AN INDUSTRIAL LIQUID ATOMIZER

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The atomizers of liquids must meet stringent requirements: they must produce a solid and uniform cone of the atomized liquid and must be able to atomize contaminated liquids and liquids containing resinifying substances.

It is known [1-4] that the atomizer cone can be produced by "shower" type atomizers with a working element having a perforated surface or by atomizers with a nozzle consisting of a set of plates with complex holes or with worm-type inserts having a central channel. However, these atomizers can only be used with noncontaminated liquids. In addition, their cone angle is limited (40-60°).

Investigations carried out at the VNIINP (Scientific Research Institute of the Petrochemical Industry) produced a new type of atomizer (Fig. 1), which is free of several of the usual short-comings. The liquid enters its chamber in two streams: through the central hole and through one or several tangential holes. The flow of liquid entering the chamber in a tangential direction (through side holes) tends to pass through the atomizer by rotation, as is the case in centrifugal atomizers which produce a hollow cone. The theory of centrifugal atomizers [5] shows that the central portion of the chamber is not filled with the liquid; this part contains an air vortex. The pressure inside the vortex is equal to the atmospheric pressure. An axial liquid flow entering the atomizer chamber (through the central hole) causes an agitation of the air vortex and the adjoining layers of the rotating liquid while the tangential forces disturb the direction of the central flow. With a correctly selected diameter of the central hole a complete hydrodynamic interaction can be achieved between both flows, which produces a well-filled cone of atomized liquid. An increase in the number of tangential inlets into the atomizer chamber produces, as in the centrifugal atomizers, an improvement of the quality of atomization.

The laboratory testing with water of an atomizer for residue oil with a high content of mechanical impurities showed that a device of this type can produce cones with an angle of 90° and more which cannot be achieved with atomizers having worm-type whirl plugs. The nozzle has one central inlet (d = 5.2 mm) and one tangential inlet (d = 6.2 mm). The volume flow rate of water with an excess pressure of 1-6 atm was varied in the range 1.8-4.3 m^3/h according to the equation

$$Q = \mu s \sqrt{2g \frac{p}{\gamma}} \ m^3/sec,$$

where μ = 0.45 is the flow rate coefficient, s is the cross sectional area of the outlet nozzle in m^2; p is the pressure in front of the atomizer in kg-wt/m^2; and γ is the specific gravity of the liquid in kg-wt/m^3.

A certain irregularity of spraying which was observed in these tests (Fig. 2) is due to the use of only one peripheral inlet into the atomizer chamber.

A prolonged testing of the atomizer in contact equipment where it atomized tar and sludge at 300-350°C showed a complete absence of coking or contamination of the channels and holes of the atomizer. This is due to the absence in the chamber of any guiding elements, to the sufficiently large nozzle diameter (10 mm), and to the shortness of the tangential and central channels.

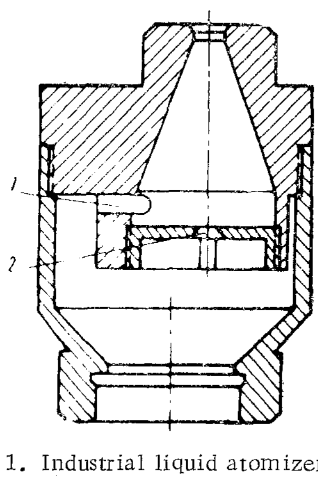

Fig. 1. Industrial liquid atomizer: 1) tangential side inlet; 2) central inlet.

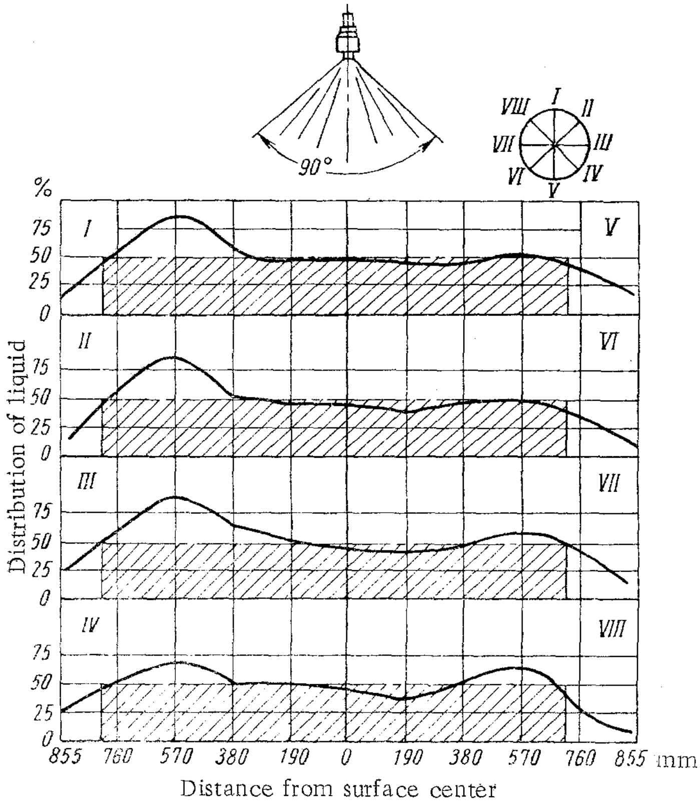

Fig. 2. Distribution of liquid on the surface being sprayed.

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