Thermal methods of stabilization

Soil stabilization by heating the ground and by freezing the ground come under, Thermal Methods of Modification. Heating evaporates water and causes permanent changes in the mineral structure of soils. Freezing solidifies part or all of the water and bonds individual particles together. Both these methods are very effective in improving the soil. However they are less common since they are expensive owing to huge energy consumption.

Soil heating

The higher the heat input per mass of soil being treated, the greater the effect. Even small increase in temperature may cause strength increase in fine grained soils by reducing the electric repulsion between the particles, a flow of pore water due to thermal gradient and a reduction in moisture content because of increasing evaporation rate.

Temperature(^{0}C)	Effect
100	Can cause drying and significant increase in clay strength
500	Can cause permanent changes in the structure of clays hence decreasing its plasticity
1000	Can cause fusion of clay particles into a solid substance

Heating is applied to the soil by burning liquid or gas fuels in boreholes or injection of hot air into 0.15 to 0.2 m diameter boreholes that can produce 1.3 to 2.5 m diameter stabilized zone after continous treatment for about 10 days. This techniques can be effectively used when a large and inexpensive heat source is located near the site.

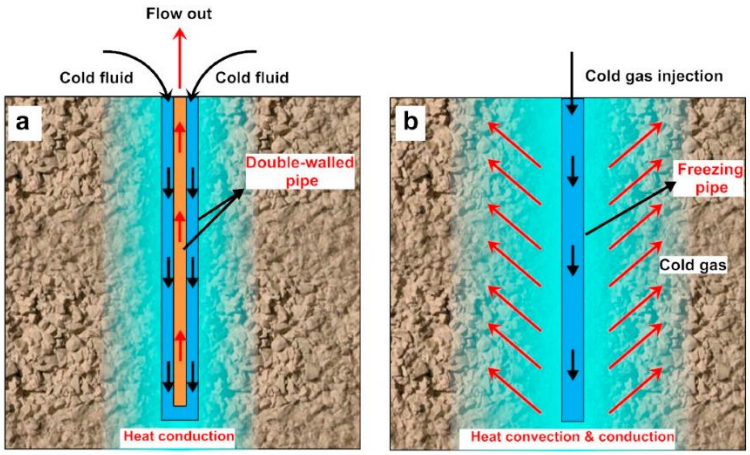
Ground freezing

Ground freezing is a construction technique used to stabilize soil or create underground barriers by freezing the surrounding ground with the help of coolant pipes. This method involves the intentional freezing of subsurface materials to create a stable, impermeable barrier or provide temporary support during construction projects. The process of ground freezing typically utilizes a refrigeration system to circulate a chilled fluid, such as brine or calcium chloride solution, through a network of freeze pipes or tubes installed in the ground.

Ground freezing is a process of converting pore water or pores into ice by continuously refrigerating the soil. The water bearing soil is very lose and doesn't have enough compressive strength and shear strength to withhold its own loads. To increase these strengths and make the water bearing strata temporarily impermeable ground freezing method is used. This is usually done to provide structural underpinning, temporary support and prevent ground water flow into the site area. When the water-bearing strata is frizzed, the water in it transforms into ice which becomes a seal against the water and strengthens the soil. In grouting, extraneous materials are used. But in this method no extra material is required and after the work is completed, the soil reverts into normal state as before. This method can be use in any type of soil, regardless of size, shape or depth of excavation, soil or rock formation regardless of structure, grain size or permeability. However, it is best suited for soft ground rather than rock conditions. It is applicable

to a wide range of soils but it takes considerable time to establish a substantial ice wall and the freeze must be maintained by continued refrigeration as long as required.

The effectiveness of freezing depends on the presence of water to create ice, cementing the particles and increasing the strength of the ground to the equivalent of soft or medium rock. If the soil has doesn't enough amount of water to fill all to pore when they freeze, then it may be necessary to provide extra water so that the pores are complete sealed. This method is very effective in the places where the ground is made up of silts



Soil stabilization

Soil stabilization involves the use of stabilizing agents (binder materials) in weak soils to improve its geotechnical properties such as compressibility, strength, permeability and durability. The components of stabilization technology include soils and or soil minerals and stabilizing agent or binders (cementitious materials). The binders when in contact with water or in the presence of pozzolanic minerals reacts with water to form cementitious composite materials. The commonly used binders are: cement, lime, fly ash and blast furnace slag. Stabilization helps in reducing the compressibility, swelling, shrinkage and permeability of soil.

Cement stabilization

Cement is the oldest binding agent since the invention of soil stabilization technology. It may be considered as primary stabilizing agent or hydraulic binder because it can be used alone to bring about the stabilizing action required. Cement reaction is not dependent on soil minerals, and the key role is its reaction with water that may be available in any soil. Hydration process is a process under which cement reaction takes place. The process starts when cement is mixed with water and other components for a desired application resulting into hardening phenomena. The hardening (setting) of cement will enclose soil as glue, but it will not change the structure of soil. However, this process can be affected by ♣ presence of foreign matters or impurities ♣ water-cement ratio ♣ curing duration and temperature ♣ presence of additives ♣ specific surface of the mixture. Cement stabilized soils have the following improved properties:

• decreased cohesiveness (Plasticity)

• decreased volume expansion or compressibility

• increased strength.