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Robert E. Moar
Little Salmon Carmacks First Nation
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Dear Mr. Moar,

Re: Review of the EcoMetrix Report to YESAB on the "detoxification" of the heap leach pad, March 31, 2008.

As per your request, I am providing my comments on the above mentioned report. With regards to the rinsing of the heap, the EcoMetrix report justly points out the need to optimize the distribution of the solution on top of the heap to prevent the formation of preferential flow pathways. However, it is important to add that this optimization should take place before the leaching starts, and not just during the rinsing phase. Indeed, as described in my earlier report (Catalan, 2008), the low permeability zones that hindered the rinsing efficiency in the Gaspe field tests were created during the leaching phase and not during the rinsing attempts. Hence, optimizing the solution distribution only for rinsing would be of little value if low permeability zones had already been created during the leaching phase. In fact, the Gaspe field tests showed that the change of solution distribution system at the end of the first draindown, from drip emitters to sprinklers (which allow a more homogeneous distribution of the rinse solution), had little effect on the outcome of the second sodium carbonate rinse. The drop in pH and rise in copper concentration during draindown occurred after rinsing with sprinklers (Catalan, 2008; Catalan and Li, 2000).

If the solution distribution is not optimized prior to leaching the Carmacks ore, then there is a significant risk that flow of the leaching solution will preferentially take place in routes directly beneath the drip emitters and that secondary minerals such as jarosite or gypsum may precipitate between these routes where higher-pH conditions may exist. This is what happened during the Gaspe field tests. These minerals then plug the pores in the ore, cause cementation, and reduce the permeability in the zones located between the main flow routes. Hence, poor leaching efficiency can result in a chemical modification of the ore (i.e., mineral precipitation) which later prevents efficient rinsing. This process of mineral precipitation can be self-reinforcing because the loss of permeability leads to a further reduction in the flow rate of acid solution through these zones, and therefore to a higher pH and to more precipitation. Pictures of Gaspe ore taken during excavation of vats that were leached but not rinsed show the presence of cemented (brown) material between drip emitters, which demonstrates that the problem originated during leaching, not rinsing (Figure 1).

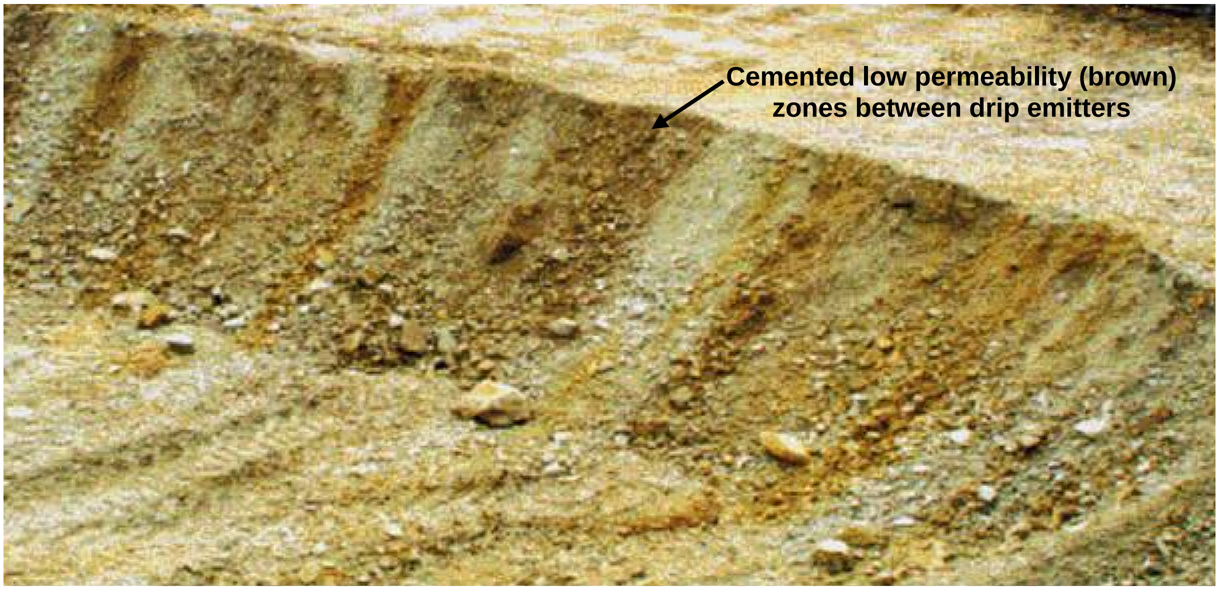

Figure 1: Vertical section of leached ore (not rinsed) showing that cemented low permeability zones (brown colour) formed during the leaching phase.

Although the Ecometrix report emphasizes the differences in ore placement methods and in emitter spacing between the Carmacks project and the Gaspe field tests, it is questionable whether these differences will be sufficient to prevent the formation of low permeability zones during leaching and to provide for efficient heap rinsing. Moreover, although agglomeration of the fines in the ore may reduce segregation of the Carmacks heap leach material, it will not completely eliminate it (O'Kane et al., 1999). Figure 2 shows a photograph of an excavation in an agglomerated heap leach pile deposited by a radial stacker (Kinard and Schweizer, 1987). Alternating zones of coarse and fine material are visible throughout the depth of the excavation. Segregation may also result in preferential flow pathways, depending on the solution application rate.

The EcoMetrix report does not provide recommendations on how to optimize the layout of the solution distribution system and the spacing between drip emitters. This optimization should be carried out in tests at a scale large enough to approach the flow conditions in the heap, using actual drip emitters. Unfortunately, laboratory columns are not representative of flow conditions in a full scale heap.

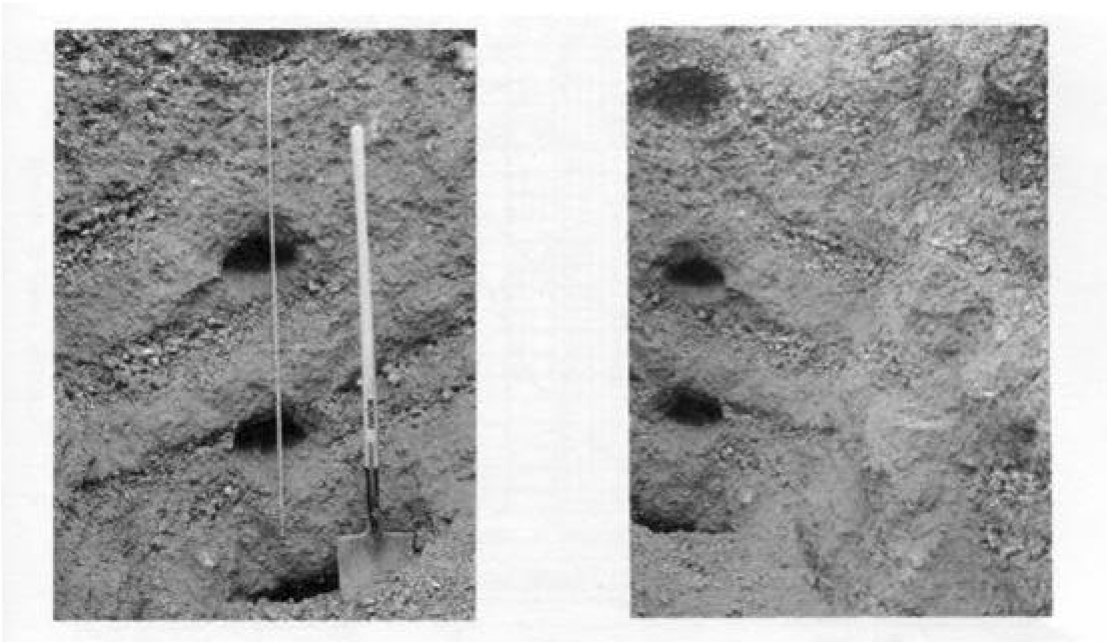

Figure 2: Photographs showing segregation in an agglomerated heap leach pile (from Kinard and Schweizer, 1987)

References

Catalan L.J.J., 2008. Letter from Lionel Catalan to Gerry Couture, Yukon Conservation Society, 01 February 2008, comments on the rinsing/neutralization plan for the Carmacks heap leach residues. YESAB Online Registry, Document No: 145-1.

Catalan L.J.J. and M.G. Li, 2000. Decommissioning of Copper Heap-Leach Residues by Rinsing with Water and Alkaline Solutions – A Pilot Scale Study. *Environmental Engineering Science*, *17(4):*191-202.

O'Kane, M., Barbour, S.L., and Haug, M.D., 1999. A framework for improving the ability to understand and predict the performance of heap leach piles. Paper presented at the 1999 Copper Conference.