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Versatile environment parameters measuring sensors

The article presents a line of sensors offered by Przedsiębiorstwo Produkcyjno-Usługowo-Handlowe EMAG-SERWIS Sp. z o.o. intended for permanent monitoring of coal mine air, including methane concentration, carbon monoxide and dioxide concentration, humidity, temperature, pressure and differential pressure.

1. INTRODUCTION

The increasing concentration in the Polish mining industry and the need to reach for deeper coal deposits result in deteriorating mining conditions. The methane risk is also growing. This forces underground mining companies to use monitoring and prevention equipment and systems. Several companies in Poland design, manufacture and service the automatics equipment for mine air control systems – including Przedsiębiorstwo Produkcyjno-Usługowo-Handlowe EMAG-SERWIS Sp. z o.o.

EMAG-SERWIS was founded in March 1993, after the restructuring of the former EMAG Mining Electrification and Automation Centre (currently, EMAG Institute of Innovative Technologies). In the 20 years of activity, the company managed to position itself as one of the leading manufacturers of industrial electronic, electrotechnics and automatics dedicated mostly for the mining industry.

The main group of products offered by the company is mining safety equipment such as methanometers, air parameters sensors and seismic equipment. The product range of EMAG-SERWIS includes: methanometers, air parameters sensors, seismic equipment, intrinsically safe power units, acoustic signalling devices, intrinsically safe separators, control and safety transmitters and industrial surveying equipment.

2. EMAG-SERWIS SENSORS FOR MEASURING MINE AIR PARAMETERS

The Dxx-series sensors with digital data transfer, Mxx-series sensors (licensed by ITI EMAG) as well as control and measurement devices are among the most interesting gas concentration measurement equipment manufactured by EMAG-SERWIS.

2.1. Dxx-series sensors

The Dxx sensors are designed for ongoing measurement of gases concentration in mine air, transmission of measurement data to the air control system and local equipment control through the internal systems of binary outputs.

EMAG-SERWIS offers the following sensors in this range:

– DCH – methane concentration sensor with digital data transmission (fig. 1),
– DCH IR – methane concentration sensor with digital data transmission (NDIR sensor),
– DCD IR – carbon dioxide concentration sensor with digital data transmission (NDIR sensor),
– DHT – humidity, temperature and pressure sensor with digital data transmission,
– DOX – oxygen sensor with digital data transmission,

– DRC – differential pressure sensor with digital data transmission,
– DCO – carbon monoxide sensor with digital data transmission.

Fig. 1. DCH – methane concentration sensor with digital data transmission

The common function of all these devices is the possibility to install the measurement heads directly on the enclosure or to connect them with a 30 m cable. The inlet of the measurement head in all sensor types is protected with a replaceable filter. The devices are powered from a telephone line, also used for data transmission (V23 standard). The devices have two digital outputs with galvanic isolation, used to notify about the dangerous has concentration or automatically cut off power. The gasometric system operator can set alarm thresholds. The sensors have a durable enclosure with IP54 protection rating.

All Dxx-series sensors are also available with RS485 digital interface and with analog outputs in the 0.4-2 V and 4-20 mA standard. The sensors are also designed to work with the SMP-NT/A system station devices (fig. 2) providing power and data transmission through the power supply line. They can also work individually (as long as they are powered from an intrinsically safe power unit of appropriate specifications).

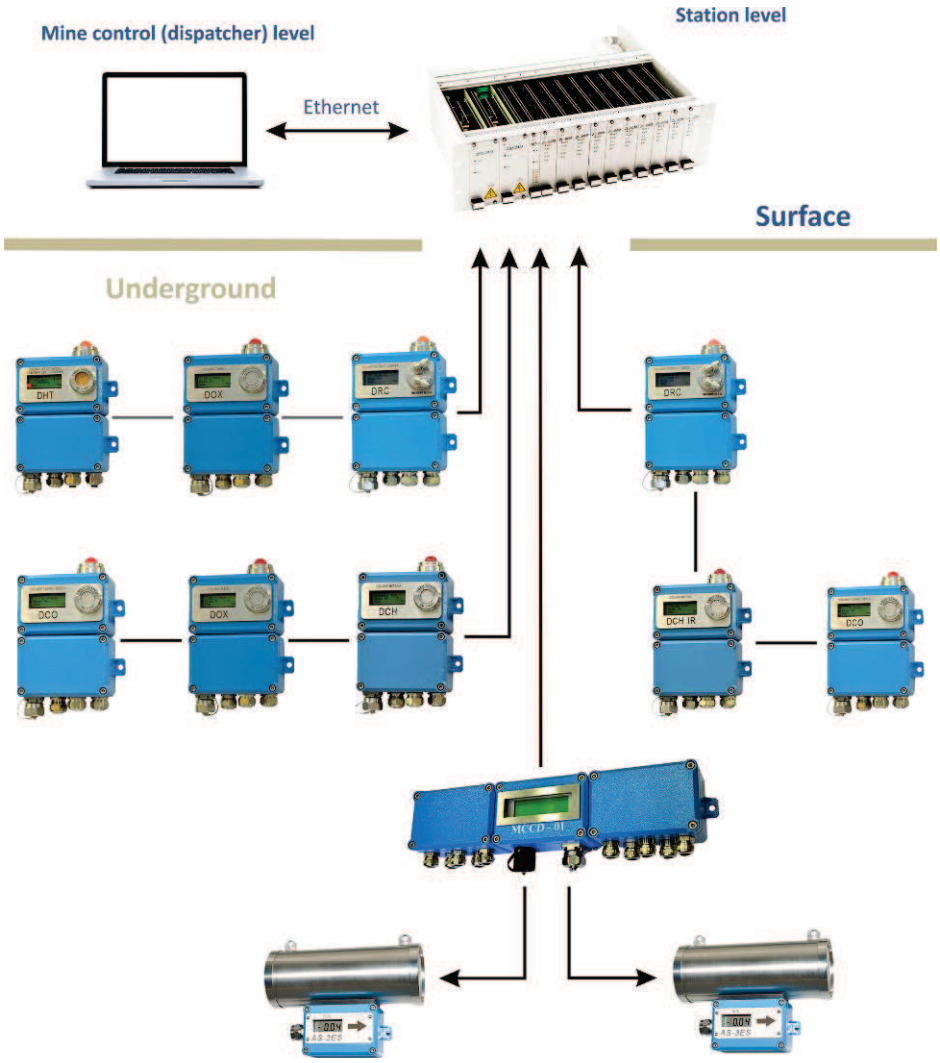

Fig. 2. Cooperation of Dxx sensors with the SMP-NT/A system

2.2. Mxx-series sensors

The Mxx series includes:
– MCO – dual-range carbon monoxide concentration sensor,
– MO2 – oxygen concentration sensor,
– MHT – air humidity and temperature sensor,
– MCH – methane concentration sensor.

These sensors provide great measurement precision in the range appropriate for the specific sensor types. The calibration, depending of the type and model, is performed with an integrated or included keyboard. After exceeding the threshold concentration, the sensors automatically cut off power and present the results on local displays.

The devices can be emergency-powered from intrinsically safe power supply units with battery backup.

2.3. Integrated goaf sensor ZCZ-MP

The ZCZ-MP sensor (fig. 3) is designed for ongoing measurement of carbon monoxide, oxygen, carbon dioxide and methane concentrations in gases sucked in from the goafs and transmission of the measurement data to the mine air control system.

Fig. 3. Integrated goaf sensor ZCZ-MP

The sensor is also designed to work with the SMP-NT/A system station devices (MZT-10/60M modules) providing power and data transmission through the power supply line.

2.4. Stationary anemometer AS-3ES

The AS-3ES stationary anemometer is designed for ongoing measurement of air velocity in mine galleries, tunnels and corridors and to notify on lack of airflow according to the set threshold. The device can be connected to an alphanumeric display to present the risks upon entering the controlled area. The AS-3ES anemometer is powered with a direct current from the methanometry stations type MCCD-01, CCD and underground VAL stations or from an intrinsically safe power supply unit. It generates output signal in a voltage standard.

The velocity measurement in the AS-3ES anemometer uses the ultrasound temporal method. All necessary functions related to the measurements, arithmetical operations and results presentation are performed by a microprocessor.

Other versions of the anemometer, compatible with the SMP-NT system as well as one with 4-20 mA outputs and RS485 interface are currently being designed.

Fig. 4. Stationary anemometer AS-3ES

2.5. Control and measurement equipment

The measurement of mine environment parameters would not be possible without the control and measurement devices. In this segment, the most notable products of EMAG-SERWIS are:

Miniature digital underground control station MCCD-01 – a control and measurement device acting as an interface between analog and binary sensors and the surface part of the SMP-NT/A system. It provides an ongoing reception and conversion of analog and binary signals to a digital one, transmits the converted data to the surface part of the system and receives configuration and control data from the surface. Based on the surface configuration and control data and the state of the analog and binary inputs, the device can generate control signals according to the algorithm or in co-operation with the surface part of the system.

Power and transmission module MZT 10/60M is designed to supply power and exchange data with the sensors located in the underground part of the mine. The module is equipped with ten linear power supply units, each capable of powering up to four underground sensors (depending on type). MZT 10/60M continuously monitors the currents and voltages of the power supply and the resistances of individual lines. In order to provide stable power supple, it is equipped with two independent network power supply units. It is also possible to power it from a DC source with the nominal voltage of 48 V. Two Ethernet interfaces with galvanic isolation allow the creation of a redundant network connecting the MZT module with the primary system computers. The MZT 10/60 M module can be installed in a standard 19" rack.

Calibration keyboard KB-1 intended for the calibration, setting the options and working modes of the Mxx and Dxx sensors as well as other devices manufactured by EMAG-SERWIS. It protects against making any changes to the settings by unauthorised persons. It is equipped with four function buttons and a CONSERWIS bus to connect to a device. The built-in microcontroller allows the recognition of the keyboard by the controlled device and using it to input calibration data and other necessary information. The keyboard is also equipped with LED diodes displaying the working mode, calibration phases or other states, depending on the type of device. The keyboard is powered from the controlled device.

Binary signals separator with input line diagnostics DSI (fig. 5) designed for operation in mine control systems and in other applications where the compatibility with devices in potentially explosive atmospheres is required. The device provides intrinsically safe galvanic insulation between controlling and controlled circuits and an ongoing control of the input lines parameters with the distinction of the following states: short circuit, break, closed contact, open contact. All operation states are displayed with LED diodes.

The DSI-01 separator is designed to be powered from the power supply and transmission line. Due to its low power consumption it can share one line with other devices, such as a methanometer, control station, etc. In order to do that, the devices must be connected in series.

The separator's inputs are compatible with intrinsically safe lines. The outputs can be connected both to intrinsically safe and non-safe circuits with the working voltage up to 230 VAC.

Fig. 5. Binary signals separator with input line diagnostics DSI

Besides the equipment presented above, the company manufactures or takes part in manufacturing many other technologically advanced products, not only for the mining industry.

3. EMAG-SERWIS INVESTMENTS AND THE NEW QUALITY OF PRODUCTS AND SERVICES

EMAG-SERWIS prefers balanced growth, research and development of new products on the one hand, and on the other – adjusting the existing process to current needs and the introduction of new processes (technological as well as organisational).

Recently, EMAG-SERWIS has put a lot of effort and resources to implement a number of investment processes to improve the quality and effectiveness of our products.

The first of such projects was the introduction of the ***traceability*** system to ensure better management of supply chain and production processes. As a result, every product and its origin can be monitored on all stages of the supply chain, the safety and integrity of products was also raised. The precise tracking of all product batches together with regular and rigorous inspection as well as entering the production data into a database allow constant verification of the history of an individual product and the prevention of further manufacturing in case a fault is discovered.

Other innovations, supporting the business processes at EMAG-SERWIS, are the introduction of the modern ABC/RCA cost accounting and the digital document circulation.

The establishment of the state-of-the-art SMT assembly line was an important step (raising SMT as-

sembly rate to 17100 CPH, improving assembly precision and allowing the use of components from 04 02) as well as the purchase of new CNC machining centres t resulting in better machining efficiency and capacity.

The introduction of these solutions result in the highest quality of our products, warranting its extremely reliable operation in difficult mining conditions (as corroborated by independent equipment testing after the accident in KWK "Halemba" mine).

4. SUMMARY

The deteriorating mining conditions in Polish hard coal mines require the use of state-of-the-art, reliable systems as well as measurement and control equipment which are custom-tailored for the conditions and the specific requirements of the customer.

One of the most important challenges, resulting from these growing risks, is ensuring the safety of the miners and machinery through the prevention and, if possible, elimination of mine environment hazards. The best way to prevent potential unwanted events is to appropriately monitor the mine air parameters, methane and carbon dioxide concentrations with the best possible measures.

The solutions offered by Emag-Serwis for gasometry, backed by the nearly 20 years of experience, original engineering and modern research and production facilities can significantly help mining companies to implement this task. Numerous implementations in Polish and foreign mines are the best proof of that.

The dynamic growth of our company helps us to offer products on the highest possible level of quality and technology and be a reliable supplier for our corporate partners.

The articles uses PPHU EMAG-SERWIS Sp. z o.o. products documentation and informational materials.