

## Testing soils for water holding capacity

When selecting sites for new dam sites, or when choosing clay with which to repair leaking dams, it is critically important to assess the soil's ability to hold water. Soil samples should be collected by auger or drilling rig from a series of holes to a depth 4 metres below the intended bottom of a new dam. The following extract from the Department of Agriculture Bulletin 4576 'Dam design for pastoral stock water supplies' clearly explains how such soil testing can be done:

"Soils from a proposed dam site should be given at least three tests in sequence, these tests are:

1. hand texturing for clay content;
2. hand moulding for strength; and
3. dispersion test in distilled water.

### Hand texturing

Soil from a proposed dam profile must contain sufficient clay to prevent dam leakage. A soil contains sufficient clay (i.e. it contains at least 25 per cent clay) if it hand textures as a clay or clay loam.

Despite some limitations, the hand texturing of soil provides a useful field guide to water holding characteristics.

The clay content can be estimated by squeezing moist soil out between the thumb and forefinger into a ribbon 2 to 3 mm thick. If a continuous ribbon 50 mm or longer can be formed, the soil contains enough clay.

### Strength

The strength of a dam site soil relates directly to soil hydraulic conductivity and stability. The strength of the soil can be estimated by moulding the soil when it contains enough moisture to be plastic.

A strong soil has superior water holding characteristics. That is, the soil is stiff, with a high resistance to deformation when its moisture content is such that it starts to crumble when manipulated.

A weak clay, on the other hand, is very soft and easily deformed. It is usually these weak clays that cause piping failure in dams. These clays should be tested for dispersion.

### Dispersion

Different soils show varying degrees of dispersion. The degree of dispersion of soil aggregates is judged visually after immersion in distilled water for 20 hours.

### Soils with more than 25 per cent clay

Soils that are strong and show no dispersion should also be studied closely for structure. Well-structured soils (blocky peds) may leak. These should be avoided or further tested for dispersion in sodium tripolyphosphate (STPP) solutions to determine if the use of STPP might be a possible sealing technique. (STPP is a chemical used to improve water-holding characteristics of some soils.)

Weak soils that completely disperse should be avoided as this indicates the possibility of piping, but weak soils with moderate dispersion are generally suitable for dam construction. Soils that show nil or slight dispersion should be tested with STPP.

Soils with less than 25 per cent clay

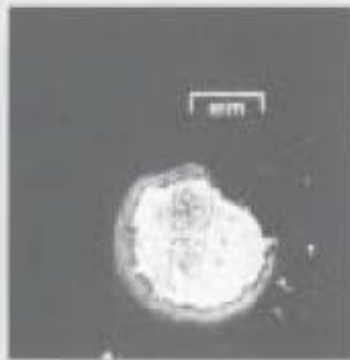
Strong soils with less than 25 per cent clay should disperse moderately if they are to hold water. If dispersion is nil or slight, they will leak and require testing with STPP.

Dispersion tests should be carried out on air dry aggregates in varying concentrations of STPP to determine the amount of STPP to dissolve in the dam water. Concentrations of STPP used to test dispersion are 0.05, 0.1, 0.2, 0.3 and 0.4 g/L. The air dried aggregates are placed in these solutions and rated after 20 hours. A score of 0 to 4 is used to rate the degree of dispersion.”

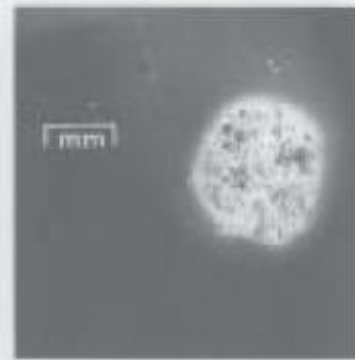
Pictures of soil dispersion with scores of 0 to 4 are given below, followed by a key for testing soils.



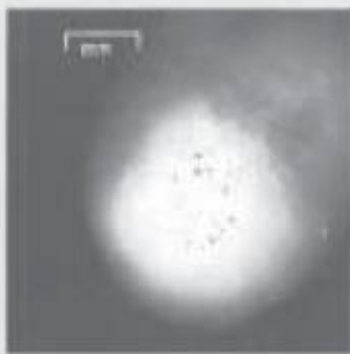
*Figure 2a. Soil aggregate showing no dispersion (Score 0), note how the original 1 - 2 mm aggregate has slaked into finer aggregates.*



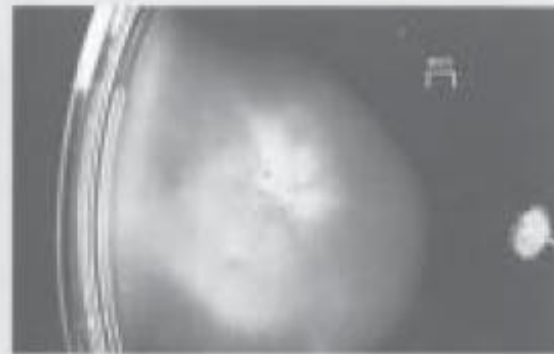
*Figure 2b. Soil aggregate showing slight dispersion (Score 1), seen by a slight milkiness of the water adjacent to the aggregate.*



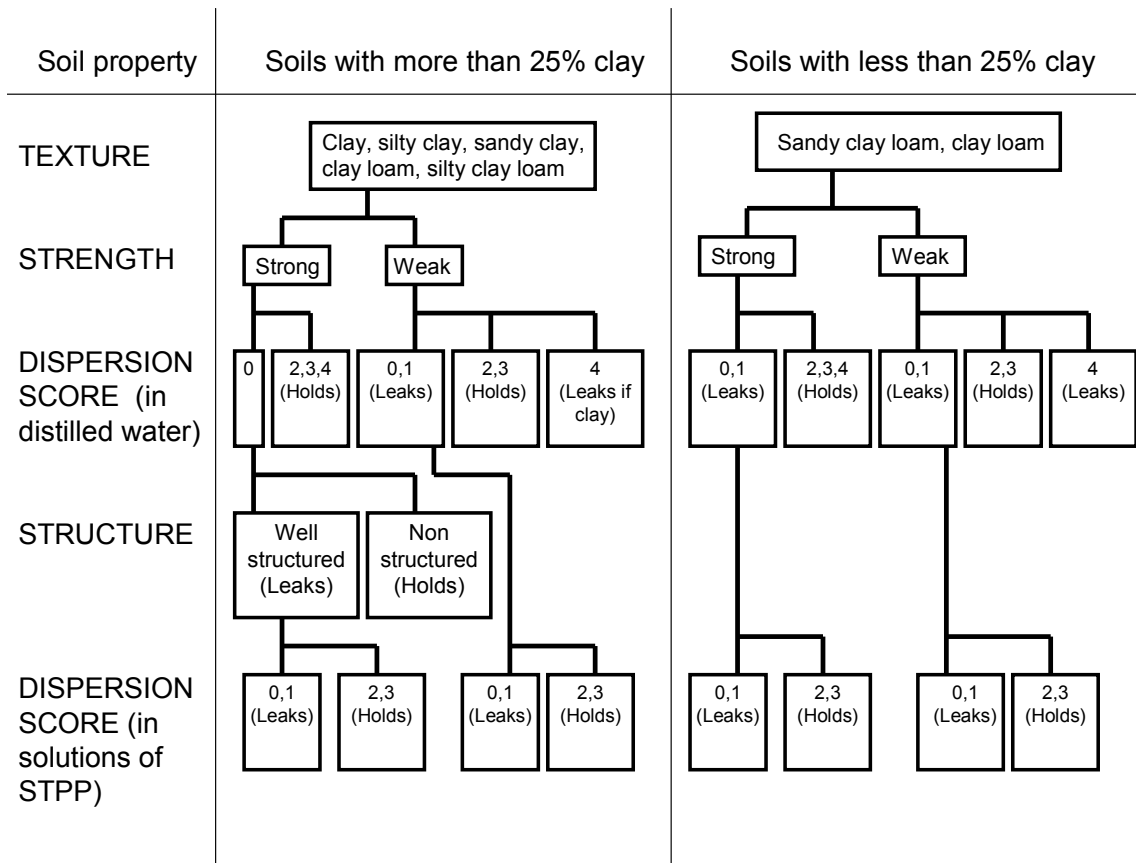
*Figure 2c. Moderate dispersion of aggregate (Score 2).*



*Figure 2d. Strong dispersion (Score 3), just over half the aggregate has dispersed; there is considerable milkiness.*



*Figure 2e. Complete dispersion of aggregate leaving only sand grains in a cloud of dispersed clay (score 4). Slaked aggregate also shown for comparison.*



A key for testing soils

Sodium tripolyphosphate (STPP) may decrease leakage or seepage in certain soils by increasing their dispersion. However, it is not suitable for use on all soils and can make leakage or seepage worse if applied to the wrong soil.

Although written with the rangelands in mind, this publication by Jim Addison, John Law and Geoff Eliot contains much practical information relevant to a wide range of locations in Australia. This would be a useful reference to anyone planning to site and sink a dam. In particular, the publication views the catchment and the dam storage as an integrated system, and explains how to balance water demand, catchment size and dam size. The Bulletin contains a lot of practical information regarding dam site selection and construction, and provides useful equations and tables. The Bulletin can be accessed via the Department's website [www.agric.wa.gov.au](http://www.agric.wa.gov.au).