Characteristics and behaviour of the mudstones from the Upper Triassic

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In sites where the mudstone was recently excavated, after exposure to persistent rain, the surface of the ground was transformed from a soft rock to a muddy ground impeding or turning very difficult the traffic of the equipment and the prosecution of the normal construction tasks. The Portuguese mudstones (siltstone and claystone) dated from the end of the Triassic, often show severe geotechnical problems when affected by engineering works, changing very rapidly from a soft rock to soil when uncompressed and in the presence of water. To evaluate their characteristics, field and laboratory tests were executed. The mineralogy is constituted essentially by illite (or muscovite), kaolinite, chlorite and quartz. Calcite and dolomite can also be found. Despite the geotechnical problems they present, they do not contain expansive minerals (smectite). In the intact rock, the porosity is about 15 to 20%, but with very fine pores, presenting a unimodal distribution, with dimensions around 0.03 to 0.05 micra. The total area of pores of the mudstones is from 10 to 14 m^2/g. The apparent unit weight of the intact mudstones is ca. 22 kN/m^3. The point load strength is under 1.27 MPa when dry, reducing drastically even below 0.1 MPa after a few minutes of submersion, corresponding to water content between 5% and 15%. After the 2^{nd} cycle of the "Slake Durability Test" 60% of the mudstone is lost, being disintegrated until the 6^{th} cycle. The expansibility is more intense in the first minutes of wetting, stabilizing after 10 to 20 minutes, developing an expansion stress between 0.1 MPa in the intact rock, up to 0.35 MPa in the soils derived from the laboratory disintegration of these soft rocks. These soils have a PL=24% and a LL=34%. The methylene blue value (VBS) is between 0.5 and 1.2 g/100g. According to the unified soil classification, the disintegrated soil derived from the mudstone is ML-MI (silt of low to intermediate plasticity) or CL (low plasticity clay). Using the AASHTO classification the soils are A1 (silty soil) or A6 (clay soil). Using the LCLC/SETRA classification the soils are A1 (low plasticity silt). The results from the SPT tests and from the dynamic penetrometers (DPSH) showed very low penetration strength at the surface of the muddy material, increasing very rapidly in depth when reaching the less weathered material. In vertical cuts with moderate heights in the periphery of the work area, the behaviour of the *in situ* and undisturbed mudstone was quite reasonable without significant degradations or instabilizations of the cut face. These abrupt properties transition showed that a reasonable way to prevent the degradation of the mudstone is avoiding both the relief of the vertical stress and the contact with the water. In conclusion, the field observations and the tests executed allowed to clarify the causes of the deleterious geotechnical behaviour of these mudstones, in particular when they are subjected to human intervention, associated with the presence of water during the execution of engineering works. The Triassic mudstones are an unusual soft rock material, with very fine pores, without expansive clays, suffering rapid degradation, loosing strength and durability, showing an evolution from a soft rock to a muddy soil, when wetted or saturated, more rapidly than it was anticipated by the field observations, creating very serious geotechnical problems of exposed ground surfaces without any confinement. The more problematic situations are related to foundations and slopes, which suffer degradation after intense rainfalls following the exposure or remobilization of those materials. The extremely fast weatherability of these mudstones after wetting, mainly results from the fine equidimensional network of pores, developing high capillarity stress and driving rapidly the water to the interior of the material. The water absorbed destroys the cohesion forces between the uncemented silt particles, turning the soft rock in a muddy soil.