Application Brief

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Zinc Ore Analysis

1. Overview

Rare metals such as Ni, Cr, Mo, and Co, which are essential in industry today, are collected and reused due to their scarcity. However, these are generally used in alloy form. To reuse the metals what and how much is in the alloy must be determined.

Up until now, visual inspection, magnets, spark, and chemicals were used in the analysis, but these techniques require special training and are not something anybody could learn. Furthermore, qualitative identification was also required.

With the SEA2010, anybody can quickly and accurately determine a variety of alloy steels. Because the component density of each metal is detected by weight percent the amount of rare metal within the alloy can be rapidly and accurately determined.

An example of non-standard analysis is given below.

2. Analysis Conditions

Analysis conditions are listed in Table 1.

Table 1

Item	Settings
Beam diameter	3 mm
Tube Voltage	50 kV
Target	Rh
Atmosphere	Vacuum
Measurement Time	300 seconds
Pre-treatment	Crush and mix then press into tablet form

3. Analysis Sample

Zinc ore (zinc concentrate, zinc baked ore)

4. Quantitative Method

One Standard Fundamental Parameters Method (One Standard Theoretical Calculation Method)

5. Analysis Results

5-1 Zinc Concentrate

Table 2 displays analytical results of samples of zinc concentrate. Zinc concentrate is zinc ore before refining. Zinc is contained mostly in sulfides and therefore the density of sulfur is high. At this step, how much Zn there is in the ore is important. From table 2 it is clear that Zn density within the ore can be measured at an error of less than ±2%.

Table 2 Results of Analysis of Zinc Concentrate

Element	Analysis Method	Zn Conc 1	Zn Conc 2	Zn Conc 3	Zn Conc 4
Zn	Chemical Analysis SEA	56.66 56.46	56.53 55.03	49.65 51.66	50.74 51.07
S	Chemical Analysis SEA	32.31 33.95	31.36 33.32	33.58 35.02	31.76 32.86
Fe	Chemical Analysis SEA	5.64 6.18	4.22 4.57	8.35 7.79	9.84 9.71
Pb	Chemical Analysis SEA	1.04 1.18	2.13 2.78	1.98 2.29	2.74 3.13
SiO_2	Chemical Analysis SEA	1.14 0.914	0.81 0.702	1.61 0.802	2.57 1.58
Cu	Chemical Analysis SEA	0.40 0.43	1.25 1.05	1.81 1.35	0.25 0.26
CaO	Chemical Analysis SEA	0.07 0.009	0.67 0.790	0.38 0.490	0.35 0.590
Cd	Chemical Analysis SEA	0.257 0.207	0.337 0.365	0.228 0.261	0.169 0.167
As	Chemical Analysis SEA	0.230 0.295	0.048 0.166	0.043 0.147	0.197 0.322
Mn	Chemical Analysis SEA	 0.198	 1.13	 0.075	 0.069
Ti	Chemical Analysis SEA	 0.074	 0.082	 0.103	 0.111
Sn	Chemical Analysis SEA	 0.097	 0.009	 0.009	 0.132

Units: %

5-2 Zinc Baked Ore

Table 3 displays the analysis results of zinc baked ore. Zinc baked ore is zinc concentrate ignited with coke and oxidized. The purpose is to remove the sulfur by oxidizing the sulfide.

Consequently, at this step determining the density of sulfur along with the density of zinc is essential. This is because it is necessary to verify whether sulfur is at or less than the target density. From table 3 it is clear that zinc and sulfur can be accurately quantified.

While this sample is being analyzed each component is quantitatively calculated as an oxide then converted to a metal density. Consequently, you should be aware that the total of the surface and middle of each component density is not 100X.

Table 3 Results of Analysis of Zinc Baked Ore

Element	Analysis Method	Zn Conc 1	Zn Conc 2	Zn Conc 3
Zn	Chemical Analysis SEA	65.4 66.10	62.1 62.62	63.1 64.06
S	Chemical Analysis SEA	1.42 1.70	2.46 2.62	2.58 2.74
Fe	Chemical Analysis SEA	6.89 6.64	7.38 7.35	5.66 5.44
Pb	Chemical Analysis SEA	1.20 1.31	1.60 1.62	1.56 1.65
SiO_2	Chemical Analysis SEA	1.22 0.408	1.37 0.488	1.38 0.724
Cu	Chemical Analysis SEA	 0.749	0.42 0.519	0.67 0.774
CaO	Chemical Analysis SEA	0.17 0.152	1.04 1.28	0.98 1.26
Cd	Chemical Analysis SEA	0.297 0.306	0.321 0.302	0.320 0.341
As	Chemical Analysis SEA	0.226 0.215	0.414 0.145	0.194 0.184
MnO	Chemical Analysis SEA	 0.225	 0.184	 0.171
TiO_2	Chemical Analysis SEA	 0.026	 0.013	 0.000
SnO	Chemical Analysis SEA	 0.141	 0.062	 0.083

Units: %

6. Simple Repeatable Precision

Zinc concentrate sample 1 was measured 30 times and simple repeatable precision examined. The results are listed below in Table 4.

Table 4 Zinc concentrate simple repeatability precision

Component	AVE (%)	Sigma (%)	CV (%)	MAX (%)	MIN (%)	Range (%)
Zn	56.80	0.312	0.55	57.59	56.49	1.10
S	33.63	0.267	0.79	33.99	33.00	0.99
Fe	5.89	0.0258	0.44	5.95	5.87	0.08
Pb	1.64	0.036	2.21	1.69	1.57	0.12
Si	0.783	0.0695	8.88	0.908	0.664	0.244
Cu	0.389	0.0180	4.63	0.432	0.365	0.067
Ca	0.075	0.0314	41.84	0.125	0.036	0.089
Cd	0.258	0.0170	6.56	0.286	0.230	0.056
As	0.203	0.0207	10.21	0.238	0.176	0.062
Mn	0.173	0.0174	10.05	0.201	0.138	0.063
Ti	0.081	0.0187	23.07	0.113	0.061	0.052
Sn	0.080	0.0071	8.96	0.091	0.069	0.022

CV = (Sigma/Ave)×100

The CV value of components of 1% or greater is in all cases less than 3% and shows good repeatability. High precision CV values of less than 1% were obtained for major components Zn, S, and Fe.

The CV values of Si, Ca, Ti, Mn, As, and Sn are high but this is because they have low densities. Increasing measurement time can decrease dispersion of these components.

7. Summary

By using the SEA2010 in way explained here, samples having 10 to 20 elements, or more, can be accurately analyzed within several minutes (major components at CV values of less than 1%). Analysis also includes applications such as all types of ore and clay minerals.