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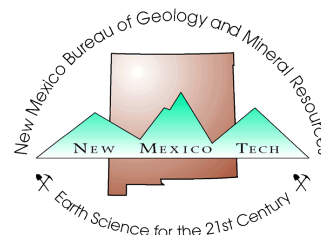
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by Michael Harris, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801

Introduction

Many people are familiar with the New Mexico Bureau of Mines and Mineral Resources through its excellent publications, its large collection of specimens in the mineral museum, and the annual mineral symposium. However, many of these same people do not know that the Bureau offers many other services to the public, including those of a well-equipped metallurgy lab. The metallurgy staff is prepared to work with anyone needing test work done on an ore. Some of the work might qualify to be done at no cost, and charges for most of the extended tests are very reasonable.

The metallurgy lab offers a wide range of capabilities, including sample preparation and ore-leaching, gravity-concentration, flotation-concentration, and fire-assay tests. When these capabilities are combined with others offered by the Bureau, such as X-ray fluorescence or wet analytical chemistry, they provide a wide spectrum of possible tests that can be performed on ore samples.

Metallurgy laboratory

The metallurgy lab has a well-equipped room for preparing coarse ore samples for analysis. With this equipment it is possible to prepare an ore sample to any specified size down to 200 mesh. Equipment includes three jaw crushers (the largest one capable of handling rock pieces up to 6 inches), a roll crusher, a rotary-disk pulverizer, and a fine-pulverizing machine. For sizing crushed or ground materials, the lab has a Gilson Testing Machine with a complete set of screens ranging from 2 inches to 200 mesh. For sizing small amounts of material, the lab also has a new Rotap machine with a full set of Tyler sieves ranging from 1 inch to 400 mesh. In addition, the lab has a Holtain air elutriator for determining the size distribution of particles finer than 200 mesh.

The met lab is well equipped to handle batch-flotation testing. The lab has a new Denver D-12 flotation machine with a full range of flotation cells to handle samples weighing from a few grams to two kilograms. The lab also has a Wemco flotation machine and an attrition scrubber. The lab is stocked with a wide range of flotation reagents, and specific reagents can be ordered with advanced notice.

The metallurgy lab has a two-liter Parr autoclave to carry out leaching tests under very aggressive conditions. Tests can be conducted at temperatures exceeding 200°C and at pressures of more than 600 psi. Many refractory ores, which are not amenable to leaching at ambient conditions, will respond to leaching at higher temperatures and pressures.

For gravity-concentration testing the lab-

oratory has a small 3' × 5' single-deck Deister shaking table. Although it is recognized that this device may not yield the optimum results for gravity concentration, it does provide an indication of whether the ore can be treated by gravity techniques. The lab has two different decks for the table, the regular deck and a slime deck, so that particles from 10 mesh down to about 200 mesh can be tested.

The lab also has a Bond mill for performing Bond grindability tests. The Bond test is the standard test used on a laboratory-sized sample to determine the amount of energy required to grind the material to a given size. Answers are given in kilowatt hours of electricity per ton of ore ground.

Standard ore-testing services

Without a doubt the most popular service offered by the Bureau's metallurgy lab is fire assaying potential ore samples to determine their gold and silver content. Because of the current high degree of interest in gold ores, the metallurgy lab conducts fire assays nearly every week. Recently the lab upgraded its capabilities by adding a new gas-fired furnace to the assaying equipment. This furnace replaces an electric furnace that had been in service for many years.

Another popular service offered through the metallurgy lab is testing samples of gold ores to determine if they are amenable to treatment by gravity concentration or leaching. Typically this is done by cyanide leaching. Tests can be conducted in almost any desired fashion from the standard "rolling bottle" test, or beaker tests, to column tests used to simulate heap-leaching conditions. Leach testing can be extended to many other applications, including leaching gold ores with solutions other than cyanide (i.e., thiourea), leaching copper ores for copper recovery, leaching uranium ores, etc. In addition to determining the amount of gold and silver that can be extracted by leaching, tests can also be conducted to recover the dissolved values from solution. Recovery tests include carbon adsorption, electrolytic recovery, or precipitation on zinc. Charges for these types of tests are based on the individual project and may vary depending on the amount of work performed.

Sample-size requirements

Sample-size requirements are highly dependent on the type of material being tested and the test work to be done. Fire assays can be performed using only a few grams of material, although it would be hard to insure that such a small sample is representative of a deposit. Typically, fire assays are carried out using either 29.17 grams (assay ton) or 14.6 grams (half assay ton) of sample that is

obtained by splitting a larger sample. Ore samples required for other tests are:

Type of test	Minimum ore-sample requirement
Flotation	5-10 pounds
Bench-scale leaching	5-10 pounds
Gravity concentration	20-50 pounds
Large-column leaching	200 pounds

Examples of ore-testing projects

The projects described below are illustrative of the capability of the metallurgy lab.

—*Bond grindability testing of a low-grade gold ore.* This test was carried out to determine what the grinding costs would be for a 500-ton/day mine and mill.

—*Fluorite flotation studies.* A series of flotation tests were carried out to examine the potential of a low-grade fluorite deposit to produce commercial-grade products. This work was done for a division of one of the nation's largest mining companies.

—*Column-leaching tests on low-grade gold ore.* These tests were carried out for a gold mine to investigate the effects of several variables on the cyanide extraction of gold. The columns were 10 feet tall and had 6-inch diameters. Each contained approximately 250 pounds of ore.

—*Numerous gravity-concentration studies on gold ores.*

Perlite-testing facility

In conjunction with the met lab the Bureau operates a perlite-testing facility. The facility includes a vertical expanding furnace and specialized equipment to perform a variety of tests on the expanded perlite fractions. Tests include: expanded density, brightness, percent sinkers, silica content (by X-ray), and size-distribution determination. Recently, the perlite facility began testing perlite samples as filter aids.

Analytical chemistry capabilities

The Bureau also has a well-equipped analytical chemistry laboratory for determining the composition of geologic samples as well as doing water-quality studies. The capabilities of the analytical laboratory include AA (atomic absorption spectroscopy) and ICP (inductively coupled plasma spectroscopy). The analytical lab is also capable of performing the more traditional, wet chemistry determinations.

Conclusion

The New Mexico Bureau of Mines and Mineral Resources offers a variety of services to the public. Included in these services is a well-equipped metallurgy laboratory that is capable of carrying out test work on different ores. The most requested test work consists of fire assaying samples to determine gold and silver content. □