STABILIZATION AND MICROSTRUCTURAL MODIFICATION OF DISPERSIVE CLAYEY SOILS

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ABSTRACT: Soils that are dislodged easily and rapidly in flowing water of low salt concentration are called dispersive soils. Structures such as embankments, channels and other areas are susceptible to severe erosion, when such soils are used for construction. The erodabilty of clayey soil due to flow of rain water is a critical factor in long term performance of earth structures. Hence, for these applications it becomes essential to test the erodablity especially during conditions of high surface flow. This kind of erosion manifests itself as the internal erosion which creates a progressive removal of soil particles along the internal pore channels termed as “piping”. The dispersive nature of the soil minerals and its erodability can be assessed by a “pinhole test”. This comprises of measuring the rate of flow through a 1mm diameter hole in the test soil of standard dimension under specified condition. The erodabilty is decided based on increase in rate of flow and turbidity of the outflow. The dispersive soil can also have a high swell shrink potential and low resistance to erosion and have low permeability in an intact state; hence in this paper an attempt is made to alter this basic characteristic by stabilizing with suitable additives. The effect of these stabilization agents are studied through the, pinhole tests, double hydrometer, crumb test and chemical tests. The strength development takes place through the alteration in the microstructure and mineralogy. Hence the intricate mechanisms through which the stabilizing effects manifest itself in the microstructure level are studied by Scanning Electron Microscope.

Keywords: dispersive clay; erodability; piping; pinhole test; stabilization; mineralogy

1. INTRODUCTION

Many earth dams, hydraulic structures and other structures like road way embankments have suffered serious erosion problems and have failed due to the presence of the dispersive soils. Though the problem has been identified in many parts of the world in recent times, design advances and technical preventive measures are yet to be fully developed and practiced. As the scope and magnitude of the problem which can result from the use of dispersive soil is very high, preventing the failures caused by the dispersibility of the soils has become one of the major concerns of the geotechnical engineers.

In the earlier days clays were considered to be non erosive and highly resistant to water erosion, however recently it was found that highly erosive clay soils do exist in nature. The tendency of the clays to disperse or deflocculate depends upon the mineralogy and soil chemistry and also on the dissolved salts in the pore water and the eroding water [1].

Based on the observed dispersive soil in the world, clays of alluvial origin, some soil derived from Mud rocks laid down in a marine environment can be dispersive. Soil derived from weathering of igneous and metamorphic rocks and soil with high organic content usually are non dispersive. Dispersive soils are usually found in flood plains and lake bed deposits. They are abundant in various parts of Thailand, United States, Australia, Mexico, Brazil, South Africa and Vietnam [2].

2. DISPERSION PHENOMENON

When the dispersive clay comes in contact with water, the clay fraction behaves more like a