Media communiqué

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Doctoral thesis on chemicals in Lake Thun awarded prize

Flame retardants with unknown consequences

They are to be found in settees, curtains, building materials and electrical appliances. And they accumulate in various ecosystems, because they do not easily decompose. The culprits are brominated fire retarding agents, and little is yet known of their effects on man and beast. A doctoral thesis on work performed at Empa investigating the environmental effects of such chemicals, using Lake Thun as an example, generated a great deal interest at the recent Dioxin Congress in Oslo and was awarded a prize.

Many substances possess a gravely disadvantageous characteristic which only becomes apparent after they have been developed – they turn out to be extremely poisonous. In 1930 it was polychlorinated naphthalene (PCN), which vanished from the scene shortly after it was discovered because of its toxicity, then a little later came the polychlorinated biphenyls (PCBs) which lasted somewhat longer. In 1986, however, they were banned in Switzerland and in 2004 consigned by the Stockholm Convention to the “dirty dozen” group of highly toxic endocrine disruptors. Today PCBs are globally proscribed, but there are still hundreds of thousands of tonnes of these chemicals around in old transformers and other equipment.

Because both PCN and PCBs degrade very slowly in the environment they are classified as persistent organic pollutants (POPs). PCBs are suspected of affecting the reproductive capabilities of the European otter and so having contributed to the extinction of this species in Switzerland. Brominated fire retardants, which have similar chemical structures and characteristics to PCBs, have also newly been named as POPs. It is not at all clear at the moment, however, what consequences the accumulation of these fire retardants in different ecological systems may have.

Toxins with long term effects

In research work for his doctoral thesis at Empa, Christian Bogdal has since 2005 been analyzing the impact of fire retardant chemicals and other organic substances on Lake Thun. The environmental scientist from the Swiss Federal Institute of Technology Lausanne first heard of the project when it was advertised publicly. “I decided to take on the project because I am fascinated by the interaction between the environment and chemistry,” he says. The reason why Lake Thun was chosen as the subject of investigation was the widely occurring malformation of the reproductive organs of its population of whitefish. Identifying the chemicals which might be responsible for this effect became one of Bogdal’s aims. To this end he analyzed sediment from the lake bottom, water samples drawn from different layers, tributaries and outflows, as well as air

samples, and samples from surface deposits, plankton and fish. The analyses were performed at Empa's Analytical Chemistry laboratory in partnership with EAWAG, the ETH Zurich, armasuisse (the former Swiss Defense Procurement Agency) and the authorities of Canton Bern. Based on these results, in spring 2007 together with colleagues from the Safety and Environmental Technology Group of the ETH Zurich he will begin to describe the transport routes taken by the toxins with the help of a model. This should lead to an improved understanding of how these chemicals enter the ecosystem, how long they remain in global circulation, and where they accumulate.

The first results are only partially reassuring and demonstrate a clear need for action. "The PCB concentration in the Lake Thun sediment over the whole of the period under consideration – that is from 1900 to date – is very low and on the whole reducing sharply," according to Bogdal. On the other hand the dramatic increase of brominated flame retardants is cause for concern, "although until now there have been no visible effects," Bogdal explains. The concentrations measured today would not be seen as threatening by most experts. "The problem is really not knowing the possible long term consequences," worries Bogdal. In addition, one cannot rule out the possibility that the malformation of Lake Thun whitefish is caused by these kinds of chemicals.

No PCN from abandoned munitions

Bogdal's measurements also showed low PCN concentrations, an environmental toxin which found use in fog-generating munitions formerly used by the Swiss army. Since the army "disposed" of about 4600 tonnes of unwanted ammunition by dumping it in Lake Thun between 1940 and 1963, it was easy to assume that this included a certain amount of fog-generating ordnance. The low PCN values do not bear out this assumption though. The catastrophic consequences of the emission of PCN and similar chemicals into the environment from fog-generating munitions were described in an army document which was long kept under lock and key. Use of the ordnance in exercises during the Second World War resulted in the compulsory slaughter of 15,000 cattle because of the severe symptoms of poisoning they suffered.

The project, which is supported financially by Empa and Swiss National Research Fund, runs for another 18 months. Despite this, Bogdal has already presented his first results at the Dioxin Conference in Oslo, internationally the most significant conference in the field of POP research. For his efforts he was honored with the coveted «Otto Hutzinger Student Presentation Award», of which he is very proud. "I am very pleased that the experts have recognized my work in this way," he says. The prize was presented by Heidelore Fiedler of the United Nations Environmental Program (UNEP). The glass bow of a Viking ship symbolically represents the fight against dioxin as the epitome of environmental pollutants.

That something must be done soon against the effects of brominated flame retardants and other endocrine disruptors is for Bogdal self-evident. The consequences for humanity are currently practically unknown, and the distribution in the environment already so widespread as a result of the slow rate of degradation that POPs have even been discovered in seals and polar bears at the North Pole. Due to their tendency to accumulation in the food chain POPs have also in many places – including Switzerland – been found in mother's milk.

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«We have to do something before it is too late», urges prizewinner Christian Bogdal.

Christian Bogdal has declared war on the mostly unknown effects of these toxins. This struggle is depicted symbolically by the Viking ship with the dioxin molecule.

Christian Bogdal taking a water sample from Lake Thun

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Several drill cores from the bottom of the 220m deep Lake Thun have already been analyzed by Christian Bogdal.

The images in high resolution format are available from sabine.voser@empa.ch