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USE OF SALT COMPOUNDS FOR THE STABILIZATION OF NIGERIAN LATERITES.

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ABSTRACT
The use of salt compounds for the stabilization of laterites is investigated are NaCl CaCl2 and MgCl2 in various percentages (2%, 4% and 8%). The results show that the salt compounds are direct proportional to the maximum dry unit weight and the unconfined compressive strength (UCS) and inversely proportional to the optimum moisture content and atterberg limits.

Keywords: Laterites, Salt Compounds, Atterberg Limits, Unconfined Compressive Strength, Maximum Dry Unit Weight, Optimum Moisture Content.

1. INTRODUCTION

Soil stabilization is the improvement of soil properties by adding a special soil, a cementing material or other chemical material to it (Perloff 1976). Thereafter, compaction of the blended soil follows. The stabilization agents can improve the soil moisture, soil cohesion and cement/waterproof the soil (Jonathan et al 2004).

However, there is problem when subgrade is found to be clay soil, which would have the tendency to swell when in contact with water (Chen 1981). The most common stabilization methods for laterites is cement and lime (Ola 1983, Otoko 2014a, 2014b). However, the high strengths obtained by these stabilization methods may not always be required, therefore there is need for seeking cheaper addictives for laterites stabilization. Additives such as $CaCl_2$, Gypsum, cement and lime have been used to stabilise soils (Pyne 1955, Chen 1981, Ghafoori & Cai 1997, Ghafoori 2000, Azadi et al 2008).

Previous work on laterite has been reported by Faniran 1970, 1972, 1974 and 1978, Adekoya et al 1978, Ola 1978, 1980a, 1980b and Alao 1983. This paper therefore, presents the effect of salt compounds for the stabilization of laterites. The salt compounds used were NaCl, $MagCl_2$ and $CaCl_2$. Typical salt compound (Magnesium Chloride) is shown in fig. 1. The laterite sample was taken from station road, opposite lubbricks construction company in Port Harcourt, Nigeria.

Figure 1: Typical Salt Compound and Test Specimen (Magnesium Chloride).

2. EXPERIMENTAL PROCEDURE

2.1 Characteristics Of The Laterite.

The laterites of the geological zone 1 (Dry flat country) of the Niger Delta, Nigeria (see fig. 2) is the subject of this study.

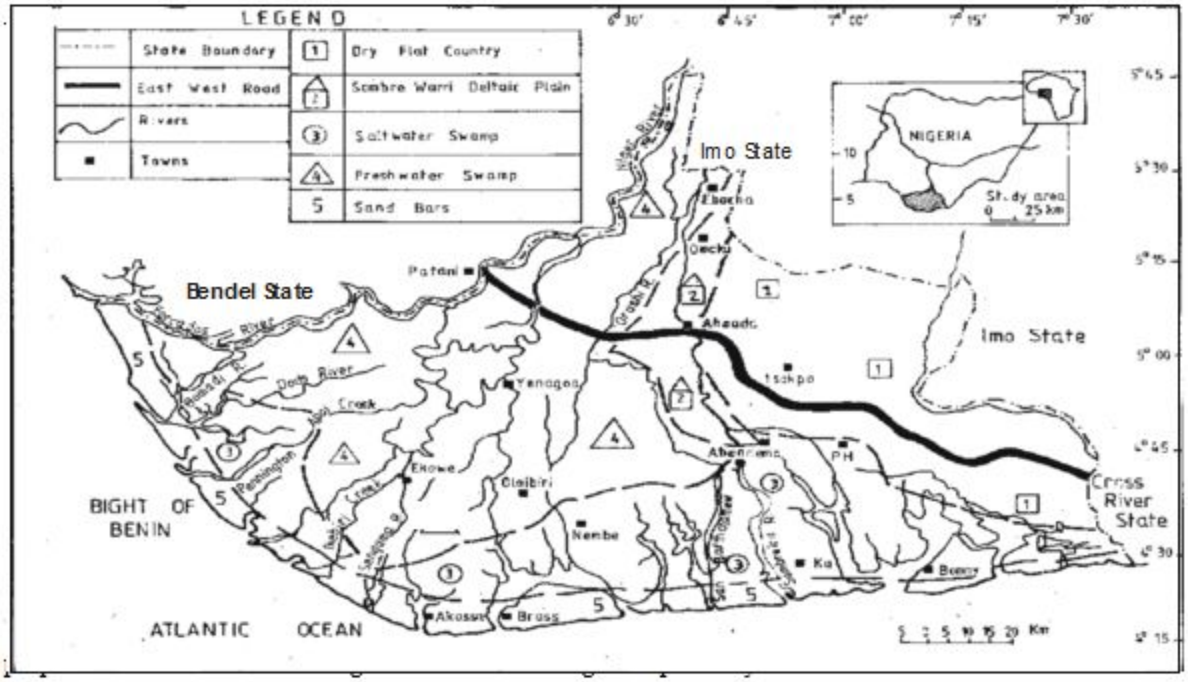

Figure 2: Geomorphological Zones of the Niger Delta, Nigeria.

The laterites sample was taken from geological zone 1 and at the depth of about a meter below top soil; which properties and classification are given in table 1 and fig. 3 respectively.

Table 1: Properties of the Laterite.

Variables	Data
Moisture content	24.1
Liquid limit	37.5
Plastic limit	21.3
Plasticity index	16.2
Liquidity index	0.17
Specific gravity	2.64
Unified classification	CI
Clay fraction	45%
Silt fraction	51%
Sand fraction	4%

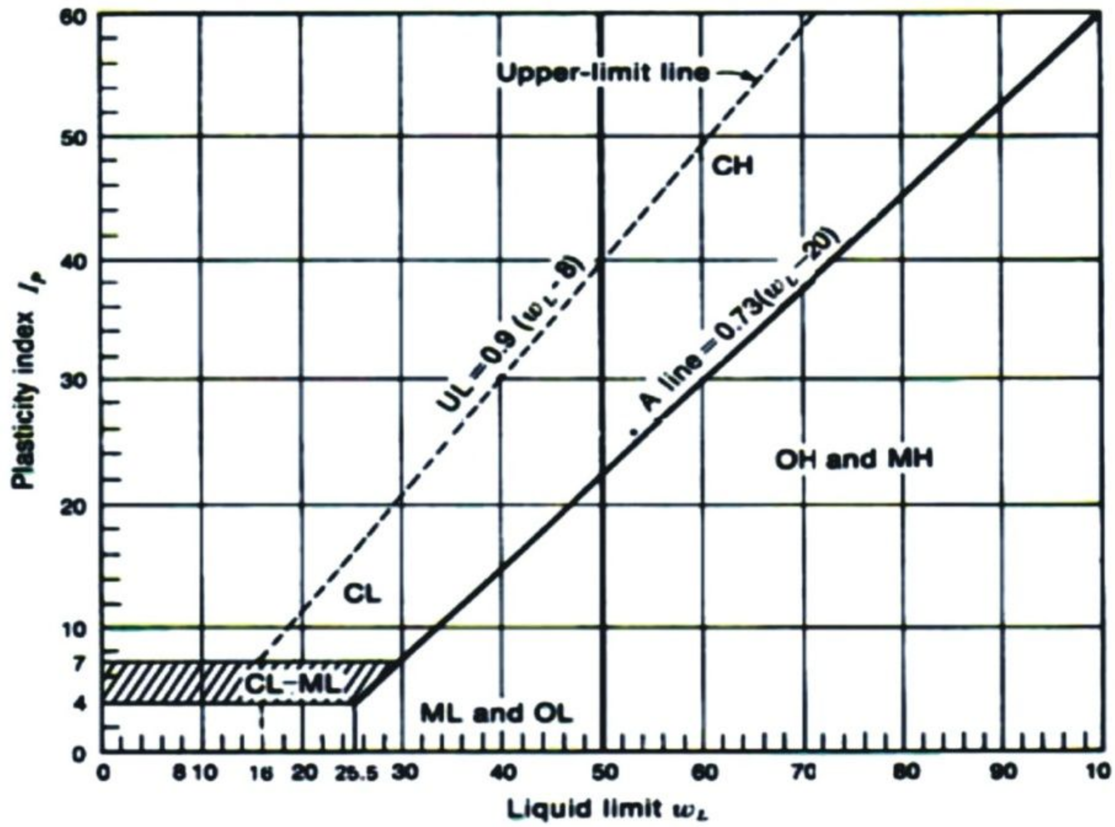

Figure 3: Plasticity Chart (after Bowles 1982).

2.2. LABORATORY TESTS.

Salt compounds used were $CaCl_2$, $MgCl_2$ and $NaCl_2$. They were each dissolved in water, left for one day, mixed with soil and the soil prepared and tested according to ASTM (D1557) for modified Proctor Compaction moisture content - dry unit weight relationship. The soil was compacted in 5 layers into 1000 cm^3 mould, and

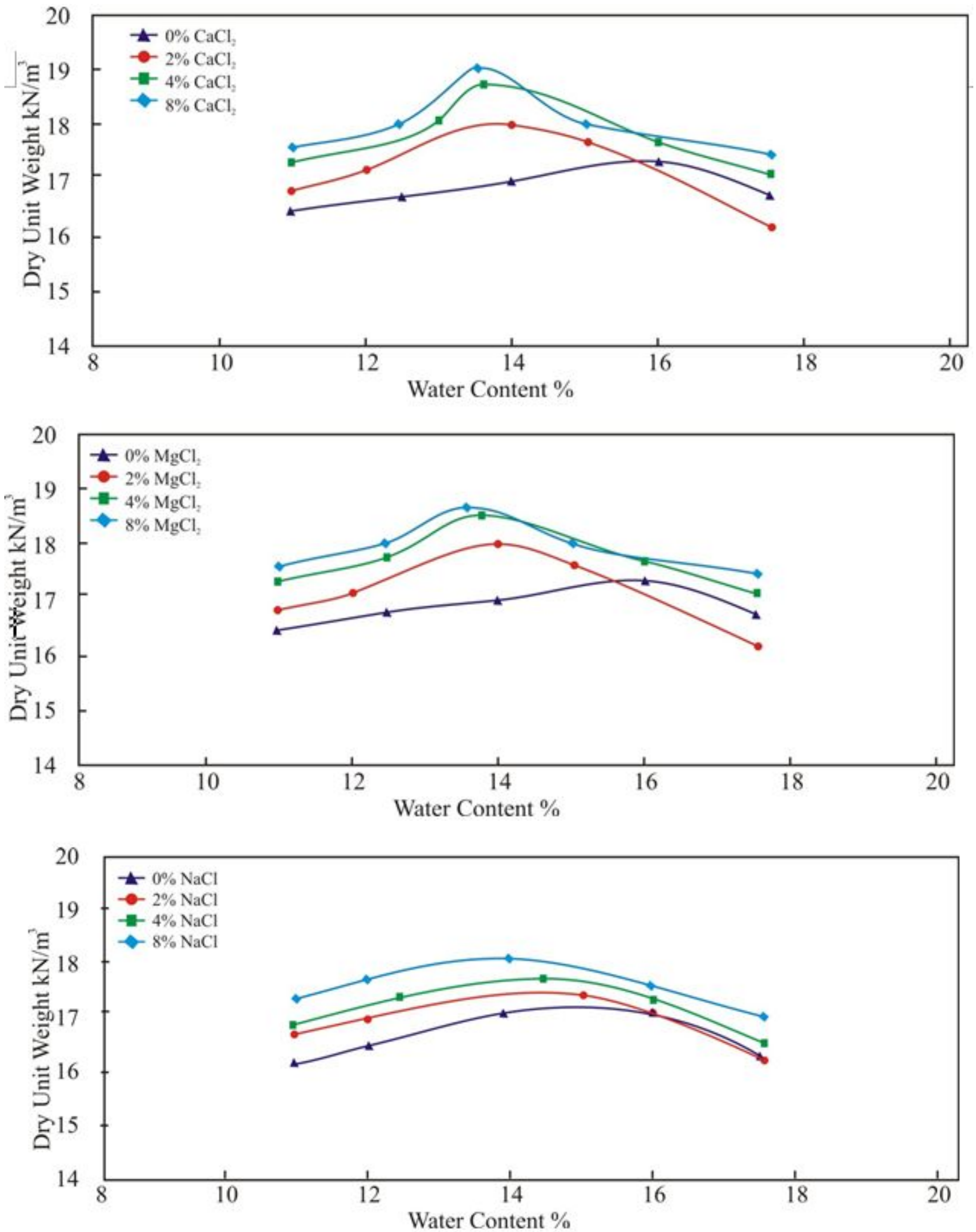

Figure 4 - Moisture Content - Unit Weight Relationship of the Three Salt Compounds.

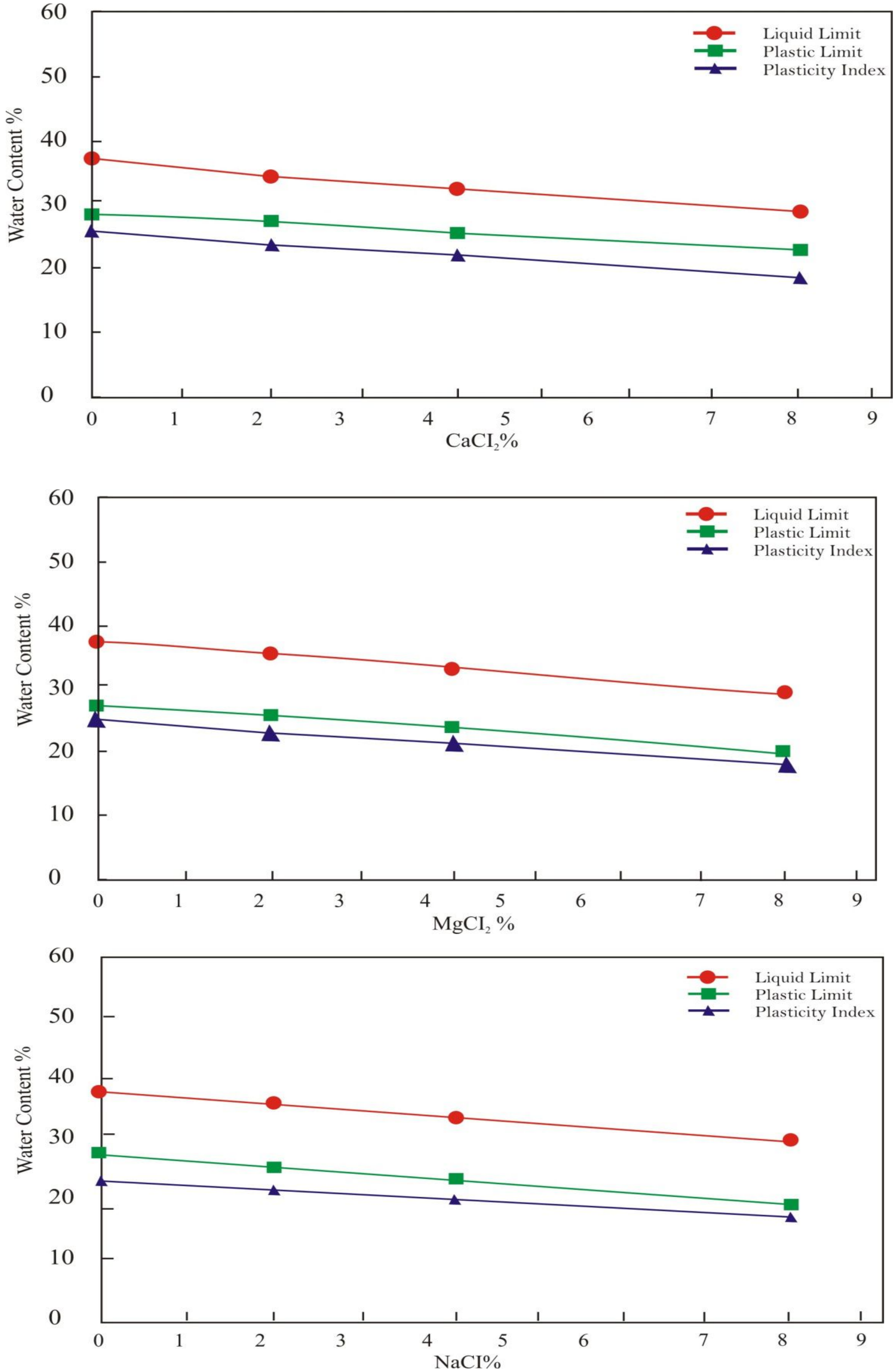

Figure 5 - Effect of Salt compounds on the Atterberg Limits of the Soil

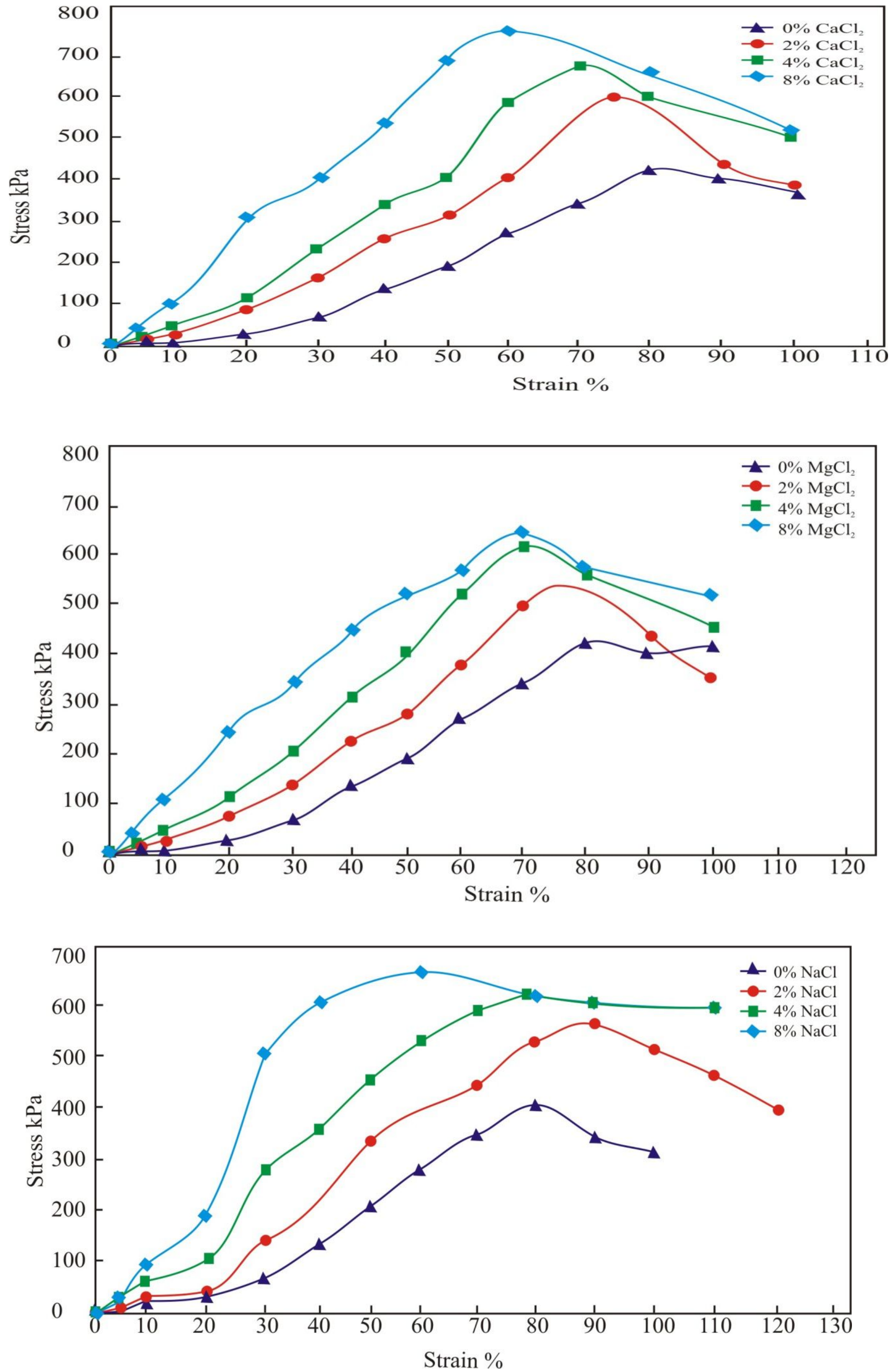

Figure 6 - Stress - Strain Curves of Unconfined Compression Test.

the dry unit weight - moisture content relation for different percentages of the different salts determined (see fig. 4). Cassagrade apparatus was used in determining the liquid limit of the laterite according to ASTM (D423-66), while the plastic limit was determined according to ASTM (D424-59); all to investigate the effect of the added salt on the consistency limits (see fig. 5).

Unconfined compression machine was used in determining the unconfined compressive strength of the laterite samples according to ASTM (D2166-65), the strain rate was 0.9mm per minute. The stress - strain curves obtained are shown in fig. 6.

3. RESULTS & DISCUSSION

Fig. 4 shows that the dry unit weight is directly proportional to the salt content while optimum moisture content is inversely proportional to the salt content; both of which is in agreement with Frydman and Ehrenreich (1977), Wood (1971) and Lambe (1958).

The Atterberg limits are shown in fig. 5 to be inversely proportional to the salt content, which is in agreement with Venkatabor (1977).

The stress-strain relationship of the soil is given in fig. 6, which shows that unconfined compressive strength is directly proportional to the salt content which is in agreement with Perloff (1976).

4. CONCLUSION

The effect of three salt compounds on the properties of laterite were studied. The atterberg limits and optimum moisture contents were found to be inversely proportional to the salt content, while the unit weight and the unconfined compressive strength were found to be directly proportional to the salt content.

It is therefore concluded that the salt compounds tested has the potential to stabilize laterite soils.

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