

R & L PROSSER CONTRACTING LTD***RICHARD PROSSER*****VITICULTURAL & WINEMAKING CONSULTANT**

435 Earnscleugh Rd
R D 1 Alexandra
Central Otago 9181
New Zealand

Phone +64 27 491 7816
Fax +64 3 449 2340
Home Phone +64 3 449 2370
Email rprosser@es.co.nz

Friday 28th October 2005

Craig McKenzie
Project Manager
Works Civil Construction
Christchurch

Dear Craig

Please find attached my report from a QA perspective on the MacArthur Ridge dam lining project recently completed at Springvale near Alexandra.

This was a satisfying project to be involved with, and I look forward to any future involvement with such a professional company as Works Infrastructure.

If I may be of further assistance in any way please do not hesitate to contact me.

Sincerely

Richard Prosser

Q.A. REPORT

BENTOFIX DAM LINING PROJECT

**MACARTHUR RIDGE VINEYARD, SPRINGVALE,
ALEXANDRA**

September/ October 2005

Contractor: Works Infrastructure, Christchurch
Subcontractor: Dunstan Sprayers, Alexandra

Abstract

This report details Quality Assurance findings and issues relating to the installation of lining material to a large water holding dam on a major ongoing vineyard development.

Overview

MacArthur Ridge Vineyard is a major commercial and lifestyle vineyard development located at Springvale, near Alexandra, in Central Otago. When complete, the vineyard will include plantings of some 235 hectares of grafted grapevines, in selected modern clones of Pinot Noir, intended for the production of quality table wine for domestic and export consumption.

The holding dam project is intended to provide a store of water for both irrigation and frostfighting purposes. This is a large-scale holding dam, with a nominal capacity in the order of 220 million litres.

General

Waterproofing of holding dams in New Zealand may utilise any of a number of materials or options. Small dams (or ponds) constructed mostly in-ground, and with a depth of less than three metres, may not require a waterproof lining. Often the clay content of the prevailing soil type may be sufficient to prevent leakage.

Alternately, where dams are deeper than three metres or where the natural soil clay content is low, a layer of clay of a suitable type may be introduced to the finished pond structure, which will provide adequate waterproofing once compacted into place by bulldozer or excavator tracks.

Where suitable clay is not available locally, or where space and depth are critical factors in terms of pond placement and holding capacity, plastic or bituminous liners may be used. These require careful fitting, and protection from puncture, in order to ensure water tightness.

Specific

This project has utilised Bentofix, a brand of Geo-Synthetic Clay Liner. GCL consists of a thin layer (approximately 12mm thickness) of dried Bentonite clay, sandwiched between two layers of fibrous synthetic cloth material. It is delivered and installed in rolls on a central core, some 4.7 metres in width (including overlap edge), and in this case, 30m in length.

Bentonite is of the class of montmorillonite clays, highly colloidal plastic clays consisting primarily of impure hydrated aluminium silicate with a defined expanding crystal lattice structure. This structure exists in very small, overlapping, flat plates or sheets. Combined with the clay's high swell factor, this structure provides for a very high degree of water tightness, particularly under extreme hydraulic head loadings.

For a dam of the type and depth which this project involves, a GCL is an ideal choice, being better suited to withstand the pressure experienced on the pond floor when the dam is at capacity, than would be the case with a lesser grade of clay, or a plastic or bituminous liner.

Project

Successful installation of the GCL required close attention to the condition of the subgrade. Neither projections, nor indentations, greater than 10mm in size could be permitted. This required condition of the subgrade was achieved by heavy rolling, the introduction of crusher dust as necessary, and the visual inspection, and physical modification of the subgrade (removal of stones and filling in of holes), as required, both before and during installation.

The edges of the GCL are impregnated with a high concentration of finely powdered Bentonite material. The overlapping of these prepared edges provides for water tightness at the joints between individual rolls of the product.

Where ends or edges require joining without two prepared edges being available, a Bentonite paste is required to ensure water tightness.

Careful attention to the straight, flat, laying of rolls, is necessary to ensure that overlapping edges are uniformly and consistently flat, without laps or kinks which would provide a pathway for water to exit the structure.

Careful attention is also needed in the application of paste to ensure that these joints will also be consistent and water tight.

Findings

Successful installation of the GCL did not present major difficulties when certain procedures were followed. Critical to the success of the project were an ongoing focus on quality control on the part of all staff, good communication, and in particular, the performance of the highly skilled and attentive digger operator / foreman employed on the project.

Dunstan Sprayers were able to supply a consistent pool of energetic and conscientious staff for the term of the project. The steady work rate and attention to detail displayed by the young men concerned, allowed for the task of Quality Assurance to be carried out quickly and with confidence.

Preparation of the subgrade did not pose major problems. The application of crusher dust as required, and the close attention of all staff, allowed for the creation of a uniform surface over the entire area of the pond structure.

Accountability across the scope and timeframe of the project is high, with daily records, both written and photographic, allowing for precise monitoring of the progress and quality of work.

Issues

In general, the Bentofix GCL was found to be a very consistent product. However in some instances, fluffy material left untrimmed on the outer edges of rolls, whilst immaterial other than in an aesthetic sense, was prone to collecting and being pushed up by backfill material, particularly on the pond batters, and this led to lifting of the edges on several occasions. I would suggest that the trimming of this material during the manufacturing process would improve the overall quality of the product.

Several discrepancies were noted, between the handwritten serial numbers marked on the rolls of GCL material, and the printed numbers present on the stickers placed on the covering bags. This could present a problem in the future, if it is necessary to back trace any problem which may present itself, to a particular manufacturing batch.

Pasting of non-impregnated joins proved to be a time-consuming and labour-intensive process. By its very nature such a method is open to the possibility of inconsistency, and perhaps most importantly, the fluid nature of the paste material left the joins prone to movement on backfilling. Despite close attention being paid by both the bulldozer operator and myself during the backfilling operation, movement of these joins did occur on a number of occasions, requiring the affected areas to be cleaned back and re-pasted. Covering pasted joins with a digger prior to backfilling with the bulldozer minimized this problem, but was a time consuming process in itself.

The manufacturer may wish to give consideration to the development of a dry component to replace the need for wet pasting of joins. This could perhaps be in the form of a doubled-over roll of powder-impregnated material of the type present in the edges of

rolls. Such a product could improve the speed, consistency, and integrity of the installation of the GCL.

The GCL was not a difficult product to work with in itself. However the catches on the lifting bar supplied by the manufacturer would benefit from minor modification, both to facilitate easier operation by hand, and to prevent the ingress of dirt and dust.

Exposure to the product may have been the cause of a minor and unexplained illness experienced on at least one occasion by all staff involved in handling the GCL, myself included. Characterised by fatigue and nausea, it appeared to follow a day or two after exposure to the Bentonite material from within the liner, usually after cutting the product to fit on joints and corners. Exposure to the dry material when mixing paste did not appear to cause the same problem, whether staff were wearing dust masks or not.

This temporary illness, and exposure to the product, may well be coincidental; but I believe there would be little harm in investigating the issue further, and perhaps some benefit.

Conclusion

GCL as a pond lining appears to offer a good quality and well-developed product solution. Successful installation of this product centres on close and consistent attention to detail in quality control.

In my opinion, staff and companies involved in this project carried out the installation well and successfully, and in accordance with the manufacturer's required specification. Records taken and kept by the contractor and subcontractors offer sound accountability in this regard.

The manufacturer may be able to extract some benefit in terms of ongoing product development and quality control, based on the experience and observations of this installation project.

Faithfully submitted Tuesday 1st November 2005

Richard Prosser
027 491 7816
rprosser@es.co.nz

