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1981/15. An appraisal of possible groundwater use for gas absorption at the A.P.P.M. mill, Burnie.

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Abstract

The A.P.P.M. paper mill at Burnie has a problem of dissolving the gases produced in their electrolytic plant in summer when the water temperature of their existing supply from the Emu River rises above 18°C. Because groundwater has a lower and more constant temperature, a request for a preliminary appraisal of the possibilities of using groundwater in the electrolytic process was made. This would require 1200 *l*/min (16 000 gal/hr) of water for three months of the year with continuous pumping during this time.

The only two potential source rocks for groundwater in the confines of the mill property are Tertiary basalt and Precambrian quartzite. The basalt is a small flow confined to the eastern end of the mill, and the quartzite is the most likely potential source. To obtain the amount of water required, it is estimated that at least sixteen bores to an average depth of 50 m would be required, and drilling and installation costs of such a scheme would be in excess of $50 000. If this cost is competitive with other alternatives, a minimum of two exploration bores would be required and if suitable quantities of water are found it would require long-term pump testing with two observation bores. This exploration is estimated to cost $5000. This would allow the feasibility of the scheme to be costed accurately and to predict the effect of such long-term pumping by modelling the aquifer and extrapolating these results over a long period of time. If this exploration drilling is to be undertaken some preliminary geophysical investigation will be required.

INTRODUCTION

A problem occurs during the summer months in the electrolytic process at the Associated Pulp and Paper Mills paper mill at Burnie when the temperature of the Emu River, the mill's water supply, rises about 18°C. Above this critical temperature gases created by the electrolytic process cannot be absorbed by the water.

This report was prepared at the request of Messrs R. Harvey and P. Hablutzel of the A.P.P.M. Technical Division. It is written to give management and the engineering section of the mill a guide to the costing, an appraisal of the risks, and preliminary investigation required if groundwater is to be considered as a possible alternative supply to overcome the above problem.

It should be realised that this report is based on the extrapolation of results from other bores situated in similar rock types in Tasmania, mainly at other locations outside Burnie. It is at the best only a rough guide based on scientific guesses, and should not be considered as anything but an approximation. It will require a follow up with a preliminary on-the-site investigation if groundwater is considered to be an economically feasible alternative, which to the writer appears very unlikely.

REQUIREMENTS FOR THE ELECTROLYTIC PROCESS USING GROUNDWATER AS AN ALTERNATIVE SUPPLY

(a) The amount of water required is 1200 *l*/min (16 000 gal/hr) for three months of the year, with continuous pumping during the summer when the water from the Emu River becomes too warm.

(b) The temperature of the groundwater during this three-month summer period should remain below 18°C.

(c) The quality of the groundwater is not critical. If the groundwater is slightly acidic, as it frequently is, it would be advantageous in the dissolving of the gases. No limit on the amount of total dissolved solids or organic content was given, but apparently sea water is not a suitable alternative because of temperature fluctuations.

GROUNDWATER TEMPERATURE

Groundwater temperature is generally lower than surface water temperature and remains relatively constant, showing little diurnal or seasonal fluctuation. It was these facts that makes groundwater attractive to the A.P.P.M. technical and engineering staff as a means of overcoming the temperature problems associated with the Emu River supply.

The temperature of Tasmanian groundwater is thought to be generally about 15°C, but it should be stressed that no bore has been monitored for temperature over any long period in Tasmania. This would be required to be done in an investigation bore at the mill site.

SOURCES FOR GROUNDWATER SUPPLY

The mill is situated at the foot of a plateau on a narrow foreshore platform which consisted of sand dune ridges with a lagoon and swamp area behind the dunes. The dune area has been flattened and the lagoon area reclaimed. Both of these areas are unattractive as sources of groundwater. The dune sand is too thin to form an aquifer. In the lagoon and swamp area, organic clay and silt are very likely to be present and such sediments have no groundwater potential. The fill of the reclaimed areas would be difficult material to drill through to reach the underlying older rocks. Consequently, the drilling and investigation area is restricted to the non-reclaimed areas of the mill, if the investigation, as indicated, is to be confined to the mill area.

The two source rocks available for groundwater at the mill are Tertiary basalt and the Precambrian quartzite of the Burnie Formation. It is from the plateau basalts of north-west Tasmania that good supplies of groundwater have been obtained, with yields of up to 300-450 *l*/min not uncommon. To reach the plateau area and drill this potential source would require the water to be transported 1.0 - 1.5 km. The bores would be sited outside the confines of the mill and the cost of piping alone makes this source uneconomical.

The regional geological map of the Burnie district (Gee *et al.*, 1968) shows a small basalt flow coming from the plateau down to the eastern area of the mill. Because this is such a small flow, it is unlikely to have an adequate thickness to form a good rock aquifer, although it may be worth considering siting an investigation bore in this flow as it may have a

hydrogeological connection with the plateau basalt.

Without doubt the most reliable aquifers are in the quartzite, but because they are rock-fracture aquifers the yields are anticipated to be low (within the range of 15 - 80 *l*/min), with exceptional bores yielding 230 *l*/min. The water from these aquifers is likely to be of a suitable quality.

DEPTH AND NUMBER OF BORES REQUIRED

As the thickness of basalt in the mill area is unknown and any hydrogeological connection of this basalt to the plateau basalts behind the mill would be most fortuitous, only the quartzites are considered in the following section of this report.

Because the yields in a rock fracture aquifer depend on the number and frequency of the joints intersected by a bore and the depth at which these joints or fractures remain open, such bores are drilled to a minimum depth of 30 m and generally average 60 - 70 m. In exceptional cases, the depths of such bores can be to 100 - 150 m. If the depth of the drilling is averaged at 60 - 70 m with a yield of 80 *l*/min, a minimum of sixteen bores would be required. At the current cost of about $60 per metre for a 150 mm diameter hole, the estimated cost of drilling would be $1800 to $2000 per bore. Most rock fracture bores require some casing at the top of the bore, approximating at least one-third of the total depth. If ten metres of 130 mm drill casing is allowed, an additional cost of $300 per bore should be added to the cost of drilling.

As the drawdown of the water level from such long-term continuous pumping is likely to be in the order of 30 - 40 m for each bore, bore pumps will be required to be set for below this level, and the cost of pump, driving rods, and electric motor is estimated at a further $1000 - $1500. This makes a total estimated cost of $48 000, and with bores set at a minimum of 50 m centres the cost of such a scheme, with piping and electrical wiring *etc.*, will be in excess of $50 000.

INVESTIGATION PROGRAMME

Given the limitations of the above assumption, one and preferably two exploratory bores will be required, and these should be drilled if possible before the coming winter.

If the yields and temperature of these bores appear at all satisfactory, a long-term continuous pump test should be undertaken with the water level of the pump bore measured in two observation bores at distances 25 and 50 m from the pump. The depth drilled in the observation bores will depend on the water table level and the anticipated water table movements during the pump test. These holes should be kept open to measure seasonal variation in the water table levels and temperature changes. This pump test will allow the hydrological properties of the rocks to be estimated and any proposed groundwater extraction programme to be mathematically modelled, its feasibility evaluated, and cost estimated with a degree of reliability. This evaluation should be undertaken by a reputable groundwater consultant firm with experienced hydrogeological and engineering staff and the necessary computer facilities for modelling the properties of the aquifer under continuous long-term pumping and extraction of large quantities of groundwater over a period of years.

CONCLUSIONS

If this report has not discouraged the prospects of using groundwater as an alternative supply for absorbing the gas, and management are prepared to accept the risk and the loss of up to $5000 for the two exploration bores, the selection of the sites will require a geological and geophysical investigation. The latter would comprise two or three refraction seismic spreads, several resistivity soundings, and possibly some magnetometer traverses. It is estimated this work would probably involve one geologist and two field assistants in one or two days of work. The cost of materials for this geophysical investigation would be about $100, but the cost of travelling and accommodation for the above staff could also be added to the cost of this work.

Because of the problems associated with using explosives within an operating mill, even though detonators will probably be sufficient in this investigation, it would be better that this work be carried out when the mill is closed. The close-down period would also have the advantage that no seismic noise from heavy machinery working would be present.

In similar geophysical investigations at the Round Hill quarries, 2 km east of the mill, high seismic velocities were recorded on the floor of the quarries and on the wave-cut shore platform (Moore, 1976). Such high velocity areas in the quartzite have tight joints and little groundwater and as such would not be suitable drill sites. The aim of the geophysical investigation is to delineate any similar areas at the mill.

REFERENCES

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