EDXRF1366 - Analysis of Metals in Nickel Ore

Scope

This application note uses [NEX QC+](NEX QC+) to demonstrate the analysis of important metal oxides in nickel ore using the empirical approach.

Background

During site characterization and preparation for smelting, it is important to determine concentrations of various metals in nickel ores. While NiO and Fe_2O_3 are the most important metal oxides, TiO_2, Cr_2O_3, and MnO may also be present in significant quantities. Characterizing the ore is important to determine potential yield, as well as during extraction and smelting. EDXRF is an excellent tool for mine site exploration and characterization, and can be used throughout the processing steps, extraction, and smelting to measure the ore material, concentrate, matte, filter cakes, and slags.

Calibration

20 site-specific calibration standards were supplied as pressed pellets for empirical calibration. Optimum calibration can be achieved using standards that represent the ore material at the site, where each standard is assayed for all oxides of interest and concentrations evenly span each range and vary independently. Given assays for light element oxides such as Al_2O_3, SiO_2, and SO_3, those calibrations can be made as well.

Component	Concentration range (mass%)	Standard error of estimate
NiO	0.06 − 3.00	0.0146
Fe_2O_3	8 − 66	0.2306

TiO$_2$	0.01 − 2.41	0.0184
Cr$_2$O$_3$	0.04 − 3.64	0.0296
MnO	0.10 − 2.00	0.0157

Standard sample recovery and precision

Representative low, medium, and high NiO concentration calibration standards were measured 10 consecutive times each in a static position to demonstrate effective recovery and analytical precision.

Sample ID: Sample ST14
Units: Mass%

Oxide	Assay value	NEX QC+ average value	Std. dev
NiO	2.98	3.00	0.003
Fe$_2$O$_3$	21.71	21.89	0.02
TiO$_2$	---	0.019	0.004
Cr$_2$O$_3$	1.07	1.106	0.007
MnO	0.38	0.366	0.002

Sample ID: Sample S103
Units: Mass%

Oxide	Assay value	NEX QC+ average value	Std. dev
NiO	1.28	1.297	0.006
Fe$_2$O$_3$	65.63	66.19	0.07
TiO$_2$	0.05	0.051	0.003
Cr$_2$O$_3$	3.64	3.636	0.015
MnO	1.16	1.178	0.008

Sample ID: Sample 1696
Units: Mass%

Oxide	Assay value	NEX QC+ average value	Std. dev
NiO	0.73	0.746	0.003
Fe$_2$O$_3$	12.21	12.16	0.02
TiO$_2$	0.18	0.166	0.004
Cr$_2$O$_3$	0.32	0.322	0.003
MnO	0.20	0.190	0.001

Sample ID: Sample 1702 Units: Mass%			
Oxide	**Assay value**	**NEX QC+ average value**	**Std. dev**
NiO	0.26	0.257	0.001
Fe_2O_3	12.14	12.05	0.02
TiO_2	0.30	0.292	0.005
Cr_2O_3	0.23	0.238	0.002
MnO	0.20	0.204	0.001

Analysis of unknown samples

Unknown samples with expected values were submitted from the mine site for measurement against the calibrations built. Results are shown below.

Sample ID	NiO		Fe_2O_3		TiO_2		Cr_2O_3		MnO	
	Expected Mass%	Measured Result	Expected Mass%	Measured Result	Expected Mass%	Measured Result	Expected Mass%	Measured Result	Expected Mass%	Measured Result
ST11	2.41	2.43	24.95	25.27	<0.01	0.03	1.21	1.31	0.38	0.38
ST16	2.04	2.05	15.37	15.32	<0.01	ND	1.23	1.22	0.22	0.25
ST20	1.79	1.76	65.45	64.96	<0.01	0.05	2.73	3.08	1.22	1.24
AP06	1.33	1.41	16.38	17.17	0.02	0.03	0.60	0.63	0.27	0.27

Conclusion

The NEX QC+ offers analysts a simple yet powerful and versatile system for quantifying elemental composition using the empirical approach. The results of this study indicate that given stable samples, proper sample handling and proper calibration technique, the Rigaku NEX QC+ EDXRF can achieve excellent results for the measurement of the key metal oxides NiO, Fe_2O_3, TiO_2, Cr_2O_3 and MnO in nickel ores.

Related products

NEX QC Series

Combines quality, affordability, and performance for a wide range of applications