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## SUMMARY

The main objective of the current study is to verify the validity of light transmittance measurements to study some parameters related to flocculation-dispersion of the saline and sodic soils. This objective is achieved through the following trails:

1- Examine the effect of SAR, EC and pH on flocculation-dispersion using % T measurements.

2- Estimate the effect of exchangeable, Ca and Mg on clay dispersion.

3-Compare measured hydraulic conductivity with that inferred from % T measurements.

4-Evaluate the Critical Coagulation Concentration (CCC) using % T measurements

The current study was conducted using two soils, the first named

Al-Rahmania – **El-Beheira governorate** (15% clay), and the second named Al-Gemmeza - **El-Gharbya governorate** (35% clay). Both soils had low electrical conductivity 1.4 and 2.1 dS/m , and low SAR 2.68 and 4.8 for Al-Rahmmania and Al-Gemmeza, respectively.

– The soil was artificially sodified to six sodium adsorbed ratio (SAR) levels. The actual SAR levels obtained were 5.86, 9.27, 12.0, 17.3, 21.8 and 26.4 for Al-Rahmania soil and 4.83, 8.87, 14.16, 19.05, 23.59 and 29.45 for Al-Gemmeza soil.

- The soil was artificially salinized to five EC levels. The averages of actual EC levels were 3.09, 5.98, 8.99, 11.92 and 14.69 dS/m for Al-Rahmania soil and 2.94, 5.66, 8.46, 11.34 and 14.1 dS/m for Al-Gemmeza soil.

- Al-Rahmania and Al-Gemmeza soil are performed to have EC-SAR combinations to test validity of light transmittance (%T) and optical density (A) measurements to detect coagulation and dispersion of soil suspension.

- Results revealed a negative Relationship between % T and SAR i.e. as SAR increased % T decreased. This was general trend with both soils, suggesting tendency of soil suspension toward dispersion resulting from increments of sodium cations. In other words, Na cations push soil aggregates to disintegrate to smaller aggregates and individual soil particles, forming a dispersed soil system. Such trend is independent to soil salinity (EC).Al-Gemmeza soil had higher clay content (35% clay) as compared to Al-Rahmania soil (15 % clay), reflecting its varied response to dispersion, readings of % T are small at all SAR levels correspond to high dispersion intensity. Gradual decrease of % T is recorded as SAR increased for Al-Rahmania soil, followed with moderate decrease at SAR 17 (moderate dispersion). On the other hand, a sharp drop of % T is detected for Al-Gemmeza soil at SAR of 19 forming dispersion condition. % T readings follow the effect of salinity to induce flocculation and explore the opposite effect to Na ions.

- In general relation between % T and pH is explored and showed negative relationship, as pH increased % T decreased. Increasing pH was due to added sodium bicarbonate required to adjust soil SAR. The effect of pH on % T was in reasonable agreement with the effect of pH on dispersion. The sharp decrease of % T was occurred at rang of pH, thus it is difficult to relate both dispersion and coagulation to a definite soil pH. Shape of curves relating % T against SAR at varied EC are similar and independent to clay concentration and the sharp decrease of % T at SAR of 19 for Al-Gemmeza soil is occurred for all clay concentrations with varied % T readings at all Clay concentration (1.0, 0.5 and 0.25 gm/l). Such decrease is independent to salinity level and to clay suspension concentration and has varied % T readings lied between 34.4 - 61.8., 63.9 - 82.1 and 80.9 – 87.2 for clay suspension concentration 1.0, 0.5 and 0.25 gm/l for El- Gemmeza soil respectively. The clay suspension concentration in both soils did not affect the sharp decrease in % T readings.

- Clay concentration 0.5 gm/l seems to be the most indicative one although the other clay concentrations have explained the data.
- Both % T and relative optical density ($A/A_{Na}$) are valid indicative parameters to monitor tendency of soil system to dispersion or coagulation.
- All Na-Mg and Na-Ca treatments showed that as SAR increased % T decreased, suggesting that soil suspensions are not always stabilized by an increase of SAR. Second, Development of dispersion is continuous with higher slop after SAR for Ca or Mg suspensions increased and no sharp decrease of % T was observed as detected with Na-Ca-Mg suspensions.
- The data showed that clay dispersion % increased (%T decreased) as SAR increased. Both the two treatments displayed higher dispersion % as compared to Na-Ca-Mg treatments up to SAR of 17.3. Above such SAR, an opposing situation is characteristic to Na-Ca-Mg system.

– There is no much difference for Na-Mg treatments when compared with Na-Ca treatments which means that dispersion process depend mainly on the concentration of the electrolyte and sodium ion still the most effective ion.

– It was noticed that salinity treatments have an important effect on dispersion, since at given SAR, as salinity (EC) increase % T increased. Extent of this effect was greater with Na-Ca than Na-Mg treatments.

– In case of Al-Gemmeza soil, the results exhibited the same general trend. Na-Mg treatments of Al-Gemmeza are effective to disperse soil particles at all SAR values as compared with Na-Ca system. Exchangeable Mg showed more efficiency in dispersion, due to the smaller radius compared with Ca and therefore its larger hydration shell will result in an increased distance between particles of Mg saturated clay and a decrease in inter particles attraction. Specific effect of Mg on dispersion/coagulation depends on individual soil properties, thus Na-Mg treatments showed varied dispersion efficiency with Al-Rahmania and Al-Gemmeza soil related to varied soil characteristics. Dispersion intensity of the three systems takes the following decrease order:

For Al-Gemmeza soil: Na-Ca-Mg > Na-Mg > Na-Ca treatments

For Al-Rhamania soil: Na-Ca-Mg > Na-Mg $\geq$ Na-Ca treatments.

– The Hydraulic conductivity (HC) had a negative relationship with both SAR and ESP for the two soils. HC showed sharp decrease in HC occurred at SAR 12.5 for all EC values, just as did most reduction in %T approach but at SAR 17.3 for Al-Rhamania soil .It means that HC measurements are more sensitive to detect the impact of sodicity and salinity. Al-Gemmeza soil had similar effect since the sharp decrease occurred at SAR 8.87the corresponding reduction in %T was at SAR 19.05. It was concluded that HC measurements predict the sharp drop point at lower value of SAR when compared with that inferred from %T approach. The beneficial effect of salinity on HC is consistent with dispersion measurements using %T approach.

– The Results revealed the negative relationship between pH and HC. The effect of pH on HC was in reasonable agreement with the effect of pH on %T approach. Hydraulic conductivity of Al-Gemmeza soil (35% clay) reduced at lower value of SAR due to its instable aggregates which led to high proportion of micro pores and caused HC reduction.

– HC was measured by the three tubes method and was taken as a reference state to test validity of HC derived from %T approach. The relation between HC and EC-SAR treatments is very complex and it is difficult to describe by single equation. Therefore a set of equations have been derived to cover wide rang of clay content, EC and SAR. Three correlation equations are derived from HC - %T relation for soils contains less than 20% clay and more than 20% clay. Such relations are tested using fifteen soil samples which subjected to HC measurements. The results revealed that soils contain less than 20% clay showed that calculated HC from %T approach was slightly less than measured HC. For soils contain more than 20% clay, measured HC are much closed with correlation coefficient ($R^2$=0.9637) to that inferred from %T approach. These results need to confirm in future research.

– A Calibration Curve is constructed to explore the relation between %T and clay concentration (0.03 – 0.36 gm/l). 17 unknown soil samples are subjected to clay fraction determination by hydrometer method and by calculation from the calibration curve. The results showed that clay % by the two methods are identical and much closed, indicating the possibility of using %T approach as alternative method.

– Clay dispersion % for all treatments are high for Al-Rhamania soil despite its lower clay content. It is possible to calculate weight of clay fraction required to plug one Kg of soil at the dramatic change of HC. It was 24.0-16.5 gm clay/Kg soil at SAR=12 and 32.9-14.0 gm clay/Kg soil at SAR=14.16 for Al-Rhamania and Al-Gemmeza soil received Na, Ca and Mg ions respectively. There is no much difference for Na-Mg and Na-Ca treatments regarding weight of clay needed to plug one Kg of soil.

– Critical coagulation concentration (CCC) is defined as minimum concentration of the electrolyte for a given level of SAR at which the onset of clay flocculation observed after 24h. The results showed that (CCC) is nearly constant for all SAR-EC combinations, it occurs at 0.5 and 0.2 meq/L of added $CaCl_2$ for Al-Rahmania and Al-Gemmeza soils respectively.

It was observed that dispersion% was not reduced to zero; the lowest reduction (3.8 %) was recorded at SAR 12 and EC of 14.8 dS/m for Al-Rhamania soil and (3.4 %) at SAR of 14.16 and EC of 14.3 dS/m for Al-Gemmeza soil.