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# Improving Swelling Performance Using Industrial Waste Products

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**Abstract :** Expansive soils regarded as one of the most problematic unsaturated formations in the Egyptian arid zones and present a great challenge in civil engineering, in general, and geotechnical engineering, in particular. Severe geotechnical complications and consequent structural damages have been arising due to an excessive and differential volumetric change upon wetting and change in water content. Different studies have been carried out concerning the swelling performance of the expansive soils using different additives including phospho-gypsum as an industrial waste product. However, this paper describes the results of a comprehensive testing programme that was carried out to investigate the effect of phospho-gypsum (PG) and sodium chloride (NaCl), as an additive mixture, on the swelling performance of constituent samples of swelling soils. The constituent samples comprise commercial bentonite collected from a natural site, mixed with different percentages of PG-NaCl mixture. The testing programme had been scoped to cover the physical and chemical properties of the constituent samples. In addition, a mineralogical study using x-ray diffraction (XRD) was performed on the collected bentonite and the mixed bentonite with PG-NaCl mixture samples. The obtained results of this study showed significant improvement in the swelling performance of the tested samples with the increase of the proposed PG-NaCl mixture content.

**Keywords :** expansive soils, industrial waste, mineralogical study, swelling performance, X-ray diffraction
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