Mercury contamination in water can be detected with a mobile phone

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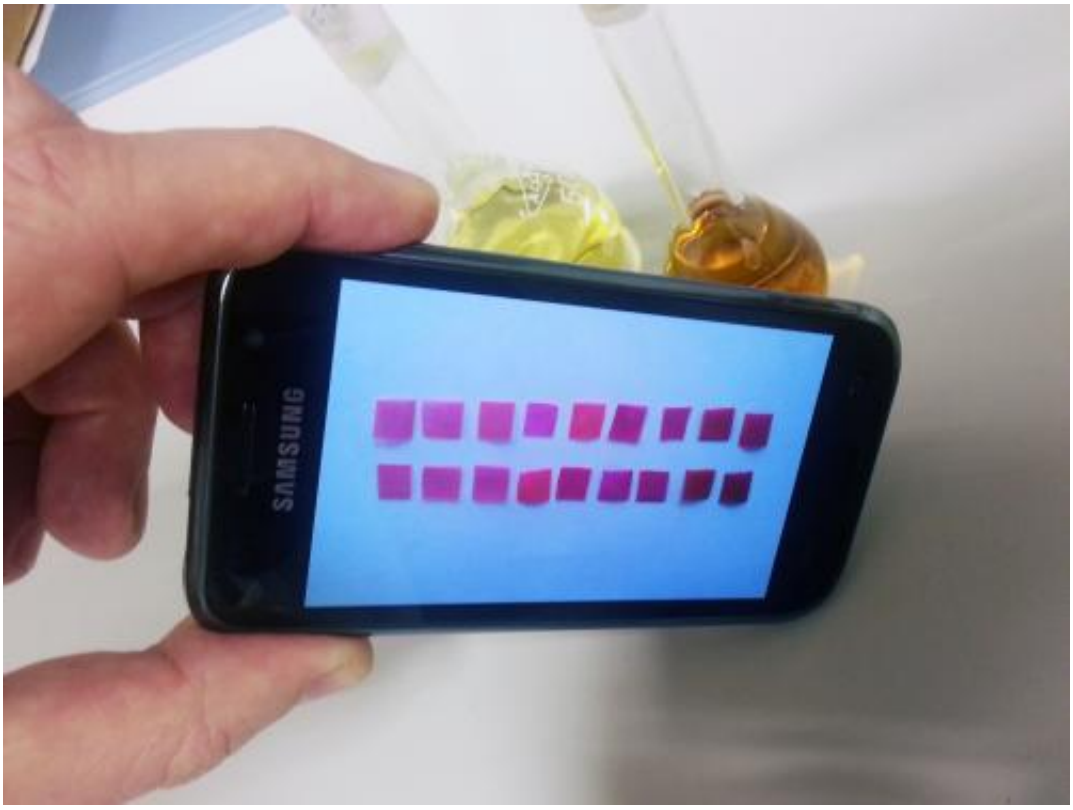

The mobile detects the differences in the color of various membranes submerged in waters with varying mercury concentrations. Credit: J. M. García et al.

Chemists at the University of Burgos (Spain) have manufactured a sheet that changes colour in the presence of water contaminated with mercury. The results can be seen with the naked eye but when photographing the membrane with a mobile phone the concentration of this extremely toxic

metal can be quantified.

Mercury contamination is a problem that is particularly affecting developing countries. It poses a risk to public health since it accumulates in the brain and the kidneys causing long term neurological illnesses. It is emitted from industrial and mining waste, especially small-scale gold mining.

A team at the University of Burgos have now developed a technique for detecting the presence of this dangerous metal in water "in a cheap, quick and in situ way," as explained to SINC by José Miguel García, one of the authors of the study. Details have been published in the 'Analytical Methods' journal.

The method consists of placing the fine sheet created by the researchers in the water for five minutes. If it turns red, this signals the presence of mercury. "Changes can be seen by the naked eye and anyone, even if they have no previous knowledge, can find out whether a water source is contaminated with mercury above determined limits," outlines the lecturer García.

In addition, if we take a photograph of the sheet with a digital camera, like those in mobile phones or tablet computers, we can find out the concentration of the metal. We only need image treatment software (the team used the open access GIMP programme) to see the colour coordinates. The result is then compared with reference values.

The membrane contains a florescent organic compound called rhodamine, which acts as a mercury sensor. "Rhodamine is insoluble in water," says the researcher. "But we chemically fix it to a hydrophilic polymer structure in such a way that when put into water it swells and the sensory molecules are forced to remain in the aqueous medium and interact with mercury."

The exact composition of the sheet can be adjusted to the desired parameters. More specifically, the researchers have calibrated the sheet so that it changes colour when limits established by the Environmental Protection Agency (EPA) of the United States are exceeded: 2 ppb (parts per billion) of divalent mercury –Hg(II), one of the most reactive, in water destined for human consumption.

Having also developed a method for other elements like iron or cyanide, the researchers believe that the water drunk in Spain "is of excellent quality due to highly efficient controls." Therefore, the technique could be used there for detecting mercury in certain spills and for studying its presence in fish.

A global problem

A recent study by the United Nations Environment Programme (UNEP) demonstrates that a large part of human exposure to this toxic metal is due to consumption of contaminated fish.

Named the Global Mercury Assessment 2013, the report analysed for the first time the mercury released into the rivers and lakes around the whole world. The small-scale extraction of gold and the combustion of coal for electricity generation seem to be behind the increase in the emissions of developing countries.

As for the sea, in the last century the mercury quantity has doubled in the first hundred meters from the surface of the planet's oceans. Concentrations in deep water have also increased by up to 25%.

To stop the global contamination of this metal, in January more than 140 countries came together in Geneva and approved the start-up of the Minamata Convention, a new international binding regulation bearing the name of the Japanese city where hundreds of people died in the

1950's due to mercury poisoning.

More information: Hamid El Kaoutit, Pedro Estévez, Félix C. García, Felipe Serna and José M. García. "Sub-ppm quantification of Hg(II) in aqueous media using both the naked eye and digital information from pictures of a colorimetric sensory polymer membrane taken with the digital camera of a conventional mobile phone". *Analytical Methods* 5: 54–58, 2013.

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