STUDY ON MONITORING THE TEMPERATURE IN LIGNIT DEPOSITS OF THE THERMOELECTRIC POWER PLANTS

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Abstract: The paper presents a case study on temperature monitoring in coal deposits from the lignite mining of the Oltenia Energy Complex (CE Oltenia). The purpose of temperature monitoring is to avoid the occurrence of coal self-ignition. A thermal imaging chamber was used to perform the experimental measurements. A Squirrel SQ Data Logger temperature measurement and recording system was used.

Key words: Thermovision, ANSYS software, mathematical modeling, meteorological parameters.

1. INTRODUCTION

The operation of the thermoelectric power plants from the Oltenia Energy Complex is carried out with lignite from the surface of lignite exploitations. In Gorj county operates the largest coal fired power stations in Romania: power plants Rovinari and Turceni. The Rovinari thermal power plant has an installed capacity of 1320 MW and the Turceni thermal power plant has an installed capacity of 1980 MW. The two plants are equipped with 330 MW energy groups. Energy groups consist of steam boilers with a flow rate of 1035 t / h. Boilers work with lignite dust. At the Rovinari thermoelectric plant, the lignite reaches the center directly from the quarries, using conveyor belts. At the Turceni thermal power station, the lignite is transported by railway wagons. Both coal deposits in the thermoelectric power stations and coal deposits in surface pits have the potential to cause self-ignition of coal. For this reason permanent temperature monitoring is required in coal deposits.

For the study, the situation of a coal deposit in the Jilţ quarry of the CE Oltenia was analyzed. Many thermocouples have been installed on the surface of the lignite deposit to measure the temperature at different depths. Temperature recording at various points of the deposit was carried out over a period of 36 days. A **Squirrel SQ Data Logger** temperature measurement and recording system was used.

An automatic weather station was used to monitor the meteorological parameters. Figure 1 shows the Squirrel SQ Data Logger. Figure 2 shows the FLIR A655SC infrared thermal imaging camera. Figure 3 shows the Data Logger configuration. Figure 4 shows the studied coal deposit. Figure 5 shows the change in temperature over time in the coal deposit. Figure 6 shows the distribution of storage temperature on day 36.

Figure1 Squirrel **SQ** Data Logger System

Figure 2 Infrared camera, FLIR A655SC

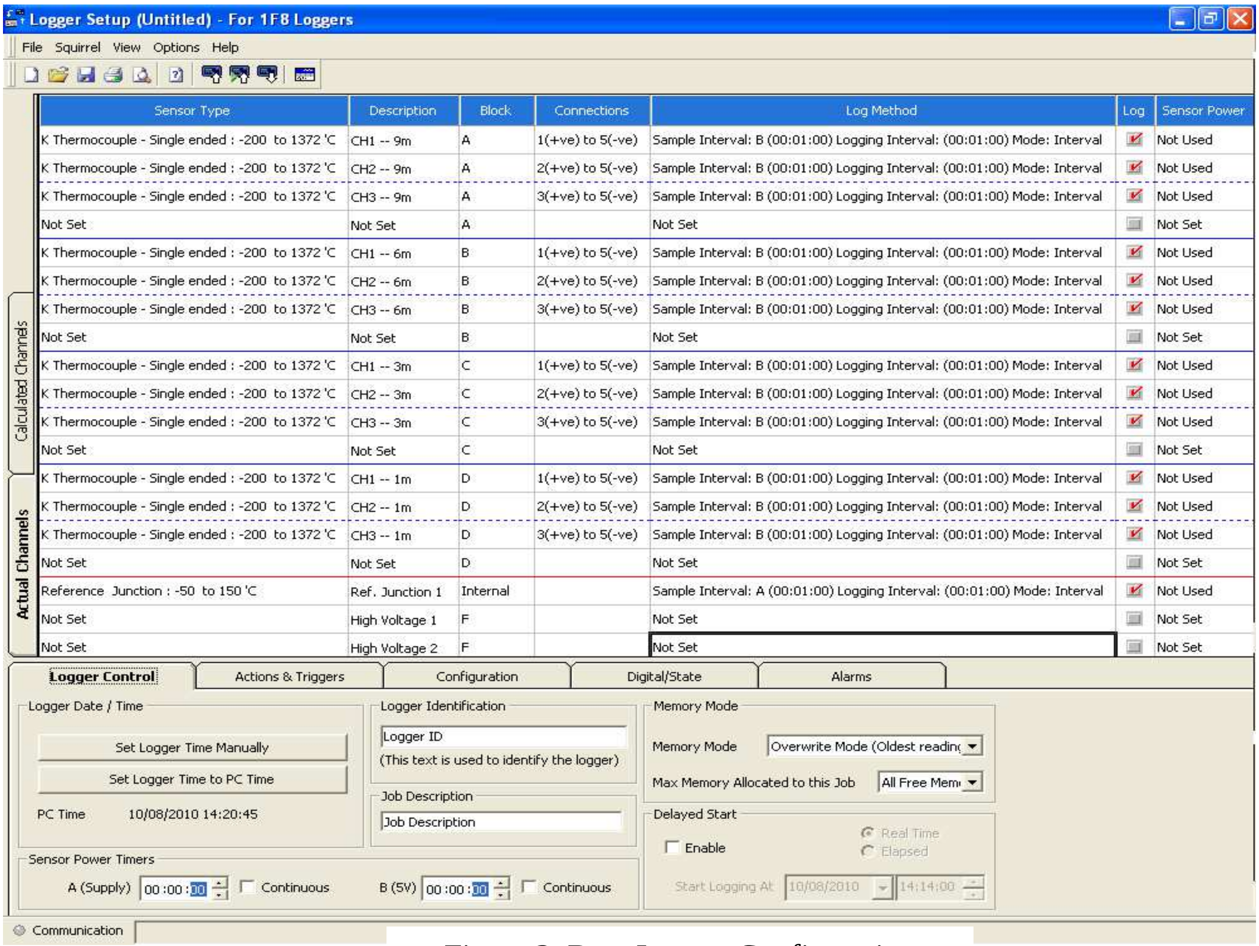

Figure 3. Data Logger Configuration

Specifications of FLIR A655sc Infrared Cameras

IR / image detector characteristics

Field of vision (FOV): 25º x 18.8º
Infrared detector resolution: 640 x 480 pixels
Thermal sensitivity (NETD): < 0.05ºC
Sensor type: FPA microbolometer without cooling
Spectrum: 7.5 ... 13µm standard
Temperature range: -40 ... + 650ºC
Accuracy: ± 2ºC or ± 2% of reading
Video Streaming Ethernet: 16bit 640x480 pixels **200Hz radiometer**, GenICam, GigE Vision
Video streaming USB: 16bit 640 x 480 pixels 200Hz radiometric

Digital input/output

2 digital inputs: general purpose, optoisolated 10-30Vcc
2 digital outputs: general use, optoisolated 10 - 30Vcc max 100mA
Digital output: alarm or output to other equipment (programmable)
Insulation voltage I / O: 500Vrms
I / O connector: 6 contacts

General characteristics

Optical focus: autofocus / motorized
Control and image interface: Ethernet (RJ45)
Ethernet communication protocol: TCP, UDP, SNTP, FTP, SMTP, etc.
Ethernet Standard: IEEE 802.3
Power supply: 12 - 24Vcc (24W)
Weight / Dimensions: 0.9kg / 216 x 73 x 75mm
Ambient temperature: Operation -15 ... + 50ºC / Storage -40ºC ... + 70ºC
Humidity (operating and functioning): IEC 60068-2-30 / 24h 95% RH
Protection degree: IP40 (IEC 60529)
Shock resistance: 25 g (IEC 60068-2-29)
Vibration resistance: 2 g (IEC 60068-2-6)
Clamping system: 2 x M4 on three sides of the camera and tripod support

2. EXPERIMENTAL RESULTS

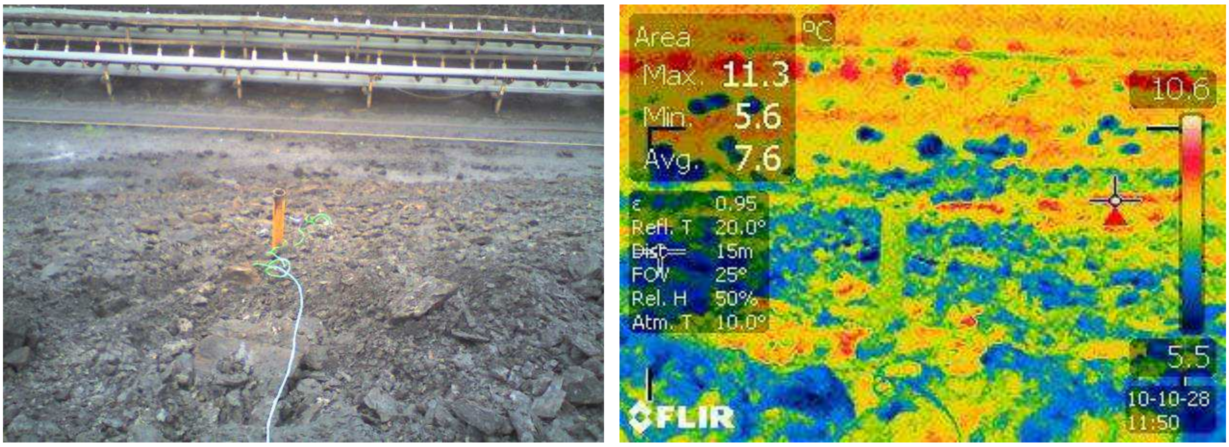

Figure 4 Coal deposit

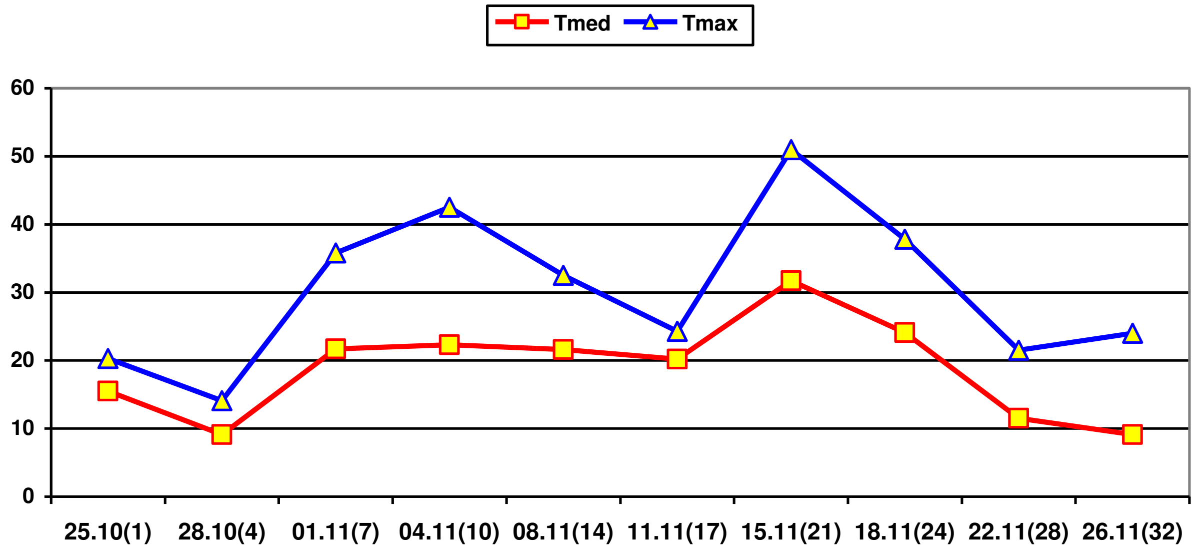

Figure 5 Temperature variation over time in the coal deposit

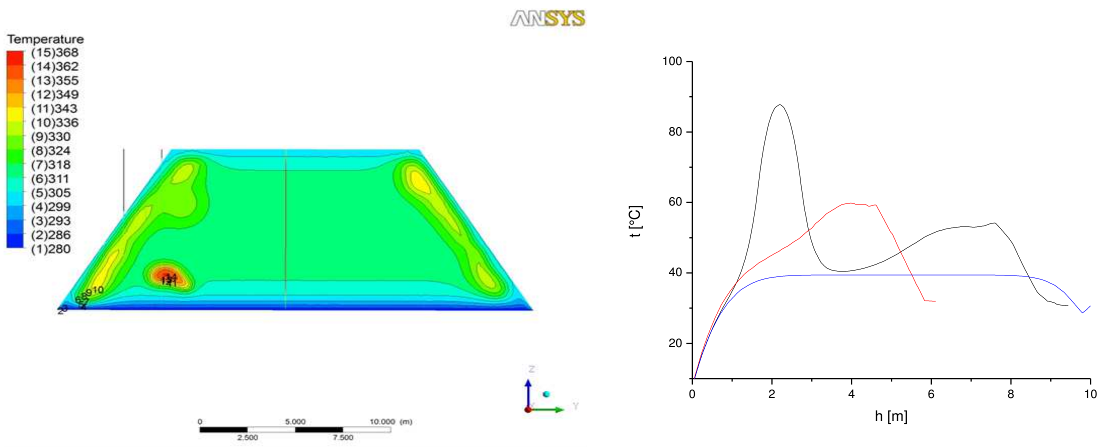

Figure 6 Temperature distribution in the coal deposit on day 36

3. CONCLUSION

The temperature on the outer parts of the coal deposit depends on the temperature of the environment and on the heat exchange between the coal in the deposit and the environment.

From the analysis of the thermographic images it results that the temperature in the deposit in the vertical direction has higher values.

The monitoring of the coal deposit with the thermal imaging camera can provide information on the temperature level in the deposit and may indicate the areas where carbonization may occur.

The temperature on the surface of the deposit is influenced by the environment and by the deposit temperature.

Increasing the temperature inside the deposit takes place at high depths where the influence of the environment parameters on temperature is almost non-existent.

As a result of mathematical modeling, it was observed that the smaller and homogeneous particles deposit has a lower heating compared to the actual deposit.

For deposits with storage periods longer than 30 days, it is recommended to monitor the temperature of the coals in the storage using fixed thermal imaging cameras and temperature probes.

To avoid the phenomenon of self-ignition of stored coal, it is recommended for the height of stacks of:

- 8,0 m for small-scale coal,
- 6,0 m for large compressed grain coal,
- 4,0 m for briquettes,
- 4,5 m for uncompacted inferior coal.

At the time of the coal stacks formation, the temperature of the coal should not be higher than 35 ° C.

In order to prevent the phenomenon of self-ignition, coal deposits shall be kept under constant observation. By daily observation of coal deposits, it will be possible to identify areas in the stack deposit, which have a more pronounced tendency to self-ignite.

In case of small-scale fire, it is recommended to isolate and to remove the outbreaks and coal will be delivered immediately after a preliminary cooling by spreading them in a layer about 30 cm thick.

In order to stop larger fires, the operations of extinguishing fires can be done either by flooding them with suspended clay (5% ÷ 7% clay solution) or by exhausting self-ignition coal on the platform for cooling by ventilation and immediate delivery to the beneficiaries.

In order to extinguish fires in large coal stacks, only chemical solutions based on sulfur dioxide and carbon dioxide are used. Will be marked with visible signposts.

During the action of extinguish the outbreaks inside the coal deposits, it will be taken into account that by burning the coals considerable amounts of carbon dioxide and sulfur dioxide are released, which are toxic (harmful) gases that affect the working personnel on the isolation and extinction of fires.

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