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Phosphate Tailings in View of a Better Waste Disposal And/or Valorization: Case of Tunisian Phosphates Mines

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Abstract : In the context of sustainable development and circular economy, waste valorization is considered a promising alternative to overcome issues related to their disposal or elimination. The aim of this study is to evaluate the potential use of phosphate sludges (tailings) from the Kef Shfeir mine site (Gafsa, Tunisia) as an alternative material in the production of fired bricks. To do so, representative samples of raw phosphate treatment sludges were collected and characterized for their physical, chemical, mineralogical and environmental characteristics. Then, the raw materials were baked at different temperatures (900°C, 1000°C, and 1100°C) for bricks making. Afterward, fired bricks were characterized for their physical (particle size distribution, density, and plasticity), chemical (XRF and digestion), mineralogical (XRD) and mechanical (flexural strength) properties as well as for their environmental behavior (TCLP, SPLP, and CTEU-9) to ensure whether they meet the required construction standards. Results showed that the raw materials had low density (2.47g/cm 3), were non-plastic and were mainly composed of fluoroapatite (15.6%), calcite (23.1%) and clays (22.2% - mainly as heulandite, vermiculite and palygorskite). With respect to the environmental behavior, all metals (e.g., Pb, Zn, As, Cr, Ba, Cd) complied with the requirements set by the USEPA. In addition, fired bricks had varying porosity (9-13%), firing shrinking (5.2-7.5%), water absorption (12.5-17.2%) and flexural strength (3.86-13.4 MPa). Noteworthy, an improvement in the properties (porosity, firing shrinking, water absorption, and flexural strength) of manufactured fired bricks was observed with the increase of firing temperature from 900 to 1100°C. All the measured properties complied with the construction norms and requirements. Moreover, regardless of the firing temperature, the environmental behavior of metals obeyed the requirements of the USEPA standards. Finally, fired bricks could be produced at high temperatures (1000°C) based on 100% of phosphate sludge without any substitution or addition of either chemical agents or binders. This sustainable brick-making process could be a promising approach for the Phosphate Company to partially manage these wastes, which are considered “non-profitable” for the moment and preserve soils that are exploited presently.

Keywords : phosphate treatment sludge, mine waste, backed bricks, waste valorization
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