

CHEMICAL INVESTIGATIONS OF INCRUSTED STONE ON HISTORICAL MONUMENTS

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The corrosion damages on natural stones of historical buildings have accelerated during the last decades. The cause of the accelerated corrosion is connected to the nature of building materials, partly with construction style, but the most important factors are environmental conditions. After some years the built stone becomes discolored or covered by aggressive incrustations/crusts and finally the stone may be totally destroyed. The knowledge of causes and mechanism of decay is necessary for the conservation of historical monuments. Especially, it is very important for the choice of appropriate ways of cleaning of incrustated stones. These problems were subject of the investigations carried out on the monument "Unknown soldier" on the Mt. Avala near Belgrade.

The monument built from 1934 to 1938 is made of blocks of gabbro (Jablanica quarries). In this monumental mausoleum, 3971.95 m³ of stone blocks were built (ZIVANOVIC, 1962). The blocks are of different size and mortar connected with some joints filled by molten lead. At that time building contractors put sheets of lead alloy between the blocks. Today, we found relicts of these sheets and lead in empty joints. After 65 years of their exposing to atmospheric influence the stone blocks show different forms of physical-chemical and biological degradations.

A visual observation of stone blocks pointed out immediately on the very different state of the gabbro decay between the outer part (exposed to rain water) and the protected, inner one. On the outer parts of facade the most important damage types of stone are: blistering, peeling, granular disintegration and scaling. All of these pathological forms are induced by aggressive incrustations from joints (MATOVIC & ROSIC, 2004).

The two different types of incrustations were identified on stone surfaces (white and black). Using X-ray diffraction (XRD) it was possible to identify their mineral compositions responsible for the genesis of stone decay. The following associations of minerals were identified in samples of incrustations:

white sample: hydrocerussite $Pb_3(CO_3)_2(OH)_2$, X $NaPb_2(CO_3)_2OH$, plumbonacrite $Pb_{10}(CO_3)_6(OH)_6O$, calcite - $CaCO_3$;
black sample: anglesite - $PbSO_4$.

The forms of decay and obtained data show that the main causes of gabbro decay are atmospheric water, moisture, frost, hard dissolved salts, dissolution of mortar and lead in joints, thermal changes of stone etc.

References

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ZIVANOVIC, G. (1962): Vesnik, br. 13-14. Vojni muzej - Beograd, 1968: 247-275.