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Study of Heat Transfer Processes in Liquid Cooling of a Gas in Cyclone-Foam Equipment, S. A. Bogatykh and E. A. Reut, pp. 315–318.

A new type of contact equipment having a very large contact surface permits significantly greater gas velocity and lower hydraulic resistance.

Although foam equipment is characterized by relatively high heat and mass transfer rates, it is known to be limited by low gas rates and high hydraulic resistance. Thus the optimum gas rate during cooling by a liquid is 3 m/sec and accounts for 50% of the total unit resistance in perforated plate equipment. A new type of contact equipment having a very large contact surface (cyclone-foam) permits significantly greater gas velocities (up to 5–7 m/sec, depending on the cross section) and with lower hydraulic resistance.

The operating principle of the apparatus is the establishment of a circular motion of the liquid and gas through centrifugal and frictional forces. The gaseous vortex penetrates the liquid mass forming a two-phase medium in the form of an unstable film which is continuously broken and regenerated. The two-phase system (foam) rises due to the progressive gas motion. Small foam layer heights are completely broken in the cylindrical portion of the unit, while larger foam heights are broken in the upper helix and the liquid droplets are removed in the separator.

Motion of Solid Bodies in a Fluidized Bed, Yu. P. Gupalo, pp. 376–378.

Experimental results are used to determine the rheological properties of the two-phase medium and the velocity of the ascending flow.

The investigation of the motion of a solid body in a fluidized bed and the rheological properties of the two-phase medium comprising the bed are of interest in connection with the use of fluidized beds in a number of branches of industry.

In order to investigate the motion of a solid body in an opaque medium, such as a fluidized bed, we have used a radiometric method, which consists of using as markers bodies made of radioactive isotopes and subsequently fixing the positions of these control particles along a vertical line by the use of the usual equipment.

The experiments were carried out in a cylindrical column with a diameter of 120 mm. A porous screen was made up from aviation felt of thickness 10 mm, and immediately above it was placed a layer of Raschig rings which were held in place by a copper gauze. This gas distribution arrangement insured a high degree of uniformity of the air stream at the entry of the fluidized layer and prevented the formation of bubbles. Sand of size classification 0.42–0.1 mm and density 2.61 g/cm^3 was used as the suspended material. The height of the undisturbed layer of sand was 90 mm, or three-quarters of the column diameter.

The solid bodies which were investigated consisted of spheres of diameters from 6 to 25 mm; their densities varied over the range 1.3 to 2.5 g/cm^3. A radioactive isotope, cobalt-60, of activity 30–40 microcuries was placed in the center of each sphere.

By analyzing the impulse distributions on oscillograms it was found that the behavior of the solid body in the fluidized layer could vary considerably, depending on the dimensions of the body and the ratio of the densities of the body and the two-phase medium. Bodies whose densities were less than that of the two-phase medium did not sink into the depth of the fluidized bed, but "floated" on its surface. On the other hand, bodies with densities greater than that of the two-phase medium "sank," falling with an almost constant velocity. In the cases when the densities of the bodies were almost the same as that of the two-phase medium, they underwent random motions within the fluidized bed, sometimes sinking, sometimes "floating." The rest of the investigation was concerned with the determination of rates of fall in the fluidized bed of bodies of various sizes and densities near the axis of the column. Since in this case the motion of the body soon reaches a steady state and takes place with an almost constant velocity, this can be determined as the ratio of the distance between the upper and lower check points to the time of fall, which is obtained from the oscillogram.

Methods and Results of an Investigation into the Kinetic Characteristics of Combustion of a Powdered Fuel in a Stream, L. N. Khitrin, M. B. Ravich, and L. L. Kotova, pp. 384–388.

At the present time, both the general physicochemical fundamentals of the combustion of carbon and also concrete methods for the design calculation of the main types of combustion process (the bed and suspension processes) have been developed on the basis of numerous theoretical and experimental studies carried out in recent years, and, in particular, as a result of the systematic investigations carried out in the Soviet Union.

From the point of view of calculating the process, the combustion of pulverized fuel is the most complex case, since there are marked changes in the thermal conditions and in the relative parts played by the physical and chemical factors while the process is being carried out. In addition to this, the kinetic characteristics of the solid material manifest themselves to a very marked degree when a pulverized material is used, since in this case the retarding action of oxygen diffusion is conspicuous only at relatively high temperatures. Up to the present, unfortunately, there has been little work on the practical development or simplification of the methods necessary for the experimental determination of the reaction constants for pulverized fuels (or rather, the coke residues of fuels) at temperatures as high as possible. The methods of determining these constants have been developed only for particles of quite large dimensions, for which diffusion processes within and without the particles play an important part even at relatively low temperatures. One deficiency of the results so obtained is that they do not make clear the possible part played by sorption processes in combustion. For a long time these processes have been the subject of detailed investigations, but up to now they have not appeared to be directly related to the determination of combustion characteristics, although, as we know, an important part is played in the theoretical schemes for the mechanism of oxidation processes by the formation of hypothetical solid surface oxides of carbon.

In connection with these problems, the first aim of the present work was the development of a suitable flow method for the determination of the constants for the interaction of pulverized fuels (their cokes) with oxygen, which would answer rather better than existing methods the requirements for studying the kinetic characteristics, including the sorptional characteristics and which would allow us to obtain practical data over the widest possible temperature range.

Diffusional and Thermal Relaxation of Evaporating Drops, M. V. Buikov and S. S. Dukhin, pp. 399–403.

An important feature of the investigations dealing with the unsteady-state growth or evaporation of droplets consisting of pure materials is that they have dealt separately with the processes of diffusional and thermal relaxation. In actual fact, however, both these processes are interrelated through the boundary conditions at the drop surface. It is clearly important to take diffusional and thermal relaxation into account if there is a marked change during the evaporation either of the drop temperature (for example, in the case of the evaporation of drops whose initial temperature differs considerably from that of the surrounding medium), or of the temperature of the surrounding medium (if the evaporation of a mist occurs under adiabatic conditions).

A joint consideration of diffusional and thermal relaxation is of interest for a number of technical applications, and this is the subject of the present paper.

As we know, the calculation of the growth or evaporation of drops is usually divided into two steps: in the first, the temperature field and vapor density distribution are calculated for a constant drop radius, and then, using these, the change in radius is found (quasi-steady-state approximation). In the present paper we will deal only with the first step, that is, the temperature field and vapor density distribution are derived with an unchanged drop radius for the case when the initial temperature of the drop coincides with that of the surrounding medium, and it will be shown that the relaxation process can also occur in a quasi-steady-state manner in the sense that the drop temperature, while remaining constant over the cross section of the drop, changes with time, and that the temperature field and vapor density distribution in the vicinity of the drop follow the changes in the drop temperature instantaneously, as in the steady-state case.