

Automation and Control Systems at Coal Preparation Plants in Czech Republic

Ing. Roman Danel, Ph.D.

KOVO, INFORMAČNÍ SYSTÉMY Joint Stock Company

This paper discusses automation and control systems at coal preparation plants in Czech Republic. The paper solves black coal treatment only (there is a brown coal mining in Czech republic also, mining in open pit mines). Black coal mining is concentrated in Ostrava – Karvina region and all the mining activities fall under OKD Joint Stock Company. There are five coal preparation plants nowadays.

Description of the automation and control systems at the coal preparation plants depends on control level. There are three control levels: process control level, dispatching control level and management control level.

Process Control Level

At the process control level of coal preparation plants we are in the field of process automation of technological nodes, such as heavy liquid separation, jig separation, flotation, dewatering, homogenization etc. This control level includes automatic direct control of technology (for example control of homogenization), through automatic regulation to a data acquisition. General contractor in the area of process automation at coal preparation plants is ATP Soukup Ltd. The company provides its own solution of the control of technological nodes. This includes supply of sensors (more than thousand analogue and binary sensors), weight systems and continual ash-meters, from solution of PID control to a direct control of machines.

Control of the jig separation is based on ADiS modular control system (Amit Ltd.). There is a several control loops that must be solved. The unit itself forms the automatic pulsation control in the jig. Several pulsation types can be selected: simple pulsation where the pulse rate per minute can be controlled or multiple pulsations with the cycle period set in seconds. In addition, the system allows for further control loops: automatic control of heavy product raising, automatic bed elevation, air pressure control in jig field collectors, and bottom water flow control. The jiggling automation increased the cleaned product yield by 2 % (according tests done by VŠB TU-Ostrava).

The flotation process is controlled by dosing the flotation agent according to the ash content of the flotation gangue with a correction using the rate of flow and the specific mass of the input raw material. As a stabilising element for the main control circuit, the level in the flotation machine is regulated by controlling the flotation gangue output. The implementations in coal preparation plants are always tailored to the local conditions, the flotation machine type, the requirements of sludge management and dewatering systems.

Heavy liquid separation control include: measuring the quantity of ferromagnetic heavy medium in the suspension, regulation of water or suspension dosage and density regulation and regulation of a separating “cut” (control system by ATP Soukup Ltd).

The visualisation of technological process at coal preparation plant is solved mainly by SCADA/HMI system Promotic (Microsys Ltd, Ostrava).

The latest control system launch on OKD Join Stock Company is CSM Coal Preparation Plant control system. The system has been implemented on spring 2009. At process control level, there is solution from Temex Ltd, based on Siemens Simatic PLC control, Siemens SCADA system and all devices are connected via Profibus.

Dispatching Control Level

Dispatching control level covers control of technological process as a whole. The key process on coal preparation plants is to comply with quality parameters of the coal to meet contracts requirements (the most important quality parameters are ash content and water content). In the field of automation at this control level we are talking about real time control systems. Nowadays there is the third generation of coal plant preparation information systems. First generation based on Digital PDP computers with RSX operation system has been run twenty years ago, followed by next generation of information systems built on Digital ALPHA (with VMS operating system). Latest generation of systems developed by KOVO, INFORMAČNÍ SYSTÉMY a.s. (IS KOVIS, since 2006) uses standard hardware and software platform (Intel, Windows Server 2003/2008) with compliance to easy maintenance. These information systems are supply with a SQL database (Microsoft SQL Server 2005 or 2008).

The coal plant preparation plant information system is working at dispatching control level and ranks among “real-time” control system. The system is connected to process level – via a lot of sensors (more then 1000) with a real-time data acquisition. This allows on-line visualization of technological processes. Information system also automatically processed data on the railway wagon and lorry weighing by the track and road weights (Schenck, Wesico). To the control of a product quality, the key activity is to collect on-line data from continual ash-meters (Enelex, Wilpo). Data from ash-meters are processed and system calculates a trend of quality of the loading coal. The management of the coal preparation plants has a tool allows execute a control action to comply quality parameter with a contract.

All collected or processed data are stored into databases. It allows keeping history of technological process, history of alarms, and history of a workers activity. This is background for compliance the product quality with ISO 9000 certification requirements. Another benefit of the information system is monitoring of the workers activity, leading to increase the productivity. The continuous supervision over the process provides the managers with a tool allowing them to identify and analyze the deviations from process regulations and eliminate the causes.

The coal preparation plant information system is build with a modular structure and has a several software layer. Modularity allows making system alive when technology is changing. Division into software layers (data acquisition layer, data processing layer, database layer, layer of alarms, user

interface layer, system layer, communication layer) allows for easy maintenance and modification of the software.

Management Control Level

Management control level extends to the economy and includes activities like planning or balance. This is an area of corporate information systems (ERP) with analytical processing. OKD mining company runs SAP R/3 corporation information system.

SAP R/3 is added to the local sales control systems. Sales control systems are strictly database oriented and these systems are usually connected to coal mine laboratory to store precious laboratory measure of a quality (ash content, water content, calorific value, dilation, phosphorus content, sulfur).

The system also handles with daily loading plans with emphasis on quality of products according requirements of customer. Sales systems are connected to the coal preparation plan information systems operate at dispatching control level. This allows on-line monitoring of loading according the daily plans with check-in of quality parameters. Data from sales system are transferred to SAP R/3 as basis for the invoice creation. Sales control system also could create all necessary transport documents (such as inland and export bills, train loading, reports on the quality). Another benefit of the sales system are summary reports, statistics of loading, statistics of quality parameters (according to customers, type of coal etc.)

Conclusion

Nowadays in Czech Republic is currently the level of automation and control system at coal preparation plants on high level at all of the control levels. The development over the three generations of systems has led to implementation and usage of modular and scalable systems that fully covers the needs of coal preparation plant management. Deployment of systems has led to a direct savings as well as to improve the management of technological processes.