BUCK Scientific

Application Note #AA3008

Indirect Determination of Gold Purity by Measurement of Impurities with Flame Atomic Absorption Spectroscopy

The determination of the purity of scrap and refined gold is a very important procedure for the financial markets, the jewelry business and the electronics industry.

Over the years, the classical fire assay technique has been used for gold determination but this is a very labor-intensive procedure, and prone to many operator errors. Hundreds of books have been written with special steps and secret protocols to follow for accurate and reproducible fire assays; but it still is a subjective method and is sometimes used more for semi-quantitative analyses for those labs without experienced asssayers.

Trying to determine the exact concentration of gold instrumentally can be done directly by measuring the gold itself, but preparing an accurate dilution of a sample is very difficult unless the volumetrics are calibrated, the water is thermostatted and the balance is certified. Slight changes in temperature, or vessel cleanliness or calibration can result in percentage errors in the final data. The error of the measuring instrument (Gravimetric balance, Arc / Spark, Flame-AA, Plasma Emission, etc) can also affect the final value by defining a limiting precision; for example: D-C Plasma has a systematic error of 1.5%; so the best data for gold off a DCP instrument will have a built-in error, or variability, of 1.5%. A better, and more useful procedure, is determining the total impurities in the sample and subracting this from 100% to get the gold by difference. Many large companies (Engelhard, Texas Instruments, Krementz) use this procedure to assay their incoming gold. Reporting errors can be reduced to less than 0.1% in some case for a more accurate purity determination of the gold material.

Atomic Absorption Spectroscopy is a very acceptable technique for gold assays, and is a very simple technique for technicians and chemical operators to learn. Sample preparation and calibration are easily performed according to a standardized procedure, and the operation of Buck AA instruments takes only a few hours to master. Performing these analyses is actually simple on the Buck Model 210VGP Atomic Absorption system. The high optical throughput and stability of our “Stable-Beam” design provide excellent sensitivity, superb precision and, with the proprietary Background Correction modes on the 210, complete freedom from interferences. The unique single-mirror monochromator used in the optical system is the key to the system’s small size and high performance. It is the incorporation of the “in-line” Deuterium Background Correction that will minimize or eliminate most types of spectral or spectrochemical interferences without any loss in data quality. The data shown on this appnote is a clear statement to the stability and energy of the Buck AA instruments.

SIC: 1041, 367, 3911, 6011

Analysis of Gold Purity by Measurement of Impurities

Samples: [1] Smelted scrap (~75% Au)
[2] Refined ore (~99% Au)
Preparation: 1.0gm in 25ml Aq. Regia, fumed with HCl, dilute to 100gm.
Standards: A Hydrochloric Acid Blank (0), and a 1 ppm (µg / gm) Standard.
Results: Values are ppm (µg / gm) in the original solid sample, with RSD calculations on triplicate runs (using 1:100 dilution factor).

Element	Wavelength (nm)	Flame Type	Sample #1 / RSD	Sample #2 / RSD
Silver	328	Air – even	5220 ppm / 1.3%	3.8 ppm / 2.5%
Cadmium	228	Air – lean	1740 ppm / 2.1%	<0.9 ppm / -
Chromium	357	Air – rich	120 ppm / 2.6%	<2.5 ppm / -
Copper	324	Air – even	51850 ppm / 0.8%	15 ppm / 1.8%
Iron	248	Air – lean	690 ppm / 3.0%	<3.0 ppm / -
Nickel	232	Air – lean	82700 ppm / 1.2%	33 ppm / 1.7%
Lead	283	Air – even	21500 ppm / 1.6%	12 ppm / 2.4%
Tin	286	N_2O – rich	60700 ppm / 3.2%	265 ppm / 4.7%
Zinc	214	Air – even	10350 ppm / 0.9%	21 ppm / 1.3%
Total Impurities PPM (wt%) =			234,870 (23.49%)	365 (0.036%)
Gold Purity (by difference) =			76.51% Au	99.964% Au

BUCK Scientific

1-800-562-5566

58 Fort Point Street East Norwalk CT 06855
Tel: 203-853-9444 Fax: 203-853-0569
www.bucksci.com sales@bucksci.com