



BOXA-II ON-STREAM X-RAY FLUORESCENCE ANALYZER

Technical Description Version 2

BGRIMM AUTOMATION

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ABOUT BOXA

The BOXA on-stream X-ray fluorescence analyzer offers high sensitivity and real time measurement to all sizes of concentrator plants to control and regulate the mineral process flow sheet. BGRIMM provides the necessary technical service to guarantee performance to meet the concentrator's unique requirement.

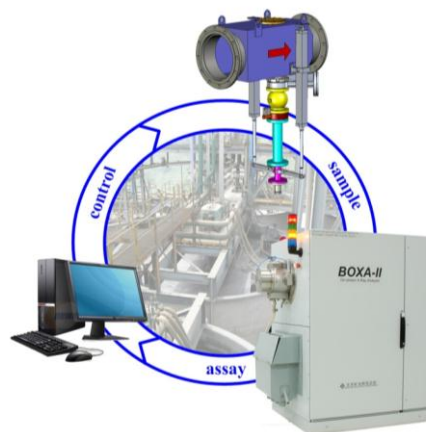


Figure 1: BOXA Composition

WHAT CAN BOXA DO?

- Sampling and analyzing are done automatically in the same consistent way around the clock to reduce cost.
- Any process disturbances can be detected quickly to maintain the recovery rate.
- Concentrate quality is controllable and undesired variations are minimized. The plant operation is optimized with less circulating loads to get a high throughput
- Replace the classical manual laboratory procedure with new analyzing techniques, which combine the wavelength dispersive and the energy dispersive method for every element measuring channel.



- Improved measurement technique with modular design provides the flexibility and expandability required to meet the changing demands of the flow sheets in concentrators in all areas of the world.

BOXA ANALYZING SYSTEM

Analysis Method

BOXA combines the wavelength dispersive X-ray fluorescence (WDXRF) and the energy dispersive X-ray fluorescence (EDXRF) for **each** element measuring channel. Plus the enhanced feature of an optional separate EDX Channel which allows the display of the whole measurement spectrum available in the sample.

Sample Streams

BOXA is capable of taking up to 24 sample streams with 4 multiplexers (MXA)

Primary sampler control (optional)

BOXA Probe control Set can provides 3 digital output signals in order to control each sampling stream connecting to the multiplexer(s) for; Start sample, Stop Sample and Flushing sample line.

Flow rates

70~300 l/min sampling slurry are required from the primary samplers and multiplexers and then 20~30 l/min sampling slurry are required to the measuring cell

Cabinet sealing

The analyzer probe and the Probe Control Set comply with IP54, and the multiplexer complies with IP65.

Probe Cooling System

Air conditioning:

The RITTAL CS9776.500 air conditioning system was selected to give isolated, stable environment temperature for the BOXA probe. The AC Unit is part of an integrated package which includes a custom sectional cabinet providing a reliable environment for the critical components of the BOXA



measurement spectrum. The user has control to set the working temperature depending on the conditions of the installation location.

The stability provided to the spectrum environment by the Isolated Integrated Cabinet/AC Unit allows a wider working range of the BOXA: +5°C ~+45°C. Plus the longer term performance is greatly enhanced by an isolated Cabinet/AC Unit over the former water – cooling system

Controls and indications

- Maintenance switches are provided for each multiplexer and the analyzer probe control set.
- Manual controls are provided to collect composite sampling or calibration samples.
- Light indicators for X-ray power supply status, alarms, reference briquette measurement and MXA measurement status.

Local Display Unit

The human machine interface is touch sensitive and displays:

- Operational status
- Assay data
- Alarms
- Special commands for maintenance



Figure 2: Probe Control Set (PCS) with Human Machine Interface and Indicators



Analyzer Management Station

The analyzer management station uses a windows PC to:

- Define the process parameters
- Manage the calibration data
- Run the BOXA CALIBRATION ROUTINE (BCR_{BGRIMM}): the calibration software for determining the measurement calculation models
- Manage analysis data
- Collect alarm data from the analyzer
- Display the work status and assay data

Connect to DCS

BOXA can provide an Ethernet port with MODBUS/TCP protocol or MODBUS RTU protocol to communicate with the DCS.

Safety

All measurement testing has been performed and no radiation can be detected outside the probe cabinet.

The BOXA meets the radiation safety regulations of China.

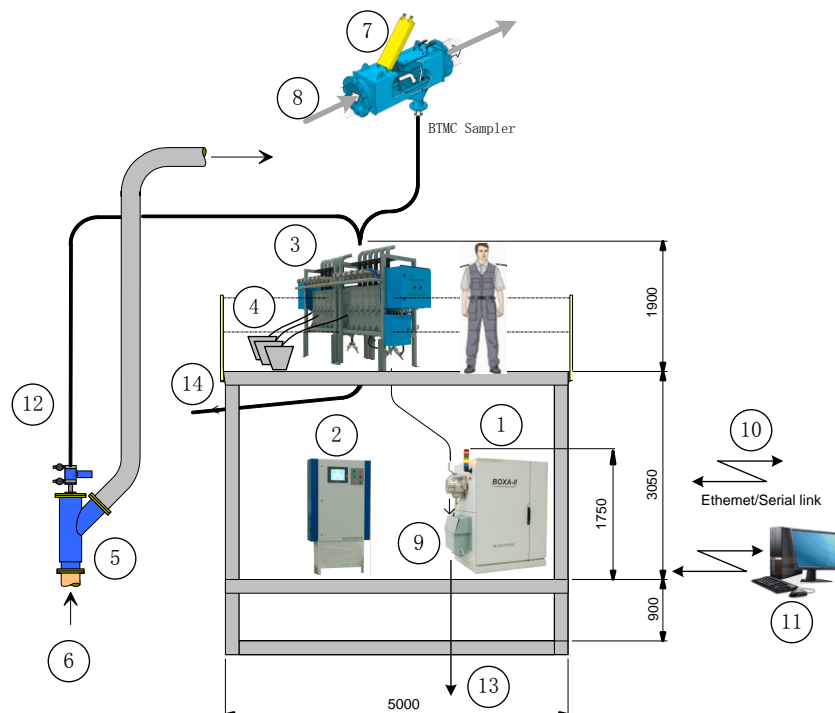


Figure 3: The BOXA Slurry Analyzer System



Fig.3 includes:

- 1 = Analyzer Probe,
- 2 = Probe Control Set
- 3 = Multiplexer
- 4 = Composite Sampling
- 5 = Example of Pressure Sampler available as Model: PPV, PPH, PPVNB, PPHNB (can be customized with H&S sampling technology.)
- 6 = Process flow by pressure
- 7 = Example of Gravity Sampler available as Model TMC, TMCF (can be customized with H&S sampling technology.)
- 8 = Process flow by gravity
- 9 = Calibration sampler
- 10 = Process control System
- 11 = Analyzer Management Station
- 12 = Primary sample by pressure 70...300 l/min
- 13=return back to process 25...40 l/min
- 14= RETURN BACK TO PROCESS 70...300 L/MIN

SAMPLING

- BTMC sampler is specially designed for the primary sampling on the normal atmosphere process flow
- BPPV sampler is specially designed for the primary sampling on the pressure process flow
- A representative 70~300 l/min primary slurry sample is circulated through a fast loop to the secondary sampler (MXA) and back to a convenient return point in the process. Primary samples are not mixed with each other.
- A 20~30 l/min sample is divided out to the measuring cell for accurate analysis. The secondary sample stream can be sampled by a calibration sampler for the laboratory assaying during calibration.

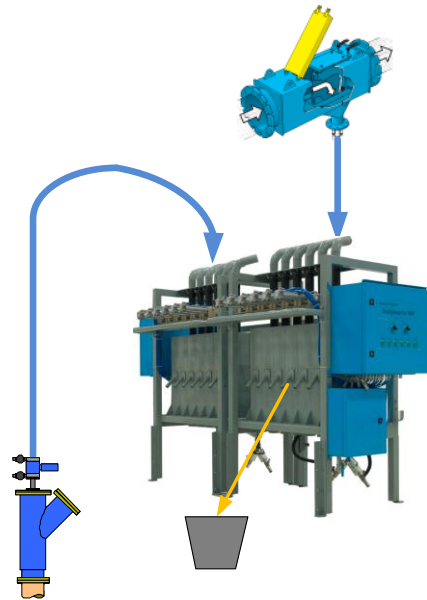
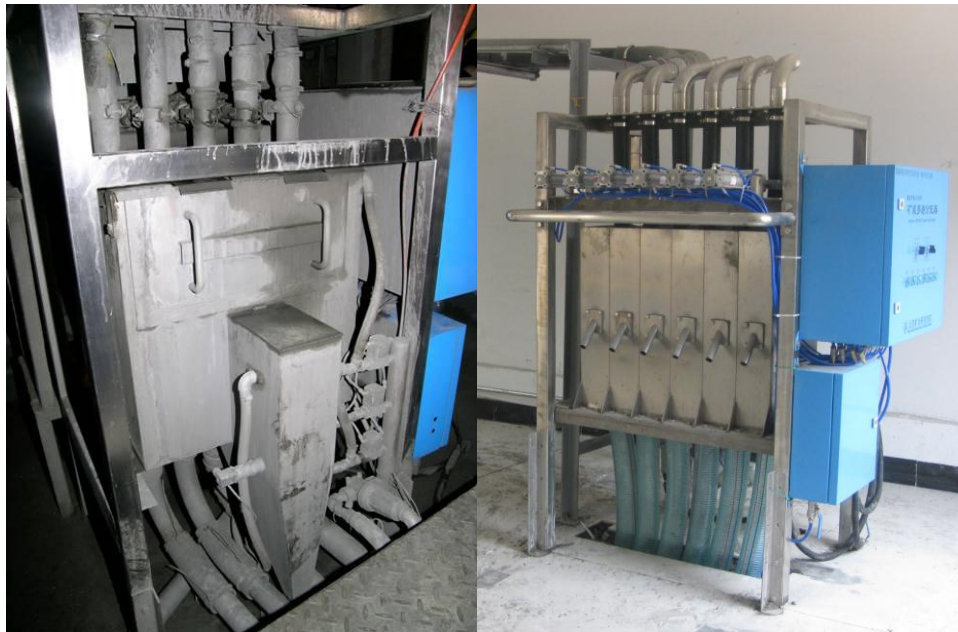


Figure 4: Sampling System



(a)

(b)

Figure 5: (a) Multiplexer with 5 inlet streams. (b) Multiplexer with 6 inlet streams.

NEW TECHNIQUES

Combination of WDXRF and EDXRF



BOXA's provides reliable and stable analysis method which combines the high selectivity of WDXRF and the high sensitivity of EDXRF, plus extreme high count rate capacity of modern solid-state detectors to provide analyzing performance of superior accuracy and high sensitivity.

BOXA firstly uses the synthesis crystal to extract the measured element's characteristic spectral line from the originally emitted spectral line, and then uses the semiconductor solid-state detector to detect the energy intensity of the extracted element's spectral line.

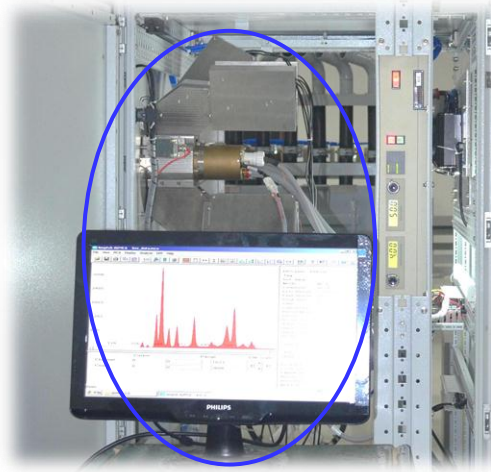
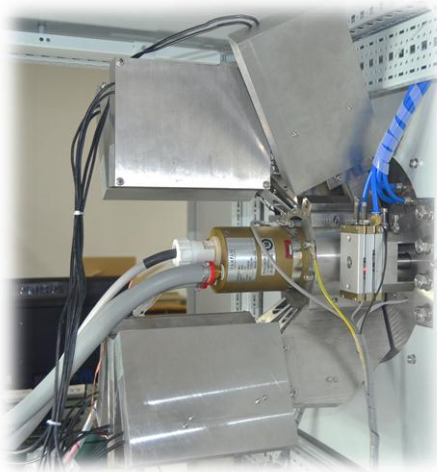


Figure 6: BOXA-I- PROBE Internal

Figure 7: WDXRF and EDXRF

- In view WDXRF/EDXRF Measurement Channels & X-Ray Tube
- Up to 6 parallel measurement channels 5 element grades, 1 for slurry density
- Optionally one of the 5 element measurement channels can be replaced with a EDX Channel to display the whole spectrum

MULTI-MODEL AUTOMATIC CHOOSING (WITH RULES)

While using a group of samples to calibrate the analyzer, one or more models may be obtained at same time when the samples' physical and chemical characters are different with each other. BOXA may build one or more models, and set the conditions of the availability of every model according to the calibrating result and the customers' measuring requirement and



experiences. This method has proved to be useful when the ore's character changes often.

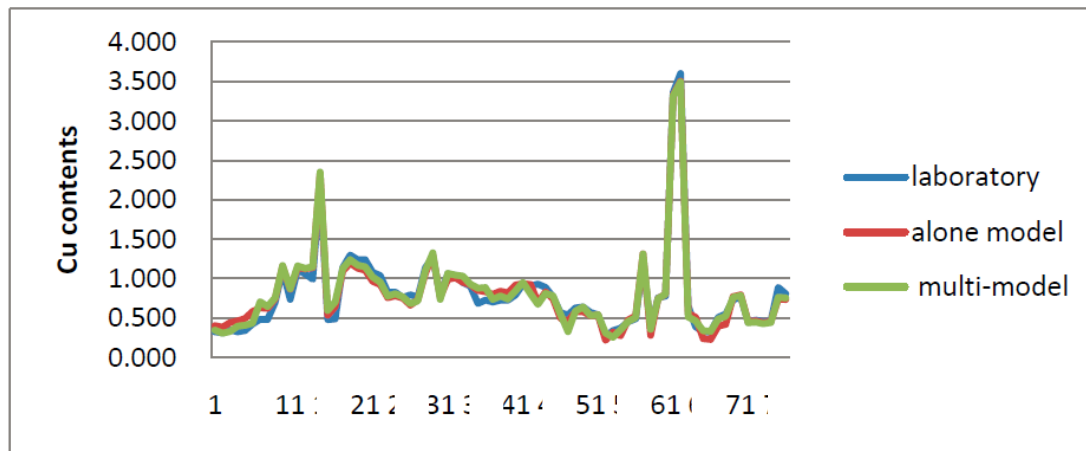


Figure 8: Comparison with different modeling methods

PERFORMANCE

Element range

The element range is from Calcium to Uranium (atomic numbers from 20 to 92).

Measurement time

Depending on application, the measuring time will be 15~30 seconds per stream, leading to a total time is 10~13 minutes per 10 streams with 2 multiplexers.

Simultaneous assay number

BOXA's probe has a maximum of 6 parallel measuring channels, 5 channels may be used to measure five elements grade simultaneously, and the sixth is reserved to measure the slurry density.

Measurable range

Typically measurable range is from 0.01 to 100% by weight for slurries.

Detection limit

The detection limit for most elements is 25~150ppm in slurries.



Sensitivity

For most elements, changes of 0.01% can be detected at 1% level with a probability 95% from a homogenous sample.

Short term stability

In specified operating circumstances, the measured intensity stabilized is 0.3%.

Long term stability

The long term instrument drift is compensated by automatic internal reference sample measurement.

High selectivity

The high resolution of the crystal spectrometer allows measurements with no peak overlap of neighboring elements. For instance, 8 ppm Cu can be detected in the presence of 100,000 ppm (100g/l) Ni.

High accuracy

The measuring accuracy is a function of the mineral sample parameters, such as the matrix composition, mineralization, and particle size. In common conditions, for individual slurry sample measurements of concentration levels well above the relevant minimum detection limit of the analyzer, the following relative standard deviations are achieved:

- Minor concentrations: 3~6%,
- Major concentrations: 1~4%.



LAYOUT

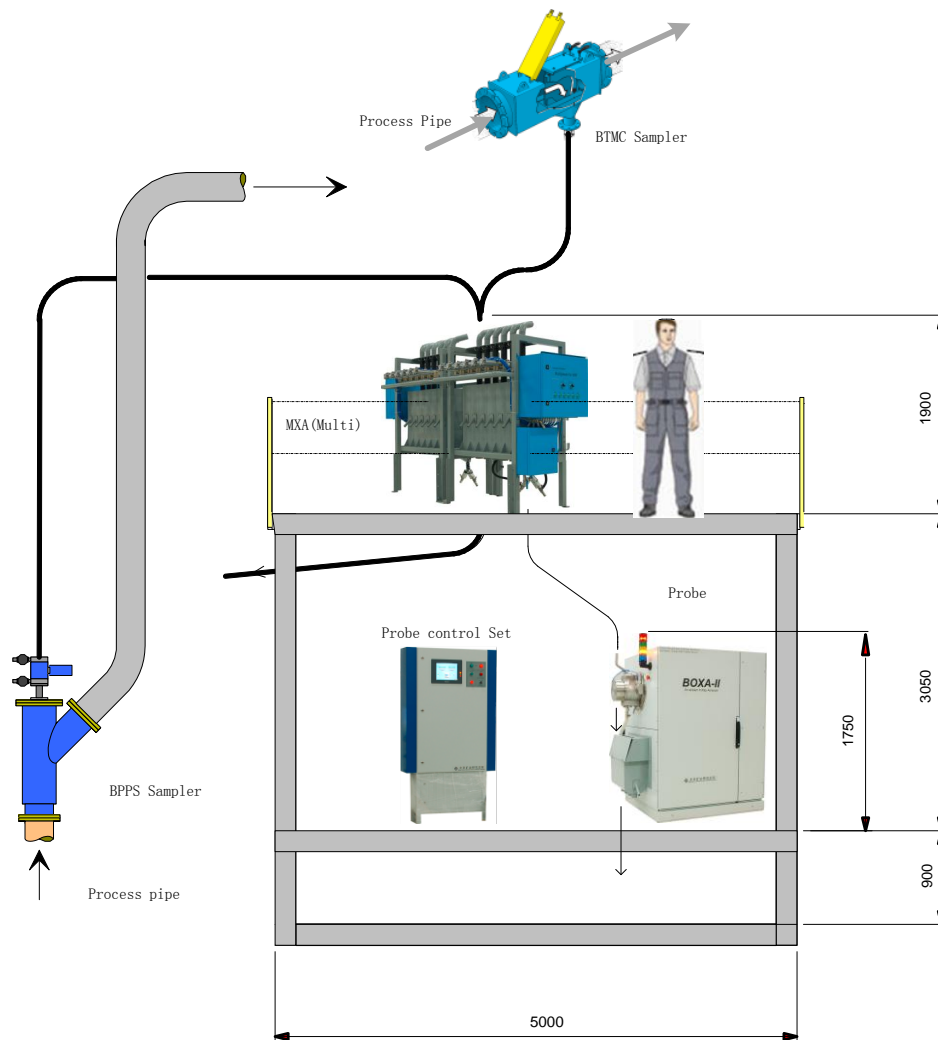


Figure 9: BOXA Layout

SPECIFICATIONS

Analyzer dimensions and weight

Probe Set:

1050(L)×910(W)×1750(H)mm, 300Kg.

Probe Control Set:

950(L)×250(W)×1700(H)mm, 100Kg



MXA:

1150(L)×961(W)×1150(H)mm, 200Kg

Power supply for the analyzer

Basic single phase 220V +10%, -15% 15A 50Hz or **customized by Country of Order**. A double conversion (AC/DC/AC) UPS 6 kW/10 min is highly recommended to secure trouble-free and stable operation.

Temperature

Operating ambient temperature at sea level: +5~+45 °C

Storage temperature: -33~+55°C

Flushing water

Flushing water is used for flushing the multiplexers and the calibration sampler.

Quality: Sand filtered raw water

Pressure: 0.2~0.5MPa, 30 l/min average

Instrumentation air

Instrument compressed air is used for the multiplexers, calibration sampler, and reference measure actuators.

Pressure: 0.4~0.8MPa

Consumption: 16 NL/min average