Environmentally safe system for treatment of bio corrosion of ETICS

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Abstract. Effects of microorganisms on building facades are responsible for aesthetic, bio-geophysical and biogeochemical deterioration. The process of cleaning of contaminated facades involves the removal and eradication of micro flora on the surface of insulation using chemical products, killing cells and eliminating all living mass, including organic ingredients. The removal of bio corrosion coating from ETICS structure by means of chemical and preservative substances (biocides) is currently the only effective and most used technology. Uncontrolled leaching of the used biocides is unacceptable. Meantime, new technology for environmentally safe maintenance of ETICS is needed. Scientists have been working on replacement the biocides currently used in facades treatment with eco-friendly biocides that have no negative effects on the environment or human beings. While the eco- treatment will be available, safe dewatering of chemicals being leached from the surface of the facade could be provided by e.g. special drain systems adjusted to the building type, use and age. The paper gives an overview of the problem in context of Slovakia and examples of leaching systems designed for new and renovated buildings.

1 Introduction

World Commission on Environment and Development (WCED) understands the concept of sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This requirement is contrary to uncontrollable and rising demand for chemical products in construction practice and maintenance of buildings.

Maintenance of bio corrosion of existing External Thermal Insulation Composite Systems (ETICS) is mostly based on chemical disposal of microorganisms. It means removal and eradication of micro flora on the surface of insulation using chemical products, killing cells and eliminating all living mass, including organic ingredients. Fact is, that removal of algae coating from ETICS structure by means of chemical and preservative substances (biocides) is currently the only effective technology [1].

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Maintenance and protection cycle of the ETICS related to bio-corrosion resistance is then proposed in the interval of 3-6 years, depending on other factors. The expected life of ETICS is 25-30 years (ETAG 2004) so this treatment should be repeated [2].

Fig. 1. Typical façade with bio corrosion. Deteriorated areas reflect climate conditions of the environment (direction of prevailing winds, defects in plumbing, sealing etc.). Bratislava, Lamač. Author of a picture: K. Minarovičová.

Studies in the field of ETICS colonization by microorganisms have been oriented to assess the significance of colonization [3-4]. The chemicals used for microorganisms' elimination on the facades, either as bounded, encapsulated in pigments and plaster or loose, un-encapsulated agents, reducing their development and growth, containing mainly toxic heavy metal compounds, are based on the basis of active silver. Their durability in applications is controversial; some research results show the opposite, bio accumulative effect and the negative impact of toxicity to the environment. This situation is unsustainable [5]. Biocidal products can pose risks to humans, animals and the environment. As a result, the EU has set up strict rules and procedures to ensure a high level of protection for human health, animal health and the environment.

European legislation on chemicals has changed in recent years and four regulations have been introduced to ensure the free transfer of chemicals in the European Union and a high level of protection for human health and the environment [6]:

- REACH - Regulation on the Registration, Evaluation, Authorization and Restriction of Chemical Substances;
- CLP - Regulation on Classification, Labelling and Packaging of Substances and mixtures;
- BPR - Biocidal Products Regulation;
- PIC - Prior Informed Consent Regulation (concerning the export and import of hazardous chemicals)

The Biocidal Product Regulation (BPR, Regulation (EU) 528/2012) concerns the placing on the market and use of biocidal products, which are used to protect humans, animals, materials or articles against harmful organisms, like pests or bacteria, by the action of the active substances contained in the biocidal product. This regulation aims to improve the functioning of the biocidal products market in the EU, while ensuring a high level of protection for humans and the environment. It repealed the Biocidal Products Directive (Directive 98/8/EC).

In Annex V to the BPR the biocidal products are classified into 22 biocidal product-types, grouped in four main areas. The most used products in the building industry are preservative agents PT7, PT8, PT10 and PT12 - in group- preservatives. There is recorded more than 1000 types of biocides.

2 Sustainable ETICS maintenance

There are 2 basic types of technologies for removal of microorganisms [7]:

1. Elimination of microorganisms by biocides, which is used in combination with subsequent washing of the cleaned surfaces with power water,
2. Application of biocides, contaminated surface should be dry cleaned if needed or washed with pressurized water before application of biocides.

When using both technologies it leads to rinse off chemically active substances to the environment at an early stage during the washing of dead residues of biofilm from the surface of the facade, followed by washing by rainwater or rinsing as a long-lasting washing of the façade surface.

Maintenance of ETICS may be operative or planned; in practice they are often combined. Operational disposal is in fact high-efficiency decontamination according to required technological procedures. The planned maintenance is related to a professional planning approach. It should be based on the ETICS manual of use, which contains information on the maintenance intervals and the renewal of the surface biocide protection [8].

3 Sustainable leaching systems

The concept of a safe drain of chemicals leaching from the facade must take into account building structural system of the building, perimeter wall construction, the purpose of the building, arrangement of house surroundings, financial and technological context of bio corrosion elimination. Drain system must be designed with regard to the amount of water required to wash the facade (for regular cleaning of the facade biocide solution) or on the amount of precipitation water in a given area (spontaneous leaching of biocides) [9-10].

The collected water must be piped into collection containers, respectively tanks; they will be transported for processing or disposal in accordance with applicable legislation.

Fig. 2. Gutter leaching system (temporary structure). **Fig. 3.** Line drainage channels (permanent).

Leaching system may be applicable as:

- a) special biocide-resistant foils at the level of the perimeter sidewalk, the problem can be the collection of contaminated water from these areas,
- b) flat collection mechanism - like in the previous case - under the surface of the thermal insulation (e.g. underpass)
- c) gutter at the plinth profile of thermal insulation structure (installation of hooks carrying gutters sloping into the collecting containers. During construction it would be necessary to prepare profiles for the anchoring of the hooks, that will be settled during regular cleaning and the contaminated water should be collected in collecting receptacles and prepare for further processing - Fig. 2),
- d) linear drains around the house - at the level of the surrounding terrain (the line drainage channels around the house that remain part of the house surroundings with the possibility of collecting the water-contaminated water should be collected in collecting vessels and prepared for further processing or through filtering and decontamination shafts the system will be connected to the sewer system, shafts or drain into the surrounding green - Fig. 3). This system ensures the permanent collection of chemically active substances washed from the surface of the insulation and is part of the house pavement. The installation of line drainage or filtration drains is part of planned maintenance.

4 Conclusions

Drain construction system will have to adapt to the design of the facade and to its close surroundings. Uncontrolled leaching of the used biocides is unacceptable. We have to

develop technology, which controls the release of biocides into the environment, especially in soil and water. Research on reducing the use of biocides by supplementation with enzymes and bio dispersants is in progress. It is needed to replace the biocides currently used in facades treatment with eco-friendly biocides and have no negative effects on the environment or human beings.

The "polluter pays" principle is becoming a common policy (Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage) [11-12]. On the other hand, we believe that if the current trend is back to the nature, maybe in this area it would be easier to replace the effort to regulate biological organisms on ETICS by the desire to exploit their natural characteristics in the built environment.

There is a wide range of materials used for ETICS finishes. It is important to take into account reliability and maintainability of the construction in the whole life cycle of a building. Operation and maintenance should be a significant element of the life cycle cost of a building.

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