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The Importance of Sample Integrity: A Commercial Lab's Perspective

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Background

The complexity of proper sampling and sample preparation is often overlooked. This oversight has a significant impact on the quality and utility of the data a laboratory provides to its customers. The apparently simple sampling activity is fraught with manifold pitfalls since the material being investigated is routinely nonuniform in composition and morphology.

This paper will highlight some of the areas that should be investigated as a sampling plan is developed in order to ultimately produce sample material that properly represents the bulk material for the test data sought.

Sample Volume

Most frequently initial sample volumes are inadequate for the test results to bear statistical significance. As one example, Fig. 1 provides a guide for the sample weight required in pounds against the top size of the bulk material being sampled. This graph makes some effort to adjust the sample volumes required against the value and uniformity of the material being sampled. For gold ores with a top size of 5 in., a sample requirement of 1 000 000 lb certainly emphasizes the need for sizable initial sample volumes in order to even start out with a representative sample. Such estimates are supported by a study performed by Round Mountain Gold Company where a daily sample of 1870 t of ore was required to achieve a 90% confidence limit.

Even under more normal circumstances, an initial bulk sample can readily amount to several tons and must be reduced to only a few grams or milligrams for the analytical sample. Figure 2 represents the normal steps leading to analytical size samples.

The sample reduction plan used must carefully consider the character of the sample and the type of testing to be performed. For example, if only bulk analytical values of a uniform friable material are desired, then the sample can be pulverized and blended, and small fractions split out. For less uniform material, the type of size reduction employed must be based on the characteristics of the feed material. For example, if the sample contains malleable metals along with friable slag particles, the two components may have to be separated and analyzed separately.

Comparison of Sampling/Production Methods

Table I provides a comparison of commonly employed sample reduction methods. As the uniformity of the sample decreases, riffle or spinning riffle methods should be employed.

Nugget Effects

Wide variation in test results for sample replicates often result from a nugget effect. Commonly, gold ores are used as examples of the ultimate nugget effect. In these ores, the target mineral is of low concentration and occurs in dense particles whose size distribution often is quite different from its low-density gangue mineral matrix. Nugget-type sample problems are hardly restricted to precious metal ores. Similar effects are commonly encoun-

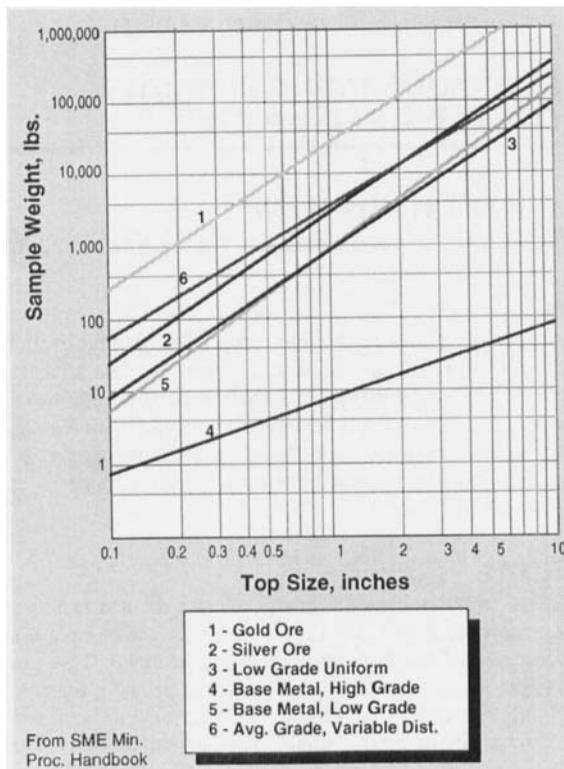


Figure 1. Sample weight versus particle size.¹

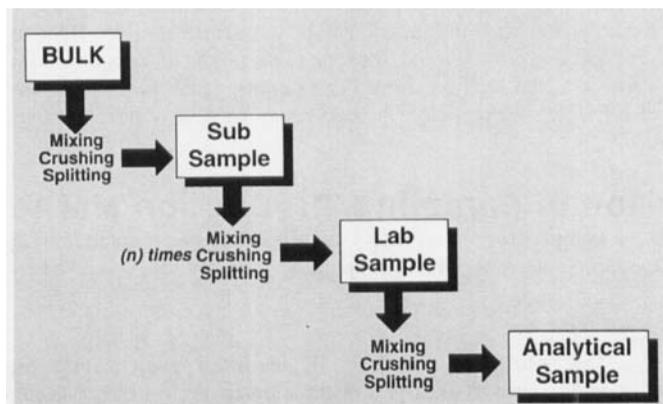


Figure 2. Sampling scheme.

Table I. Comparisons of Sampling/Reduction Methods*

Method	Coarse and fine sand		
	σ_n (standard deviation, %)	Var (P_n , % ²)	<i>E</i> (estimated maximum sample error, %)
Cone and quartering	6.81	46.4	
Scoop sampling	5.14	26.4	17.1
Table sampling	2.09	4.37	7.0
Chute riffler	1.01	1.02	3.4
Spinning riffler	0.125	0.016	0.42
Random variation	0.076	0.0058	0.25

*After Ref. 2.

tered in routine mineral and environmental samples. Figure 3 represents metal particles found in incinerator ash residues.

If the sample material contains multimodal distributions of its mineral components, great care needs to be exercised in the sample reduction steps. In addition to a large initial sample sizes, thorough blending and riffle splitting are employed to generate reliable analytical samples.

Sample Containers

The sample storage containers should maintain the sample in the same condition over extended periods of storage. Figure 4 demonstrates the effect of storage containers on the copper content of sulfide concentrates stored in various sample bags. The selection of the sample container is extremely critical when samples are stored for extended periods of time as reference material.

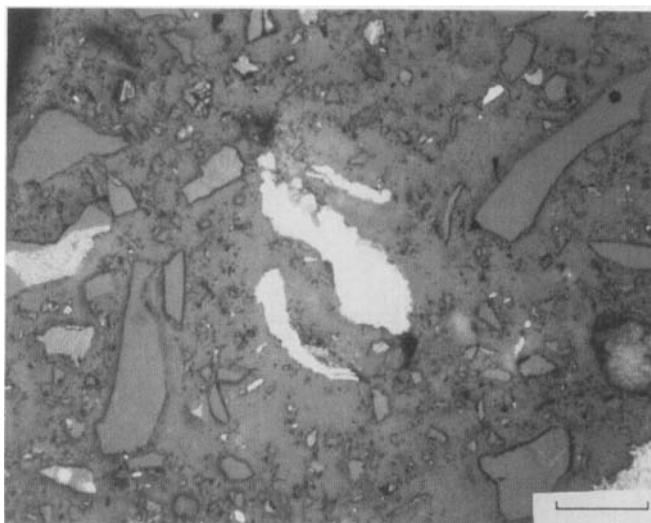


Figure 3. Incinerator ash consisting of metallics (white) and silicates (gray). Bar is 1 mm.²

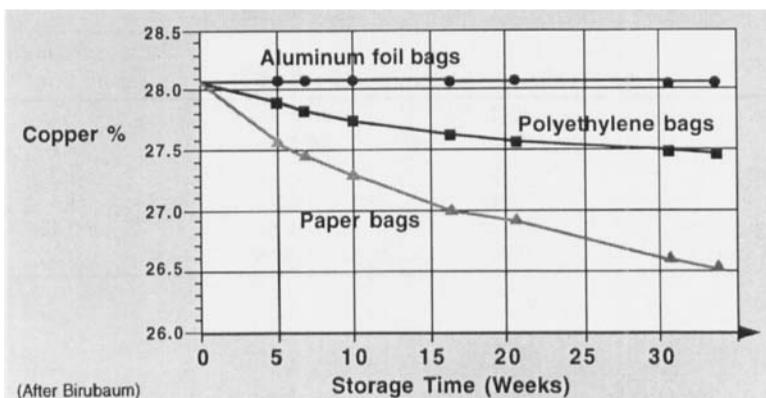


Figure 4. Impact of storage containers: oxidation of copper sulfide concentrate.

In addition to the chemical/mineralogical changes that can occur as a result of improper sample container selection, samples may also segregate during shipping as a result of density variations or due to electrostatic forces separating metal particles from the sample.³

Conclusion

In general, sampling of minerals is hardly a trivial undertaking. Proper samples often reflect significant expenditures of effort and resources. This is especially true with materials that have relatively high value but exhibit nonuniform mineral compositions and distributions. The procedures that are effective in producing appropriate analytical samples may destroy the sample's value for process or environmental testing. Alternate size reduction and splitting strategies may be required for such test work.

In all cases the sampling strategy should be developed based on the types of test work planned, and after a basic understanding of the sample characteristics is developed via visual and microscopic observations. Commercial laboratories providing testing services are generally quite willing to provide their clients with assistance during the development of a sampling plan. Such assistance will yield a significantly higher quality end product directed toward the client's specific information needs.

References

- ¹*SME Mineral Processing Handbook*. Edited by N.L. Weiss. AIME, New York, 1985. Pp. 30-14.
- ²T. Allen and A. Khan, "Critical Evaluation of Powder Sampling Procedures," M.S. Thesis, Bradford University, 1968.
- ³L. Hamalainen and E. Kontas, "A Potential Systematic Error in the Analysis of Gold Samples," *Appl. Geochem.*, 7 [3] 287-88 (1992).