STABILITY AND ECONOMIC CONSIDERATIONS
IN DUMP DEVELOPMENT

(PAPER NOT AVAILABLE)

by

D. Campbell

Golder Associates
DISCUSSION RELATED TO D. CAMPBELL'S PAPER

Niel Duncan - Energy Resources Conservation Board, Calgary: Can you describe the types of equipment that were used in the inclined trench method?

Answer: I should get Tony Milligan to answer your question because Kaiser used the inclined bench method.

Tony Milligan (continues with the answer): You can operate with bulldozers on both the horizontal and the inclined bench methods. However, you may not work directly down the fall line; that is, you may work at an angle down the slope. It doesn't invalidate the amount of material you have to move, but if you move diagonally rather than directly down the slope it does change (increases) the distance that you have to transport the material. Kaiser feels that they can operate equipment on 2:1 slopes. They also operate large cultivating equipment on these slopes in order to prepare the surface prior to seeding and fertilizing.

Niel Duncan: I have a second question. With some of the dumps that are built by benching from the bottom, down, there are a series of benches right from the start, without having to rework at either the level bench or the inclined bench. How do the economics of that system compare to the other two?

Answer: First let me say that I would like to commend the B.C. Department of Mines for their enlightened approach to waste dump development in British Columbia. There are jurisdictions in North America that have precluded this type of waste dump development. They say that waste dumps must not be built on slopes of "less than 50". This is a blanket regulation. It does not take into account the height of waste dump you are going to build, the properties of the foundation, or the methods you are going to use.
to build it. Some jurisdictions also say that you cannot build a waste dump by end dumping from the crest. You have to start from the bottom and build up. Now, I see two disadvantages in building from the bottom up. First, is that you don't get this segregation of rock sizes on high waste piles that you get by end dumping from the crest, and therefore there is no drainage on the bottom. So, for a given dump configuration, it follows that building the waste dump pile from the bottom up may not provide the degree of stability that we get by end dumping. Don't misinterpret that comment. Provided the factor of safety is high enough above 1.0, the waste pile is not going to fail. It doesn't really matter whether the factor of safety is 2 or 1.7 or 1.5. Second, is the aspect of economics. We are mining in British Columbia in areas where there is very high topographic relief. If you're going to start operating an open pit mine in a mountainous area and part of your ore is up near the top of a ridge, that's where you have to start. If the regulations say that you cannot build the waste dump by end dumping, I can tell you right now that there are a number of ore bodies, whether they are ore metaliferous or whether it's coal mining, that the cost of hauling will kill the economics. The projects just won't go because the money isn't there. I think those types of regulations are unnecessary. However, I'd like to commend the B.C. Department of Mines for their independent look at this problem. I think that is the proper approach to take.

**Questioner Unidentified:** Is the height the distance from the crest of the dump to the original floor of the dump?

**Answer:** No, the height that we're looking at is the difference in elevation between the crest and the toe prior to failure. Now the cotangent of alpha also takes into account whatever natural slope there may be before the failure occurred. We haven't many data points on waste dumps.
Questioner Unidentified: (Distorted recording. The question related to number of data points.)

Answer: Six. The points all plot, I think, as close to a straight line, or as close to a curve as you could expect from field data. I think the data does give us a pretty good indication of what the potential danger might be beyond the toe of the dump.

Jim Meier - Byron Creek Collieries: I'm wondering if you have an optimum height where you don't get segregation.

Answer: I think that we're dealing with rock as opposed to soil. The degree of segregation is going to increase with the height of the dump. The median size of the particles at the bottom are going to be a function of dump height. That is, the larger the dump, the larger, probably, will be the median size particles. To answer your question, if you dump shot rock over a bank twenty to thirty feet high, you will get significant particle size segregation. The one example that I know is a consultant who lives in California. His name is Barry Cooke. Some of you may know him. Barry is a very practical guy, and if you have a real problem with a dam, especially if you're a contractor, you call Barry Cooke. I recall one job he had where that happened. It was an unexpected flood through a partially completed dam. Barry went out and tried a number of things to get the flows down so they could close the lower gates. One thing he did was to make up boulder necklaces. These were boulders which they drilled holes through and strung with cables. They picked up these necklaces and dropped them in the channel. The way Barry got those boulders was by quarrying rock and dumping it over a slope. The coarse stuff segregated out at the toe, and they selected the big pieces they wanted. As I recall, the bank was twenty or thirty feet high.