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November 1997

## **HEAP LEACH PROJECT EVALUATION DURING THE INITIAL STAGES**

### **PROGRAM FOR EVALUATION OF THE OREBODY**

The first step in designing a complete program prior to testing the orebody is to have a conference between the field geologist and the metallurgists who are designing the test program to determine such things as:

- availability of core samples for testing deep-level ore;
- accessibility for near-surface and deep-level bulk samples;
- variability of ore and ability to geologically identify tonnage/geological parameters of the various ore types.

### **INITIAL EXAMINATION**

A preliminary test program designed to tell quickly if an ore is heap leachable or not should be limited to a few column leach tests. These tests are normally inexpensive.

For a low-grade hard (non-clayey) rock, a good first test would be a column leach test at an intermediate crushed size, such as 25mm. Normally at least two samples from the orebody should be tested, and maybe more if there is significant variation in rock type. The best samples for evaluation are bulk samples composed of fairly large rocks.

A head sample of the column material and the test tailings would be screened into five or six size fractions and then assayed to determine if there is an approximate relation between recovery and crushed size. For accurate percent recovery calculations normally 4 to 12 assays would be run on tailings samples.

If the recoveries obtained after 30 days of leaching are low on a column test, it is sometimes advisable to suspend the test, air dry the sample, crush to a finer size, and then restart the test.

The test program should include a cyanide solubility test on a pulverized portion of the head material so total cyanide soluble gold levels can be used to monitor the progress of the column test.

Preliminary data (such as estimated gold recovery based on solution assays) will typically become available from the column test about three weeks after the sample arrives at the laboratory. Tests should normally run 60 days, so final information will be available three months after the sample arrives at the lab and the final report will be issued a month later.

The amount of sample placed in the leach column will typically range from 25 to 75 kilograms, and would generally be tested in a column 150mm to 300mm in diameter and 1.5 to 2 meters in height. The total cost of the test program including the report should be about \$2,500.00 per test. Involved sample preparation procedures would increase the test cost.

#### STEPS FOR A GENERAL TESTING PROGRAM

1. Determine Ore Types. In conjunction with the geologists, review rotary drillhole chip logs, and/or core photographs to try to determine important metallurgical ore types.
2. Determine Distribution of Cyanide Solubility of Gold Within the Orebody. Run a series of cyanide solubility tests (centrifuge tube tests) on all 1.5-meter (or appropriate) intervals of the rotary drillhole samples, to determine uniformity of cyanide response. These tests are usually run on the same pulverized pulps which were used for fire assay of the drillhole intervals. Each test will cost between \$5.00 and \$6.00.

A typical major orebody might require 500 such tests. The tests show recovery trends throughout the orebody, and can identify zones with special metallurgical problems. They are used as a guide to further testing and to selection of areas for bulk sampling.

3. Run Column Leach Tests. A series of laboratory column leach tests at various crushed sizes would be run on bulk samples taken from underground and surface exposures, or if necessary from drill cores. The preliminary tests mentioned above would provide one data point. Typically, the ore may be tested at three crushed sizes: 75, 25, and 12mm. The column test program on each ore type would cost approximately \$7,500.00. Simple, smaller orebodies might end up with two ore types; complicated large orebodies might involve four to six sets of such tests.

This outline of column leach tests assumes the ore is hard and clay-free. The test program can be modified for clayey ores - for instance, testing at various crushed sizes is not so important as testing using agglomerated samples.

The general laboratory small column test program for an orebody can therefore range between \$15,000.00 and \$50,000.00. A few progress meetings and interim reports are normally included as part of the cost. Sample procurement costs, feasibility studies, extended scoping meetings and client oversight costs are not included in that estimate.

4. Need for Field Leach Test. Proceeding beyond the small column test phase is a function of both technical and managerial requirements. For hard, chemically inactive, simple ores that are going to be crushed before leaching, it is technically possible to proceed directly from the lab tests to production heaps, and this is normally done on small ore bodies.

Large projects, especially on marginal grade ores which contain actively oxidizing sulfides and possibly copper minerals which may lead to high cyanide consumption, usually require scale up tests to reduce the degree of risk. A field test program consisting of one to three 2,000 to 3,000-tonne field test heaps may be necessary. The cost for an individual test at a remote location with no existing support facilities ranges from \$200,000.00 to \$350,000.00, inclusive of mining the sample in a small open pit, conducting the test for 60 days, and all final shutdown and report costs.

5. Design/Basic Cost Study. Simultaneous with or subsequent to the field test, a pre-feasibility study can be developed which contains the basic design and cost elements (or alternatives). For orebodies up to 5,000 tonnes per day, such studies take two to four months and cost from \$35,000.00 to \$70,000.00.
6. Final Engineering/Design Study and Construction. The pre-feasibility study is generally sufficient to be accepted on smaller projects without a final full-blown feasibility study. Design and construction can then proceed.