DETERMINATION OF ZINC IN FIRE-PROOF DOLOMITE USING A MODIFIED FLUORESCENCE/SCATTER RATIO METHOD WITH A $^{238}$Pu SOURCE

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A radiometric method for the determination of zinc in fire-proof dolomite is described. Matrix effects were eliminated by means of the fluorescence to scatter ratio method in combination with a copper filter. A theory of this filter method is presented. Standard deviations below 0.06% Zn were obtained.

Introduction

Zinc present in dolomite applied as a fire-proof material in metallurgy is a critical component, the concentration of which cannot exceed about 0.5% by weight. For the rapid control of zinc content in such a material, radioisotope X-ray fluorescence analysis has been used. Matrix effects, due mainly to the variable content of iron, were eliminated by means of the characteristic to scatter ratio method developed by ANDERMANN and KEMP.\textsuperscript{1} A further improvement in overcoming the matrix effects has been achieved by applying a copper filter. A theory of this filter method is presented. The experiments were performed on natural samples of dolomite containing less than 3% zinc.

Theory

The intensity of fluorescent radiation of an element A excited in an infinitely thick multicomponent sample, can be described by the simplified expression:\textsuperscript{2,3}

$$I_A = \frac{K W_A}{\sum_i (\mu_0 + \mu_A)_i W_i}$$  \hspace{1cm} (1)
where $K$ — coefficient constant for the given geometry, radiation source and element to be determined;
$W_A$ — weight concentration of element A in the sample;
$W_i$ — weight concentrations of other elements in the sample;
$\mu_o$ — mass absorption coefficient for the incident radiation in the i-th element;
$\mu_A$ — mass absorption coefficient for the fluorescent radiation of element A in the i-th element.

The corresponding formula for the intensity of scattered radiation is:

$$I_s = \frac{K_s}{\sum_i (\mu_o + \mu_A)W_i}$$

(2)

where $K_s$ — coefficient constant for the given geometry and radiation source;
$\mu_s$ — mass absorption coefficient for the scattered radiation in the i-th element.

When the fluorescent and scattered rays are transmitted through a filter, the intensities of the radiation can be expressed as follows:

$$I'_A = \frac{KW_A}{\sum_i (\mu_o + \mu_A)W_i} e^{-\mu'_A \rho d}$$

(3)

$$I'_s = \frac{K_s}{\sum_i (\mu_o + \mu_s)W_i} e^{-\mu'_s \rho d}$$

(4)

where $\rho$ — density of the filter;
$d$ — thickness of the filter;
$\mu'_A$ — is the mass absorption coefficient for the fluorescent radiation of element A in the filter;
$\mu'_s$ — is the mass absorption coefficient for the scattered radiation in the filter.

Now let us assume that the absorption matrix effect arises only from one interfering element occurring in the samples at a variable concentration $W_i$. One of the