GEOTEXTILE FOR UNDERDRAINS OF TAILINGS DAM ERGO TAILINGS DAM, SOUTH AFRICA

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The outer impounding walls of tailings or slimes dams for the disposal of mining residues in South Africa are generally constructed of the waste material itself. The fine wet slimes are retained behind stable confining walls of structurally competent material.

Underdrains are installed to have several functions. The seepage surface below the outer slope is drawn down and prevented from emerging on the face. The pore water pressures within the wall zone are reduced. The effective shear strength of the material is increased. And the wall stability is enhanced.

DESCRIPTION

The East Rand Gold & Uranium (ERGO) project recovers mineral rich material from old residue deposits. After the gold, uranium and pyrites have been extracted, the resultant barren residues are disposed in the ERGO tailings dam. The dam is sited across a shallow valley and on the side hill of the next valley. It is 10 to 15 km from the process plant.

The dam, one of the largest in the southern hemisphere, covers an area totalling over 1300 ha. Within a perimeter of 15 km, some 680 Mt of tailings can be deposited at the rate of 2.7 Mt per month.

The walls of the tailings dam are constructed of cycloned coarse tailings within low earthfill toe walls. The cyclone underflow produces a free-draining, free-standing, high strength outer wall within which the fine overflow material is deposited. The dam will eventually reach a maximum height of 76 m above the valley floor.

Construction of the predeposition works, including earthfill starter and toe walls and underdrains, began in 1976. Tailings were first deposited in the central valley during 1977. With the predeposition works extended to enclose 3 sides of the dam perimeter, deposition continued on this site until December 1984. The tailings dam extension on the side hill of the adjacent valley has been kept separate from the original dam. The predeposition works for this major extension were constructed during 1984 with further additions later. Tailings deposition is planned to continue until the end of the century.

The underdrainage system must function effectively both during the many years of the construction of the residue deposit and after its completion. Geotextiles are incorporated in the filter layers which separate the deposited material and the underlying soil from the drainage medium. The geotextile function is to prevent the ingress of fine soil and tailings while seepage water passes through.

TECHNICAL CONSIDERATIONS

Typical construction details of filter drains installed at the ERGO tailings dam are shown in Figure 1. The filter sand layer is designed to collect the seepage water, derived from the tailings slurry and from stormwater, into the drain without any appreciable head loss. The required water through flow rate thus determines the surface area of the sand layer. The coarse tailings layer acts as a protective cover until wet tailings have been deposited over the drain.

The stone and perforated pipe are sized according to the required longitudinal flow capacity along the drain. The stone serves the dual purposes of feeding the water into the pipe and of supplementing the longitudinal flow path.

By incorporating geotextiles into the filter drains, the grading requirements for the filter sand and stone can be relaxed and an intermediate natural gravel layer can be omitted. The material costs are thus reduced and construction is facilitated.

Laboratory flow tests were first carried out with the various brands of geotextile then available in South Africa and with samples of the tailings and sand. These tests were designed to model filter performance in terms of

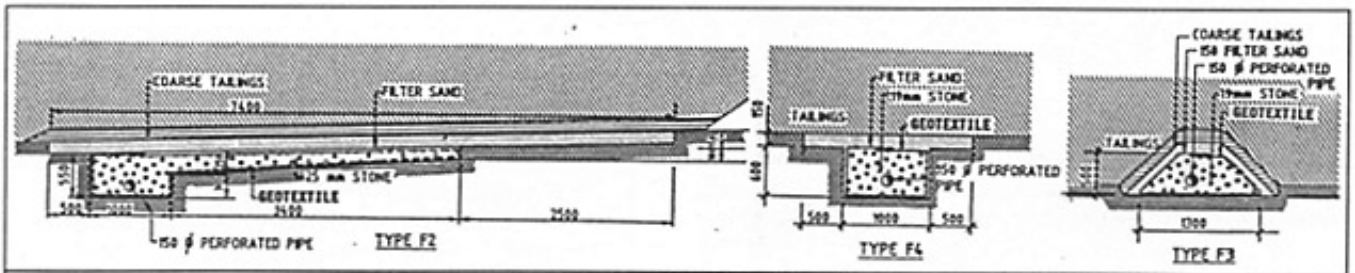

Figure 1. Typical details of filter drains.

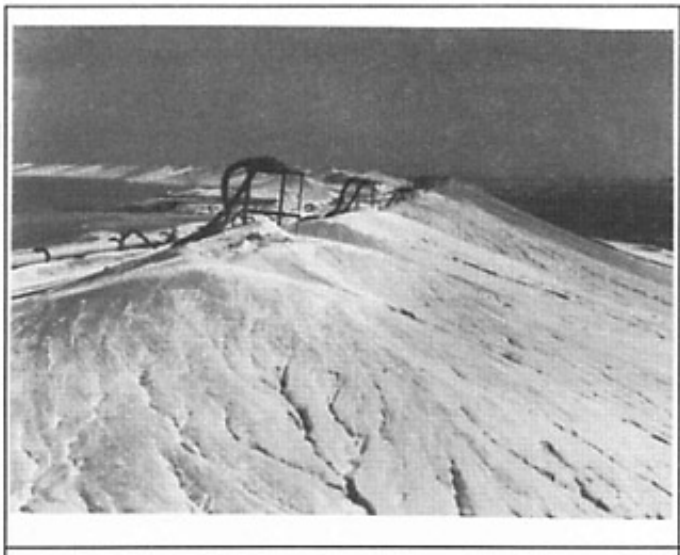

Photo 1. ERGO Tailings dam - Tailings deposition through hydrocyclones.

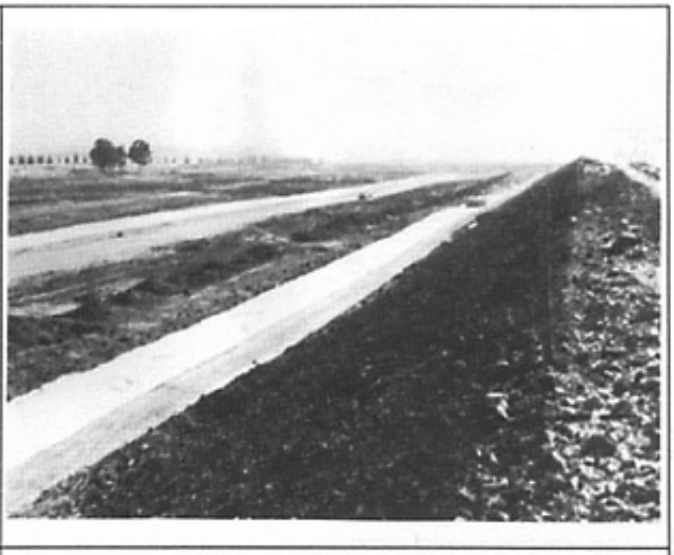

Photo 2. Filter drains under construction outside earthfill starter wall.

through flow capacity and solids retention without clogging. A nonwoven needlepunched polypropylene or polyester geotextile (e.g. Bidim U14) was found satisfactory. Subsequent experience showed that a heavier grade of geotextile (e.g. Bidim U24) could better withstand the handling forces and damage during construction.

As further knowledge was gained, the geotextile properties could be specified for the required performance both during construction and in operation. Geotextile with a minimum unit mass was required to meet all the criteria tabulated. The established criteria are given in Table 1.

Acceptable grades which have been used successfully include:

- Bidim U24 (nonwoven needlepunched continuous filament polyester);
- Polyfelt TS600 (nonwoven needlepunched continuous filament polypropylene stabilised against UV radiation);
- Geoindustex S135T (woven fibrillated flat tapes, of polypropylene stabilised against UV radiation).

At all splices, the geotextile was lapped, folded and either stitched with a woven nylon thread or stapled at close centres.

Certain sections of drain have malfunctioned at various times in locations where water was forced to flow out of the sides of drains. The cause was either because of internal positive hydraulic heads at those locations or because of a downstream mechanical blockage. Where the drain became exposed to the air, a reddish brown deposit formed and the geotextile surrounding the drain became clogged. This was due to the formation of ferric oxide precipitates which, together with micro-organisms, coagulated the fine particles of quartz tailings and trapped them in the pores of the geotextile.

The damaged filter drains were reconstructed and covered. They have since functioned satisfactorily.

Table 1. Established criteria for geotextile filters.

Property	Specified Value	Test Method
Water through flow capacity normal to plane of geotextile under 100 mm water head and confining pressure 200 kPa	minimum 5 l/s/m²	---
Effective opening size O_{90}	> 110 μm < 800 μm	wet sieving
Strip Tensile strength (in any direction)	10 kN/m	DIN 53857
CBR puncture resistance (minimum piston force)	2.0 kN	DIN 54307

REFERENCES

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