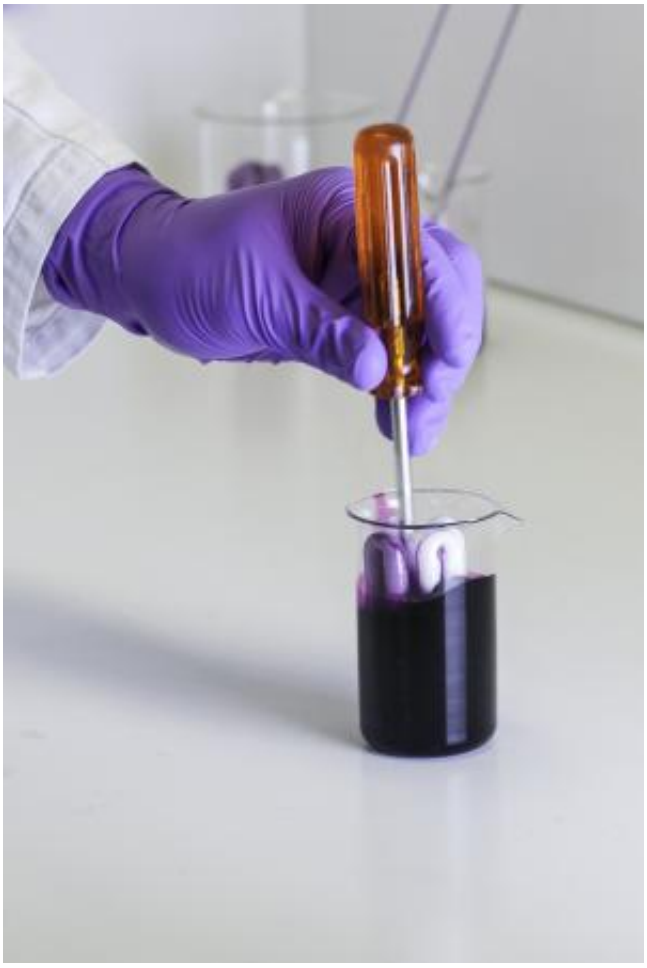

A new method developed at Empa allows scientists to determine not just the quantity of bound mercury in an energy-saving lamp, but also the amount of mercury vapour. To do this the lamp is immersed in a solution of potassium permanganate and its glass envelope broken open. The chemical solution is sucked into the broken lamp where it immediately reacts with the vaporized mercury, preventing it from escaping.

Empa has conducted an investigation to find out how much mercury energy-saving lamps contain and if this is within legal requirements. Altogether, 75 commercially available lamps were tested, with encouraging results – as far as mercury content goes they all contain less than the maximum allowed by law.

Every energy-saving lamp contains some mercury, a toxic metal which is added to help ignite the device. Nobody in Switzerland has ever investigated whether commercially available energy-saving lamps actually meet the legal requirements for the maximum amount of mercury permitted. And so far, worldwide, only the quantity of bound mercury in these lamps has been measured.

To date, the gaseous mercury content has not been measured, even though it poses by far the greater health risk. In addition, in used lamps, up to 80 per cent of the mercury content exists in gaseous form, whereas in unused lamps this figure is only 5 per cent. Acting on behalf of the Swiss Federal Office for the Environment (FOEN), therefore, Empa scientists have developed a method which allows the quantities of mercury in its various forms to be determined. The environmental department selected Empa as the partner for this task because the institution possesses the necessary know-how to develop such analytical methods. As Empa scientist Renato Figi put it, "Nobody has managed to do this before."

A first in the field of mercury analysis

Figi succeeded in developing a simple but effective method of measuring the total amount of mercury in an energy-saving lamp. The entire lamp is immersed in a solution of potassium permanganate and then the glass envelope is broken open with a tool. Since the glass tube is

evacuated, when the envelope is broken open the potassium permanganate solution is sucked in and immediately reacts with the mercury, binding to it so that it cannot escape. Subsequently, the quantity of gaseous mercury can be exactly determined using UV spectrometry.

Figi separately measures the quantity of non-gaseous mercury in the lamp, which is usually in the form of a ball of amalgam (a compound of mercury, tin and zinc). To do this, the little metal balls are dissolved in concentrated nitric acid in a high-pressure incinerator at 250°C and under a pressure of 135bar. As a final step, the Empa scientist then measures the quantity of mercury adhering to the broken glass envelope. To this end the glass fragments are cooled to -197°C and pulverized in a ball mill. Due to the very low temperature the mercury does not evaporate, remaining attached to the pulverized glass where it can also be measured.

Using this technique, Figi has evaluated the mercury content of 75 lamps, analysing five samples each of 15 different types of commercially available lamp. These included the "mini ball" variety (a typical household lamp shaped like an old-style light bulb), as well as linear and ring shaped lamps which are often used on ceilings and walls. Figi's measurements show that none of the tested lamps contains more mercury than is allowed by Swiss law, namely 2.5 milligrams for a lamp of less than 30 Watt.

Health effects caused by mercury

According to the Swiss Federal Office of Public Health (FOPH), undamaged energy-saving lamps do not present any danger, as far as is currently known. However, mercury vapour can be emitted by broken lamps. This only represents a danger to health when large quantities of vaporized mercury are inhaled, which could for example happen if

several linear-form energy-saving lamps, each containing up to 15 milligrams of mercury, were to break open in a small room. Mercury poisoning causes damage to the central nervous system, with symptoms including trembling, excitability, change of character and reduced short-term memory. When high concentrations are involved cramps and paralysis may develop.

What should you do when an energy-saving lamp breaks?

- Open the windows and air the room for a good 15 minutes
- Use a cloth to carefully wipe up the glass shards, using sticky tape to gather any fine particles
- DO NOT use a vacuum cleaner as this will blow mercury vapour and particles into the air
- Place the glass shards, sticky tape and cloth in a glass jar with a screw top, seal it and take it to a recycling point

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