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Material properties of Godula sandstones and forms and reasons of their deterioration in constructions in industrial environment of the Ostrava region

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The Upper Cretaceous green glauconitic sandstones, referred to as Godula or Těšín sandstones according to their stratigraphic position or area of mining, represent a traditional building and decorative stone widely used since the turn of the 19th and 20th centuries in constructions in the industrial region of Ostrava and adjacent part of the Těšín Silesia. In terms of their physical and mechanical properties, the sandstones can be characterized by high values of bulk density, low absorption capacity and low total porosity, high abrasion resistance, high to very high values of strength properties and high fracture toughness. Due to their high compactness and strength, they can get relatively good polish, as one of few sandstones mined in the Czech Republic. However, in contrast to high quality of physical and mechanical properties of the Godula sandstones, degree of their durability in the case of exterior use is often very low. Already after 5 to 10 years of exposure to weather, moreover in combination with road salting, almost total surface decay of the stone can occur. In order to determine the reasons of usually very rapid degradation of the Godula sandstones in exterior conditions, time-dependent water saturation and evaporation, and size distribution and shape parameters of rock pore space were determined using the Hg-porosimetry and the X-Ray computed micro-tomography. It has been found that typical for the Godula sandstones is a closed pore space with domination of small pores (<500 nm) of configurative and cemented type in the matrix with gradual saturation of pores by water and retardation of evaporation from the rock surface. Therefore, there is high probability of water retention in the pore system with all consequences on rock stability, for example, due to freezing and thawing. The process of stone weathering can also be encouraged by the chemistry of authigenic glauconite which is a typical mineral component of the Godula sandstones, as well as by presence of authigenic carbonates (dolomite and calcite) in the matrix and presence of very fine-grained framboidal pyrite localized especially in upper and more lutitic parts of sedimentary bodies. Using the method of 57Fe Mössbauer spectrometry, the Fe2+/Fe3+ ratio close to 1:1 in the crystal structure of glauconite separated from the Godula sandstones was estimated. In glauconite in the Godula sandstone, there is a sufficient quantity of Fe2+ which can be transformed to the Fe3+ form by the weathering process, which causes glauconite instability in the contact with the atmosphere. Structural features of rock are other risk factors influencing weathering. The Godula sandstones represent deep-marine turbiditic sediments with typical graded bedding. Problematic parts represent thin laminas rich in clay matter with dominant illite and/or illite/smectite mixed-layers in upper parts of mined sedimentary bodies. Due to significant structural anisotropy of the Godula sandstones, the final form of stone element degradation is also affected by the relationship between cutting plane during stone block processing and bedding planes. Ignorance of these aspects which influence durability of the Godula sandstones in exterior is the reason of often inappropriate use of stone in building industry in the environment affected by temperature and moisture changes which may result in early rehabilitation or reconstruction of constructions.