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Problems in the Operation of Boilers and How to Avoid Them

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High rates of industrial production and social progress require a sharp increase in heat generation on the basis of strong development of the fuel and energy complex of the country.

Centralized heat supply systems from thermal power plants (TPS) are the most effective ones. Currently, centralized heat supply of large cities is carried out on the basis of powerful nuclear heat supply stations.

Coal, peat, shale, wood waste, gas and fuel oil are used as fuel for boiler plants. Gas and fuel oil are efficient sources of heat energy.

Boiler houses play an important role in the heat supply of large cities, district centers, and villages. The boiler plant is a complex of devices located in special rooms and used to convert chemical energy of fuel into thermal energy of steam or hot water [1].

The most common causes of boiler accidents are: fuel explosion, water level drop, water treatment deficiencies, boiler water contamination, violation of purge technology, non-compliance with heating regulations, mechanical damage to pipes, excessive forcing, storage in inappropriate conditions, lowering the pressure to a vacuum.

Taking into account the facts described above, we can formulate a purpose of the work-analysis of existing problems in the operation of boiler plants and ways to eliminate them.

An explosion in the furnace is one of the most dangerous situations when operating boilers. The cause of most explosions is "fuel saturation" of the fuel mixture or insufficient cleaning of the furnace. Oversaturation of the fuel mixture occurs when unburned fuel accumulates in the furnace.

This can be avoided by observing the following simple rule: never inject fuel into a dark, gassed firebox.

At temperatures above 427 °C, the structure of carbon steel changes - it loses its strength. Since the operating temperature of the furnace exceeds 982 °C, cooling the boiler with water in its pipes is the factor that prevents an accident. To reduce the likelihood of accidents for this reason, it is necessary to switch off when the water level is reduced. For this, direct-acting or float-type water level sensors can be used.

The build-up of scale in the pipes can lead to damage due to overheating. To prevent scale formation, the content of hardness salts in the boiler water must be within acceptable limits [2].

Deviation from the heating rules is one of the strongest tests that a steam boiler is subjected to. During start-up and shutdown procedures, all equipment experiences severe loads, therefore, more stringent adherence to operating rules is required here than with continuous operation in the calculated mode. Correct regulations and phased completion of start-up operations contribute to prolonging the life of the equipment and reduce the likelihood of an accident.

The operation of boilers at modes above the maximum permissible continuous load (MCR) has long been the subject of debate. Typically, designing auxiliary systems “with a margin” allows the boiler to be operated at peak loads of more than 110% MCR [3].

The occurrence of problems associated with overheating of the boiler, significantly depends on the type of fuel used.

Designers of boilers scrupulously calculate the heat fluxes on the furnace screens, partitions, determine the temperature of the walls of pipes, lining and other surfaces. Overheating of the furnace leads to an increase in heat fluxes and the temperature of the lining.

The design of the boilers is designed to work under excessive pressure, but does not provide for the possibility of vacuum (pressure drop below atmospheric). A vacuum can occur when the boiler stops. As the boiler cools, steam condensation occurs and the water level decreases, which leads to a decrease in pressure, possibly below atmospheric pressure. Vacuum in the boiler leads to leaks through flared ends of pipes, as they are designed to seal with excess pressure. This problem can be avoided by opening the ventilation hole in the steam drum while there is still excess pressure.

Here are some practical recommendations to avoid problems when operating boilers:

- More often look at the flame in order to notice burning problems in a timely manner.

- Determine the cause of the extinction of the burner before attempting multiple reignition attempts.

- Thoroughly clean the firebox before igniting the burners.

- Check the operation of the water treatment equipment, make sure that the water quality complies with the standards for a given temperature and pressure. While the absolute criterion is zero water hardness, it is necessary to comply with the standards for the operating parameters of the boiler. Never use untreated water.

- Never stop the circulation of water.

- Regularly check the internal surfaces of the deaerator for corrosion.

- The standard schedule for heating the boiler provides for ordinary boilers to increase the water temperature by no more than 55 °C per hour.

- Make sure that the boiler personnel understand the danger of mechanical damage to thin-walled pipes. - If the production need forces to force boilers, regularly evaluate the potential impact of the overload and bring it to the attention of the management.

- When the boiler is switched off for a long time, keep it warm. - Ensure the opening of the ventilation hole in the steam drum when the pressure drops below 136 kPa [4].

Each boiler room user should understand that he deals with a very complex system that needs maximum attention and concentration. It is necessary to carry out the above actions in order for the boiler equipment to serve its owners for a specified period.

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