Soil Dispersivity Potential of Irrigation Canals in Arid and Semi-Arid Areas by the Influence of Electromagnetic Waves in the Chemical Method: Khuzestan- A Case Study

Behnaz Shahrokh[*1], Mohsen Oftadeh[1], Nasrin Sohrabi[1]
1. Department of Chemistry, Payame Noor University, Tehran, Iran

Received: 10 Jul. 2020 Accepted: 6 Oct. 2020
(Paper pages 283-306)

Introduction

An accurate study of the physical-chemical properties of soil has a significant effect on the determination of mechanical parameters, classification and evaluation of soils, and the civil project management aspects. The obtained accurate results of the chemical parameters of soil can determine the type and amount of cement or lime used in stabilizing the problematic soils, which leads to better estimation of sub-channel substrate consolidation behavior, accuracy in engineering designs, and so on. Previous researches showed that the chemical changes such as increasing soil solutes are one of the affecting factors on the change of the mechanical parameters of the soil [1-3]. In this study, the effect of the waves on the saturated paste and the saturation extract was presented as a novel method in order to determine the soil chemical parameters as well as the soil dispersivity potential more precisely. Also, the effect of the waves on the arid and semi-arid regions can be considered as one of the environmental parameters affecting the solubility of solutes in the saturated soil and pre estimated dispersive and semi-dispersive of the soils.

Materials and Methods

In order to investigate the effect of the electromagnetic waves on the solubility of the solute soil in the chemical analysis, 11 soil samples (problematic soils) were collected from 0-20 cm depth, each weighting 1 kg from the south of Ahvaz, Abadan, Ramhormoz, and Behbahan. Then the

samples were passed through a 2 mm sieve after drying. For each soil sample, pinhole and chemical tests on the saturated extracts obtained from the saturated paste under the irradiation of ultraviolet waves (256-360 nm), visible waves (400-700nm), and no irradiation (standard method) were performed. The chemical parameters of EC, pH, the concentration of cations, and important anions of the soil were measured. The results of the electromagnetic waves effectiveness were compared with standard methods of saturation extraction and pinhole test. For all the irradiated and no irradiated (standard method) samples, sodium adsorption ratio (SAR) was calculated by Eq. (1), and the results have been shown as the column diagram in Figure 3. Then the soil dispersivity potential is determined based on the modified method introduced by Esmaeeli and Bazargan [4].

$$\boldsymbol{SAR} = \frac{\boldsymbol{Na^{+}}}{\sqrt{\boldsymbol{(Ca^{++}+Mg^{++})/_{2}}}} \quad (1)$$

The results of EC, pH, and SAR measurements for all 11 irradiated samples and standard samples were evaluated according to the modified method introduced by Esmaeeli and Bazargan. The results have been listed in Table 1, EC>5$mScm^{-1}$for all samples pH> 7.5 and SAR> 12 for the samples 1, 3, 8 and 10 under the electromagnetic radiation, which indicate that these soils are semi dispersion, pH< 7.5 and SAR< 14 for the standard samples which specifies that these soils are non-dispersion, and the samples 6 and 5 demonstrate the dispersive potential. To further compare, the pinhole test was also performed as an acceptable physical method on the samples as follows: because of the samples 6 and 11 were not suitable for reconstruction, so the experiment was performed on remained nine samples. The results in Table 1 show that sample 10 was not dispersive.

Conclusions

1-Effectiveness of the electromagnetic waves in the saturated extracts causes more accurate determination of essential and effective chemical parameters such as EC, pH, and SAR for a description of the soil dispersivity potential than the standard method. As a result, more accurate detection of semi dispersive soils based on the improved chemical method was made possible quickly in a short time.

Table 1. Description of the soil dispersivity potential for eleven soil samples based on the results of the pinhole test and the chemical methods by the saturated soil paste: under the ultraviolet wave irradiation, under the visible wave irradiation and non-irradiated (standard method).

Number of samples	Pinhole test results	Samples under the standard method	Samples under the visible waves Irradiation
1	ND4	Non dispersive	Semi dispersive
2	ND2	Non dispersive	Non dispersive
3	ND4	Non dispersive	Semi dispersive
4	ND1	Non dispersive	Non dispersive
5	D1	Dispersive	dispersive
6	-------	Dispersive	dispersive
7	ND2	Non dispersive	Non dispersive
8	ND4	Non dispersive	Semi dispersive
9	ND1	Non dispersive	Non dispersive
10	ND3	Non dispersive	Semi dispersive
11	-----	Non dispersive	Non dispersive

2-Considering the limitations of the pinhole erosion test for identifying dispersive soils, especially in arid and semi-arid regions, the chemical method with efficient electromagnetic waves is the most accurate method for describing the dispersivty potential of soils with low moisture content.

3-The effectiveness of these waves on the saturated paste reduces the retention time of the saturated extract from at least two hours to one hour and increases the rate of achieving the results of laboratory analysis.

*Corresponding Author: r10719853@yahoo.com