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Characterisation of the chemo-mechanical behaviour of clays polluted by BTEX: a case study of benzene

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Abstract

In chemo-mechanical coupling of clays, chemical phenomena are likely to have a stronger influence on the mechanical behaviour and mechanical actions can modify the chemical behaviour. The understanding of these different phenomena, taking into account the coupled mechanisms, is essential in the context of the problem of the durability of structures and works built on polluted sites. Thus, the laboratory characterisation of the chemo-mechanical behaviour of a clay contaminated by light hydrocarbon pollutant (BTEX: benzene) was carried out. First in the absence of pollutants, i.e., by the presence of water only, then under the influence of the pollutant, all in two stages: with no external stress, then under imposed external stress. This study presents an experimental protocol based on a series of uniaxial consolidation tests, specific oedometric tests and direct shear strength, this tests performed under controlled saturation conditions and in the presence of organic contamination by benzene. All results confirm the influence of pollutants in different concentrations on the mechanical behaviour of the soil. They show a strong increase in compressibility and a significant increase in swelling, the soil becomes more cohesive, low friction and less elastic. Furthermore, the results show that external load forces play a major role in modifying the behaviour of clay.

Keywords: Contaminated clay, Organic contaminant, Benzene, Chemo-mechanical coupling, Laboratory tests, Soil rheology

Introduction

Understanding the chemo-mechanical coupling of clays is of interest to geotechnical engineers and environmental scientists to solve many problems. These issues range from pollution studies to waste control or liquid contaminants produced by an accidental spill of the hydrocarbons are partially dissolved in water to form a mobile phase that can saturate soil pores. Natural clays could be exposed to chemical fluid effects resulting in a modification of their mechanical properties, under natural or artificial causes. The risk of rupture or leakage of a hydrocarbon transport line in natural clay is an important aspect of the study of the stability of this soil to assess the possibility of its future exploitation in the field of construction and others.