# The Effects of Chemical Fluids with Different Dielectric Constants on the Behaviour of A Clayey Soil

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**Abstract**

The physico-chemical forces between the clay particles due to the variation of the dielectric constant of the pore fluids cause to have changes in the structure and the behaviour of the soil. Therefore, it was aimed to investigate the behavior of the clay at the existence of different chemical fluids with various concentrations as the pore fluid. Atterberg limit, shear strength and consolidation tests were performed by using the chemical fluids. Moreover, the optical microscope (OM) views of the specimens obtained from the mixtures in suspension form were examined. According to the experimental results; liquid limit values and consolidation parameters considerably decreased, but cohesion values increased with the increasing chemical fluids concentration and decreasing dielectric constant of pore fluid.

**Keywords: chemical fluids, shear strength, consolidation, optical microscope.**

## 1. INTRODUCTION

Today, many fields that have been contaminated with various chemicals depending on the rate of increasing population and urbanization or having the possibility of contamination are changed into settlement areas. Besides, lutes for various purposes, clay barriers in solid waste storing facilities can be influenced by organic chemical fluids. In such cases, there are changes in the characteristics of present soil such as strength and compressibility, especially permeability with the effects of chemical fluids. Particularly, clay soils are affected from the changes in the pore fluids more than other types of soil due to their small particle sizes and thus their particle surface forces.

The first studies for the attitudes of clay soils under the effect of chemical fluids have been performed on permeability and the exchange between physico-chemical forces and particles. Researchers performed studies on clays using chemical fluids and they determined that the clay flocculated in the existence of chemical fluids and turned to aggregate and thus it led to an expansion in pore cavities and increase in permeability [1-3]. Two basic physico-chemical factors that affect the attitudes of clay soils are diffuse double layer force and Van der Walls attractive forces [4]. There is a repulsive force due to the similar loads on double layer when two clay minerals line up, at the same time an attractive force occurs due to the Van der Walls attractive forces. The researcher said that, according to the double-layer theory, the thickness of the double-layer was directly proportional with the square root of the dielectric coefficient of pore fluids. Another researcher stated that net interaction force acting on the clay particles gradually increases with the decreasing dielectric coefficient of the pore fluid from 80 to 30, and the force of attraction decreases with the dielectric coefficient decreasing further [5]. The writer said that especially high-active soils were considerably affected from these changes, since they had clay content having large surface loads. Chemical fluid caused the narrowing of diffused double layer around the soil particles and thus led to the flocculation of the particles [6]. Researchers associated the decrease in the liquid limit (LL) of the soils with the net increase in the attractive forces due to considerable decrease in the repulsive forces between the particles and the collapse of the diffused double-layer [7].

The effects of chemical fluids on the strength of the clay soils show differences according to the experimental conditions and the structures of clay minerals. After the triaxial compression tests on clays using methanol and acetic acid, writer [3] found that strength values decreased. Another researchers [8] performed unconfined compression tests on the clay soils for various concentrations of chemicals and found that the strength value decreased. However the other researchers, performed triaxial compression tests and stated that the normally consolidated specimens behaved as the over-consolidated soils when they were washed with organic fluids [9].

Many researchers [10, 11] examined the compressibility attitudes of soil under chemical fluids. They have determined that the changes occur in physico-chemical forces among the particles with the effect of