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Use of Electron Microscopy in the Evaluation of the Bio-corrosion of Interfloor Flagstone.

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Some time ago, the damages caused by microorganisms to constructions were worse than at the present time and less attention was paid to this fact but today there are many investigations on the area. The aforementioned attack is known as bio-corrosion, and microorganisms are responsible for diverse aspects of the corrosion. It is for this reason the great importance that has for the recovery or rehabilitation of the building, the evaluation of the causes of this phenomenon using different techniques.

In the present work it was studied the problems of corrosion observed in the interfloor flagstones of a group of buildings, where it was noticed strong deterioration of the structural elements. The objectives of the work were: a) To study the topography of the diverse materials that compose the flagstone of different areas, looking for any defect and presence of microorganisms; b) To compare the results of the physical-chemical rehearsals with the obtained by elemental analysis by EDX; c)To determine the cause that originated the bio-corrosion in the flagstone to be able to begin with the rehabilitation of the structure.

After inspection of the structure they were carried out physical-chemistry studies to the concrete of the flagstone starting from rehearsal according to ASTM norms of contents of Cl^- (ASTM D512), $CaCO_3^=$ (ASTM D1067), $SO4^=$ (ASTM D516) and pH (ASTM 1293). In order to observe the possible morphologies and chemical composition in the materials of the structural element of study, it was used SEM with EDS detector. To identify the microorganisms it was used light microscope and TEM. The physical-chemical studies carried out on the concrete showed high concentration of $CO_3^=$, Cl^-, $SO4^=$ and $S^=$, as well as a less alkaline pH of that required (smaller than 12.5).

As concrete is isolated it was ruled out that high levels of $CO3^=$ was possible due to the effect of the CO_2 that spreads from the enviroment, and probably the microorganisms are responsible for this effect. Figure 1 shows the products of biological metabolism with enrichment of calcium, EDS studies (Table 1) shows the results of the elemental analysis. In figure 2 it is possible to appreciate the zincite formation and simonkoleite as zinc corrosion products in the galvanized steel sheet in the external face of the flagstone. Figure 3 shows the maghemite formation as corrosion product of the steel in the interior face of the flagstone.

On the other hand it is possible to conclude that the presence of microorganisms in the flagstone is possibly owe to the wrong employment of building supplies and to the non execution of the constructive methods demanded by the Venezuelan and International construction laws.

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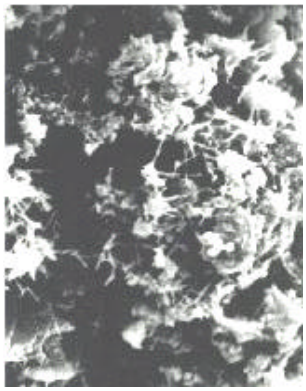
Table 1, EDS Analysis.

Sample	%C	%Ca	%O	%Zn	%S	%Cl	%Al	%Na	%Si	%Fe
Concrete, near the steel Analysis of metabolism product	5.1	35.5	3.3	4.5	___	___	0.5	___	___	10.0
Concrete near the steel.	0.7	1.6	9.8	2.0	___	___	0.4	0.6	1.5	83.5
Concrete steel Galvanized.	0.1	0.2	9.7	___	___	___	___	___	0.2	88.7



5um

Figure 1

5um

Figure 2

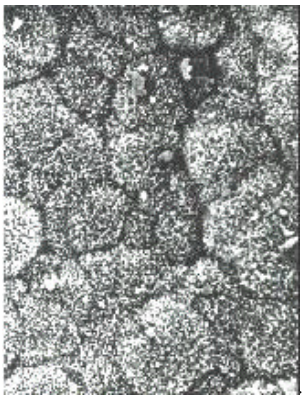


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Figure 3

Figure 1: Products of biological metabolism.
Figure 2: Zincite formation and simonkoleite, external face of the flagstone.
Figure 3: Maghemite formation, interior face of the flagstone.

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