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Facades: a source of water pollution

For many years, fingers have been pointed at agriculture whenever pesticides are detected in rivers and streams. Studies carried out by Eawag and Empa now show that built-up areas also account for a considerable proportion of such inputs. For example, substances can be leached out of facade renders and paints by rainwater and enter the environment, where they may have toxic effects on organisms. In cooperation with manufacturers, cantonal authorities and other partners, the researchers have studied these leaching processes and are currently discussing ways of tackling the problem.

The Zurich Office of Waste, Water, Energy and Air (Awel) routinely analyses surface waters for pesticides, and excessive pesticide concentrations are regularly found in individual watercourses. Recent measurements carried out on the Furtbach stream (at Würenlos) and on the Glatt river identified 26 active substances. In the case of 22 compounds, the quality standard specified in the Federal Water Protection Ordinance (maximum level of 0.1 µg/l) was exceeded, with concentrations in some cases being several times higher than permitted. Not all of these substances can be of agricultural origin: certain agents are prohibited for agricultural applications, or their concentrations do not exhibit the seasonal pattern typical of products used in the fields, so they must come from a different source. These findings are confirmed by studies performed by Eawag on effluents from wastewater treatment plants and on rainwater runoff in the catchment of Lake Greifen, which clearly indicate that non-agricultural sources also contribute significantly to water pollution via urban drainage.

Up to 300 tonnes of biocides a year

As part of the URBIC project, researchers from Eawag and Empa (the materials science and technology research institute) have demonstrated – under both laboratory and real-life conditions – that a number of biocides are leached out of building facades. To provide anti-algal and antifungal protection, these substances are standardly added to synthetic resin-bound paints and renders for exterior insulation systems. It is estimated that 60–300 tonnes of biocides are used for such applications in Switzerland each year. The use of biocides has risen sharply as a result of improved thermal insulation and current architectural trends (short or non-existent roof overhangs).

Peak concentrations with first rainfall

To quantify leaching, facade elements in the laboratory were subjected to artificial rainfall and exposed to ultraviolet light and various temperatures. Tests were also carried out in the open air under real-life weather conditions, using a specially constructed small building (see photo). Finally, researchers also performed experiments on several new buildings in the Zurich region. Biocide concentrations were found to be extremely high especially in the first facade runoff collected from freshly rendered or painted houses. For example, the concentration of diuron (herbicide) measured in the first litre of facade runoff was 7000 µg/L. If released into a stream, this litre would therefore have to be diluted by a factor of 70,000 so as not to exceed the standard specified in the Water Protection Ordinance. This shows the problems that may be associated with the infiltration of facade runoff and drainage from urban areas into small waterbodies. Subsequently, however, concentrations declined rapidly, both during prolonged rainfall, and following further rain events. Leaching rates are dependent not only on

the solubility of the agent in question, but also on the photochemical degradation of substances and on the quality of the renders and paints.

Effective in minute concentrations

According to the study, there is no doubt that the biocide concentrations measured in the facade runoff and additionally estimated using a computer model have toxic effects on algae and aquatic plant and animal life. Contaminated facade runoff can enter watercourses directly via drains or stormwater sewers. Substances that inhibit algal growth on facades exert the same effects in waterbodies – even when heavily diluted. It is known that even a few nanogrammes per litre of certain substances can produce toxic effects; these include the marine antifouling agent cybutryne (also known as Irgarol®1051). It is thus important not only to bear in mind the general legal quality requirements but also to identify substances that are of particular ecotoxicological concern. In addition, a great deal of research is still required to elucidate the environmental effects of “cocktails” of substances.

Developing solutions with practitioners

Michael Burkhardt, who coordinated the URBIC project, points to the existence of a regulatory gap in the Biocidal Products Ordinance, since direct inputs of material protection agents from facades into receiving waters are not covered at present. Burkhardt emphasizes that, in general, greater attention needs to be paid to the selection of construction materials and water quality in the disposal of rainwater from urban areas. In his view, it is also legitimate to question the need for the routine use of biocides, since algal and fungal growth is certainly not to be expected everywhere. In addition, many facade-related problems could be avoided: architects could include moisture control as a design element. Likewise, property owners could assume greater responsibility through upkeep measures such as facade cleaning or tree pruning, rather than demanding warranties. As a result of guarantees, in particular, manufacturers feel increasingly obliged to incorporate biocides into synthetic renders and facade paints. However, the research team is also involved in discussions with manufacturers concerning innovative embedding processes for biocides and the use of less problematic agents or biocide-free coatings, and it is promoting a close dialogue between academia, industry and the authorities.

Box: Additives

Additives are substances added to products in small quantities to confer or enhance certain properties. This general term encompasses, for example, antioxidants, ultraviolet filters and flame retardants. Although biocides are also additives, they are governed – in view of their specific effects on organisms – by the Biocidal Products Ordinance (VBP). This regulates the authorization procedure, use in products and product labelling. The Swiss VBP, which has been in force since 2005, is in line with the EU Biocidal Products Directive (98/8/EC). To protect facades against fungi and algae, a relatively small number of biocides are available. These are used in combination as mixtures in synthetic resin-bound renders and facade paints. In some cases they contain agents also used in agriculture, e.g. the herbicides diuron and isoproturon, which also have algicidal properties. Some of the substances are no longer approved for agricultural applications (e.g. terbutryn) or are known from other areas – such as the algicide cybutryne, which is used in marine antifouling paints.

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Eawag and Empa researchers use this model building to study how rainwater leaches out biocides used as antifungal and antialgal additives in facade paints and renders.



Collection of samples from a rainwater drain in a new residential area in Volketswil (Canton Zurich).



Researchers used these drainpipes to catch facade runoff from new buildings in Volketswil (Canton Zurich). Concentrations were found to be particularly high in the first litres sampled.