Soil Stabilisation with lime, cement and other binders

bla british lime association

britpave The British In-situ Concrete Paving Association
Theory

- Why stabilisation
- Chemistry of stabilisation
- Binder choices
Why Stabilisation?

Sustainable process:
- Use on site materials / achieve recycling targets
- Reduce waste generation
- Reduce primary aggregate imports
- Reduce traffic movements on and around site

Financial and Operational benefits:
- Reduce project timescales
- Ability to work in winter months
- Reduce landfill tax costs
- Reduce project costs
- Increase profitability
What is soil stabilisation?

- The treatment of all types of soils* with a range of binders to provide a material that is fit for a specified purpose or has a specified strength.
- *Soils can be anything from gravel to clay

Chemistry of stabilisation

Soil → Binder (lime, cement or other) → Stronger soil
Chemistry of stabilisation

Stages of stabilisation

- Soil Improvement (instant)
  - Only with lime
  - Reversible

- Soil Modification (~ 2 hours)
  - Clay soils
  - Non reversible

- Soil Stabilisation (long term)
  - Clay soils
  - Non reversible
  - Granular soils use cement or mixed binder
Chemistry of stabilisation

Soil Improvement

Drying reaction
Quicklime + moisture from soil
= chemical reaction + HEAT

\[
CaO + H_2O = Ca(OH)_2 + \text{Heat} + 100^\circ\text{C}
\]

Add more quicklime and lose more moisture
Lime chemically binds 32% of its own weight of moisture
More moisture lost by evaporation due to heat
Reversible process!
Chemistry of stabilisation

Soil Modification

Soil Modification (~ 2 hours)

Physical change to the soil structure
Clay platelets reoriented
Reduces soil plasticity
Non reversible
Chemistry of stabilisation

Soil Stabilisation

Cementitious reaction

calcium + silicates and aluminates from soil = cement like product

Non reversible

Long term strength gain continues over many years
**Binder choices**

**Lime**

- Lime is usually quicklime
- Made by heating chalk or limestone in a kiln

\[
\text{CaCO}_3 + \text{HEAT (>1000°C)} = \text{CaO} + \text{CO}_2
\]

- Used in bulk or bags
- Lime for stabilisation should be CE certified to BS EN 459 “Building Lime”
Binder choices

Cement

- Cement used to strengthen soils that have been pre-treated with lime.
- Used alone on granular soils
- Sub base material with CBR values in excess of 50
- Greater stiffness
- Frost resistance
- Increased trafficability
**Binder Choices**

- **(GGBS) Ground Granulated Blastfurnace Slag**
  - Activated with lime
  - Slower initial set than cement - more working time
  - Can be used to mitigate effects of sulfates

- **(PFA) Pulverised Fuel Ash**
  - Activated with lime
  - Slow initial reaction but significant final strength
  - Useful filler - used at large percentages
Binder choices

Hydraulic Road Binders

● Blends of lime, cement, GGBS or fly ash
● Formulated for specific applications or performance
● Fast setting - cement based
● Slower setting - lime based
● Widely used in Europe and rest of World
● New in the UK, but already widely used.