# Discussion of SSAA activity in soil

Sodicity and salinity affected soils can be remediated by improving the drainage and infiltration by modification of the clay dispersibilities (e.g. Guo et al. (2006); Mehanni and Bleasdale (1983)).

AGR Science & Technology Pty Ltd has developed a technology for remediating sodic, degraded land by treating the affected clay structure to improve aggregate stabilities and soil drainage. This treatment technology uses a mixture of mixed iron and aluminium hydroxide colloids produced from spent Galvanisers' acids and caustic soda which contain the necessary starting compounds. This mixture is injected, ploughed and thoroughly mixed into a candidate soil under a controlled dosage program so as to achieve the desired level of dispersion control, whereupon the soil is rendered stabilized against the adverse effects of sodicity.

The chemistry of this process is akin to the ferrihydrite amendment process described by Rhoton et al. (2003) and Figure 1 illustrates how ferrihydrite cementation acts on clays.

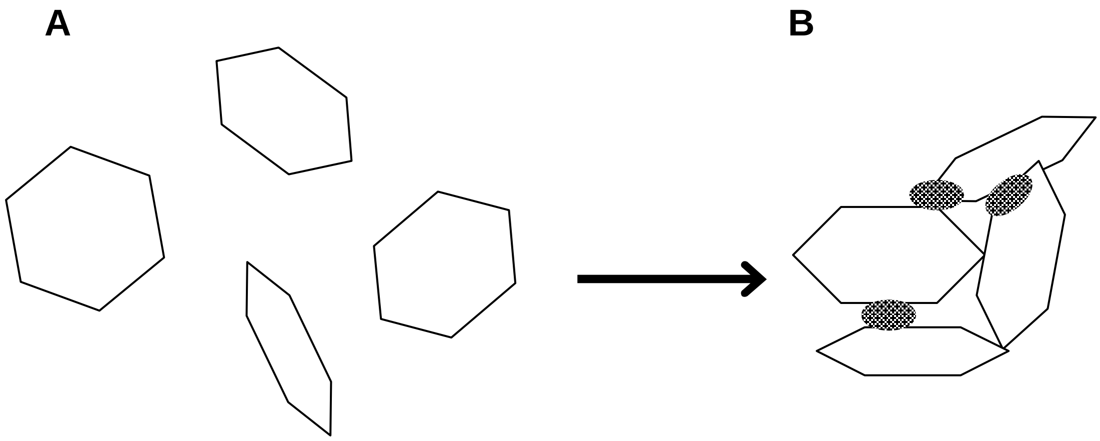


**Figure 1:** Diagrammatic illustration of how colloidal ferrihydrite causes the aggregation of a) dispersible clay crystals into b) cemented, non-dispersible clusters.

The ideallised mechanism of the SSAA treatment illustrated above is shown clearly in an electron microscope study of the technology's action of clays extracted from a sodic soil. The microscope images (Figure 2, below) of the clay fraction extracts before and after treatment show many fine colloidal iron-rich particles dispersed through the kaolinite mass, and adhering to the edges of the crystals, causing them to form cemented clusters. Similar images of associations of ferrihydrite with kaolinite crystal edges were reported by West et al. (2004).

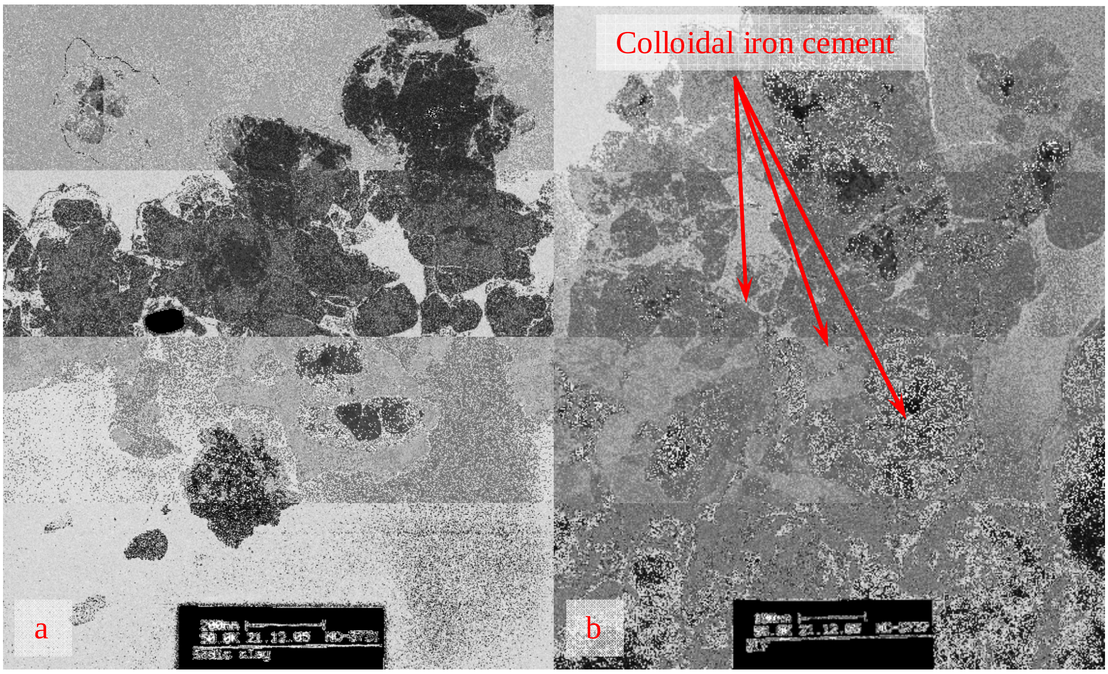


**Figure 2:** TEM images of clay fractions extracted from sodic soil a) before and b) after SSAA treatment. The treated sample shows many small clusters adhering to the edges of kaolinite crystals.

The observed iron hydroxide adhesion and aggregation of the clay particles effectively eliminates clay dispersion. Figure 3 (below) highlights how the clays within a sodic soil (from Dead Bull Creek – a property in SEQ) are aggregated upon treatment.

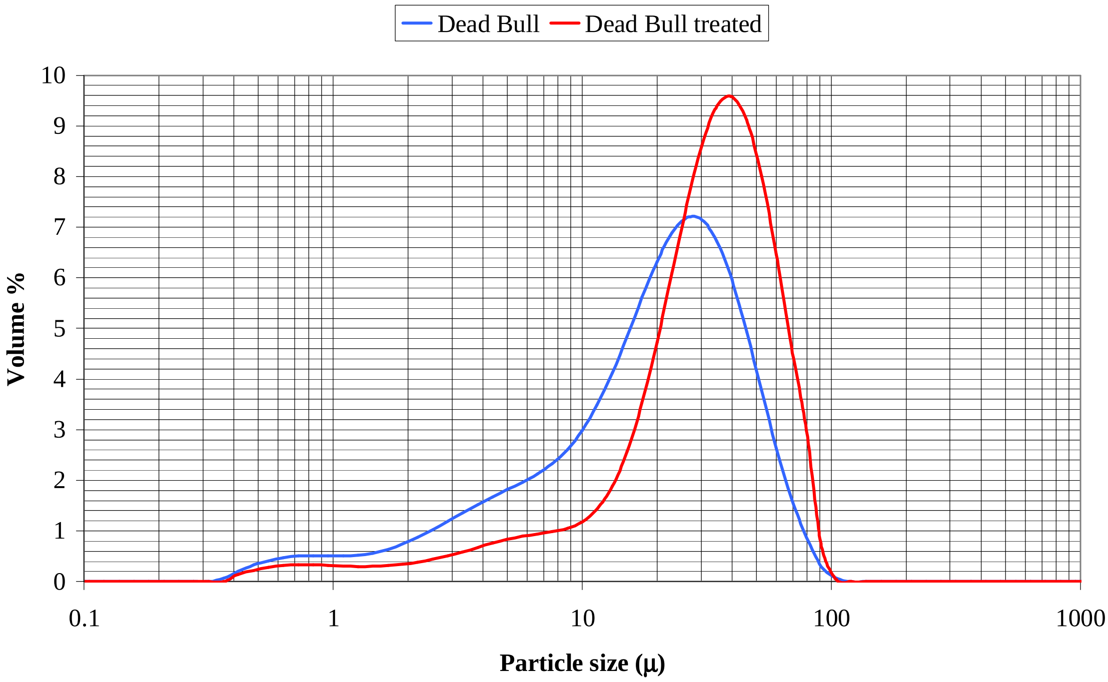


**Figure 3:** Particle size distributions found within Dead Bull Creek soil fines before and after SSAA treatment.

The resultant alteration the soil microstructure limits capillary rise of saline subterranean water tables, preventing future land salination from rising groundwater, and additionally promotes drainage through the affected profile, allowing sodium-bearing salts to flush out.

Finally, the microaggregation-cementation of the clays could be related to macroscopic changes in the soil dispersibility. Soil dispersibilities are minimized when levels of available Al and Fe are high (Figure 4). In soils which have received SSAA treatment and aged for a few seasons, the dispersibility class is most directly a function of the cohesive action of available Al and to a lesser extent, the available Fe. Even four years after the treatment event and well after excess electrolytes have been flushed out of the soils, dispersibility is still minimal. The stability of the clay aggregates brought about by the presence of iron and aluminium has been maintained.

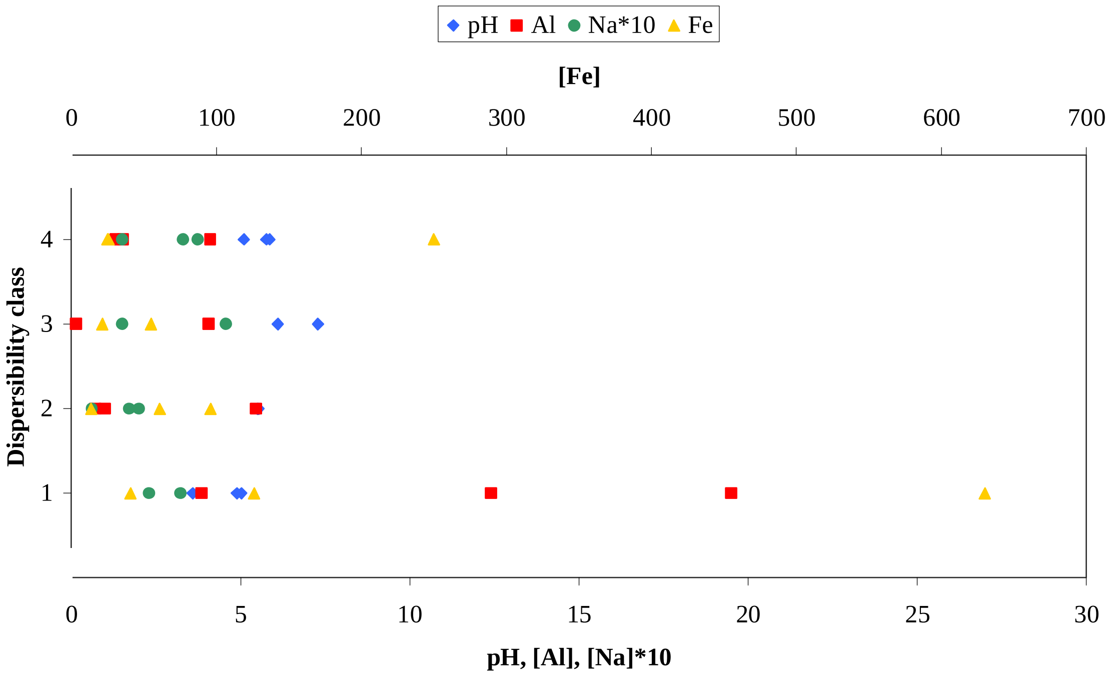


**Figure 4:** Soil dispersibility as functions of pH, Al, Na and Fe concentrations. In aged soils, the apparent relationship of low dispersibility class with Na is lost. Note that Fe concentration falls on a different scale.

The aggregation phenomenon being related to iron and aluminium levels was interpreted in light of studies such as Goldberg and Glaubig (1987) or Rengasamy and Oades (1977a, 1977b) for example. Available iron and aluminium levels related to the levels of Fe and Al hydroxides causing cementation of clay particles.

## REFERENCES


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