ULTRASONIC METHOD OF SCALING PREVENTION

During operation of heat-exchanger, there appear carbonate scale causing significant increase in fuel consumption and maintenance expenditures as well as a decrease in efficiency and overhaul terms.

Cleaning of heat-exchanger is usually done mechanically or with the use of chemicals (e.g. acids). Both ways are time-consuming and may cause damage to the heating surfaces. Moreover, during overhaul intervals the scale reappears bringing about waste of fuel and new maintenance spending.

In recent years, along with the chemical method of incrustation prevention reagentless methods and in particular the ultrasonic one becomes more and more widespread.

The ultrasonic anti-scaling method provides in-boiler preparation of water. It is based on the use of a special unit that excites ultrasonic vibrations in water filling heat exchanger. These vibrations produce a great number of cavitation bubbles in the depth of water. The bubbles act as nuclei of crystallization around which carbonates causing hardness of water begin to precipitate forming finely divided sludge. Vibrations of heating surfaces prevent deposition of the sludge on the pipe walls. Thus particles of insoluble salts do not reach the walls of equipment remaining in a suspended state and can be easily removed by the flow of water or air blowing.

Moreover, ultrasonic vibrations conduce to destruction of the existing scale. Acting on the heating surface, they produce alternating forces that reduce the strength of bonds in the carbonate scale and those between the scale and the metal thereby causing the appearance of cracks. Due to capillary pressure water penetrates through the cracks to the heating surface where it instantly evaporates causing the scale to fall off. Small particles and flakes of peeled scale concentrate in the bottom part of the heat exchanger and can be removed with periodic blowing.

The action of ultrasound is not limited only to preventing carbonate incrustation and maintaining a high efficiency of heat transfer equipment. Ultrasonic vibrations also enhance heat transmission from the heating surface due to better circulation of water at the pipe walls and its higher speed because of lower hydrodynamic resistance of pipes with oscillating walls. Improved circulation at the interface of the two mediums, metal and water, results in faster removal of vapor and gas bubbles from the heating surface and consequently, a more effective heat transfer.

The phenomenon of hydrodynamic resistance reduction is especially noticeable in micron cracks that constitute natural defects on the internal surface of pipes. Such cracks normally (without

ultrasonic) contain some atmospheric oxygen that is easily extruded under the influence of ultrasonic vibrations. As a result, one of the causes of pipe metal corrosion is excluded. Long exposure of the internal surface of pipes to ultrasonic pulses causes the most compliant areas around the cracks to deform. These deformations bring about partial closing of the cracks and cold-hardening of their peripheries thereby reducing absorption of oxygen when the water is drained from the pipes. The internal surface of pipes becomes smooth and its overall area shrinks, minimizing probability of corrosion. This produces an effect of rust protection which to some extent replaces passivation of the pipe surface.

The above-mentioned factors are interrelated and their combination is cause for positive influence of ultrasound over processes of carbonate incrustation and pipe metal corrosion as well as efficiency of heat exchanger.

Use of the ultrasonic method eliminates pollution of environment with harmful sewage of water treatment installations. Besides, the specific cost (per 1 m^3) of water preparation this way is about 200~250 times smaller than that of the chemical method.

Capital investment associated with buying, mounting and adjustment of the USP pay for itself within several month of their operation.