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THE ENVIRONMETAL ASPECT OF ETICS REGULAR MAINTENANCE

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ABSTRACT

Most of current External Thermal Insulation Composite Systems (ETICS) is protected from microbial attack by use of biocides mostly in base or finish coat/paint however this protection is time limited. Leaching of these biocides is not controlled yet. There are various studies [1-5] examining possibilities of collecting and processing the wastewater, the others try to find out new bio-biocides without negative effects on the environment. Another point of view is regular maintenance of ETICS surface that is one of the most important factors of prevention of biocorrosion. The technology includes biocide decontamination processes, mechanical cleaning, rinsing of surface by a pressure cleaner and a preventive coating with a biocidal preparation. In this maintaining process, ambient environments are loaded with running water with detergents which are usually based on heavy metals. System designed to collect wastewater from the cleaned surface is currently considered as the most effective way to reduce unwanted effects of biocidal substances on the environment throughout the whole lifespan of ETICS.

INTRODUCTION

Evaluation of environmental effect of construction industry is an extensive issue dealt with by many researchers and companies. It is important to take into account the whole lifespan of biocides. Use of biocides and their presence in the natural environment can affect fauna and flora even at low concentrations [1-3]. Latest research studies confirmed that substances released from facades and buildings can be transported, accumulated, degraded, and also up taken by living organisms, including humans [6]. According to research on toxicity of building materials [7] combination of physical and chemical properties of construction elements with their treatment - e.g. biocides - may result in creation of more dangerous substances than the parent compounds and can also interact with other agents. The goal of current architecture is to use resources more efficiently and to reduce a building's negative impact on the environment. However, many of the chemicals used in construction products have not undergone a risk assessment and assessment techniques are still developing.

Set of regulations and procedures has been created in the EU region to control and regulate use of chemicals (not only) in building industry. There are four most important regulations that have been introduced to ensure the free transfer of chemicals in the European Union and to ensure high level of protection for human health and the environment:

- 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

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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). The "polluter pays" principle is becoming a common policy according to Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage and according to Regulation (EU) No 1062/2014.

In context of regular ETICS maintenance in Slovakia it is very important to follow a law regarding water (In Slovakia – Act No. 409/2014 based on the Directive 2006/118/EC on the protection of groundwater against pollution and deterioration and Directive 2014/80/EU amending Annex II to Directive 2006/118/EC). According to current regulations it is obligatory to ensure protection of the environment (mostly soil, water and flora) against chemically contaminated water being leached during the cleaning and treatment of ETICS. This fact is very often neglected by owners and building/facility managers.

Figure 1. Typical sign of contamination by biocorrosion - local contamination show process of water run-off on façade and failures of metal flashigs.

BASIC RULES OF REGULAR ETICS MAINTENANCE

Maintenance cycle in order to prevent biocorrosion is recommended in 3 to 5 year intervals, depending on various factors. Expected lifespan of ETICS according to (ETAG 2004) is 25-30 years. It means that disposal of wastewater during cleaning occurs at least 4 to 5 times during the entire lifespan of ETICS [8].

First step is visual and laboratory assessment of the severity of the ETICS technical condition that results in decision for the choice of recovery. Diagnosis of building construction is carried out by visual, basic, preliminary or detailed surveys, at which the procedure and extent is not mandatory, there are several methods used:

- **non-destructive (indirect)** - minimum damage, or no damage at all of strata of thermal insulation composite system. These methods include visual assessment and determination of the area of biocorrosion, evaluation of the samples of biological material by dross, laboratory cultivation of biological material, measure the size of the cracks, measuring humidity, absorbability, temperature displaying, acidity test.
- **destructive (direct)** - these methods require structural failure of ETICS construction. The most common way is to carry out a probe in order to verify the composition of strata and the

technology of recovery, laboratory verification of physical properties, in particular of plasters, and also verification the presence and penetration of biological organisms into strata.

The proper assessment of the condition of ETICS based on its complex diagnosis results in a decision for the most effective technology for its treatment. The basic conceptual design of disposal of micro-organisms and their prevention is based on laboratory examination of types of micro-organisms and their degradation effects. Disposal technology is therefore considered as operational technology, with direct mechanical and chemical intervention to minimize further colonization of surfaces [9]. In terms of affecting the original layers of ETICS the disposal technology may be:

• conservative (technology with minimal intervention to the original strata of ETICS)
• radical (technology with mechanical intervention to the original strata of ETICS).

Conservative technology means decontamination and repair or maintenance, as part of secondary prevention. The principle of this technology is combination of mechanical and chemical action; in fact it means an effective way of cleaning. This type of technology is considered as a barrier protection of ETICS surface. The technology requires periodicity over the life cycle of ETICS. However, in the case of failure of adhesion of strata, reduction of mechanical or physical properties of ETICS, decrease of plaster hydrophobicity, or lack of thermal properties of ETICS or penetration of micro-organisms into the layers of insulation- then it is appropriate to consider radical technologies such as recovery - replacement and completion of insulation layers (finishing or insulation with new plaster) or total replacement of insulation. By combining several techniques, it is possible to achieve the desired effect in all of stages of bio-corrosion severity. Regular cleaning, sealing of joints and cracks, and regular monitoring of the ETICS condition are the most important measures for biodegradation prevention [9].

Figure 2. Taking of samples with sampling tape (Fungitape) from the surface of contaminated plaster [10].

Figure 3. Sampling by tape from the strata under the plaster [10]. Sampling must be complemented by samples of surrounding facades- for comparison.

LEACHING OF CONTAMINATED WATER

Basic rules for cleaning surface of ETICS contaminated by microorganisms implies, that the most optimal time interval for application of the product is when the algae and microorganisms go through vegetation period, spring and fall [8]. The disposal of microorganisms can be realized within of the building options and the site construction from scaffolding, or from the assembly platform. Construction site must include source water designed to rinse surface of the façade and also electrical energy source. Construction site also must include collecting mechanisms for runoff water with applied active substance according to the legislation. Collected wastewater must be drained into collecting tanks, which need to be always accessible on the construction site. Contaminated water must be disposed of according to legislation in force. It is unacceptable to drain the contaminated water with active chemical substance into a sewage system without the permission of the canalisation network administrator. The drainage system has to be designed with regard to the amount of water required for washing and regular cleaning of the facade.

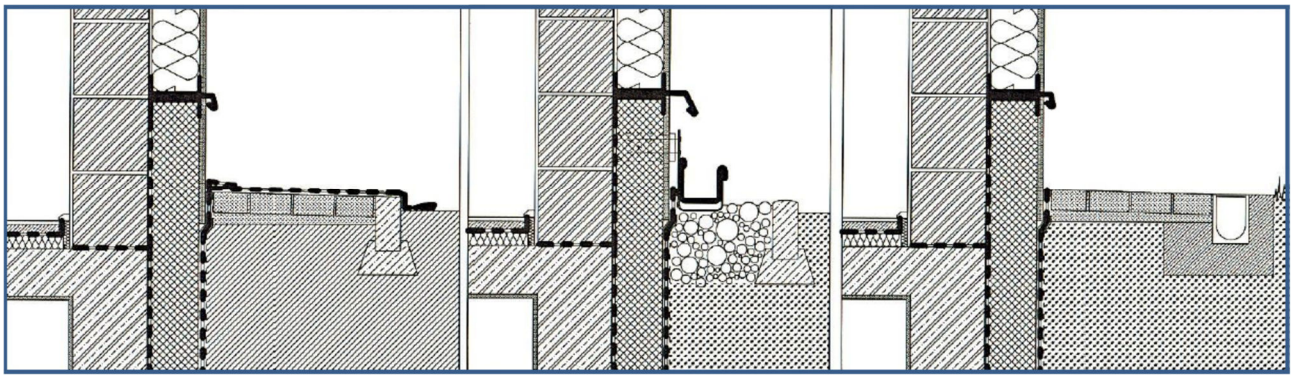

Figure 4. Example of leaching systems according to [12]: a) easy operational temporary solution with absorbing mats (they must be treated as hazardous waste; there is a risk of leaching of liquid into the ground), b) gutter leaching system as temporary structure, c) line drainage channels as permanent structure that is part of the building design.

According to [12] there are more ways of disposal of contaminated water drained from the façade- one of them is gutter leaching system as temporary structure (Fig. 4b) or line drainage channels as permanent structure as a part of the building design (Fig.4c). Use of Both systems must be taken into account already during project phase of renovation or new construction with ETICS. The simplest way is use of absorbing mats (Fig. 4a) however it is less effective and there is a danger of leaching the wastewater into the ground.

Another approach of environment protection during ETICS maintenance is based on operational and easy applicable system designed in [13]. The authors invented an easy operative system with use of portable gutters laid on wooden or concrete pads of different sizes that produce decline of the gutter and so enable leaching contaminated water to collection tank. Waterproof membrane of about 1m width must be used in order to ensure safe leaching of water to the gutter (Fig. 5). Collection of wastewater can be provided by gravity or by pumping with small submersible pump into a collection tank. The advantage of this system is its easy application and multi usability with reduced capital costs of the maintenance. System designed to collect wastewater from the cleaned surface is considered an effective way to reduce unwanted effects of biocidal substances on the environment throughout the whole lifespan of ETICS.

The comparison of investment costs therefore confirmed [13] that after multiple uses, the cost of the operational solution is much lower. The high costs of planned drainage systems are mainly influenced by the cost of the collection tank that needs to be connected to the system and placed underground. Case study [13] showed that ninety percent of water used for cleaning of the ETICS can be collected. This solution seems to be very effective and easy applicable alternative system.

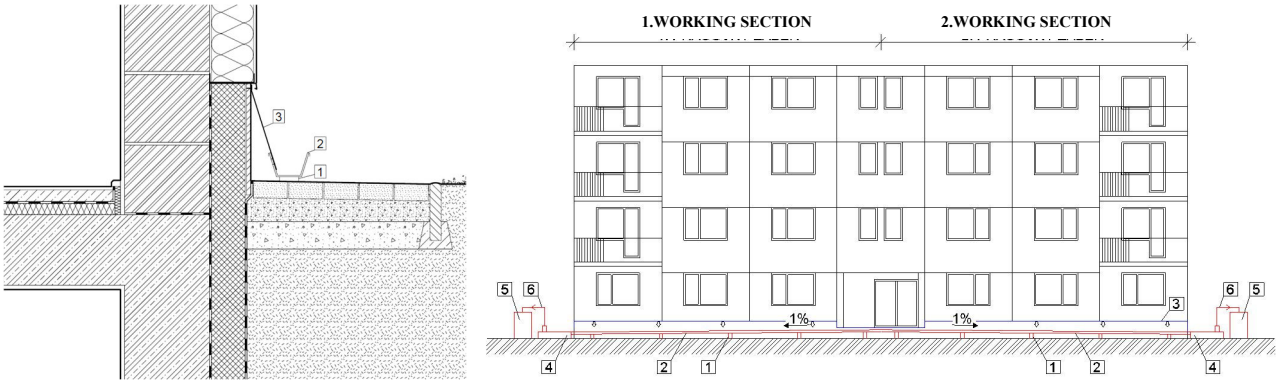

Figure 5. Proposal of temporary solution for leaching of contaminated water [13]: a) temporary leaching system (detail in a plinth) b) view: 1. wooden (concrete) pads, 2. collecting inclined gutter, 3. membrane attached to the object, 4. collecting container for contaminated waste water, 5. collecting tank for pumping water, 6. pump

CONCLUSIONS

Uncontrolled leaching of the used biocides is unacceptable. Leaching should be predictable, regulated and the amount of leached compounds comparable. New knowledge on compounds behaviour in leachates should be incorporated in legislation and in new technologies for prevention and remediation of facades with biocorrosion on ETICS. One of the possibilities is use of biological biocides (enzymes, parasites, plants etc.). Finally, biocides used for the protection of facades should be non-persistent, non-bio accumulative and non-toxic to organisms. However, the residues of some biocides can be more toxic than parental compounds and it is not exactly known yet how some of them behave in mixtures with other chemicals [7]. In the case we can´t avoid use of biocides based on heavy metals it is inevitable to control the release of biocides and its transport to surface and groundwater.

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.

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