Construction Methodology of Fill Placement over Sabkha

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ABSTRACT

This paper documents field and laboratory testing performed on Sabkha at a project site located in the Middle East. Constructability of placing fill material on Sabkha was assessed to ensure that temporary structures could be built on the fill material overlying Sabkha. The field investigation included: (1) performing seventeen field Dynamic Cone Penetrometer (DCP) Tests to estimate shear strength parameters and Sabkha thickness, (2) excavating two test pits to collect composite Sabkha samples for geotechnical and chemical laboratory testing, (3) and conducting a field test pad to assess the required fill material thickness over Sabkha for stability of operating equipment.

Laboratory testing indicated low shear strength parameters and a high concentration of chlorides and sulphates. Finally, field observations from the field test pad indicated that in order for equipment to operate in stable conditions during placement of the fill over Sabkha, the thickness of the fill material must not be less than 70 cm. Construction methodology for fill material placement over Sabkha was developed and applied for construction of temporary structures.

KEY WORDS: Sabkha; DCP; fill material; temporary structures; sulphates; chlorides.

INTRODUCTION

Sabkha is defined as a salt bearing arid climate deposit which consists of sand deposits mixed with silt and clay particles. The term Sabkha is defined in Arabic as a “salt flat”. Sabkha has: (1) low shear strength, (2) high soil compressibility, and (3) high concentration of chlorides and sulphates which are corrosive to concrete, steel, and other materials. Under climate changes, significant volume change occurs when naturally occurring gypsum undergoes hydration to form anhydrite and dehydration to reform gypsum again (Amin, 2004). Groundwater movement related to evaporation precipitates salts at or near the surface, and as a result, temporary cementation can take place in the upper layer, forming a surface crust.

Permanent structures are not recommended to be constructed on Sabkha unless soil improvement, removal and replacement, or piling is considered. These techniques will improve bearing capacity and minimize settlement. Soil improvement techniques include soil preloading with a vertical drainage system; solidification; injection grouting, and use of geosynthetic materials (Akili and Torrence, 1981).

The use of spread footings on fine-grained soils depends heavily on the soil shear strength, consolidation parameters, and type of loading on the structure. Structures built on Soft Sabkha will require either the use of piles or soil improvement (Juillie and Sherwood (1983). Therefore, investigating the Sabkha for the determination of shear strength and consolidation characteristics should be a requirement in order to evaluate the stability of the structure.

The shear strength of Sabkha can vary depending on the location, formation, age, preloading, and other type of soil improvement (Butler, 1969). The consolidation settlement relies heavily on the geotechnical properties, over-consolidation ratio, magnitude of loading, and thickness of the compressible layer.

A geotechnical field investigation was conducted at an industrial site located in the Middle East to assess the effect of construction methodology of fill material placement over Sabkha and the stability of temporary structures.

This paper presents a narrative description of the field investigation, summary of the geotechnical and chemical laboratory testing, a description of the construction methodology of fill placement over Sabkha, and field monitoring of temporary structures for stability.

BACKGROUND

The project consisted of constructing temporary structures to support the construction of an industrial plant located in the middle East. These temporary structures included light weight warehouses, tanks with diameter up to 15 m and heights up to 10 m, asphalt pavement roads, and storage of heavy equipment and machineries.

These temporary structures were located in areas where Sabkha was encountered with thickness ranging from 0.5 m to 4 m. The stability of these temporary structures was the main concern due to the presence of soft Sabkha material.

Preloading the Sabkha was the most economical option for the construction of these temporary structures. The preloading was conducted with limitations in the thickness of fill material and time of preloading. A field investigation was needed to be conducted to determine whether these temporary structures can be built if the Sabkha is preloaded.