

BOILER FLYASH AND EFFLUENT DISPOSAL AT UMZIMKULU

SSGGOVENDER

Umzimkulu Mill, Port Shepstone, South Africa

Abstract

The disposal of effluent in conjunction with flyash in a landfill site is reviewed. Problems associated with corrosion of concrete pipes and drainage of the dam wall are highlighted, and solutions to these problems are outlined. It is concluded that the system, which has operated since 1987, is a successful means of treating mill effluent.

A history of Umzimkulu's ash disposal dam

The ash disposal dam was constructed close to the Umzimkulu Mill in 1982. It comprises a compacted earth dam wall that spans a steep sided valley draining into the Umzimkulu River. The dam was intended for the settling of fly ash from the boiler scrubbers and grate ash from the boiler grates.

In close proximity to the dam a separate effluent treatment plant in the form of an anaerobic dam and an aeration pond contended with all other wastewater from the Mill.

The floods of September 1987 destroyed most of the aeration control equipment in the effluent treatment plant. An alternative means of treating the effluent was urgently required. The ash disposal dam with its 70 000m³ of sand and carbon at the time was thought to be an ideal filter medium. From May 1988 the factory effluent was pumped together with the waterborne ash to the settling dam. The initial results were positive with almost 95% removal of COD. In the ensuing years the dam wall was raised by approximately 1,5m per annum with each lift founded partially on the previous crest and partially on ash fill.

Operation of the sediment dam

Effluent from the Mill is composed of, inter alia, cooling tower overflow, floor washings, and septic tank overflows. This effluent together with waterborne ash is discharged into the dam close to the wall. The dam then naturally performs as a wastewater treatment plant with primary and secondary processes. The primary process is that of sedimentation where solids are removed by settling. The secondary processes are those of a packed anaerobic filter and a stabilisation pond.

The collection of "clean" water from the dam is effected by two simultaneous means. The raisings of the dam wall were interspersed with filter drainage systems in the wall to keep it as dry as possible. These drains collect water that has percolated through the ash bed. This water is of very good quality and is discharged directly into the receiving stream that drains into the river.

Imbedded deep below the dam bed is a reinforced concrete pipe with a number of vertical shaft spillways (penstocks) emerging

up to the water surface at various points along its length. The surface water is allowed to flow into these penstocks and via the concrete draw-off pipe to a clean water dam that is situated immediately downstream of the sediment dam. From the clean water dam the water is pumped to the Mill to be used in the boiler scrubbers and for boiler de-ashing. High TDS due to re-circulation is combated by dilution with storm water run off from the hills surrounding the dam.

Another contributing factor to the operation of the dam is significant. At some stage in the life of the dam the Port Shepstone Municipality was allowed to dispose of sewage sludge in the dam. This sewage together with the septic tank overflows from the Mill provided the dam with nutrients not normally found in sugar mill wastewater.

System setbacks

The concrete draw-off pipe from the penstock collapsed twice (1991 and 1999) resulting in uncontrolled release of sediment from the dam. Soon after the second failure an inspection of the draw-off pipe via a manhole revealed extreme corrosion of the concrete on the inner wall of the manhole. The corrosion was attributed to the presence of sulphuric acid found mainly in the sewage sludge but also to a limited extent in the coal ash. The Municipality sewage disposal into the dam was stopped immediately after the incident.

Another threat to the continued operation of the dam had to be contended with. In 1997 engineering geologists condemned further use of the dam. In their opinion it was not possible to evaluate the efficiency of the filter drainage system in the dam wall. They were concerned that the water table would rise within

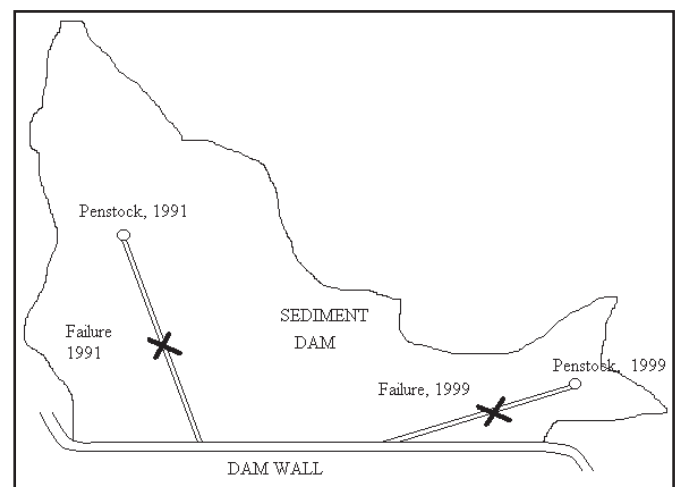


FIGURE 1. Map of the sediment dam showing the locations of the spine drain failures.

the dam with further raisings of the dam wall and make the wall vulnerable.

A new lease of life

In 1998 a firm of geotechnical engineers was consulted. Their proposals culminated in a complete upgrade of the dam during the 1999/2000 off crop.

The dam wall was raised a further two metres. A new 450mm I.D. Weholite HDPE draw-off pipe was laid that spans the furthest reaches of the dam. Three new concrete penstocks feed the pipe. The penstocks have a 150mm thick inner lining constructed from concrete made using calcium aluminate cement. The HDPE pipe and the calcium aluminate cement were specified to resist the acid attack.

To counteract the effect of the rising water table on the dam wall a new elaborate cut-off drainage system was constructed upstream and parallel to the toe of the raised dam wall. The design of this system was based on experience with a similar one at the Sezela mill where piezometers, installed to measure

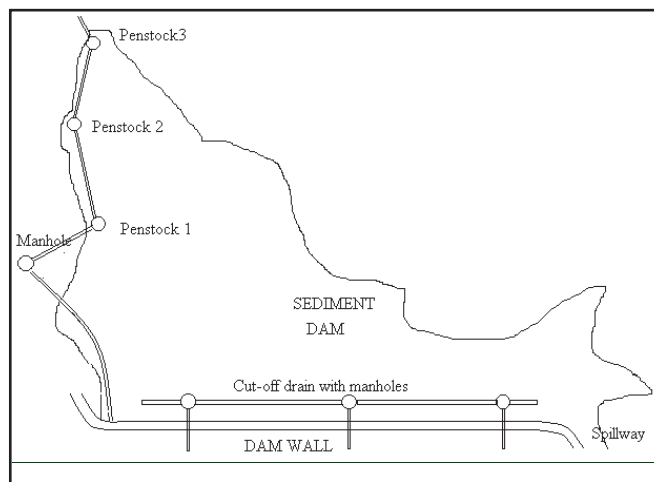


FIGURE 2. A schematic layout of the sediment dam upgrade during the 1999/2000 off-crop.

the build-up of water pressure due to the rising water table, have shown that the system is operating successfully.

The Results

The dam is presently functioning very well and as predicted. COD measurements of the water being discharged from the clean water dam are 25 ppm on average. The cut-off drain upstream of the wall is producing a constant flow from all three manholes. A substantial and even distribution of coarse ash deposit parallel to the dam wall was achieved. This helped provide a stable foundation for the next raising of the dam wall, which took place in February, 2001.

Recommendations

- It is apparent that the use of an ash-settling dam for the treatment of effluent can be successful. However it is not recommended if any part of the existing effluent reticulation system in contact with the effluent is not corrosion resistant.
- In the management of an ash-settling dam one needs to pay particular attention to the draining of the dam wall. This is of utmost importance to maximise the life of the dam. Adequate drawings of all drainage piping that is laid should be retained for reference. The adequacy of the drainage should be reviewed at least biennially.
- The discharge of the waterborne ash should be as close to the wall as possible and distributed evenly along the length of the wall. The sand settles first adding stability to the dam wall and provides a firm footing for the next raising of the wall.
- The penstock should be located as far as possible from the discharge point so as to maximise settling of the suspended solids and digestion of the organic matter.
- If possible the growth of vegetation (reeds, bulrushes and grasses) is to be encouraged and even introduced if lacking. Vegetation consumes nutrients in the water and diffuses oxygen into the water.