SUBMISSION TO THE NSW PLANNING DEPARTMENT RE DARGUES REEF PASTEFILL MODIFICATION PROPOSAL

From:
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While I support the concept of using paste fill at the proposed Dargues Reef mine site, both for the increased economic viability of the Project as well as for possible environmental benefits, including stability and decreasing the risks of the tailings dam facility, I object to its use without further safeguards, as well as further testing to substantiate the safety of both drinking and household water downstream, the endangered species immediately downstream, and the ongoing integrity of the water table.

The safeguards currently in place for the mine operation have been arrived at after much public input and Land and Environmental Court scrutiny. Any diminishing of their integrity would be unfortunate.

According to independent expert advice, the tailings sent to the TSF will be treated as toxic, with permeability specs (<1 x 10-9 m/s) attached to the flow of the leachate, while the tailings to be used in the paste fill mix off tailings and concrete will be treated just like common gravel.

This means that the tailings in the tailings dam will be treated as a hazard, with strict controls to stop their leaching, while the tailings used as back fill will be used without these safeguards agreed to.

The Tailings Characteristics table shown at section 2.2.3.2 of the proposal does not list amyl xanthate, although presumably these tailings, like those destined for the tailings dam, will be treated. Cortona claim that the Xanthates will bind to the ore sent to the proposed Parkes Processing plant. They do not, however, supply adequate substantiation of that, given that expert consensus on the issue is that paste fill is a relatively new process, and that the many variables mean that both the cement content and the leachate vary, even on a single site.

I suggest that we need to ensure sampling and assessment of the paste-fill material as it is produced so that there is no risk of leaching of xanthate residues into groundwater. Cortona state that no approved sampling techniques exist. If this is the case, I ask that the Department define and impose an adequate testing process before any paste fill approvals are given.

There also appears to be no study to substantiate the presumption that there will be no risk of alkaline concrete leaching leading to long term changes in the naturally acidic the water table. Any such change could be devastating to local flora, and persist for decades or even longer after the facility is decommissioned.

I also draw your attention to **a study of this proposal by Dr Grant Hose, of Macquarie University,** commissioned by the Environmental Defender's Office, which, while agreeing that the pastefill concept is a useful one in this instance, also draws attention to the inadequacy of data and need for further testing and monitoring.

Note: Dr Hose was not asked to examine the possible effects of leaching of amyl xanthate, as this would be a short term problem, and not in his area of expertise, but to look at the possibility of leaching of heavy metals. While his response was reassuring about any heavy metal contamination, he did draw our attention to other possible problems with this modification, which need to be addressed.

According to Dr Grant Hose:

"Thank you for the invitation to comment on the Dargues Reef Mine Modification.

I have reviewed the EA for the modification and have the following comments.

To the best of my knowledge the leaching tests done on the paste fill sample seem appropriate and the interpretation of those data seem adequate, such that environmental harm from metals in the paste fill is unlikely, as it was for the mine waste rock in the absence of the paste.

My concern is that the pH of the leachate (~9) is above the background pH of most of the groundwater (~7). The significance of this difference is not discussed in the EA or supplementary report in appendix 3 despite the consultant concluding that the pH of the groundwater will influence the concentrations of metals. Recent research has suggested that even limited contact with concrete channels can influence the pH of stream water (Wright et al 2011) so the dismissal of this issue in the letter from Cortona to the DRCC seems to me premature. With longer residence times in groundwater compared to surface streams, it seems likely to me that contact between groundwater and the paste fill concrete will result in an increase in groundwater pH. As suggested in the Hydrobiology report, increasing pH will likely reduce the availability of some metals in the leachate, but it will also have it's own potential affects on biota in the groundwater and receiving waters. It may be that the buffeting capacity of the groundwater is sufficient to cope with the change in pH but this should be considered in the report.

Further, there is no mention in the EA regarding the longevity and stability of the concrete paste fill. How long do the proponents expect that the concrete paste fill will remain in tact as a solid mass. What is the half life 9or similar) of concrete masses such as they will be creating?. I am no concrete engineer but if the concrete deteriorates over time then the infiltration of groundwater to the paste fill will increase as will the dissolution of metals and carbonates in the concrete etc. The long term stability of the paste fill should be considered.

Best regards

Grant

Wright, I. A., Davies, P. J., Findlay, S. J., and Jonasson, O. J. (2011). A new type of water pollution: concrete drainage infrastructure and geochemical contamination of urban waters. Marine and Freshwater Research 62, 1355–1361.

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<u>I therefore submit that before approval, the following conditions need to be put into place:</u>

1. That the pastefill contain no more than 1% Xanthate, or its breakdown products.

2. That the xanthate and breakdown content of the paste fill be tested weekly, and the results made public on the Cortona web site, as well as the register of concerned public downstream (which has yet to be put into place by Cortona), within 28 days of such testing.

3. That any spillage of paste fill, or it's components, must be reported to downstream residents as soon as possible, and no later than within six hours for residents who use the water directly downstream for drinking and household use and irrigation.

4. Autopsies of dead fish or amphibians within 10 km downstream of the Project, or where more than one animal that drinks water from up to 10 km downstream has died from no apparent cause. These autopsies must be conducted within one week of samples being provided.

5. A specified testing regime be put into place to determine any increased alkalinity of the ground or surface water, with remediation to take place within 28 days if a rise in alkalinity is detected. These results should also be made available on the website and register. This must be combined with specified remediation measures to be put into place within 28 days of any rise in the ph.

6. The long term stability and leaching potential of the paste fill should be considered, as suggested by Dr Hose. As there have been no long term studies of the integrity of pastefill, this would necessitate monitoring of both pastefill stability and effect on the ph of the watertable beyond the projected lifespan of the project, with a bond in place to fund on going monitoring and any mitigation measures, if necessary.

Substantiating material on the risks and unknown factors of paste fill use:

Quote from Mining Magazine of April 2012

'Not all mine tailings are appropriate for creating a quality paste fill that will flow properly and demonstrate the required strength properties after placement.

Betty Lin, senior engineer for backfill services, mining and mineral processing at Hatch, says: “For example, very fine-grind gold tails and high-sulphide ores can be problematic. Proper pilot plant and strength testing in the study phases is critical.”

The conditions at each mine site are unique, so the required paste properties will differ. Operations may even use several paste recipes in different fill areas. '

A further quote below also highlights the need for caution, as well as the potential major benefits.

MEND Report 10.2

Paste Backfill Geochemistry – Environmental Effects of Leaching and Weathering

EXECUTIVE SUMMARY

The influence of paste backfill on operational and long-term ground water quality and mine has been identified as one of the priorities of the MEND Program. This report provides a brief summary pertaining to current practices in the geochemical characterization of both cemented and uncemented paste backfill, and methods used to predict environmental impacts to surface and ground water quality associated with the application of paste backfill in underground applications. Data was collected via a literature review, and a survey of mines known to use paste backfill.

The findings indicate that the amount of available information and research on the influence of underground paste backfill on mine water quality is typical of a relatively new field. To date, research by the community at large has focused on the structural characteristics of paste in terms of meeting the required backfill strength using the most economic amount and mix of binder materials. In light of the belief that the chemical reactivity of tailings and the volume of leachate generated are reduced by thickening, and by the addition of alkaline additives such as cement, little information on the influence of paste backfill on mine water quality appears to have been developed. Exceptions have been where:

- the mineralogy and reactivity are extreme, with potential effects on paste strength;
- a portion of the paste is being deposited on surface (with potential surface water impacts); and,
- concern regarding potential ground water contamination from underground waste disposal in the United States led to initiation of the Underground Injection Control (UIC) Program that incidentally includes placement of mine waste backfill in underground mines under its legislation (Levens et al., 1996).

Recognition of the fact that any backfill has the potential to generate contaminant plumes in the long term, and potentially influence ground and/or surface water appears to have increased the site-specific evaluation of paste characteristics of newly proposed mines in recent years.

Despite the lack of extensive detailed study, the use of paste backfill in underground environments has been generally considered beneficial to reduce overall environmental impacts associated with mining, due to:

1. Reduction in the volume of tailings requiring surface disposal, thereby reducing surface impacts through footprint reduction;

2. Use of the full tailings stream in the backfill, rather than the coarse fraction used in more conventional sand fill, thereby reducing the need to handle and dispose of a separate slimes stream;
3. Reduction in the potential for tailings to oxidize or leach due to the nature of thickened tailings placed as underground backfill because of:

- Less free water, which reduces leachate generation;
- Less available oxygen as a result of the higher degree of saturation;
- Preferential flow of ground water around backfill, rather than through it due to the lower hydraulic conductivity of the paste backfill;
- The addition of cement that provides extra neutralization potential (NP) and decreases effective porosity; and,
- The potential for flooding at closure which reduces sulphide oxidation in long-term.

The general theories associated with paste backfill characteristics and geochemical reactivity appear sound, but there does not appear to be much field validation on the actual influence of key parameters. Lack of controlled conditions in active mine environments appears to significantly limit the ability to separately assess potential scale up issues. The field would benefit from research targeted at the specific components of paste theory (such as the separation of the influence of thickening and binder addition), examination of scale-up issues (preferably in the controlled environment of an isolated well characterized and instrumented backfilled stope), collection of detailed case studies, and additional monitoring of mine waters to assess the influence of paste backfill on mine water quality over time. The lack of detailed information currently available is of concern, and highlights the need to compile detailed site data and monitoring data for future assessment and validation of predictions currently being initiated. And as with any new field, establishing a standard base of terminology would be useful.

In the bigger picture, there may be a need to better define the potential importance of this issue, such that priorities for studying this matter can be assessed. For example, are existing backfilled mines producing significant ground water contaminant plumes? Certainly sidehill mines that continue to drain from portals or other openings are known to be potential closure problems when not suitably mitigated (i.e. Britannia Mine in B.C., Canada; Summitville Mine in Colorado, U.S.). And there appears to be sufficient information to suggest that there might be potential impacts from backfilled mines where the wall rock and backfill are particularly reactive (i.e. Bernier and Li, 2003). However, a general survey of existing underground mines might put the significance of the issue in perspective.