



ANALYZING BULK MATERIALS WITH APC ANALYTICS







apc analytics develops and manufactures sampling, sample-processing and analyzing equipment for industrial use. Apart from planning, producing, installing and commissioning these fully automatic samplers & analyzers, apc analytics also offers individual solutions for analytical problems. Furthermore, apc analytics acts as a service provider and manufacturer in the fields of automation engineering, control cabinet construction and special machinery.

apc analytics is located in Steinbach near Frankfurt/Main (Germany). apc analytics' products are based on a well-proven technology, more than 25 years of experience and innovative ideas. The equipment designed and produced by apc analytics which is used in the mining and mineral processing industries as well as in thermal power plants works absolutely reliably even under rough conditions. apc analytics' SOLAS system with its patented sampling technology as introduced in this brochure as well as various additional components open up a wide field of applications for virtually any situation. SOLAS has already been used for more than 15 years in the lignite/coal industry in several mines all over Europe, in nearly all lignite-fired power plants in Germany and in the world's largest iron ore mine in Brazil. SOLAS is a fully automatic sampling and analyzing system for the rapid determination of substances in bulk goods. Typical installation sites for the equipment are loading, conveying and processing facilities in open-cast and underground mines, in power plants, cement works etc.

SOLAS cannot only work as a standalone system, it may also be complemented by sampling and processing systems installed upstream of it that are also supplied by apc analytics and that are fully geared to the requirements of the relevant application concerned.



SOLAS[®] ONLINE ANALYZER

Fast Sampling and Analysis



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Immediately downstream of the excavator

- to determine the sulphur & ash contents as well as the composition of the ash
- to detect sand infiltrating the raw lignite
- to blend the raw lignite with overburden as a means of adjusting the ash content
- to control the quality predicted by geological models
- to detect quality changes which have to be taken care of quickly



Upstream of the blending yard

 to record the quality of the coal stocked in a bunker/stockyard in a file with quality data on the basis of a stockyard model; the required quality can be selected and set with the recording device and the help of the quality file

Downstream of the blending yard

 to control the quality of the blended product leaving the stockyard



In thermal power plants

- to avoid slag formation; SOLAS is able to calculate typical parameters, such as the acid/base ratio, the SiO₂ ratio or the slagging factor
- to optimise the control of cleaning mechanisms (such as water lance blowers) in power plants, depending on the coal quality
- as incoming quality inspection; the blending with selected additives will make it possible to respond to quality problems, so that incidents causing extensive damage can be avoided





The principle

SOLAS is based on the combination of

- a smart pneumatically operated sample conveying system, in which the sample material is transported directly by the air stream, and
- the analytical method of the energy dispersive x-ray fluorescence analysis (EDXRF) which has been designed for the use under rough conditions.

The smart sample transport system SOLAS will make it possible to take samples from different sampling points and convey them to the analytical unit of SOLAS. There are applications, to name just one example, where SOLAS takes samples from various sampling points (with plants of up to 6 sampling points being implemented so far). apc analytics also offers additional modules, such as an automatic laboratory sampler, with SOLAS being used for the fast and automatic analysis of the sample composition that have been taken manually under operating conditions.

The energy dispersive x-ray analysis makes it possible to speedily and simultaneously analyze chemical elements, including aluminium and uranium. Depending on the field of application, other parameters and variables can be calculated on the basis of the element content thus established, and derived therefrom, such as the calorific value of lignite/coal, the sulphur and ash contents as well as the composition of the ash.





HOW DOES SOLAS FUNCTION?

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An analysis cycle of SOLAS

A sample will be suctioned into a stainless steel tube by an air stream of SOLAS and, first of all, fed into a turbo mill (AIRMILL 6000), where the sample material will be ground to dust within seconds (grain size: 200 microns or less). After the milling process the sample material will be divided, in order to reduce the sample mass to be actually analyzed. Following that, the sample will be separated from the air stream in a sampling cyclone and collected in a presampling chamber, where a level sensor monitors the sampling process and stops it as soon as sufficient material has been sampled for an analysis. This sample will then be automatically channelled into a vertically installed measuring cell, with the measuring head of an x-ray fluorescence analyzer (EDXRF analyzer) being located upstream of it. The next sample will already be collected in the pre-sampling chamber, while the earlier one is being analyzed, so that it is ensured that the sampling material's quality can be monitored virtually continuously.

SOLAS offers several variants for sampling, the easiest and most frequently used being the one included in the SOLAS basic version for pneumatic sampling. In this case, the material to be analyzed will be suctioned off a downdraft under a baffle plate at a belt transfer point, a crusher etc. Another option is the use of a conventional sampler (hammer-type sampler, bucket-type sampler etc.) with processing systems (hammer mills) being installed downstream, depending on the initial grain size.

Another piece of well-proven equipment for sampling is the use of a stake box (rod box), where a part of the mass flow is sampled continuously and also channelled to a sample conditioning unit.

All these additional components can be supplied by apc analytics and be included in an overall system that is perfectly adapted to the customer's needs. These components are either already included in apc analytics' modular offer or will be individually designed for the specific conditions of the application.

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SAMPLING WITH SOLAS





Tube sampler



Hammer-type sampler



Stake box (rod box)



Bucket-type sampler

SOLAS will analyze the sample thus taken with the help of an x-ray fluorescence analyzer (X-PLORER 9000). The sample to be analyzed will be excited by the x-rays generated in a (miniature) x-ray tube, its fluorescence spectrum being absorbed by an energy dispersive detector. From this spectrum the elements contained in the sample (theoretically all elements, including sodium and uranium) can be determined simultaneously. After the measurement has been completed, which may take between about 30 s and 120 s, depending on the application, the measured sample will be discharged from the measuring cell and the measuring cell will be cleaned by an air jet. Following that, the next sample, which has already been collected in the meantime, can be fed into the measuring cell. In order to reduce the absorption of the x-ray fluorescent radiation, SOLAS can be optionally equipped with a helium flushing system that will improve the detection limits, especially those of "light" elements, with spectral lines in the low energy range.

The analysis data thus recorded will be transmitted to the process data capturing and visualisation system WinCC (Siemens). The analyzer will use breaks, during which no sampling is required, to calibrate itself with integrated standard material, to carry out automatic checks on certain components, such as the control valves, or to analyze the samples waiting in the automatic feeder system for laboratory samples.



X-Ray Protection

Since only a miniature x-ray tube with a low rating is installed in the EDXRF analyzer X-PLORER 9000° that has been equipped by apc analytics with the most advanced components and included in the SOLAS system, and since the energy emitted by the photons is low, far less efforts are required to obtain the necessary permits, while the potential risks are considerably lower than for solutions with radioactive sources.

Here are some advantages as compared with radioactive sources:

- the generation of radiation can be deactivated
- no toxic materials are used
- the intensity of the radiation generated can be controlled and adjusted
- no effects compromising the analysis, such as a weakening of the excitement (half-life of radioactive sources) need to be taken into account

The lifetime of the x-ray tube will exceed 10 years during continuous operations.

Data Processing

All data generated by SOLAS (analysis results, operating messages, alarms etc.) will be visualized in a well-structured form and stored in databases or archives. The system allows recognizing trends speedily, raises the alarm when default limits are exceeded etc. It is possible while running the process to select the calibration function, the sampling location or the sampling mode, respectively, and individual plant components.



ANALYZING WITH SOLAS

The same kind of visualisation will be provided in the client's computer that is equipped with identical operating elements and that may be remotely located several kilometres away from the system. The presence on site is virtually not required.

Computer logs and reports will be configured according to the customer's specification (such as shift protocols with mean values of the shift concerned as well as mean values from different charges) and automatically printed or transmitted. Apart from storing all process data in the visualisation system WinCC, all analysis data and the raw spectrums will also be made directly available in MS-Excel format.



Interfaces

As a means of communication with the instrumentation & control (I&C), i.e. the transmission of data and the reception of possible control signals, SOLAS offers several serial options, such as OPC, Profibus, hardware (4–20 mA, floating contacts).

Calibration

The equipment will usually be calibrated in such a way that samples with analysis data already known are either fed into the suction hole manually or fed into the system via the pneumatically operated sample transport system (see separate brochure). Ideally, the contents of the samples thus used for the calibration should cover the entire range of qualities for which SOLAS is employed. During the calibration the x-ray intensities measured by the x-ray fluorescent analyzer (count rate for a particular chemical element) will be correlated with the laboratory analysis data. The result in most cases will be simple linear functions between the intensities of the chemical element concerned and the contents in the bulk good. Contrary to other online analyzers, neither the production nor the conveyor belts need to be stopped during the calibration, and the production process will in no way be affected. The results can be verified in an equally easy way.

Long-term stability

After the system has been calibrated in line with the actually intended use, a set of synthetic samples integrated into the system will be measured. This set of samples (pure elements and lithium tetraborate samples) will make it possible to verify the stability of the x-ray fluorescent analyzer at any time. Should a problem arise, the original calibration can be restored without having to re-measure new samples with the contents known from the laboratory analyses. Again, the production process will not be affected in any way, either.





The pneumatically operated sample transport system will make it possible to install SOLAS in a flexible and simple way. Normally, SOLAS will be installed in a pre-fabricated container that houses all the necessary auxiliary equipment (compressed air, filters, heating & air-conditioning, vibration protection etc.) and that is located close to the conveyor belt, the transfer points and/or crushers or chutes.

It is, of course, also possible to install SOLAS and the associated units in any other suitable rooms that may be available on site.

The only medium required is a power supply (voltage and frequency according to the local conditions). There are no restrictions as regards the types of conveyor belts employed (e.g. belts reinforced with steel) or their throughput rate. Under favourable local conditions, SOLAS will also be in a position to take samples from several conveyors simultaneously, if their transfer points are not more than 50 m away.

Sampling techniques

- tube sampler installed underneath a baffle plate, with the sample being taken straight from the downdraft and being conveyed from here by way of the pneumatic sample transport to SOLAS
- from the top of the material on a conveyor belt (requires more or less homogenous materials, sample sizes of less than 30 mm and a continuous mass flow)
- downstream of a possibly existing conventional sampling/processing system that has been

- employed in the first place, SOLAS can be used subsequently merely as a high-speed analyzer
- direct sampling from pipelines/air-conveyor troughs for powder-like substances
- in combination with a continuously operating sampling & processing system (stake box, please refer to the separate brochure)
- in combination with a discontinuously operating sampling & processing system

INSTALLATION OF SOLAS

SOLAS standard version							
Analysis Frequency	depending on the application 20–60 analyses p. h.						
Analytical performance (elements analyzed and analysis parameters gained therefrom)	basically all chem in coal/lignite: in iron ore: in cement:	nical elements, including aluminium and uranium sulphur and ash contents, components of the ash, calorific value, slagging factors, chemical elements (Al, Si, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe) components of iron ore, chemical elements (Al, Si, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe) components of cement raw meal, chemical elements (Al, Si, Cl, K, Ca, Ti, Cr, Mn, Fe), calculation of the LSF					
Weight (container version)	6 t						
Dimensions (container version)	L x W x H 5500 x 3000 x 2600 mm or a 20 ft. "cargo container"						
Power supply	25 kW: 400, 500 or 690 V (voltage & frequency according to local conditions – please specify)						
Operating temperature range	-40 – +45° C (air-conditioning & heating integrated in the container)						
Mechanical installation/ vibration	the container rests on air springs						
Communication between SOLAS and remote visualisation station	all Ethernet connections (e.g. DSL modems, wireless, optical fibre, GSM router VPN), with the distance depending on the chosen type of connection: DSL modems up to ~10 km, wireless up to ~1 km, GSM router virtually unlimited						
Interfaces/ control contacts	OPC, Profibus, serial interface, hardware: 4–20 mA/floating contacts						

Results

The graphs show examples of the results about the iron concentration and the ash content in lignite, achieved by SOLAS during the calibration.





TECHNICAL DATA OF SOLAS

Conventional sampling systems

- hammer-type sampler
- bucket-type sampler
- stake box (rod box)

When using a hammer-type sampler, the entire cross section of the material shipped on the conveyor belt will be sampled, although this system works only discontinuously and monitors the mass flow merely by taking random samples. apc analytics offers hammer-type samplers for various conveyor belt dimensions and sample sizes to fans of classic sampling techniques.

In order to sample large mass flows continuously, the installation of a stake box (rod box) is suggested. Here, the samples will drop at a transfer point onto the stake (or rod) box which only takes off a part stream of the material conveyed (or a partial fraction of it). The stake or rod box can be designed flexibly, so as to be able to clear up blockages or to stop the sampling process (e.g. during the overburden production in open-cast lignite mines).

Hammer mills

apc analytics manufactures two different sizes of hammer mills, which have successfully stood their test under the rough conditions in open-cast lignite mines and in power plants 24 hours a day and 7 days a week.

The "big" mill HAMILL 4000 has been designed for a mass flow of approx. 4 t/h and mills the material into grain sizes of less than 10 mm, while the "little" mill HAMILL 250 has been designed for a mass flow of 250 kg/h and comminutes the material into grains sizes of less than 2 mm.

It goes without saying that apc analytics can also deliver other variants of these two models which will then be designed according to the customer's specifications.

Two hammer mills can also be combined with a screw sampler in between to form a sample processing module where the samples can be separated. This combination is the perfect sample processing module for a SOLAS system located downstream, when such an additional sampling system is installed upstream of SOLAS.



Turbo mills

apc analytics also manufactures turbo mills, which have successfully stood their test under the rough conditions in open-cast lignite mines and in power plants 24 hours a day and 7 days a week. Equipped with the relevant accessories, they are ideal for high-speed milling in laboratories.

The turbo mill AIRMILL 6000 with its special milling technique will comminute the material in the air stream to powder, i.e. to an average grain size of approx. 50 μ m (median value) in the case of lignite, depending on the field of application and the design.



FURTHER OPTIONS

Conveying equipment

apc analytics offers the right type of conveying equipment (belt conveyor, screw conveyor, troughed chain conveyor etc.) for the transportation of materials, with the relevant equipment being individually selected and agreed jointly with well-known manufacturers on the basis of the requirements of the online analysis. Depending on the conveyor type, further additional analyzers of other well-known suppliers (e.g. for microwave moisture measurements) may also be integrated in such systems.



Shift sampler

It is possible to install a sampling system for establishing mean sample values in a shift. These samples which are automatically filled in a stainless steel or plastic bin may either have to be retained or can be made available for further laboratory tests.

Steel construction

apc analytics is also in a position to plan and deliver the entire steel construction that may be necessary.



SOLAS in combination with a conventional sampling and processing system upstream

Depending on the actual application and the customer's specification, apc analytics combines various components to form a customized solution. The example below is a fully automatic analysis system comprising a hammer-type sampler (not shown in the drawing), a reversible and encapsulated conveyor belt, 3 milling and sample separating steps, a shift sampler and the x-ray analysis. Further analyzing equipment with additional functions, such as microwave moisture measurement (own developments or equipment from well-known manufacturers), can additionally be integrated into this system.

Automatic Laboratory Sample Feeder

Laboratory samples can be stored and fed into the pneumatically operated sample transport system SOLAS with the automatic sample feeder "ADOP". If SOLAS is installed as online process analyzer, the user can select, whether the laboratory samples are given priority during the sampling process. If not, SOLAS will continue accepting samples from the sampling process and process, fully automatically, the laboratory samples waiting for being analyzed, while the conveying process has come to a halt. The laboratory sample feeder is equipped with an RFID reader, so that the samples cannot get mixed up.

Engineering

apc analytics offers engineering services in the following fields: Solutions for analytical tasks and consulting in this respect, solutions for sampling and sample processing and consulting in this respect, automation engineering (Siemens S7, visualisation WinCC), planning and manufacturing switching cabinets (cubicles), planning and manufacturing steel structures (platforms, conveying equipment, conventional samplers), project execution. We are looking forward to your enquiries.

FURTHER OPTIONS



PRODUCT	CUSTOMER	APPLICATION SITE	ANALYSIS	SAMPLING YEAR OF I	STALLATION
SOLAS 1	RWE	Fortuna Bergheim mine Germany	Lignite	Direct sampling from transfer point	1995
SOLAS 2	Severočeské doly	Doly Bilina Czech Republic	Lignite	Direct sampling from transfer point	1995
SOLAS 3	RWE	Garzweiler mine Germany	Lignite	Direct sampling from transfer point	1997
SOLAS 4	Severočeské doly	Doly Nastup Tusimice Czech Republic	Lignite	Direct sampling from transfer point	1998
SOLAS 5	Severočeské doly	Doly Nastup Tusimice Czech Republic	Lignite	Sampling from Sizer, additional hammer mill	1999
SOLAS 6	RWE	Garzweiler mine Germany	Lignite	Direct sampling from transfer point	1999
SOLAS 7	Deutsche Steinkohle AG	Ensdorf mine Germany	Coal	Direct sampling from transfer point, additional Sample Dryer Modul	2000
SOLAS 8	Severočeské doly	Doly Bilina Germany	Lignite	Direct sampling from transfer point, additional mill	2000
SOLAS 9	RWE	Neurath power plant Germany	Lignite	Direct sampling after crusher, updated in 2005 with AIRMILL 6000 and helium flushing	2001/2005
SOLAS 10	RWE	Neurath power plant Germany	Lignite	Direct sampling after crusher, updated in 2005 with AIRMILL 6000 and helium flushing	2001/2005
SOLAS 11/KOLA 1	RWE	Hambach mine Germany	Lignite	Additional sample preparation unit	2002
SOLAS 12/KOLA 2	RWE	Hambach mine Germany	Lignite	Additional sample preparation unit	2003
SOLAS 13	Vattenfall Europe	Lippendorf power plant Germany	Lignite	Multiple sampling directly from 4 transfer points and from existing conventional sampler, AIRMILL 6000, helium flushing	2005
SOLAS 14	VALE	Iron ore mine Brasil	Iron ore	SOLAS Test-installation. VALE ordered a new SOLAS system for the final installation place	2006
	Severočeské doly	Tusimice Czech Republic	Lignite	Multiple sampling directly from 4 transfer points and from existing conventional sampler, AIRMILL 6000, helium flushing	2008
SOLAS 15	Severočeské doly	Doly Bilina Czech Republic	Lignite	Multiple sampling directly from 4 transfer points, AIRMILL 6000, helium flushing	2008
SOLAS 16	RWE	Garzweiler mine Germany	Lignite	Additional sample preparation unit, helium flushing, automatic sample feeder ADOP	2007/2012
SOLAS 17	RWE	Garzweiler mine Germany	Lignite	Additional sample preparation unit, helium flushing	2008

SOLAS PLANTS INSTALLED

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PRODUCT	CUSTOMER	APPLICATION SITE	ANALYSIS	SAMPLING YEAR OF INS	TALLATION
SOLAS 18	Vattenfall Europe	Jänschwalde power plant Germany	Lignite	Multiple sampling directly from 2 transfer points, AIRMILL 6000, helium flushing	2009
SOLAS 19	Vattenfall Europe	Jänschwalde power plant Germany	Lignite	Multiple sampling directly from 2 transfer points, AIRMILL 6000, helium flushing	2009
SOLAS 20	Vattenfall Europe	Jänschwalde power plant Germany	Lignite	Multiple sampling directly from 2 transfer points, AIRMILL 6000, helium flushing	2010
SOLAS 21	RWE	Niederaussem power plant Germany	Lignite	Additional sample preparation unit, AIRMILL 6000 with frequency control, helium flushing	2010
SOLAS 22	RWE	Niederaussem power plant Germany	Lignite	Additional sample preparation unit, AIRMILL 6000 with frequency control, helium flushing	2010
SOLAS 23	Vattenfall Europe	Boxberg power plant Germany	Lignite	Multiple sampling directly from 2 transfer points, AIRMILL 6000, helium flushing	2010
SOLAS 24	Vattenfall Europe	Boxberg power plant Germany	Lignite	Multiple sampling directly from 2 transfer points, AIRMILL 6000, helium flushing	2010
SOLAS 25	VALE	Iron ore mine Brasil	Iron ore	Sampling from a conventional sampler, Drying system, AIRMILL 6000, helium flushing (Installation scheduled 2014)	2014
SOLAS 26	RWE	BoA Neurath power plant Germany	Lignite	Additional sample preparation unit, helium flushing	2012
SOLAS 27	RWE	BoA Neurath power plant Germany	Lignite	Additional sample preparation unit, helium flushing	2012
SOLAS 28	Vattenfall Europe	Schwarze Pumpe power plant Germany	Lignite	Multiple sampling directly from 4 transfer points, AIRMILL 6000, helium flushing	2012
SOLAS 29	Test Unit	USA	Lignite	Multiple sampling directly from 2 transfer points, AIRMILL 6000, helium flushing, latest X-Ray analyzer X-PLORER 9000®	2014/2015
SOLAS 30	MIBRAG	Vereinigtes Schleenhain mine Germany	Lignite	Hammer-type sampler, additional sample preparation unit HAMILL 4000 + 250, NEW: sample bottler PAV, AIRMILL 6000, helium flushing, latest X-Ray analyzer X-PLORER 9000®	2014/2015
SOLAS 31	RWE	Weisweiler power plant Germany	Lignite	Multiple sampling directly from 2 transfer points, AIRMILL 6000, helium flushing, latest X-Ray analyzer X-PLORER 9000®	2015
SOLAS 32	Partner Company	Asia	Lignite	Multiple sampling directly from 2 transfer points, AIRMILL 6000, helium flushing, latest X-Ray analyzer X-PLORER 9000®	2016
SOLAS 33	MIBRAG	Profen mine Germany	Lignite	Sampling from a conventional sampler, additional sampling unit with screw conveyor, AIRMILL 6000, helium flushing, latest X-Ray analyzer X-PLORER 9000®	2016



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