EDXRF3186 - Nutrient Pre-mixes for Milled Grain Enrichment

Scope

The analysis of various minerals in enrichment concentrate pre-mixes for the enrichment of milled grain is demonstrated using [NEX DE](NEX DE).

Background

Milled grains include wheat, corn, and rice, as well as rye, barley, oats, millet, and quinoa. Milled grains are used to make a variety of food from bread and pasta to cookies, cakes, and breakfast cereals. These milled grains are enriched with several vitamins and minerals to restore various vitamins and minerals lost during grain processing or to add extra vital minerals like iron and zinc. Raw materials and compounds are mixed in different proportions and formulations within a pre-mix to give the various nutrient qualities needed by many food producers. Accurate analysis is required for various nutrients, particularly iron and zinc, to meet FDA label claim regulations and other FDA sections within the US CFR (Code of Federal Regulations).

To meet this analytical need during production quality control, Applied Rigaku Technologies offers the Rigaku NEX DE EDXRF spectrometer for the fast and simple analysis of enrichment pre-mix powders. Rigaku EDXRF analyzers can also be used to analyze mineral nutrient elemental levels in finished food grain products that utilize pre-mixes as a basis for nutrient enhancement.

Rigaku RPF-SQX Fundamental Parameters (FP)

Rigaku RPF-SQX FP software estimates elemental concentrations based on XRF theory, called Fundamental Parameters (FP).

Rigaku Profile Fitting (RPF) automatically deconvolutes spectral peaks and models the sample matrix using fundamental XRF equations to provide standardless semi-quantitative measurements of elemental concentrations without the need for any known standards. The FP semi-quant results can be tuned using a Matching Library by measuring one or more samples of the material with known elemental assay values. In this way, the XRF is tuned to the specific material and referee values to ensure optimum accuracy and reliable, high-quality data. For pre-mixes, only the Fe and Zn require the use of the Matching Library in order to ensure a high degree of accuracy to meet FDA and other requirements. Standardless semi-quant FP is ideal for measuring the other elements in pre-mixes, as well as the composition of raw materials, as these elements simply need to be screened to be in a general range of concentrations without the need for a high degree of accuracy.

Units

Measurement units are typically expressed in g/kg. The conversion factor to other units is 1 g/kg = 1000 mg/kg = 1000 ppm = 0.1000 mass%. For example, 248 g/kg = 24.8 %. Analysis Times: Measurement times used are 100 sec per analysis condition.
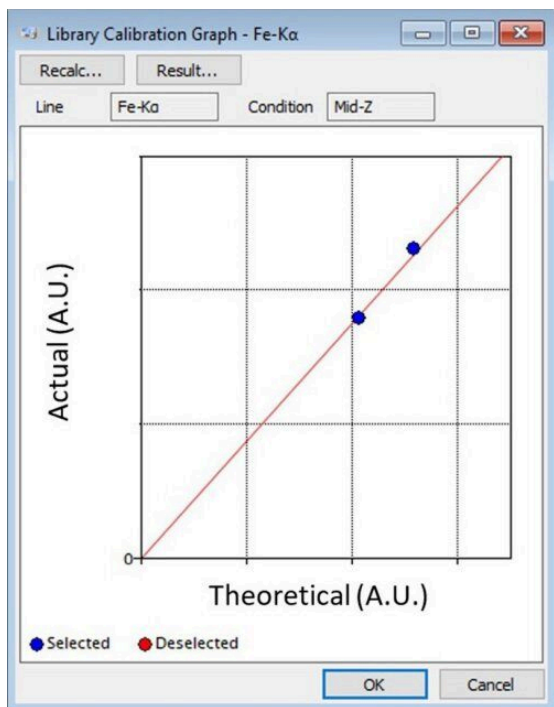
Analysis times

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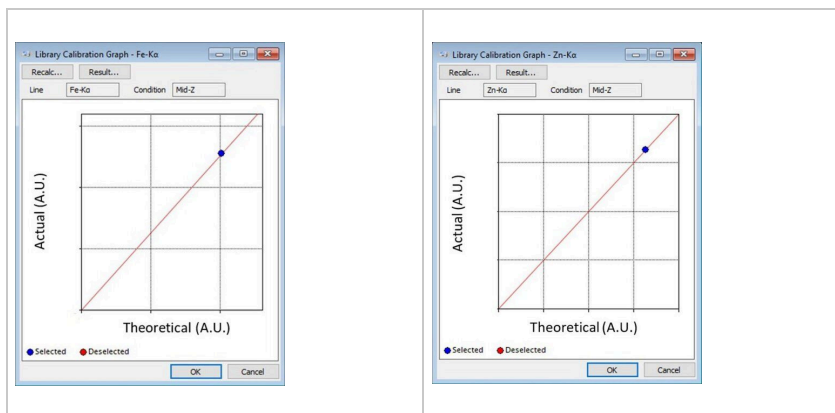| Analysis condition	Elements
1	Al, Si, P, S, Cl
2	K, Ca, Cr, Mn, Fe, Ni, Cu, Zn, Hg, Pb
3	Pd, Cd

Pre-mixes

Iron pre-mix matching library:

Fe Matching Library based on two pre-mix standards assayed by ICP.

Iron pre-mix sample

Element	ICP result (g/kg)	NEX DE result (g/kg)
Fe	248	249
Al		2.05
Si		1.01
P	N/A	11.8
S		12.6
Ca		12.9

Iron and zinc pre-mix sample

Element	ICP Result (g/kg)	NEX DE Result (g/kg)
Fe	53	54.0
Zn	82	80.8
Al		2.14
Si		1.69
P		61.1
S		16.3
Cl		3.58
K	N/A	1.89
Ca		30.6
Cr		0.181
Mn		0.248
Ni		0.123
Cu		0.081

Raw materials

Various raw materials are used for mineral enrichment, for example, reduced iron, ferrous sulfate, ferrous fumarate, or ferric orthophosphate for iron enrichment. Other pre-mix ingredients are also used as raw materials, such as calcium carbonate, to ensure the proper concentration range of calcium is in the final pre-mix.

Reduced iron semi-quant screening

Element	NEX DE result (mass%)
Fe	99.5
Cl	0.0647
Cr	0.0283
Mn	0.330
Ni	0.0217
Cu	0.0052
Zn	0.0091

Calcium mineral pre-mix semi-quant screening

Element	NEX DE Result (g/kg)
Ca	365
Al	2.67
Si	0.879
P	0.474
S	1.85
Cl	0.133
Fe	1.01
Ni	0.064
Cu	0.015
Zn	0.228

Conclusion

The Rigaku NEX DE combines filtered direct excitation with a high-performance SDD capable of 500,000+ cps throughput to deliver excellent sensitivity for the measurement of elemental composition of pre-mixes and raw materials.

Rigaku RPF-SQX Fundamental Parameters gives the user a powerful tool for standardless semi-quant screening, while the Matching Library encompasses families of premixes, allowing for optimum accuracy. With simple, intuitive, yet powerful QuantEZ software, NEX DE is an excellent tool for the process and quality control in production, quality assurance of raw

materials, and heavy metal screening.

Related products

NEX DE Series

High-power 60 kV EDXRF systems delivering speed, precision, and small spot measurements