Part 3

ASH AND SLAG HANDLING

3.2. Ash and slag handling systems at TPPs

3.2.2. Ash removal

3.2.2.4. Radar systems to control the discrete filling levels in technological tanks and hoppers

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ABSTRACT

Advantages of radio wave (radar) signaling devices in comparison with other known instruments for measuring discrete filling levels in technological tanks are presented. An example of realization of radar signal indicator for controlling the level of ash in ESP hoppers at coal-fired TPPs is described. The basic technical characteristics of the developed signal indicators are given. There is information on successful test of the created trial system at Ryazanskaya SDPP and introduction of signaling devices at Oskolskiy metallurgical industrial complex.

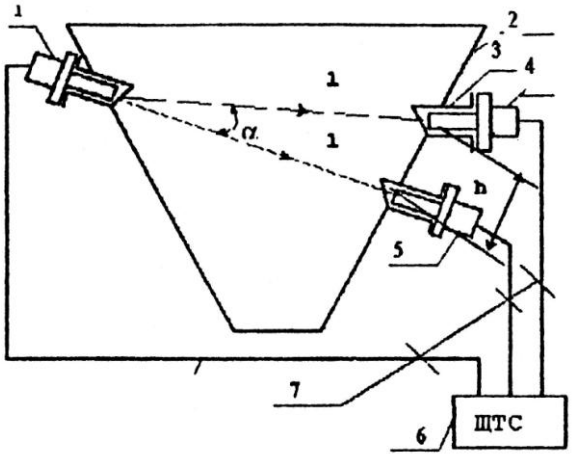
In a number of industrial processes and procedures application of signaling devices – systems for controlling one or several set filling levels in technological tanks or hoppers of the various form is required. As follows from the set technical requirements for systems of monitoring the level in technological tanks of power plants [1], the best one, in comparison with such well-known monitoring methods as capacitance, manometrical, optical, radiating, gravitational, etc., is, from our point of view, a radar method. It is rather simple in implementation and refers to ecologically sound systems of nondestructive control. In essence, this method comes to the level fixing, where breaking of the given out radio signal from the radiator to the intake happens. Absence of the signal in the receiver testifies that the tank filling level exceeds a setting level of the receiver.

As examples of implementation of the offered method a block diagram of the level signal system in ESP hoppers (option "A") and intermediate hoppers (option "B") at the coal-fired TPPs is shown. In the mentioned schemes radar signal devices are a part of the monitoring system of filling the ash in hoppers.

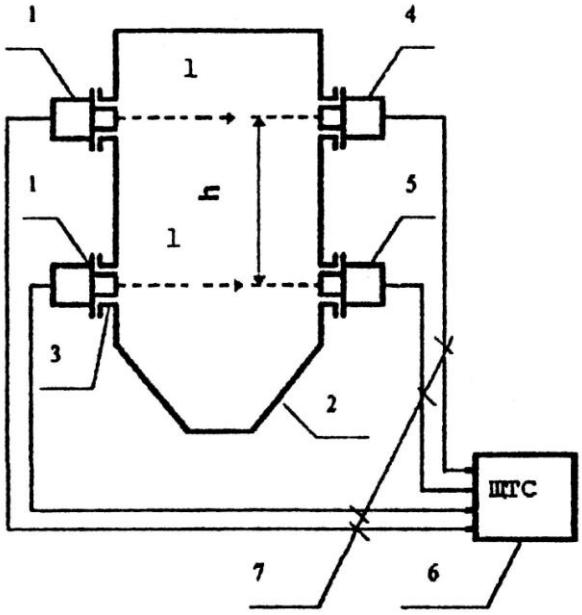
In the created system for ESPs [2] on the wall of controllable hoppers aerials of two reception modules (4 and 5) are placed, and on the opposite wall – an aerial of the radiating module (1) is set. Aerials can be placed, in particular, on the walls parallel to the gas flow, as in the implemented example. Reception modules are set at the required control levels, and radiating modules — above the top level receiver. Cases of the modules have a similar design.

A front side of the case in the form of an apron is welded to the inclined hopper wall, and other parts of modules are put together separately and fixed on the external flange of the apron as a uniform device. The aerials, placed axially in the corresponding steel glass, are protected from direct ash contact by fluoroplastic window. Axes of the cases and, accordingly, aerials of reception modules are focused on the radiator window, and its aerial – approximately on the centre between windows of receivers. The electronic part of modules is mounted on the corresponding boards in the least warm part of the case removed from the hopper. Signal indicators and execution mechanisms are connected to an output of reception modules according to specific requirements of technological process. A light signal testifies about filling the hopper at the set bottom level, and a sound signal – about its filling at the top, emergency level.

Option “A”



Option ”B”



Block-diagram of the level signal system in ESP hoppers or intermediate ash/slag hoppers:
1 – radiator; 2 – hopper; 3– landing joint; 4 - – top level receiver; 5 – bottom level receiver; 6 – process signaling panel; 7–cable; h=($h_{max.}$ – $h_{min.}$) – control level difference.

In the system developed for intermediate hoppers (option

"B") two couples "radiator – receiver" are applied, placed on the set top and bottom control levels.

The basic technical characteristics of the developed signaling devices are the following:

- maximum diameter of controllable tanks - 10 m;
- maximum temperature in the tank - 160°C;
- maximum radiator capacity - 30 mW;
- working temperature range – from -10°C to +70°C;
- maximum distance between the tank and a control panel – 150 m;
- restrictions on application of rules for technical operation and safety code are absent.

In signaling devices materials of the RF certificate on useful model [3] are used.

After MPEI employees developed the mentioned signaling devices, the trial system (TS) for controlling the level of ash in ESP hoppers (option "B") of the boiler of power unit №4 at Ryazanskaya SDPP according to the task EKO 084 of a plan on the basic R&D and works on the new technics of the Open JSC "UES of Russia", was developed and created in 1994-96. TS was put into constant operation on May 30, 1996. In July, 1998 investigation of TS was conducted. As a result it has been established that the system was efficient, and separate notes were connected with drawbacks of its operation by the personnel of Ryazanskaya SDPP and formation of steady deposits of rather thick ash on walls of ESP hoppers. This problem occurred after the transfer of Ryazanskaya SDPP to combustion of a mix of Kansko-Achinsky and Podmoskovny coals. The works on creation of systems for monitoring the ash in ESP hoppers at the Russian TPPs haven't received their further development.

The system of radio wave level control, similar to the described before, but with the reference to the specific hopper design, has been approved at peat-fired Rizhskaya TPP-1 (Latvia). Its radiating module was placed in the special rotary holder on the top cover of the hopper. That provided identification of aerials directions of the radiating and reception module. Works on system optimization, including a choice of the working frequency for signaling devices, was stopped in connection with transition of the power plant to gas combustion.

Single-level radio wave was created and is under operation at Oskolsky metallurgical industrial complex. It replaces the regular monitoring system of the level of intermediate hopper filling on the basis of piezoelectric gages. Specificity of the system is a clock operating mode with the adjustable period of the hopper discharge – about 1 minute.

REFERENCES

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