WDX-400

Wavelength **D**ispersive
X-ray **F**luorescence
Spectrometer

Application

Fields

→ Steel

→ Cement

→ Glass

WDX-400

Wavelength **D**ispersive
X-ray **F**luorescence
Spectrometer

WDX 400 Compact Multi-channel X-Ray Fluorescence Spectrometer features for 10 fixed light diffraction channels, with 10 arbitrary elements defined by the users from Na to U being analyzed simultaneously. The standard ten elements configuration is Na, Mg, Al, Si, S, Cl, K, Ca, Fe, P or Ti（optional）. The instrument is an ideal quality control choice for large and medium-sized enterprises.

Higher X-ray power

Higher measurement precision

More stable measurement data

Higher excitation efficiency

Lower limit of detection

Technical Specifications

- **High voltage supply:** 400W (50KV 8mA).
- **X-ray tube:** 400W thin Be end window X-ray tube made by Varian company, Rh anode (Pd anode optional).
- **12-hour tube voltage & tube current stability:** Within 0.05 %.
- **Measurable elements:** 10 arbitrary elements from Na to U.
- **Detector:** gas flow proportional detector + sealed proportional detector; 10 paths 1024 channels independent pulse height analyzer.
- **Vacuum system:** independent pumping station for easy maintenance with highest vacuum lower than 8Pa.
- **Gas flow system:** high-accuracy gas density stabilizer with pressure stability up to ±0.003 KPa.
- **Pre-amplifier:** high-speed pre-amplifier circuit improves analysis efficiency, enhances analysis accuracy as well.
- **MCA:** digital MCA multi-channel analyzer greatly improves analysis accuracy.
- **AC 220V power supply:** 2 sets of 1KVA AC purified stabilized voltage power supply
- **Analysis accuracy:** °η-1 (24 hours, percentage content) ≤0.05 .
- **Singe sample measurement time:** (including time for sample exchanging and vacuum pumping) ≤3-5 minutes.
- **Temperature control precision in constant temperature chamber:** setting value±0.1°C.

Configurations:

- **P10 gas (90% Ar +10% Methane mixture):** 1 bottle of gas is included.
- **Vacuum pump:** Homemade high-quality vacuum pump
- **Vibromill:** Recommended by Skyray or purchase yourself
- **Sampling machine:** Recommended by Skyray or purchase yourself
- **Fusion machine:** Recommended by Skyray or purchase yourself

Performances and Characteristics:

- Rapid and non-destructive analysis of samples in powder or lump form
- Fast analysis of compact powder, fused beads and lump material
- Multi-channel digital MCA has greatly improved the measurement efficiency, which benefits not only the instrument debugging and failure diagnosis but also enhances the measurement accuracy and stability.

Comparison with large power sequential spectrometer:

A) Good measurement precision achieved even when power becomes smaller and measurement time the same.
B) Prolonged service life.
C) Fewer failures of high voltage power supply.
D) Reduced maintenance cost of the whole instrument.
E) No wearing problem of goniometer as fixed channels adopted.

Principle of X-ray Fluorescence Analysis

● Characteristic X-rays of Elements

Different elements have extra-nuclear electronic orbitals of different binding energies, and as a result, they give off X-ray photons carrying energies different from each other when excited, I.e. each element emits an X-ray at its own special energy, representing the characteristic of this element and accordingly called characteristic X-ray. Characteristic X-ray of each element has its specific wavelength, so when we detect an X-ray of a specific wavelength, we can identify the presence of the interested element in a sample.
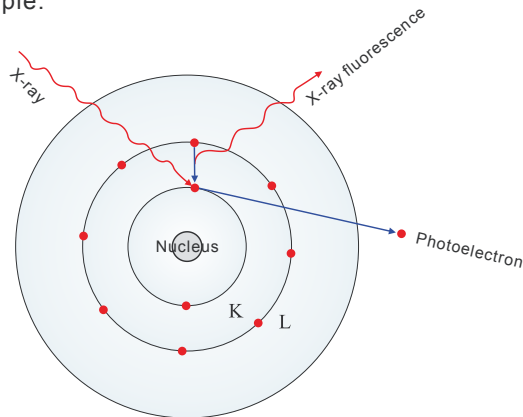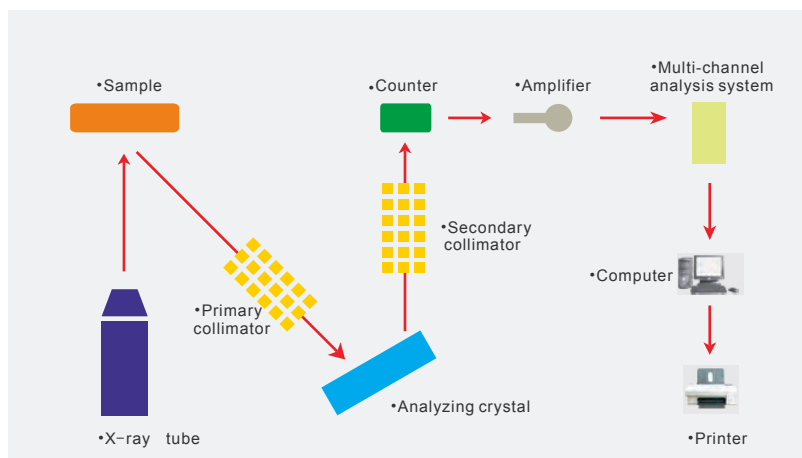

Principle of Wavelength Dispersive Spectroscopy

When many elements coexist in a sample and get irradiated by primary X-rays emitted from the X-ray tube, they will emit their corresponding characteristic X-rays. This in general is termed as X-RAY FLUORESCENCE. To separate and measure characteristic X-rays of these elements is called X-ray Fluorescence Spectroscopy. As characteristic X-rays of different elements have specific wavelengths, they can be separated by using Crystal Diffraction based on Bragg Equation. This kind of spectroscopy is called Wavelength Dispersive Spectroscopy.

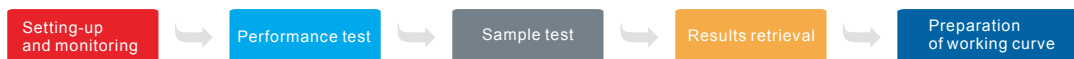Bragg's Law: $2d\sin\theta = n\lambda$

In the above equation, ."**d**" is" the distance between atomic layers in a crystal; "**θ**" is certain angle of incidence;" **λ**" is the wavelength of the incident X-ray;" **n**" is an integer of diffraction.

**Working Principle of Wavelength Dispersive Spectrometer**

Software Overview

● **Software Functions:**

| Setting-up and monitoring | ⟹ | Performance test | ⟹ | Sample test | ⟹ | Results retrieval | ⟹ | Preparation of working curve |

● **Technical Specifications:**

- ■ Sophisticated windows-based Software system for Control of X-ray Fluorescence Analyzer.
- ■ Easy manipulation via by operating interface.
- ■ With innovative technology of full spectrum analysis, every spectrum line can be timely traced and corrected, greatly improving the repeatability and stability of quantitative Analysis.
- ■ Equipped with software for two quantitative analysis algorithms: empirical coefficient algorithm and theoretical a-coefficient algorithm, among which the latter algorithm reduces the number of standard samples required and retains adequate accuracy at the same time.
- ■ Analysis data treatment, linear fitting, and various matrices correction.
- ■ The characteristic value can be calculated according to analysis values.
- ■ Man-machine interaction allows for setting and modifying the parameters.
- ■ Timely output of analysis data and report.
- ■ Complete self-diagnosis measures.

Wavelength dispersive instrument spectrum
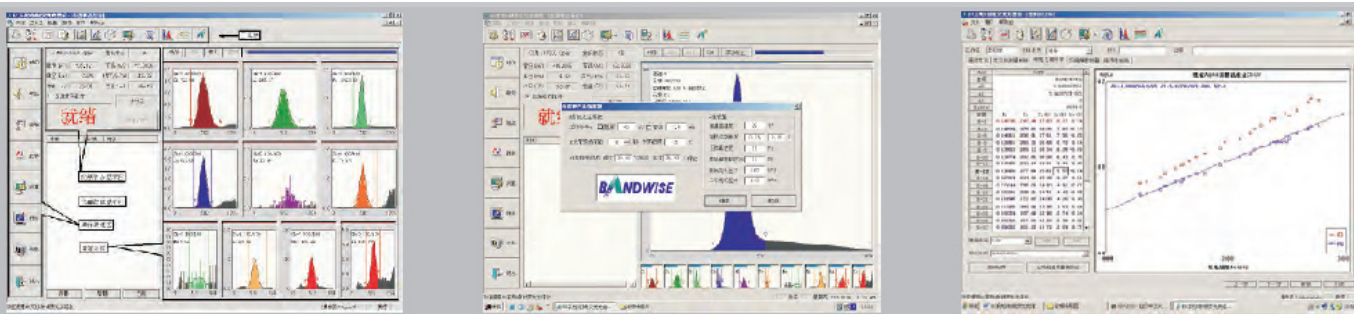
Examples of Cement Industry

Cement standard XS04-2

XS04-2	Si	Al	Fe	Ca	Mg
Standard value	12.71	2.86	3.09	43.29	1.6
Average value	12.708	2.912	3.056	43.305	1.635

Continued

XS04-2	Si	Al	Fe	Ca	Mg
Max value	12.74	2.93	3.06	43.34	1.66
Min value	12.69	2.89	3.05	43.30	1.62
Range	0.05	0.04	0.01	0.04	0.04
Standard deviation value	0.015362	0.01077	0.004899	0.01145	0.014318
Relative deviation value(%)	0.120887	0.36986	0.160307	0.02644	0.875708

Cement standard XS05-2

XS05-2	Si	Fe	Al	Ca	K	Na	Mg
Standard value	12.71	3.09	2.86	43.29	0.45	0.28	1.6
Average value	12.706	3.091	2.903	43.273	0.454	0.295	1.62
Max value	12.73	3.1	2.92	43.3	0.46	0.35	1.64
Min value	12.69	3.08	2.88	43.25	0.45	0.27	1.6
Range	0.04	0.02	0.04	0.05	0.01	0.08	0.04
Standard deviation value	0.012806	0.008307	0.011	0.015524	0.004899	0.02377	0.013416
Relative deviation value(%)	0.100789	0.268736	0.378918	0.035875	1.07907	8.057535	0.828173

Examples of Steel Industry:

Results of Agglomerate Measurement
Below are the results of repeated tests of the unknown sample:

No.	Sample No.	Measurement Time	Fe(%)	CaO(%)	MgO(%)	SiO$_2$(%)	So$_3$(%)
1	17#	2007-11-09 13:35	53.87	12.10	3.44	5.73	0.040
2	17#	2007-11-09 13:39	53.89	12.08	3.43	5.74	0.040
3	17#	2007-11-09 13:42	53.91	12.08	3.44	5.75	0.039
4	17#	2007-11-09 13:46	53.91	12.10	3.44	5.76	0.040
5	17#	2007-11-09 13:50	53.90	12.07	3.45	5.76	0.039
6	17#	2007-11-09 13:53	53.89	12.09	3.43	5.75	0.041
7	17#	2007-11-09 13:57	53.90	12.09	3.45	5.75	0.042
8	17#	2007-11-09 14:01	53.89	12.09	3.46	5.76	0.040
9	17#	2007-11-09 14:05	53.89	12.09	3.44	5.75	0.039
10	17#	2007-11-09 14:08	53.88	12.08	3.44	5.75	0.040

Test of 18-hour stability taken by unknown sample 17#; the results after total 306 times are:

Constituent	Average value	Min value	Max value	Standard deviation value
Fe(%)	53.891	53.850	53.920	0.012
CaO(%)	12.086	12.040	12.120	0.014
MgO(%)	3.446	3.420	3.470	0.010
SiO$_2$(%)	5.752	5.710	5.780	0.010
So$_3$(%)	0.040	0.038	0.042	0.001

Converter slag

Below are the results of repeated tests of the unknown sample:

No.	Sample No.	Measurement Time	Fe(%)	SiO_2(%)	CaO(%)	MgO(%)
1	D1-2702A	2007-11-12 16:52	12.75	7.74	50.41	9.11
2	D1-2702A	2007-11-12 16:56	12.73	7.75	50.39	9.12
3	D1-2702A	2007-11-12 17:00	12.71	7.77	50.38	9.14
4	D1-2702A	2007-11-12 17:04	12.73	7.78	50.35	9.14
5	D1-2702A	2007-11-12 17:08	12.74	7.78	50.33	9.15
6	D1-2702A	2007-11-12 17:11	12.76	7.80	50.27	9.18
7	D1-2702A	2007-11-12 17:15	12.76	7.80	50.27	9.18
8	D1-2702A	2007-11-12 17:19	12.76	7.80	50.25	9.18
9	D1-2702A	2007-11-12 17:22	12.77	7.81	50.24	9.19
10	D1-2702A	2007-11-12 17:26	12.76	7.82	50.24	9.23

Test of 15-hour stability taken by unknown sample D1-2702A#; the results after total 253 times are:

Constituent	Average value	Min value	Max value	Standard deviation value
Fe(%)	12.782	12.710	12.840	0.021
SiO_2(%)	7.818	7.740	7.840	0.011
CaO(%)	50.215	50.160	50.410	0.030
MgO(%)	9.217	9.110	9.290	0.027

List of some customers

- **Guangdong Tapai Group Co., Ltd. Huizhou Longmen Branch**
- **Zhaoshan Xinxing Group. Hunan Liuyang Cement Co.,Ltd.**
- **Sanhe Yanxin Cement and Building Materials Co., Ltd.**
- **Anhui Tiepeng Seal Cement**
- **Hunan Yunfeng Cement Co., Ltd.**
- **Qujing Xuanwei Yuheng Cement Co.,Ltd.**
- **Fujian Quanzhou Meiling Cement Co., Ltd.**
- **Hunan Yushan Cement Co.,Ltd.**
- **Fujian Cement Co.,Ltd. Cement Plant.**
- **Fujian Yongan Wannian Cement Co.,Ltd.**
- **Yunnan Binchuan Jinxin Building Materials Co.,Ltd.**
- **Yunnan Lijiang Yongbao Cement Co.,Ltd.**
- **Gansu Jiuquan Iron & Steel Group Hongda Building Materials Co., Ltd.**
- **Xinjiang Qingsong Cement Co.,Ltd.**
- **Inner Mongolia Xishui Venture Co.,Ltd.**

- **SDIC Hainan Cement Co.,Ltd.**
- **Hainan Changjiang Huasheng Tianya Cement Co.,Ltd.**
- **Shandong Laiwu Steel Group. Lubi Building Material Co.,Ltd.**
- **Hebei Luquan Quzhai Cement Co.,Ltd.**
- **Hainan Changjiang Hongqi Industrial Co.,Ltd. Chahe Cement Branch.**
- **Shandong Shanshui Group. Jinan Century Innovation Cement Co.,Ltd.**
- **Hebei Funing Xinhe Cement Factory**
- **Anhui Chaohu Tiedao Cement Factory**
- **Anhui Jingpan Cement Co.,Ltd.**
- **Anhui Runji Cement Co.,Ltd.**
- **Zhejiang Hushan Group Co.,Ltd.**
- **Zhejiang Juhua Import & Export Co.,Ltd.**
- **Hubei Songzi Shuangqi Cement Co.,Ltd.**
- **Shandong Shanshui Group. Liaoyang Qianshan Cement Co.,Ltd.**
- **Sichuan Hongya Yasen Cement Co.,Ltd.**

*Names of customers are too many to be listed, which are not arranged in particular order.

Design／development / Manufacture / Sale / Service

Skyray Instrument

Skyray - We Only Make Precision Instruments

Spectroscopy - Chromatography - Mass Spectroscopy

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