EDXRF Application Note
ACZA Wood Treatment

#1225

SCOPE

The measurement of ACZA treated wood and wood treatment solutions is demonstrated.

BACKGROUND

Wood treatments are used to protect lumber from fungi, insects, UV damage and general wear. Common wood treatment formulations containing only Cu, CCA, Penta and ACZA. Ammonia Copper Zinc Arsenate (ACZA) is often used to treat wood species that do not easily retain other treatments, such as Douglas Fir. When treating wood, the proper balance of treatment solution must be monitored to ensure the highest quality while minimizing waste and excess cost due to treatment usage or product rejection. Cu, Zn and As levels are monitored in solution prior to treatment, and then in the wood to ensure proper retention. A quick, simple, reliable means of analysis is required throughout the quality control process. XRF is an ideal tool for such analysis.

INSTRUMENTATION

Model:	Rigaku NEX QC
X-ray tube:	4 W Ag-anode
Detector:	Semiconductor
Sample Type:	Wood (ground) and Solutions
Film:	Mylar
Environment:	Air
Analysis Time:	100 seconds
Options:	6-position Autosampler

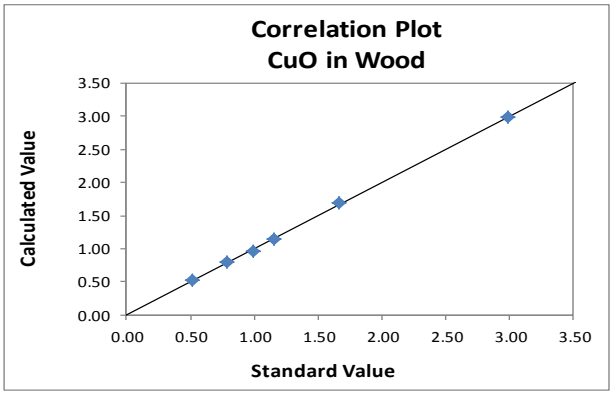
SAMPLE PREPARATION

Wood samples are ground to homogeneous powder and dried. Samples are measured as loose powders by filling a 32mm XRF sample cup 3/4 full (5g). Solution samples are slightly shaken to ensure homogeneity and a sample is prepared by simply filling a 32mm XRF sample 3/4 full (5g).

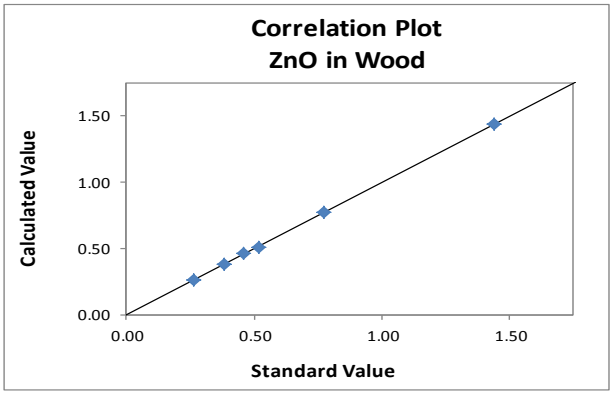
CALIBRATION – ACZA in Wood

An empirical calibration was built using a set of assayed wood standards using a measurement time of 100 seconds per sample.

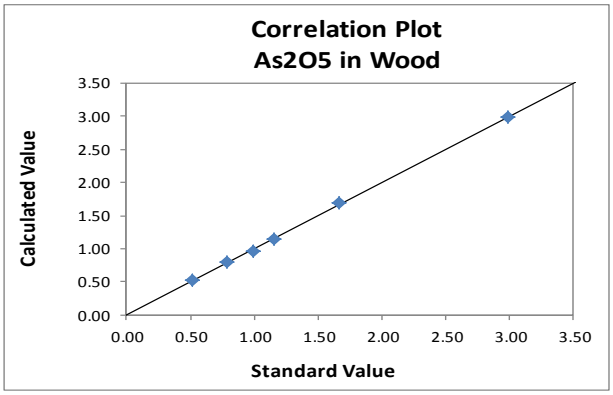
CuO	Std Error of Est: 0.0225	
Units: %	Correlation: 0.99961	
Sample I.D.	Assay Value	Calculated Value
W-A	0.518	0.531
W-B	0.789	0.788
W-C	1.150	1.145
W-D	0.989	0.963
W-F	1.660	1.685
W-G	2.990	2.984



ZnO	Std Error of Est: 0.0087	
Units: %	Correlation: 0.99975	
Sample I.D.	Assay Value	Calculated Value
W-A	0.264	0.266
W-B	0.382	0.381
W-C	0.518	0.506
W-D	0.457	0.464
W-F	0.771	0.775
W-G	1.440	1.439



As2O5	Std Error of Est: 0.0269	
Units: %	Correlation: 0.99722	
Sample I.D.	Assay Value	Calculated Value
W-A	0.518	0.531
W-B	0.789	0.788
W-C	1.150	1.145
W-D	0.989	0.963
W-F	1.660	1.685
W-G	2.990	2.984



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REPEATABILITY – ACZA in Wood

To demonstrate repeatability (precision), the low and high samples were chosen from the set of calibration standards. Each sample was measured in static position for ten repeat analyses using a measurement time of 100 seconds per sample.

CuO Units: %				
Sample ID	**Standard Value**	**Average Value**	**Std Dev**	**% Relative**
W-A	0.518	0.5209	0.0014	0.3
W-G	2.990	3.047	0.015	0.5

ZnO Units: %				
Sample ID	**Standard Value**	**Average Value**	**Std Dev**	**% Relative**
W-A	0.264	0.2601	0.0010	0.4
W-G	1.440	1.455	0.005	0.4

As2O5 Units: %				
Sample ID	**Standard Value**	**Average Value**	**Std Dev**	**% Relative**
W-A	0.189	0.1874	0.0011	0.5
W-G	1.280	1.289	0.002	0.2

TYPICAL DETECTION LIMITS – ACZA in Wood

To determine the Lower Limit of Detection (LLD) using the empirical method, ten repeat analyses of a blank wood sample is measured and the standard deviation calculated. The LLD is then defined as three times the standard deviation. The following detection limits are shown using a measurement time of 100 seconds.

Compound	LLD
CuO	4 ppm
ZnO	4 ppm
As2O5	3 ppm

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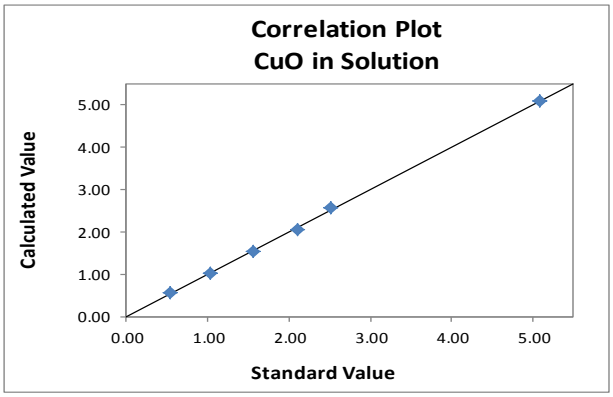
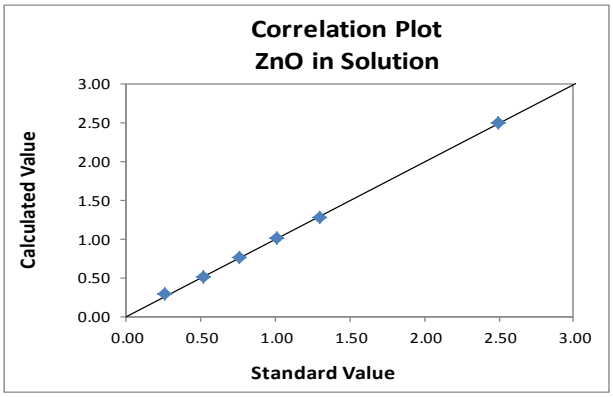
CALIBRATION – ACZA in Solution

An empirical calibration was built using a set of assayed solution standards using a measurement time of 100 seconds per sample.

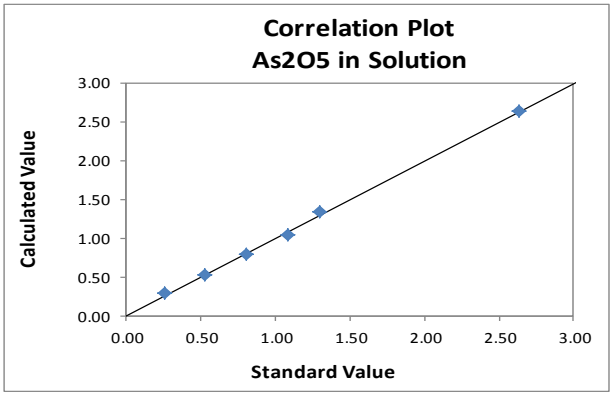
CuO	Std Error of Est: 0.0394	
Units: %	Correlation: 0.99952	
Sample I.D.	Assay Value	Calculated Value
S-A	0.53	0.552
S-B	1.03	1.032
S-C	1.56	1.541
S-D	2.11	2.061
S-E	2.52	2.574
S-F	5.09	5.086



ZnO	Std Error of Est: 0.019	
Units: %	Correlation: 0.99956	
Sample I.D.	Assay Value	Calculated Value
S-A	0.26	0.290
S-B	0.52	0.510
S-C	0.76	0.759
S-D	1.01	1.019
S-E	1.30	1.281
S-F	2.49	2.495



As2O5	Std Error of Est: 0.0302	
Units: %	Correlation: 0.99896	
Sample I.D.	Assay Value	Calculated Value
S-A	0.26	0.285
S-B	0.53	0.528
S-C	0.80	0.788
S-D	1.08	1.039
S-E	1.30	1.334
S-F	2.63	2.633



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REPEATABILITY – ACZA in Solution

To demonstrate repeatability (precision), the low and high samples were chosen from the set of calibration standards. Each sample was measured in static position for ten repeat analyses using a measurement time of 100 seconds per sample.

CuO Units: %				
Sample ID	**Standard Value**	**Average Value**	**Std Dev**	**% Relative**
S-A	0.53	0.525	0.003	0.6
S-F	5.09	5.088	0.027	0.5

ZnO Units: %				
Sample ID	**Standard Value**	**Average Value**	**Std Dev**	**% Relative**
S-A	0.26	0.263	0.002	0.8
S-F	2.49	2.479	0.008	0.3

As2O5 Units: %				
Sample ID	**Standard Value**	**Average Value**	**Std Dev**	**% Relative**
S-A	0.26	0.269	0.002	0.7
S-F	2.63	2.618	0.021	0.8

TYPICAL DETECTION LIMITS

To determine the Lower Limit of Detection (LLD) using the empirical method, ten repeat analyses of a blank water sample is measured and the standard deviation calculated. The LLD is then defined as three times the standard deviation. The following detection limits are shown using a measurement time of 100 seconds.

Compound	LLD
CuO	4 ppm
ZnO	4 ppm
As2O5	3 ppm

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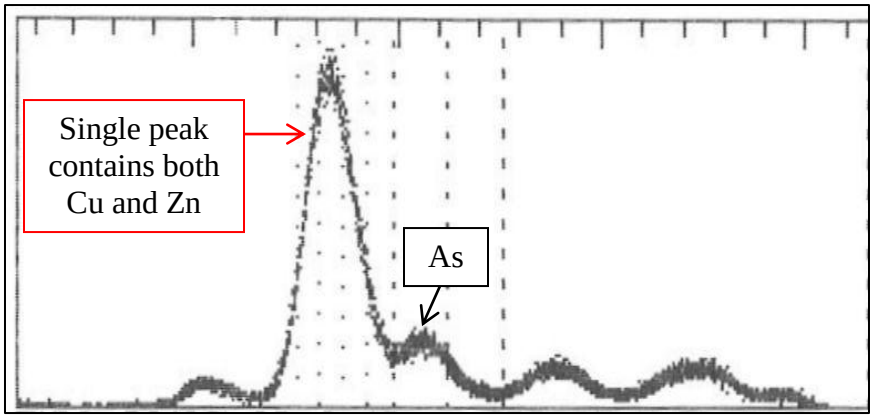
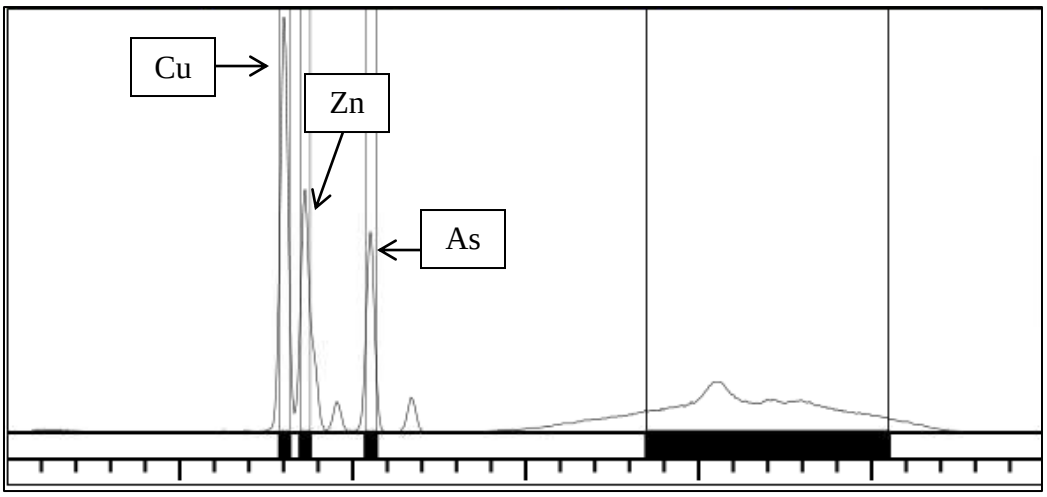
RELIABLE MEASUREMENT of Cu and Zn

Past generations of analyzers used gas-filled proportional counter detectors, called prop counters. The prop counter detection system yields broad peaks, therefore Cu and Zn are measured as one peak, as shown in Spectrum 1 below. The single peak detected by a prop counter must be separated into Cu and Zn measurements using large mathematical overlap correction factors or sequential use of Ross filters that double the count time.



Spectrum 1. Typical prop counter ACZA spectrum
giving one single peak for Cu and Zn that must be heavily deconvoluted.

The NEX QC solves this problem by using a rugged and reliable semiconductor detector that gives much sharper resolution of peaks. Spectrum shows the ACZA analysis using NEX QC, the measurement of the individual Cu and Zn is possible without the extra error introduced using large mathematical overlap corrections or the use of Ross filters.



Spectrum 2. Typical NEX QC ACZA spectrum
showing clear, distinct peaks for Cu, Zn and As.

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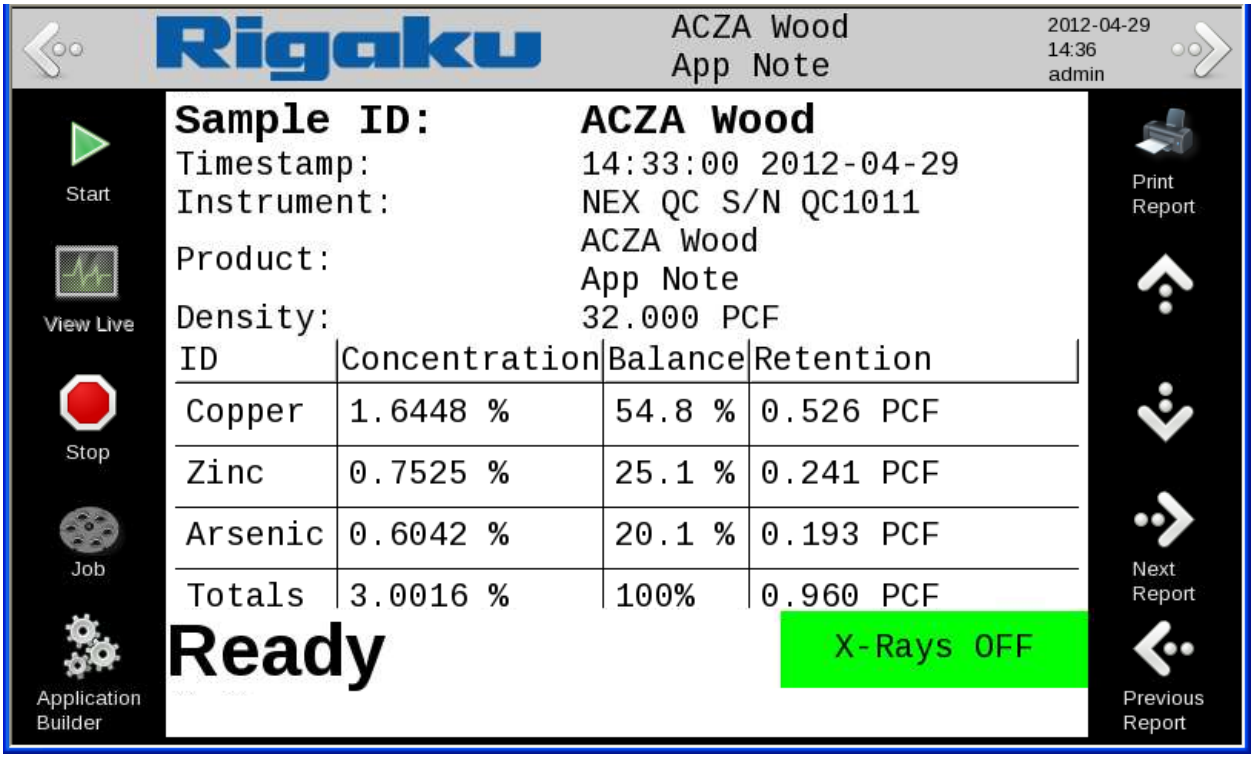
RETENTION REPORT

To measure a wood sample, enter the density of the wood. The measurement calculates concentrations of CuO, ZnO and As2O5 and also outputs balance and retention values.



CONCLUSION

The typical results detailed here show exceptional performance for the fast and simple measurement of ACZA in wood and solution, without the need for large overlap corrections or Ross filters. The Rigaku NEX QC is an excellent tool throughout the QC process in producing treated lumber, giving the production process an affordable means of optimizing quality while minimizing costs and helping to minimize product rejection and waste.

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