SODIUM BENTONITE AS A SEALANT IN THE CONSTRUCTION OR REPAIR OF EATHERN WATER STORAGE SYSTEMS

Sodium bentonite has been successfully employed as a sealant for earthen darn structures where the available soil is of a highly permeable nature and/or where less than optimum compaction can be achieved. Accurate incorporation and compaction are important in the use of sodium bentonite and less than satisfactory results may be obtained if due regard is not given to each.

Sodium bentonite is a naturally occurring hydrated aluminium silicate clay which exhibits extremely high swelling and water absorbency properties. In the context of reducing the permeability of earthen structures, the action of sodium bentonite can be seen to be twofold:

- absorbance of water with resulting swelling and therefore filling existing air and water voids with a thick plastic mass.

- this plastic mass then acts as a bonding agent for the soil particles during the compaction process.

TECHNIQUES

Sodium bentonite can be thought of as a concentrated clay such that relatively small amounts blended with sandy soils drastically reduces permeability. This is due to the swollen hydrated sodium bentonite filling the air and water voids with a stiff plastic mass which bonds the soil panicles to give an effective seal.

There are three techniques by which bentonite can be incorporated into a dam. These are: Mixed Blanket, Pure Blanket, and Sprinkle methods. Sodium bentonite is most effective, when used as a mixed blanket, in the construction stage of a dam or when an existing dam has been completely emptied. Only under these conditions can the necessary compaction be carried out. The other techniques have been used successfully but are less reliable and more costly.

New or Empty Dams

Mixed Blanket Method

This outline of the incorporation of sodium bentonite with soil to form an impermeable seal presupposes that aspects such as the prevention of

scouring by inflowing water with catch drains and specially treated inflow areas have been considered. The dam sides should not be steeper than 1 in 3. The basic technique is to accurately mix the sodium bentonite into 10-15 cm of a selected soil type, followed by wetting and compaction.

The characteristics of the soil used for the blanket are that a should be:
a) low in clay content*
b) low in gravel content, particularly bits larger than 10 mm
c) free of vegetation

**Heavy clay soils which do not mix readily with the bentonite powder are not suited to the mixed blanket method, but can be treated using the pure blanket technique, which is also suited to light soils.*

The sodium bentonite should be rotary hoed into the soil at a depth of 10-15 cm to achieve as accurate a mixture as possible. Merely having the sodium bentonite incorporated at an overall average rate will lead to less than expected performance - the relatively undertreated areas will be weak spots that will allow high percolation rates.

With the sodium bentonite accurately mixed into the soil, water should be sprayed onto the surface, after which the mixed blanket should be compacted. The level of water required to give the best compaction results is at about PLASTIC LIMIT. This is defined at the point where the soil can be just rolled to about a 3 mm thick cylinder in the hand without crumbling. This approximates the Optimum Moisture Content in most cases. The level of compaction should be a minimum of 4 passes of a wheeled or smooth drum roller. In small dams a heavy rubber tyred tractor may be able to achieve reasonable compaction.

The Mixed Blanket liner should be protected with an overlay of 10-15 cm of compacted soil.

Usage Rates

The generally recommended usage rates are 8 kg/ sq. metre for a clayey sand and 12 kg/sq. metre for a well graded sand with minimum clay. Up to 18 kg/ sq. metre is required for poorly graded sand (all sand particles a similar size) to effectively stop percolation.

Dispersive Clays

Dispersive clays have the characteristic of readily moving into colloidal solution without any agitation applied. They can be easily identified by dropping air-dried crumbs of soil into distilled or rain water. Without agitation, the crumbs will begin to disperse and a cloud will appear at the surface.

Where these soil types are encountered, special attention must be given to the compaction stage of construction to ensure permeability is reduced sufficiently to minimise any tendency towards erosion, tunnelling, piping etc.

PURE PLANKET TECHNIQUE

Heavy clay soils cannot be effectively treated by the mixed blanket method. Such soils can be treated by applying a continuous undiluted blanket of a standard grade of sodium bentonite (GTC-4) 25 mm thick over a leveled and lightly rolled surface. This blanket is then covered with 150 mm ot topsoil, sand or gravel and the whole area again lightly rolled.

Sealing Partly Filled Darns

Sprinkle Method

When leaking occurs below the water line, and the loss zone can be reasonably accurately determined, GTC-4, may be broadcast on the water surface in an attempt to seal the leakage area. This method while frequently successful, cannot be as reliable as the Soil blanket approaches as no compaction is applied in the process.

A coarser grade is required in this application as the material is sprinkled over the surface of the water where it must sink quickly to be drawn into the leaking zone by the escaping water. HR120is has a very similar specification to GTC-4 and can be used in this application. Use of the finely ground HDG is impractical for this method as the fine powder is slow to wet and tends to sit on the surface (and can therefore drift away from the area to be treated). Typical usage rates of GTC 4 in this application are 20- 30 kg per square meter of the darn floor area.