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Laboratory Investigation of the Strength Development of Alkali-activated Slag-stabilized Chloride Saline Soil

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Background

Chloride saline soil, an important type of saline soil, is widely distributed over coastal beaches, harbors, inland salt lakes and desert areas.

Soil stabilization is an important technique used in saline soil foundation treatment, in which saline soil is well mixed with stabilizer and becomes stiff and stabilized.

Need to find a **stabilizer** that is suitable for chloride saline soil stabilization.

Materials and Test Program

Chloride Saline Soils



Alkali-activated Slag

As an industrial by-product, slag, a cementitious material, has excellent anti-salt-corrosion properties, and it can be effectively used as a stabilizer in chloride environments.

Soil samples were stabilized using alkali-activated slag (AS), the unconfined compressive strength (UCS) of the stabilized soils was measured, and the microstructures of the stabilized soils were analyzed to investigate **the strength variation and stabilization mechanism of AS-stabilized chloride saline soil.**

Results

- The UCS of AS-stabilized laboratory made chloride soil (GZS) after different curing times increases with increase of the chloride content in the soil.
- NaCl in the GZS is beneficial for AS-stabilized soil.

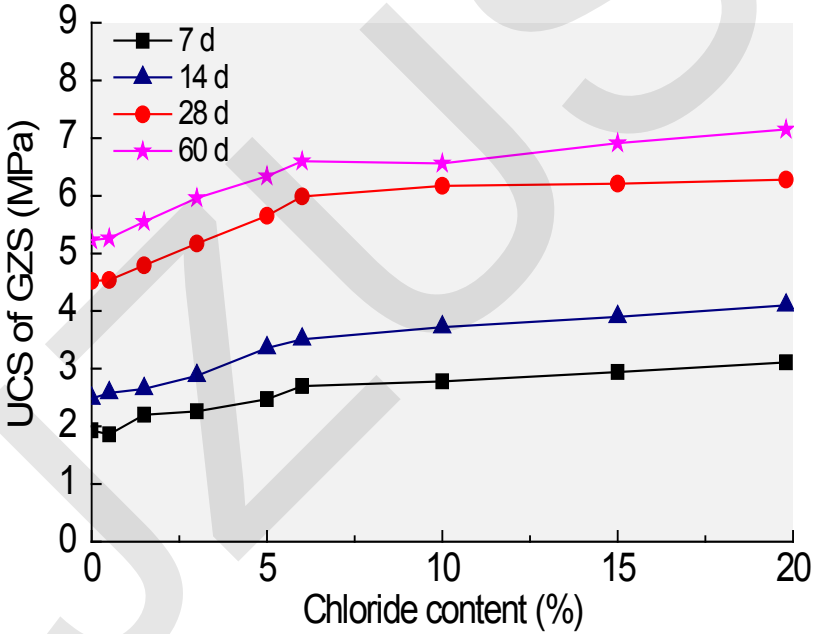

Fig. 1 UCS of GZS for different chloride contents

Results

Reaction Equation of hydration products:

$$CaO \cdot Al_2O_3 + Ca(OH)_2 + 2NaCl + 10H_2O = 3CaO \cdot Al_2O_3 \cdot CaCl_2 \cdot 10H_2O\,(Fs) + 2NaOH$$

- **Friedel's salt (Fs) crystals can squeeze and fill the pores in the stabilized soil and make the structure of the stabilized soil denser.**
- **NaOH can increase the alkalinity of the pore solution and promote the hydration of slag, which generates more CSH and enhances the cementation of the soil.**

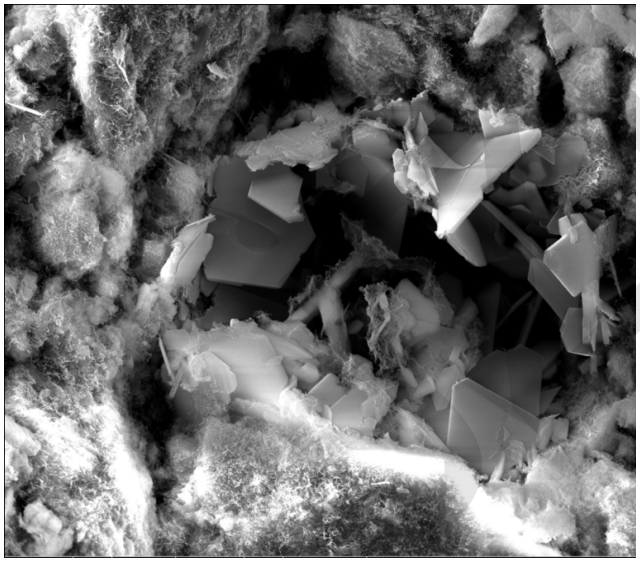

Fig.2 SEM image of stabilized soil

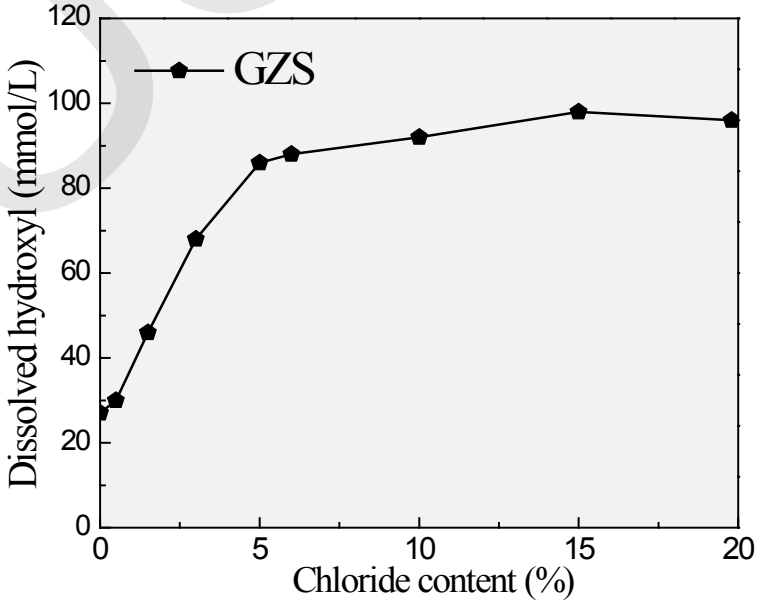

Fig.3 Dissolved hydroxyl in GZS for different chloride contents

Conclusions

- The strength of GZS increases with increase of the chloride content in the soil samples, and NaCl in the GZS is beneficial for AS-stabilized soil. AS is thus a suitable stabilizer that can be used to stabilize chloride saline soil.
- Fs and NaOH are generated by the reaction of NaCl and $CaO \cdot Al_2O_3$ in the slag. Fs can fill the pores in the stabilized soil and make its structure denser. The generation of NaOH can increase the alkalinity of the pore solution and promote the hydration of slag, which generates more CSH and enhances the cementation of the soil. These two effects together enhance the stability of GZS.

I am going to put life into scientific dream,
then the dream into reality

— Marie Skłodowska Curie