RESEARCH AND CONTRIBUTIONS REGARDING THE OPERATION OF A STATIONARY MONITORING SYSTEM FOR GAS LEAKS AND EMISSIONS IN TERMS OF COALFIELD AND POWERPLANT AREAS

Silviu Marin Nan *Phd Professor*, **Adrian Bogdan Șimon** *Ph.d Student*

ABSTRACT: *This work presents the modern trends in the operating environment and design of the monitoring systems and data acquisition, in the underground sites of coalfield with potentially explosive atmospheres and powerplants with large quantities of emissions. The advantages of these systems allows them to be successfully implemented in vast areas such as chemical industry, extractive and oil industries, where it is very important to strictly control the concentration of gas and emissions in the atmosphere so as to prevent the risk of explosion.*

KEY WORDS: Monitoring systems, gas leaks, emissions, methane, mining

1. INTRODUCTION

The application of technology so as to improve all aspects of the mining field is particularly present in communications and monitoring systems as well as in automation and robotics. It is important to emphasize the fact that the decisions taken for the application of these technologies are based on certain expectations which can be implemented, such as better safety at work and reduced costs. The mining monitoring systems can provide up to date quality information; these can be used to improve the decision-making process and the pursued benefits can be achieved. Similarly, the communication systems in the mining sector that have been correctly elaborated facilitates the information flow in all levels of the organization. However, the achievement of the pursued goals will be completed only when the technical characteristics of the selected systems will be able to cover the necessary information for a mine. On too many times, the informational needs of a mine are not carefully analyzed before the purchasing and installing a system, and once installed, the errors that may later occur will be corrected with difficulty. Thus, it is highly important that these issues be analyzed thoroughly.

The design and manufacture of the monitoring systems in the mines are in fact activities of the company who design them and not activities of the mining companies. However, a few mining companies were involved in making these circuit board systems but it is not necessary or desirable that the personnel of the mines get involved in these kind of details. If however it is desirable that the monitoring system be perfectly implemented, it is highly important that the mines personnel accurately specify the system requirements of those who manufacture and market them. In this regard it is useful to understand the composition and basic functions which make up a monitoring system and how the performance of the system will be affected by its special features.

The personnel is aware that a general monitoring of underground mine atmosphere is needed. Therefore, the types of measurements have rapidly evolved. These are the most frequently encountered:

a.) methane (range of 0 to 5% CH_4) in follow-up, dimensions;

b.) methane (range 0 to 100% CH_4) in the collecting pipes , degassing;

c.) air ventilation speed(in the range from 0.3 to 24 m/s) ;

d.) oxygen deficit (in the range from 5 to 25% O_2) in the detection of CO_2;

e.) carbon monoxide (in the range from 0 to 100 ppm) ;

f.) different pressure of the fans or galleries from one level to another.

2.THE CURRENT STAGE OF THE CONTINUOUS MONITORING SYSTEMS PRESENT IN THE COAL MINES OF THE JIU VALLEY BASIN

The telemetry station, used all throughout the mining activity, is an automated facility which allows the use and monitoring of the information received from up to 40 receptors placed at a certain distance for general function; a maximum of 10 km from the station case.

From a constructive point of view the main equipment of a telemetry station consists of:

a.) Surface equipment

a1.) A main case which is the „brain" of the installation. It is placed outside the danger zone being

the source power for the general functioning of the facility;
a2.) A cubicle with barriers of fuses, whose role is to ensure the protection of intrinsic circuits installed in potentially explosive environment.
b.) Underground equipment
b1.) A network of tele-measuring cables with bifilar lines made up of even numbers, equal to the number of the measuring points in use;
b2.) Measuring receptors of the station which is fitted in the monitored rooms.

The telemetry station is built around a microprocessor which performs the cyclic scan of the receptors by static switch. This microprocessor manages the alarms and recordings. Choosing the input tasks, the alarm levels, the manual or automatic function, the measuring types are all made by using the keyboard.
The outputs, the measurements display or different messages are made on an alphanumeric liquid crystal display. Transmission of the data from sensors for the control of the underground environment, shall be made in an environment with interference. The use of a CODE type tele-transmission system spares the system of the problems related to the environment. The CODE type encoder is an electronic system, connected on one hand to the receptors ,and on the other hand to the tele-measuring system.

3. MODERN TRENDS IN THE CONSTRUCTION AND DESIGN OF THE TELEMETRIC SYSTEMS IN THE COALFIELD MINES

The acquisition, measurement and control system with 64 Sam-64 type sensors is destined for full and concomitant use for: continuous and automatic measurement of the environmental parameters (the concentration of explosive or toxic gases); simultaneous recording from afar of toxic or explosive gas concentrations; control of environment parameters; advanced system for environment management; optical and acoustic pre-alarm and alarm thresholds when the pre-adjusted gas concentrations are exceeded.

a.) The central unit. It is the main component of the measuring, acquisition and control system. This component takes the data from the slides of acquisition-sampling and alarms, processes it, displays them in values or graphical form and depending on the results it issues commands to the slides and to the computerized recorder. Through this industrial computer one can benefit from the following: security service, measuring service, system configuration service.

b.) The computerized recorder is a computing and data storage system based on an Intel processor which takes the data from the central unit in order to store the information over a longer period of time and also displays the diagrams of the measuring points on the monitor placed on the upper side of the case.

Fig. 1. Control unit

Fig. 1.1 Control unit different construction

Fig. 2. Computerized industrial recorder

c.) Acquisition-sampling trays; with 16 communication channels, these trays receive the information as frequency sent by gas sensors (up to 16 sensors per slide), they turn this information into digital signals and are sent to the unit through the RS 232 DB9 interface. The trays are supplied with a voltage of 220 VAC, a self-contained supply, the 37 VCC voltage necessary for the sensor lines being generated by the same trays. The part of the tray that is connected to the gas sensors and to the alarms tray is galvanically isolated from the part of the tray that connects to the main control unit.

Fig. 3. Acquisition-sampling tray front panel

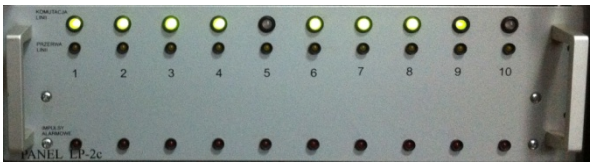

Fig. 3.1 Different acquisition-alarm tray front panel

One can read the information sent by sensors with the help of a command done by the central computing unit and in this way it can query all the sensors connected to the slide in question, or just a specific sensor. Both the time period allocated for reading the sensors information and the moment when the reading began, after stopping the 37 VCC voltage, can be set via software programs of central unit of account. In order to allow the software configuration, each card has a 16-bit stored serial number. This serial number appears on each slide as a label and must be used within the command software when accessing a specific slide.

d.) The alarm trays; these are designed to work in tandem with the aquire trays by generating alarm signals on the connection lines of gas sensors located in a dangerous area with the following specifications: the grounding of the line is carried out through a resistor for the following period of time of 0,1 ms, at a 20 -30 ms interval. Each point of the alarm tray has two control relays: one operated at the time of receipt of the pre-alarm control, and the second on receipt of the alarm control. Each relay is able to switch 3 A to 220 VAC. Alarm drawers are connected to the central unit of account via the RS 232 interface.

The lighting of the LED indicates the active status of their appropriate channels, for pre-alarm or fault. The alarm on a channel can be stopped by pressing the reset button for the respective channel. To stop the alarms on all channels of the slide use the general reset button. These resets are allowed only if the central unit of account had previously accepted this command. To allow a configuration using the programs of the central unit of account, each slide will be identified by a 2 bytes stored serial number. This number appears on each tray in the form of a label, and is used by the software in order to be able to access the trays. The alarm trays are linked together in series via RS 232- DB9 connectors, and a serial port links them to the central unit of account. The serial communication between the central unit of account and the alarm tray shall be carried out on working instructions, and the numbering of the sensors is made from 1 to 16.
The trays are interchangeable and configured through software, depending on the circumstances in case of danger.

4. SPECIALIZED SOFTWARE DEVELOPMENT IN TELEMETRY SYSTEM FOR GAS LEAKS AND EMISSIONS

The panel of the measure unit is made up of an LCD touch screen and a membrane-type keyboard. On the screen of the monitoring system is a highly intuitive graphical user interface that allows the user to easily select the functions available to the competent authorities. The monitoring program for the telemetry measurement system, has the following functions:

a.) The query for the maximum number of sensors located in the area with a risk of explosion;
b.) The storage of the primary data for the area with a risk of explosion;
c.) The processing and interpretation of primary data on a mathematical model;
d.) Reporting the interpreted values on a mathematical model in daily generated reports with 1 hour or 24 hours average.

In the main monitoring diagram we can see the main area where detailed data are displayed for a measuring point and specific information for data management, the area for displaying the measurement channels and the menus area.

Fig. 5. User Interface

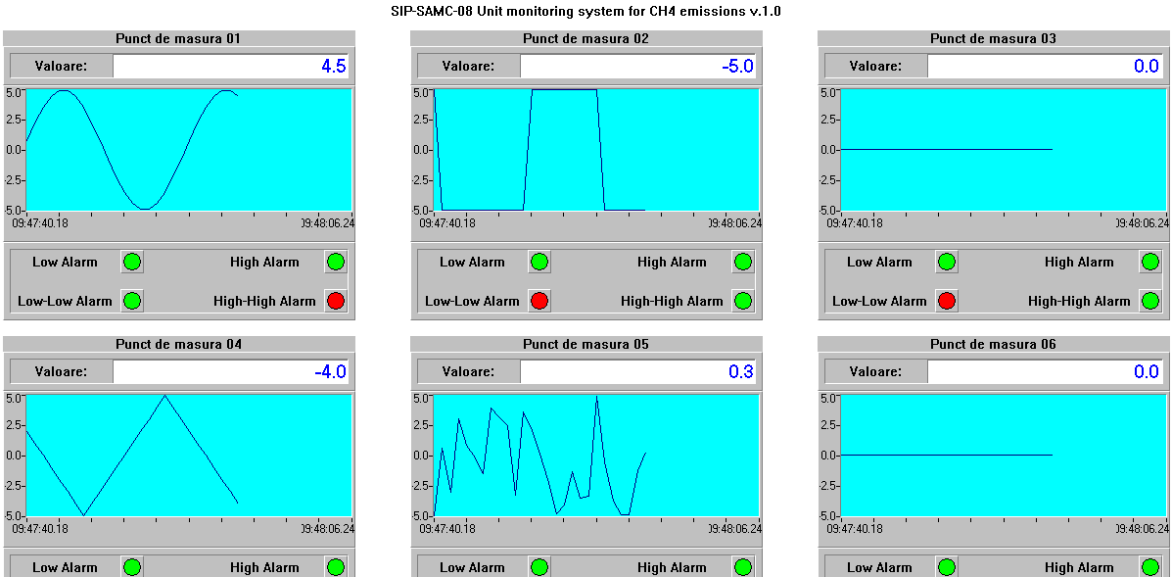

Fig. 5.1 Methane basic diagram for monitoring system

The graphic interface enables you to access the management of the measurement channels, of the measuring points and configuration of the alarms. In the programming module of the alarms array is displayed the list of alarms assigned to a channel.

Fig. 6. Active Underground communications.

Here we can add, change, and delete items in the alarms array. For a measurement channel we can assign more alarms. We can also asign more channels for an alarm. In the main menu of the interface, there is the telephone function, which allows you to activate your phone on a specific point of measurement and the establishment of a communication link with the underground mining area where the telemetry system is located.

5. CONCLUSIONS

Mining monitoring systems and communications provide employees with access to information in real-time. There are a lot of quality products used to ensure the requirements of the mining industry regarding monitoring systems and verbal communications. Because of the existing types of sensors, and adding a little imagination, it is possible to monitor almost anything. However, because of high costs and technical options, it is important that the engineer understands the technology used and has the ability to clearly state what are the mine's needs. Only then will the benefits of this technology be noticed.

The function of recorders does not affect in any way the function of the telemetry station, they fulfill the functions of the former recorder and complement it with new facilities provided by the software. The recorded data base is kept on HDDs and can be accessed from several menus. However, their comparison requires an analysis made by software specialists to confirm that they are properly archived. The telemetry station with recorders eliminates faults that appeared in the mechanical area(balancing engine, transducer, dynamic switching elements, advance system diagram).

Fig. 7. Telemetric System SAMC-64

The recorders have all they need for the use of a computing system: high precision, easy interpretation of the data, elimination of recording errors, data storage at all times, access to data from multiple users.

6. REFERENCES

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