MULTIWAVE LIDAR MEASURMENTS OF INDUSTRIAL AEROSOL EMISSIONS' CALCULATING AND MASS CONCENTRATION

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General atmosphere pollution increase and associated with it global changes of noosphere, energy balance in the Atmosphere-Earth system in peculiar, proved the actuality of applied fundamental research of chemical and physical properties and the structure of atmospheric aerosols and quantitative assessment of their role in the above mentioned processes. The aim of the research is the development of a method of estimation of different industrial enterprises' contribution to general pollution of the atmosphere over the territory of a large urban settlement. Meeting the goal objective was carried out on the basis of triple-wave (λ = 1064, 532 and 355 nm; laser radiation pulse duration on the 0,5 level is $\tau \leq$ 15-17 ns.; angular spread of laser ray in the 0,5 level doesn't exceed $\theta \leq 2$ ang. min) and polarizing laser sounding of visually observable aerosol plume at different distances from the mouth of the corresponding tubes which were from 50 to 100 m tall [1]. Lidar measurements were carried out in Belgorod in 2004-2006 years in the location unit of a range of enterprises connected with concrete production. The lidar was located at a distance not less than 2 km from the enterprises. The quantitative assessments of aerosol masses' integral parameters (volume density V [мсм^3/см^3], typical radius of the particle r_{32} [мсм] and specific surface area S [мкм^2/см^3]) were carried out by means of solving an inverse problem of aerosol optics on the data about the size of measured visual thickness of these masses for dry and damp dust condition (refraction index of n=1,55 – 0.005i, n=1,41 – 0.002i accordingly). The analysis of the results of the triple-wave subflow sounding of the aerosol (under the lower edge of the visually observable flow) shows that the typical particles' size r_{32} assessment varies from 0,6 to 1,3 mcm. It is in an adequate agreement with the results of the carried out direct microscopic measurements of the typical sizes of the particles of dust in the selected from the last aerosol filter test samples [1]. The estimation of trickling aerosol percentage in the industrial emissions was carried out by means of additional use of polarizing sounding indication for the three typical cases: clean atmosphere, visually observable aerosol flow coming out of the tube mouth and aerosol "mark" under the flow. The back scatter indications $P_{\parallel}$ (with the polarization parallel to the origin one) and $P_{\perp}$ (with the polarization orthogonal to the origin one) in relative units and also the magnitude of the depolarization degree indication of back scattering $d = P_{\perp} / P_{\parallel}$ were subject to the analysis. It was experimentally proved that in the centre of visually observable flow the aerosol represents, in general, condensed steam. Under the visually observed flow the polarizing sounding indicates the aerosol consisting of nonspherical particles of concrete dust. These results are typical of many measurements of depolarization degree of a solid aerosol and adequately agree with the results of test measurements d for concrete dust.

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The article is admitted to the International Scientific Conference "Higher School Research", Spain, Morocco, Tenerife, Madera – cruise, 2006, December 2-12; came to the editorial office on 20.10.06

ENVIRONMENTALLY SAFE SCALE RESIST METHOD TO PROTECT BOILER AND WATER HEATING EQUIPMENT IN HEATING SYSTEM

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Rational use of fuel and power resources depends much upon the heat using efficiency in

all stages of its production, transportation and consumption. An important element in this sequence is its early stage connected with heat transfer from the burning heat-carrying agent (coal, gas, oil fuel) to the water which flows through boiler heating pipes. A great negative influence upon this process is exerted by boiler heating pipes' lime scale deposits.

It is stated that a 1mm thick scale deposit reduces heat transfer from the heating agent to the water 4-7 times as much, that leads to a great waste of fuel. That is why the problem of boiler and water heating equipment protection from scale is one of the most important ones. Traditionally it is being solved by means of softening or demineralization of water delivered to heating system charge. To do it water-preparing plants, the main purpose of which is the disposal of calcium and magnesium positive ions, which are the main scale-forming substances, from the makeup water, are installed in boiler houses. However, in some boiler houses water-preparing plants work not sufficiently enough, and in the other ones, especially those of low-power, there are often no such facilities at all.

The boiler and water-heating equipment protection from lime scale deposits can be achieved by using nonchemical methods of internal water treatment, that means the water is exposed to magnetic, ultrasonic and electric fields. These methods don't need bulky structures or special labs, don't use chemical agents. As a result, the formation of unusable waste and sewage, and water contamination are excluded. Besides, the ecological safety of heat-power engineering enterprises increases.

While being treated with a magnetic field, water flows through an interpole space perpendicular to the magnetic force lines, physical and chemical properties of the water being changed. Such changes occur in the water rich in scale-forming substances if ferromagnetic black iron oxide is present. In the water treated with a magnetic field its hardness doesn't change, but the pattern of solid particles solids' precipitation becomes different: the crystallization occurs not on the heat surface, but in the water mass with finely dispersed sludge formation [1].

When affecting the processes of scale-formation occurring in the boiler and water heating equipment with an ultrasonic acoustic field, special effects conditioned by the vibratory action of the metal surface and scale happen in the aqueous medium:

- the crystallization process is broken, due to what fine particles' aggregation with secondary scale formation takes place in the aqueous phase;
- the bond strength between the formed scale and the metal decreases, that leads to water penetration into the interlayer between the crust and the metal surface, to the formation of steam under the pressure of which crust lifting and flaking occurs;
- the disintegration of coarse particles of the hard phase which are formed as the result of crust lifting occurs.

Finally, the ultrasonic influence, as well as the magnetic field's one, on the processes of incrustation leads to the formation of secondary sludge, which has to be ejected by means of blowoff of the heating system in places of its maximal accumulation. The necessity of sludge ejection from the heating grid by means of its blowoff is the main disadvantage of intraboiler system water treatment with magnetic and ultrasonic fields.

There is no such disadvantage in the method of intraboiler water treatment with constant electric field [3]. The matter of this method is in the fact that the water flow containing dissolved, solid and also colloidal scale-forming substances is conducted between two inert electrodes onto which direct current flow is delivered. In the space between the electrodes an electric field develops under the influence of which physical and chemical processes proceed in the moving water flow. As a result of these processes solid and colloid particles of calcium carbonate and magnesium hydroxide pass from the water flow to the cathodes and settle out in terms of loose deposit.

The advantages of water treatment with an electric field are:

- high efficiency of boiler and water heating equipment protection from lime scale;
- lacking of limitations on mineral and carbon dioxide compositions of the water treated;
- insignificant energy demands and maintenance expenditures;
- easy servicing of the installation.

Antiscale apparatus represents a horizontal hermetic reservoir in which a system of electrodes is installed. The shell and the cathodes are made of carbon steel, the anodes – of graphite. The electric current is delivered to the electrodes from the constant current source. Regularly, the apparatus stopping, the cathodes cleansing from scale-forming substances' deposit and the ejection of it from the apparatus are carried out. The apparatus is installed in the heating and hot water supply systems before system water transmission to a boiler or water heater.

In Kuzbass State Technical University (Kemerovo) antiscale apparatus constructions of various capabilities are elaborated and unified.

Technical characteristics of antiscale apparatus:

- Productivity, m/h……...50-300
- Diameter, mm……800-1600
- Working pressure, kgsec/cm^2…….upto 8
- Working temperature, °C…….…..20-90
- Voltage on the electrodes, V…… .5-15
- Power consumed, kW/h… ……....0,1-1,5

The antiscale apparatus have been successfully exploited since 1987 in a range of boiler houses of Kemerovo Region. The exploitation results showed that their inculcation in heating systems increases inceasing working time of water heating boilers and water heaters by 3-5 times, reduces expenditures on heat exchange equipment cleansing and considerably solves the problems connected with waste recycling.

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The article is admitted to the International Scientific Conference "Ecology and rational Nature management", Egypt, Hurgada, February, 21-28, 2007; came to the editorial office on 20.10.06