# Identification and Stabilization of Dispersive Soils: Case Study of Water Transfer Canal of Simindasht-Garmsar

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## Extended Abstract

(Paper pages 29-50)

### Introduction

In some soils, special phenomena happen with increases in their moisture content that sometimes inflict major damages on development projects. Dispersive soils are one type of such soils. The physico-chemical properties of the particles in dispersive soils cause them to disperse and separate from each other upon contact with water. If dispersive clays are not accurately identified, they will cause damages and failures. In the Simin Dasht region of Semnan Province, some hydraulic structures have incurred serious damages because they are located on dispersive soils.

The present research studied the soils around the canal transferring water from the Simin Dasht to Garmsar. This 37-kilometer long canal is situated in Semnan Province between the Simin Dasht and the Garmsar diversion Dams. Scouring and soil erosion under the concrete lining of the canal has led to the destruction of the structure. After visiting the site and taking soil samples, double hydrometer and pinhole tests were performed. The effects of adding various amounts of cement, lime and aluminum nitrate on amending dispersive clays were studied and compared in the Simin Dasht region of Semnan Province.

### Experiments

The effects of the quantities of cement, lime and aluminum amendment materials on stabilization of dispersive soils in the Simin Dasht region of Semnan Province were investigated. Two types of dispersive clayey soils

were amended. Table 1 presents the characteristics of the soils. The effects of various amounts of lime, cement, and aluminum nitrate on reduction in the degree of dispersion in the tested soils were studied. The cement, lime, and soil samples were dried at 40˚C for 24 hours. It must be mentioned that the amount of added lime, cement, and aluminum nitrate were zero, 3, 5, and 7 percent.

**Table1. Characteristics of dispersive soils used in this reserch**

| Soil | Natural water content (%) | Liquid limit, LL (%) | Plastic limit, PL (%) | Plasticity Index, PI (%) | Optimum Moisture (%) | $G_s$ |
|---|---|---|---|---|---|---|
| A | 13.84 | 17.63 | 15.09 | 2.54 | 15 | 2.72 |
| B | 3.02 | 22.44 | 16.11 | 6.33 | 11 | 2.66 |

## Results

Average changes in discharge passing through the dispersive soil samples A and B, and through samples of these soils amended with lime, cement, and aluminum nitrate in pinhole tests are presented in Figures 1(a-f), respectively. Figure 1a indicates that the behavior of the A soil samples amended with lime did not follow any specific trend, but we can cautiously say that soil A will become non-dispersive when lime is added at 4.5 percent at all moisture contents. Increases in the quantities of the cement added to the dispersive soils A and B to stabilize them independent of the moisture content of the soils were also investigated (Figure 1c, d). Behavior of the A soil samples stabilized with aluminum nitrate followed a specific trend (Figure 1 e, f) contrary to those amended with the other stabilizers.

## Conclusions

Results of the tests show that dispersion in soil A was amended (without completely preventing the occurrence of the scouring phenomenon) by the addition of cement or lime at 5 percent or aluminum nitrate at 3 percent. Moreover, dispersion in soil B was amended by the addition of cement at 3 percent, lime at 5 percent, or aluminum nitrate at 3 percent. Aluminum nitrate was a better and more effective amendment material for the dispersive soils compared to lime. Therefore, aluminum ions replaced the other ions in the structure of dispersive clays more suitably compared to calcium ions. Comparison of the results obtained from the pinhole tests performed on soil samples amended with aluminum nitrate, lime, and

cement suggests that it took a shorter time for the samples to be stabilized with aluminum nitrate compared to the other two amendment materials.

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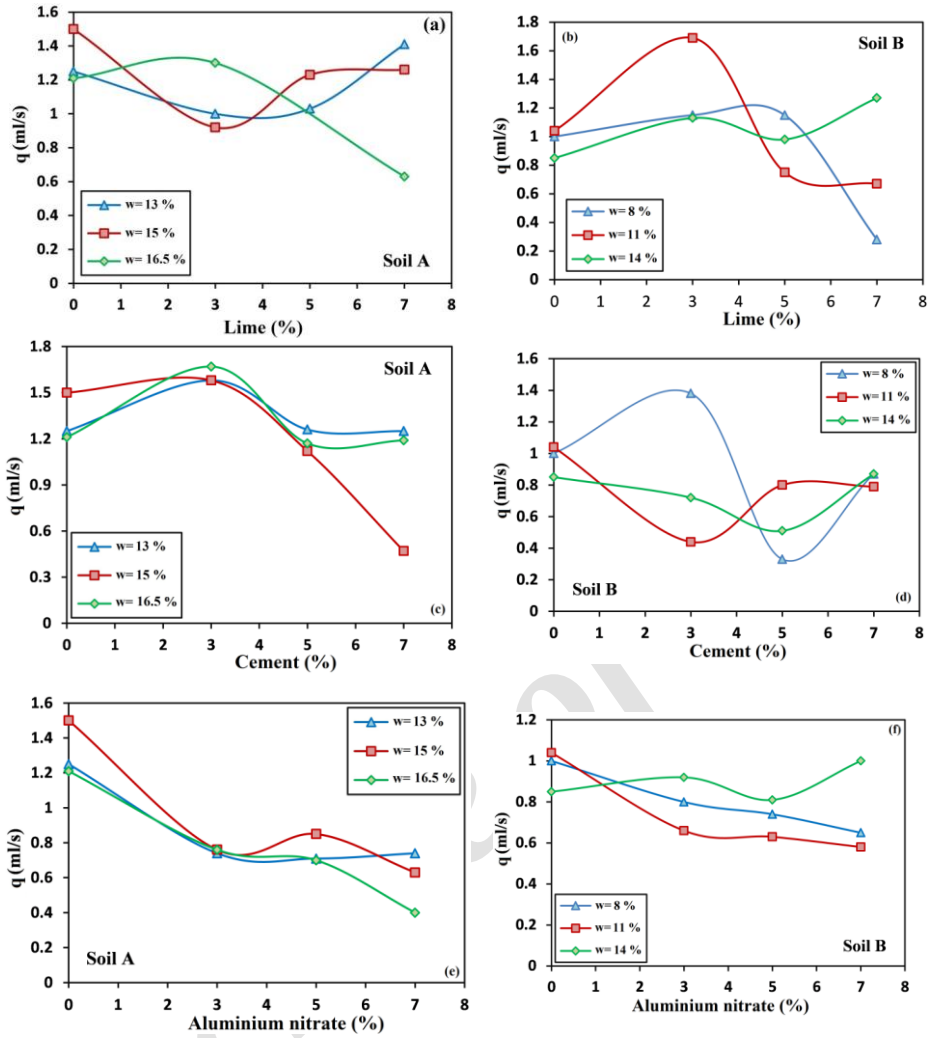


**Figure1 Variation of discharge due to soil stabilization, Lime (a and b), Cement (d and c), Aluminum nitrate (e and f)**

**Keywords:** Dispersive soil, Pinhole test, Double hydrometer test, Crumb test, Soil stabilization

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