Solution Collection Pipes & Overstressing of Geomembrane Liners[i]

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Detailed analyses of the affects of solution collection pipes at the base of high heaps have shown that there is a significant buildup of pressure immediately adjacent to the pipes due to arching of the soil over the pipe and the related stress redistribution. Conventional liner design practice typically considers only the weight of the heap over the geomembrane. This may result in a serious under estimation of the localized peak loads and related puncture risk. Based on various analyses and laboratory testing to simulate high heaps (over 100m) with a range of overliner materials, compaction and pipe types and diameters, it should be expected that most lining systems will experience about 25% greater loads adjacent to the solution collection pipes than the expected vertical load based on the depth of the ore alone.

As background, heap leach systems are usually designed with a layer of clean gravel immediately above a synthetic liner. Within the gravel layer perforated corrugated HDPE pipes are laid to improve heap drainage. Below the gravel drain layer is a geomembrane liner (typically HDPE, LLDPE or PVC), which is underlain by a low permeability soil or fine sand. Leaks are of course what the lining system is trying to avoid. To evaluate the performance of the liner with respect to punctures caused by the drainage gravel it is common to perform laboratory tests on a bench scale representation of the liner system cross section. This system is then subjected to loads simulating the planned heap depths with some factor of safety. Modern heap practice now commonly results in ultimate depths of 100m, and several projects are pushing the 150m to 200m range.

To investigate the effects of the stress redistribution near solution collection pipes a series of finite element models were run and calibrated to both small and large scale laboratory tests. A typical model run is shown in Figure 1, which shows an increase in the vertical stresses immediately adjacent to the pipe. Figure 2 shows the variation in the vertical pressures with horizontal distance from the pipe. There is a significant reduction in the load (as compared to the overburden stress) immediately below the pipe, but this increases to about 125% of overburden at a distance of one pipe diameter. The zone of overstress extends to about 4 pipe diameters. These results means there are narrow strips geomembrane on either side of each drain pipe that are receiving a significantly higher stress then commonly considered.

This 25% overstress will vary depending on the rigidity of the pipe, the type and compaction of the material surrounding it, and the height of the heap. The practical implications of this are that design analyses should consider this overstress, perhaps resulting in higher laboratory loads for design testing, and some projects may need thicker liner or a finer grained overliner gravel, or both, to obtain a safe design.

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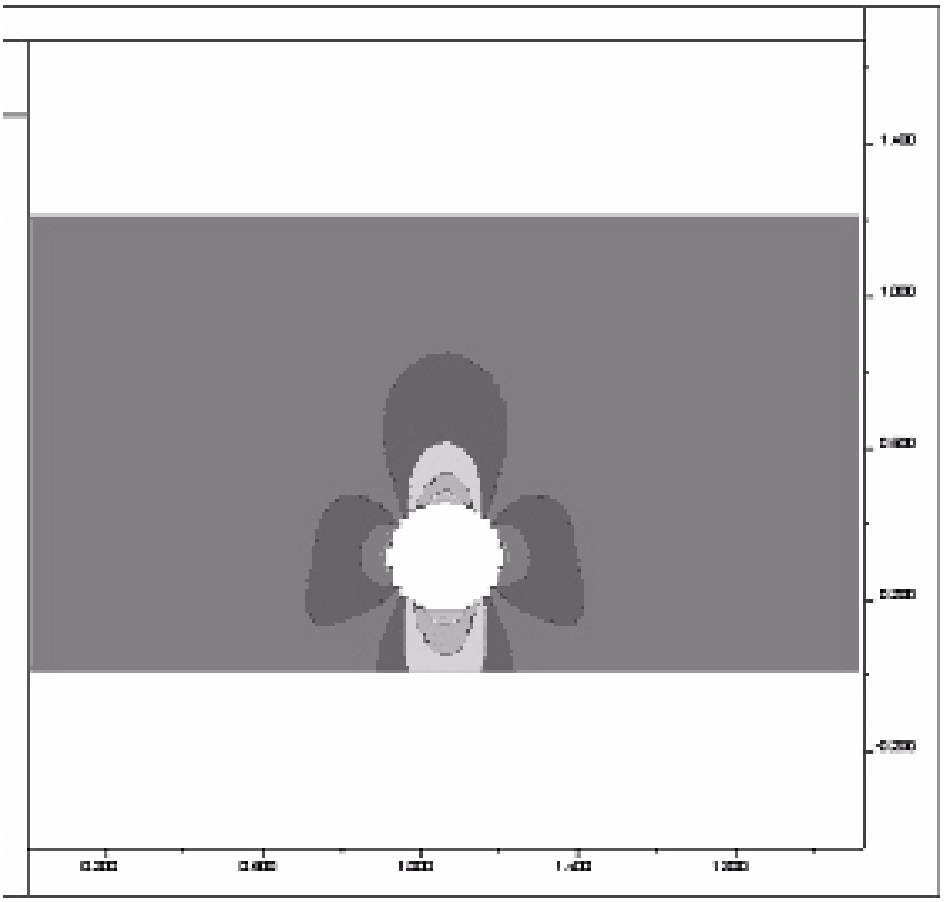

Figure 1 - Finite Element Model of Pipe Loaded in a Leach Heap

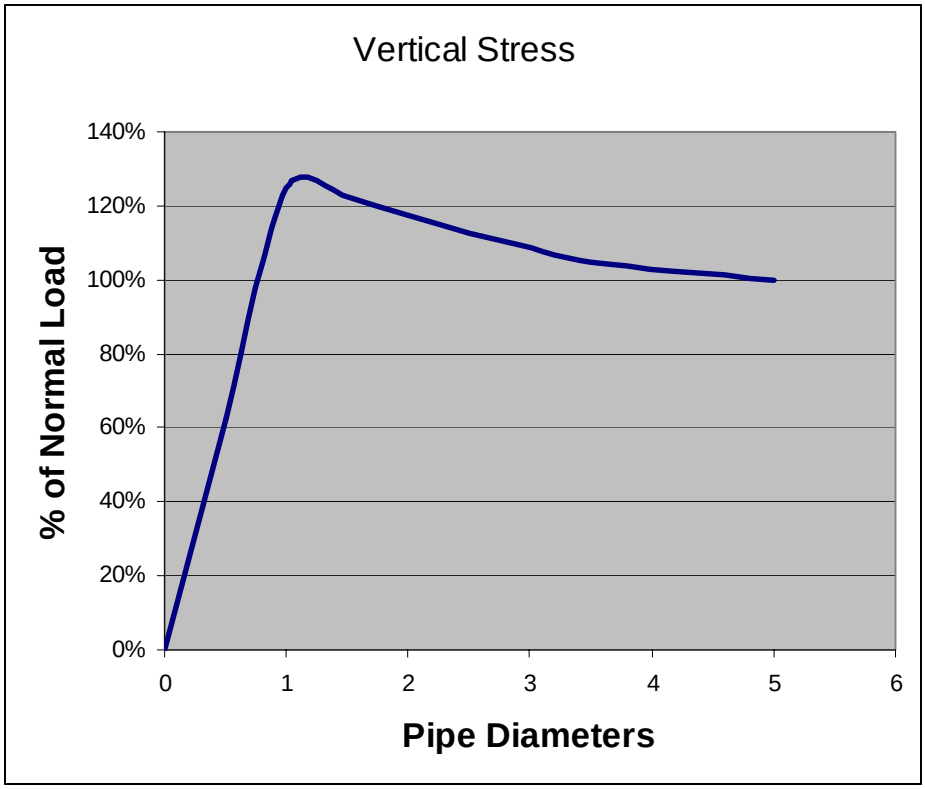

Figure 2 – Modeled pressures on Liner next to Solution Collection Pipes

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