



S2 KODIAK

- ONLINE PROCESS CONTROL FOR MINERALS & MINING



KODIAK - Good catch from the stream



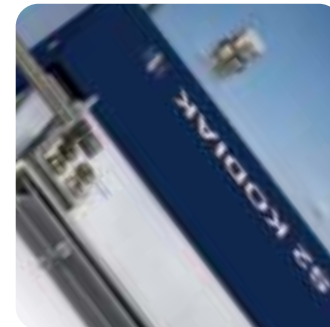
S2 KODIAK: Iron in sand



Beam Path S2 KODIAK



S2 KODIAK: Iron ore, lumps and fines



Rugged Design (Stainless Steel)



Fines and lumps



Safeguards: X-ray tube and detector



Mining truck



S2 KODIAK: Chromite ores



Integrated camera



Close geometry for analyzing fines

Achieve the next level of efficiency in mining and mineral beneficiation with S2 KODIAK!

The mining industry is facing various challenges in process control. While high-grade resources for most of the base metals are coming to an end, low-grade resources and mining in remote locations are becoming financially attractive. This will have significant influences on the mining process, in mineral beneficiation and the material supply chain.

The exploitation of low-grade resources will require early material sorting and additional optimization efforts in the mineral processing steps. Enhanced separation of waste rock before crushing and concentration steps will increase the efficiency of the mine and of the pyro- or hydrometallurgical processes.

Online analysis with our S2 KODIAK – Meet the future of process control

Real-time process control in the mine is vital in order to achieve optimal cost efficiency. At the same time, it is challenging to bring an analytical instrument into the process. These instruments must be maintenance-free, robust and work for extended periods without human interaction. In order to steer material streams, the instruments must deliver immediate results and integration into the plant control must be flawless. In addition, working safety is an important topic; conventional systems are based on prompt gamma neutron activation analyzers (PGNAA) and require extensive shielding and strict safety regulation. Not with the S2 KODIAK: The X-rays are on only in operation, simple shielding and the safety circuit are ensuring the highest safety level, all the time.

S2 KODIAK – on duty, online, 24/7

Element	Material	Typical Precision
²⁶ Fe	Iron ore	60% +/- 1 %
²⁹ Cu	Copper ore	5% +/- 0.15 %
³⁰ Zn	Multi-metal ore	10% +/- 0.2%
²⁸ Ni	Trace in ore	0.2% +/- 0.01%
¹⁶ S	Minor in ore	5% +/- 0.2%
²⁰ Ca	Waste rocks	10% +/- 0.5 %
⁸² Pb	Hazardous trace	100 ppm +/- 10 ppm
²⁶ Fe	Trace in sand	50 ppm +/- 5 ppm





Grade control of industrial minerals and sand



Material sorting of ores (iron, copper, nickel, chromium, tungsten)



Underground mining



Surface mining



Selective mining



Control of hydro- and pyrometallurgical processing



Efficient blending

- Online multielemental analysis with XRF
- Simultaneous analysis of major, minor and trace elements
- Real-time analysis of fines and lumps up to > 30 cm diameter
- Handling of dry and humid materials
- In mining, mineral beneficiation and blending
- Autonomous operation 24/7
- Integrated UPS, camera and distance sensor
- Optimal occupational health and safety, operates without radioactive sources
- Integrated online analyzer with TCP/IP data transfer to any plant control SW
- Maintenance-free operation, operates with electrical power only
- Encapsulated, rugged design with stainless steel housing
- Optimal results with fully featured analytical X-ray evaluation software
- Empty belt recognition
- Humidity and distance compensation
- Automated self alignment and data quality check
- High resolution state-of-the-art detector



The right solution, right away – S2 KODIAK!

High quality results – instantly, at any time, with the performance you need – thanks to S2 KODIAK

The actual and future demands for online analysis in mining operation are answered by the XRF spectrometer S2 KODIAK. Based on energy-dispersive X-ray fluorescence technology, the S2 KODIAK is the ideal choice to act as an element sensor for ore mining and mineral processing, providing real-time information about major, minor and trace element concentrations from 100% down to a few ppm. The material stream in the mine and in ore beneficiation plants can be closely monitored and efficient blending can be enabled in real-time based on the S2 KODIAK's results. A typical absolute deviation of less than 0.5% for major elements allows definition of clear cut-off levels. Due to the nature of online XRF, there is no need for additional sample preparation equipment and the integration into the plant is mechanically simple. The advanced software of the S2 KODIAK is optimized for online analysis: it compensates for humidity, light element matrices and changes in the material height through

integrated sensors. Another big advantage of the S2 KODIAK is the analysis of larger material volume compared to LIBS, thereby delivering more representative and more accurate results.

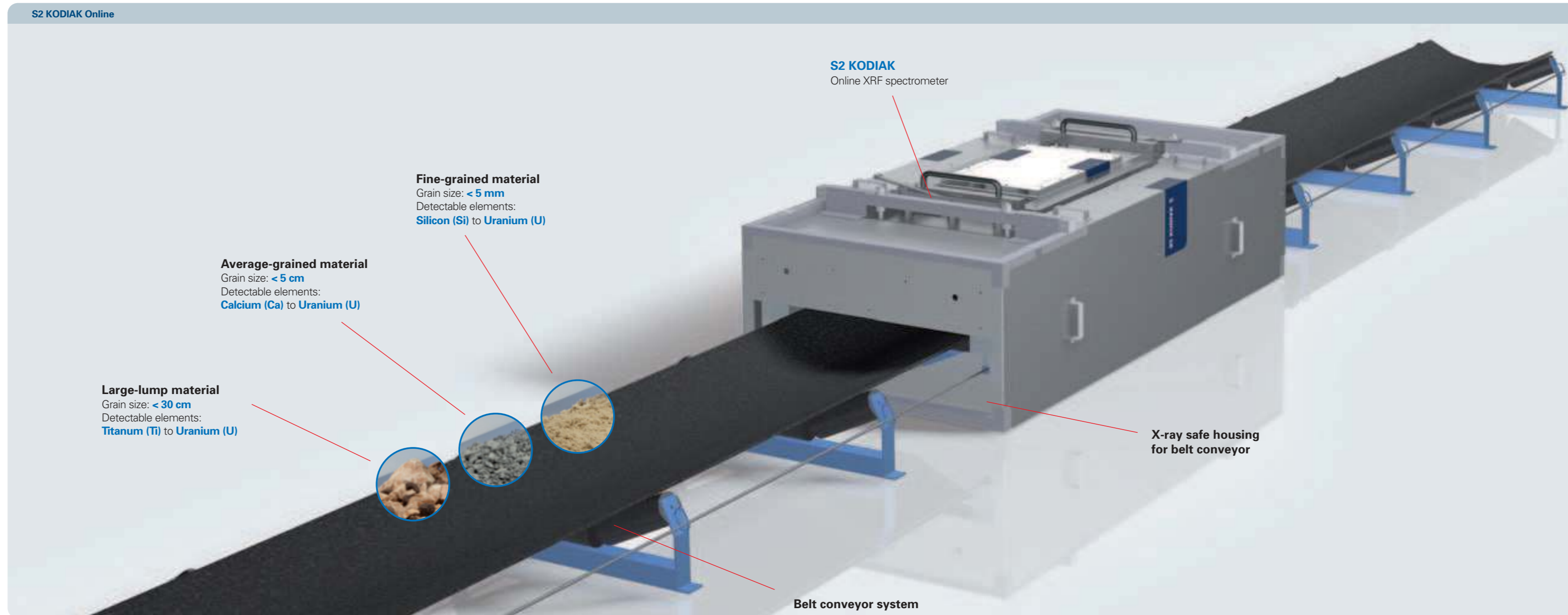
The S2 KODIAK is mounted above the conveyor belt. Large lumps from 30 cm down to fines – grain size < 5 mm – are continuously analyzed. The X-ray tube excites the elements in the material; the fluorescence radiation from the elements present in the sample is detected with an energy-dispersive silicon drift detector. Today these detectors operate maintenance-free, requiring only electrical Peltier cooling. The energy resolution is in the range of 160 eV at 100,000 cps, which allows separation of neighboring spectral lines. The complete spectrometer is mounted in an entirely closed stainless steel box for X-ray safety. The S2 KODIAK withstands the harsh environmental conditions in a mine and is completely dustproof. All system components are entirely protected. With the integrated UPS, the system shuts down into a safe state if power supply fails.

No radioactive targets, integrated safety and ≥ 98 % uptime – in short: S2 KODIAK

The S2 KODIAK comes with a complete safety circuit that makes sure the unit is completely X-ray safe at all times. Most importantly, in contrast to other techniques, the S2 KODIAK operates without radioactive targets. Installation, setup, approval from authorities, and maintenance are simple jobs. An integrated camera allows checking the material flow below the analyzer or visually inspecting the tube and detector shielding. The S2 KODIAK's software enables remote checking and maintenance of the unit. With automatic self-alignment, the S2 KODIAK delivers consistently high-quality results. Easy access to all system components allows our worldwide service network to quickly maintain the unit and to ensure instrument uptimes of 98% or more.

The benefits are clear: The S2 KODIAK delivers excellent real-time information about all process-relevant elements in your plant – constantly, instantly and absolutely safely.

S2 KODIAK Online



Large-lump material
Grain size: < 30 cm
Detectable elements:
Titanium (Ti) to Uranium (U)

Average-grained material
Grain size: < 5 cm
Detectable elements:
Calcium (Ca) to Uranium (U)

Fine-grained material
Grain size: < 5 mm
Detectable elements:
Silicon (Si) to Uranium (U)

S2 KODIAK
Online XRF spectrometer

X-ray safe housing for belt conveyor

Belt conveyor system

S2 KODIAK – the Perfect Fit for Base Metal Ore Mining

The S2 KODIAK is perfectly suited for online process control in mining operations. By measuring the exact material composition at any time, the hydro- or pyro-metallurgical process can be optimized to increase output and enhance separation efficiency. Real-time control of the blending step ensures a constant concentrate composition in support of later refining steps. At the same time that the S2 KODIAK analyzes major and minor elements, it also delivers information about hazardous trace elements, such as As or Pb. Low-quality material can simply be excluded from further processing.

Beach sands, minerals sands, zirconite, rutile and other minerals are quickly analyzed during the mining and further cleaning steps.

Larger lumps or fines – the S2 KODIAK takes it all

The S2 KODIAK comes in three different setups providing the optimal geometry to analyze fine material fractions or larger lumps up to 30 cm. Analyzing rock fractions before milling and material sorting increases the ball mill throughput and optimizes the milling process. Extensive overgrinding of iron ores is efficiently avoided.

Industrial mineralogists can count on S2 KODIAK

In glass manufacturing, a low iron concentration is becoming important today: The increased demand for SiO₂ with Fe

concentration less than 50 ppm leads to a shortage in some sand quarries. The S2 KODIAK delivers accurate information about the iron concentration even during dredging. The immediate sorting helps to increase the output of sands with higher purity. With its humidity compensation, the S2 KODIAK analyzes even wet sand streams.

Beach sands, minerals sands, zirconite, rutile and other minerals are quickly analyzed during the mining and further cleaning steps.

Larger lumps or fines – the S2 KODIAK takes it all

The S2 KODIAK comes in three different setups providing the optimal geometry to analyze fine material fractions or larger lumps up to 30 cm. Analyzing rock fractions before milling and material sorting increases the ball mill throughput and optimizes the milling process. Extensive overgrinding of iron ores is efficiently avoided.

Industrial mineralogists can count on S2 KODIAK

In glass manufacturing, a low iron concentration is becoming important today: The increased demand for SiO₂ with Fe

Technical Data

Analytical Specifications

Detector type and energy resolution	Maintenance-free, Peltier-cooled Silicon Drift Detector (no LN ₂ supply), resolution 160 eV for Mn Ka @ 100,000 cps
Fine-grained material	
Grain size	< 5 mm
Range of detectable elements	Silicon (Si) to Uranium (U)
Average-grained material	
Grain size	< 5 cm
Range of detectable elements	Calcium (Ca) to Uranium (U)
Large-lump material	
Grain size	< 30 cm
Range of detectable elements	Titanium (Ti) to Uranium (U)
Bulk material analysis precision	Depends on application; typically between 1% (relative) and 1% (absolute) for compound concentration range 0.5% to 90%.
Measurement time	Configurable (1 s – 1 h) based on the required accuracy

Technical Specifications

Mains supply voltage	95 ... 264 VAC
Maximum power consumption	max. 900 VA
Surge according to EN61000-4-6	Installation class 3
Overvoltage category acc. to IEC 664	II
Connection data transfer	TCP IP, RS 232 data transfer protocol with AXS-COM to communicate with plant control software
Dimensions	29.0 cm (21.4") x 91.7 cm (36.1") x 40.0 cm (15.7"), 70 kg (154.3 lbs) (height x width x depth, weight)
Control box (optional)	50.0 cm (19.7") x 45.0 cm (17.7") x 19.0 cm (7.5"), 10 kg (22.0 lbs) (height x width x depth, weight)

Environmental Specifications

Operating temperature range	Standard: -25°C – 50°C, Extended: -25°C – 60°C
Operating altitude	Standard: 0 to 3000 m, Extended: -2000 to 4000 m
Enclosure protection class	Storage/cleaning mode: IP69K; Acquisition mode: IP65
Radiation leakage	< 1 µSv/h at 10 cm from the side and top surfaces