Method Name	LIFTERBOTTLE™ PROCEDURE KCA BR#1		
Method	BOTTLE ROLL PROCEDURE	**Approved By**	D. Kappes

Introduction:

Preliminary bottle roll leach tests are a basic tool used in the precious metals industry and it is one of the first steps in determining the gold recovery possible by cyanide leaching.

Sample Preparation:

This standard procedure does not discuss sample preparation. However, sample preparation and homogenization are the most important step to good analyses.

Purpose:

This procedure provides guidelines to produce standard and reproducible results for cyanide bottle roll tests on rock samples in the size range from milled to 2 inch max rock size using up to 1,000 grams sample weight.

Equipment and Reagents Required:

LIFTERBOTTLE™
Jar-mill rolling table (variable speed)
Top-loading scale, 2,000 gram capacity
Weighing spatula
Weighing pan
1,000 milliliter Graduated Cylinder
50 milliliter Centrifuge Tube
Distilled or City Tap Water
Sodium Cyanide (NaCN)
Hydrated Lime ($Ca(OH)_2$)

Note: Additional equipment and reagents for solid and solution analyses are required but are not listed.

Procedure:

Prepare the material, as required to achieve the target crush or grind size.

Remove a sample of the feed material, and fire assay it in bulk or by size fraction as appropriate.

Take another portion of the sample, add the desired sample weight (normally 200 to 1000 grams of dry material) into a 3.5 liter LIFTERBOTTLE™.

1. Add water equal to 1.5 times the weight of solids (40% by weight solids).

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2. Add pH controlling agent to achieve the desired pH. The "standard' is to use hydrated lime to a pH of 10.0, but this may be varied to achieve special results. Approach the pH in a gradual fashion. After each addition of pH control reagent, close the lid, rotate the bottle on rolls or by hand for three minutes. Measure pH and add the next aliquot of reagent until the pH is stable at 9.7-10.3.
3. Add solid sodium cyanide equal to the target level in the test (multiply the milligrams/liter, times the liters of solution used). "Standard" target level of sodium cyanide is typically 500 or 1,000 milligrams/liter (NaCN basis) for clean gold ores, up to 5,000 milligrams/liter for silver ores.
4. Close the lid. Place on rollers set so that the rotational speed of the bottle is 15 RPM.
5. To prevent insitu attritioning, for coarser material +1/4" (or for the fine material), attach the rolling table to a timer. Roll the bottles for 2 seconds (0.5 revolutions) once every five minutes. For material pulverized to at least P80 of 150 mesh (80% passing 150 mesh Tyler, or 105 microns), the bottle may be rolled continuously.
6. At the end of 120, 240, 480 minutes, and at the end of 24, 48, 72, 96 hours, stop the test. Remove a sample of solution for analysis. Assay sample for pH; NaCN (free and total) by titration against silver nitrate; Au, Ag, Cu by AA analysis (other metals can also be followed, most notably Fe, Zn, Hg).
7. The best way to remove a sample for analysis is to take a sample of slurry from the bottle into a 50 milliliter centrifuge tube, centrifuge it, and remove clear solution for analysis.
8. At each sampling activity, record the amount of sample removed (e.g. weigh the centrifuge tube), put the remaining sample (including solids) back into the bottle with enough water to make up for the removed solution sample. Then, add lime and/or cyanide to adjust to the target levels.
9. At the end of the test, filter the solids on a Buchner funnel. Save and record the weight of the filtrate, and analyze the filtrate (pregnant leach solution).
10. Wash the sample on the funnel with twice its weight in water. Save and record the weight and analyze the wash solution.
11. Place the sample in a tray, record the wet weight, dry it at a temperature of 115^{o}C, and record the dry weight. Assume the loss-in-weight is wash water of the same analysis as the saved wash water. Confirm that the dry weight of tailings solids is equal to the dry weight of the feed solids (or account for this in the test report).

12. Fire assay the tailings either in bulk (for pulverized material) or by size fraction, if desired, for coarse material.
13. The time periods for sampling and total testing may be adjusted to fit different test programs. At the end of the test, the gold/silver recovery curve should be reviewed, and if the concentration of gold/silver in solution peaked at some intermediate time, the test should be re-run and ended at that peak time (with fire assay of those tailings).
14. Whenever the above procedures are followed, reports to clients or financial institutions should refer to KCA BR#1 as the test method. Other test procedures may be followed where special results are being looked for, but these should always be accompanied by a detailed explanation of procedures so that the results can be properly evaluated.

Quality control:

1. Each group of analyses done will have at least one suite of QA/QC samples. The suite will consist of a reagent blank, replicate sample(s) and standard reference material (SRM's). The number of QA/QC samples will vary depending on the analysis. The QA/QC suite will follow each step of the analytical method with the unknown samples from weighing, digestion and analysis.
2. During QA/QC processing, reagents blanks will be checked for any detectable concentrations of each analyte. If concentrations of any analyte is greater than 10% of the lower detection limit for that analyte then the blank value will be subtracted from the unknowns or the analyte will be rerun.
3. For replicate samples, if the replicate sample varies by +/- 20% from the original sample the set will be rerun.
4. SRMs are purchased from Rocklab, NIST, CANMET, OREAS and the USGS. As much as possible, standard reference materials are selected with detectable concentrations of the elements being determined. Some determinations will require multiple SRMs. For each analyte, the concentration determined by flame atomic absorption spectrophotometry is compared to certified, provisional or informational values published for that SRM. The goal to get as close as possible to recommended, provisional or informational values. If a value falls outside of +/- two standard deviations of the certified or provisional value, the data in that set will be evaluated and may be rerun.