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EDXRF1420 - Chlorine and Ash in Biomass



Scope

This application note demonstrates the measurement of chlorine (Cl) and predicted ash content in unburned biomass using [NEX QC+](#).

Background

Biomass refers to dry plant matter. Biomass is used as a feedstock in the pulp and paper industry as well as in the production of biofuels. Biomass is also an increasingly popular primary or secondary fuel at power plants and cement kilns. Ash consists of the metal oxides and heavier elements that remain after combustion removes the organic, gaseous, and volatile components. Biomass combustion properties depend in part on the ash content, and prior to incineration chlorine levels must be at safe, low levels. EDXRF offers a fast, simple, and affordable method of measuring the chlorine content and predicting the % ash content, without the need for radioisotopes or long combustion analytical methods.

Calibration

To create calibration standards, two homogeneous splits are taken from a homogeneous bulk sample. One split is ashed to determine the % ash content. This % ash number is then assigned to the unburned split as an assay for use as an XRF calibration standard. The unburned split is also assayed for Cl content.

Calibration is performed only once, and then refreshed once a year. Daily operation measuring unknowns is then fast and simple, requiring no special technical knowledge.

To demonstrate a mixed calibration, 14 assayed field samples were acquired for the empirical calibrations. Ash measurements were automatically optimized based on the measurement of other major and minor elements present in the biomass, such as S, Ca, Fe, Zn, Pb, and Sr.

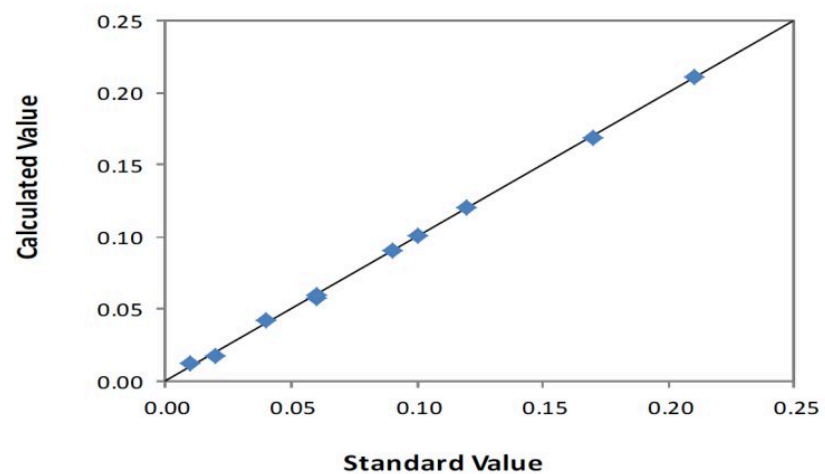
Number of standards	Type	"As Received" assay
4	Wood pellets	Ash 0.6 – 1.0%
5	Woodchip	Ash 0.4 – 2.2% Cl 0.01 – 0.10%
5	Waste woodchip	Ash 2.3 – 4.7% Cl 0.06 – 0.21%

Calibration summary

Calibrations are shown here using a mix of biomass forms. Results may be further optimized by making a separate calibration for each different biomass form of interest, for example separate calibrations for wood pellets, woodchips, and waste woodchips.

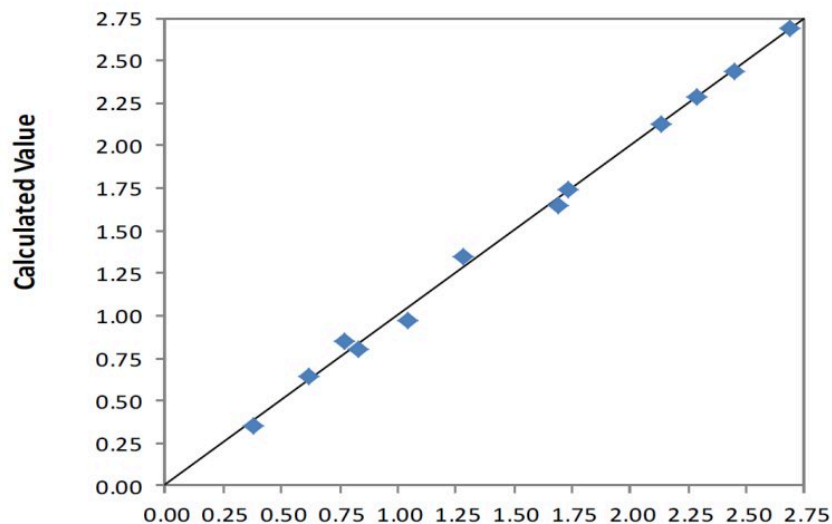
Element	Standards	Concentration range
Cl	10 Woodchip + Waste woodchip	0.01 – 0.21%
Ash	14 Wood pellets + Woodchip + Waste woodchip	0.38 – 2.65%

Chlorine Units: %		
Sample I.D.	Standard value	Calculated value
WC 5801	0.10	0.101
WC 5818	0.04	0.042
WC 5879	0.01	0.012
WC 5881	0.06	0.058
WC 5883	0.02	0.017
WW 4961	0.06	0.060
WW 4963	0.17	0.169
WW 5863	0.12	0.120
WW 5864	0.09	0.091
WW 5865	0.21	0.211



Correlation plot CI in biomass

Ash		
Units: %		
Sample I.D.	Standard value	Calculated value
WP 3101	0.62	0.639
WP 3102	0.77	0.849
WP 3103	1.04	0.968
WP4934	0.83	0.801
WC 5801	2.13	2.123
WC 5818	0.38	0.356
WC 5879	1.28	1.343
WC 5881	1.73	1.743
WC 5883	1.69	1.651
WW 4961	2.69	2.686
WW 4963	3.06	3.076
WW 5863	2.29	2.286
WW 5864	2.45	2.435
WW 5865	4.65	4.650



Correlation plot ash in biomass

Repeatability

To demonstrate repeatability, three calibration standards were selected to show the lower and higher levels of Cl and % ash concentration ranges. Each sample was measured in 10 repeat analyses without moving the sample between measurements to determine an average value for precision. If desired, repeatability can be enhanced by using longer measurement times.

Standard	% Cl assay value	% Cl average value	Std. dev	% Relative dev
WW 5865	0.21	0.218	0.005	2.4%
WC 5883	0.02	0.025	0.001	5.0%

Standard	% Ash assay value	% Ash average value	Std. dev	% Relative dev
WW 5865	4.65	4.578	0.054	1.2%
WC 5883	1.69	1.709	0.025	1.5%
WP 4934	0.83	0.862	0.028	3.4%

Conclusion

The NEX QC+ offers the lab analyst or field operator at the site a simple and fast tool for measuring chlorine and predicting % ash content in biomass quickly and easily without the use of radioisotopes or combustion techniques. The versatility of the NEX QC+ EDXRF analyzer also allows for the report of other elemental and oxide concentrations as well, provided element and oxide assay values are available for the set of calibration standards

Related products



NEX QC Series

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