

PATENT SPECIFICATION (11)

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(54) CONTINUOUS DISSOLVING METHOD AND APPARATUS

(71) We, NESTLE S.A., of La Tour-de-Peilz, Switzerland, a Swiss company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to an improved method and apparatus for continuously dissolving a pulverulent material in a liquid.

According to the invention, the method comprises spraying the pulverulent material with the finely divided liquid as the pulverulent material flows into a chamber the sprayed liquid and entrained pulverulent material being directed toward the inner surface of the chamber and causing solution to flow in a thin layer along the inner surface of the chamber by recycling part of the solution to the inner surface of the chamber.

The apparatus according to the invention comprises a chamber having an upper opening which is provided with a feed duct for the pulverulent material and a liquid spraying nozzle substantially coaxial with the duct said nozzle being adapted to direct liquid and entrained pulverulent material onto the inner surface of the chamber, an outlet pipe at the lower part of the chamber, and means for recycling solution from the chamber to a supply channel arranged around the upper opening of the chamber and from which solution can flow along the inner surface of the chamber. In a preferred embodiment, the apparatus includes means for recycling solution from the outlet pipe to a nozzle discharging into the chamber below the normal liquid level in the chamber.

The invention is described in more detail with reference to the accompanying drawing in which:

The figure is a partial vertical section and diagrammatic view of an apparatus according to the invention.

The apparatus comprises mainly a chamber 1 having an upper opening 2 and discharging in its lower part into a pipe 3. An open supply channel 4 is arranged around

the edge of the upper opening 2. In a preferred embodiment, this edge is notched and the channel is fed tangentially by a pipe 5. Baffles 6 ensure a regular distribution of the solution around the supply channel. In the center of the opening 2 are placed a pulverulent material feeding duct 7 and a liquid spraying nozzle 8 coaxial with the duct 7.

The outlet pipe 3 is connected to a pump 9 which feeds a discharge pipe 10. In a preferred embodiment, a nozzle 11 discharges into the lower part of the chamber 1, below the level of the solution collected at the bottom of the chamber.

In the embodiment illustrated by the drawing, two pipes each provided with a valve branch out of the pipe 10, one connected to the mixing nozzle 11, the other to the supply channel 4. In other embodiments, the nozzle 11 can be supplied directly with the dissolving liquid, in parallel with the nozzle 8.

In the embodiment illustrated, a tank 12 and a pump 13 are connected to the outlet pipe 3. In a preferred embodiment, the discharge pipe 10 is connected to a holding tank.

In operation, the pulverulent material to be dissolved flows out of the central duct 7 into the upper opening 2. The liquid supplied at a pressure of 3 to 10 kg/cm² squirts out of the nozzle 8. The spray has a conical shape, with an angle at the top of 60 to 120°, and intersects the flow of pulverulent material. The liquid runs down in a thin layer along the inner surface of the chamber 1, entraining and dissolving the material. The solution is collected at the lower part of the chamber, its level not exceeding about 1/3 of the total height of the chamber, and comes out by the outlet pipe 3. The solution is pumped out of the chamber into the discharge pipe 10. Part of this flow is diverted to the mixing nozzle 11 and returns under the level of the solution collected at the lower part of the chamber 1, making the solution turbulent. Another part of the solution is directed to the supply channel 4 where it overflows the notched edge of the upper

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opening and runs in a thin layer along the inner surface of the chamber 1.

The proportion of the solution returning to the chamber 1 through the channel 4 and optionally the nozzle 11 depends on the material, the concentration, the flow rate and the efficiency desired. For example, if the input and output are relatively small, it may be necessary to recirculate a large proportion of the solution in order to have a homogeneous liquid film along the inner surface of the chamber 1. On the contrary, if the concentration of material is low and/or the flow rate large, it may only be necessary to divert a small part of the solution from the pipe 10. In general, the proportion of the flow rate which is diverted and recirculated represents 50 to 500% of the in- and output of the apparatus. The solids concentration can be as high as 75%.

The temperature of the components depends on their nature. In most cases, the liquid will be heated and the pulverulent material be at ambient temperature.

The solution running in a thin layer degasses the powder and reduces the tendency to foam.

With the tank 12 and the pump 13, liquids such as liquid fat can be introduced into the solution.

The apparatus described is particularly suitable for reconstituting milk from milk powder. Its use is, however, not limited to food products and it can be used also to dissolve chemical products or to mix fine pulverulent material with liquids for example.

EXAMPLE 1

To obtain an output of 5000 kg per hour of evaporated milk with 25.9% dry matter content, 927.5 kg/h of skimmed milk powder having 97% dry matter content at 20°C is introduced by the central duct 7. The total input of water at 70°C is 3677.5 kg/h, of which 1250 kg/h are sprayed by the nozzle 8 and 2427.5 kg/h flow from channel 4. 395 kg/h of milk fat at 40°C are introduced into the pipe 3 by the pump 13. Of the flow coming out of the chamber 1, 2500 kg/h are recirculated by the channel 4 and 2500 kg/h by the nozzle 11.

EXAMPLE 2

To obtain an output of 5000 kg/h of sweetened condensed milk with 72.68% dry matter content, 1135.0 kg/h skimmed milk powder and 2178.5 kg/h sugar are introduced together by the central duct 7. 1332.0 kg/h water are sprayed by the nozzle 8 and 354.5 kg/h milk fat are injected into the pipe 3 by the pump 13. 2000 kg/h return into the chamber 1 by the channel 4 and the same hourly quantity by the nozzle 11.

WHAT WE CLAIM IS:—

1. A method for continuously dissolving a pulverulent material in a liquid which comprises spraying the pulverulent material with

the finely divided liquid as the pulverulent material flows into a chamber the sprayed liquid and entrained pulverulent material being directed towards the inner surface of the chamber and causing solution to flow in a thin layer along the inner surface of the chamber by recycling part of the solution to the inner surface of the chamber.

2. A method according to Claim 1 wherein the liquid is heated and the pulverulent material is at ambient temperature.

3. A method according to Claim 1 or 2 wherein the pulverulent material is milk powder which is reconstituted to form milk.

4. A method for continuously dissolving a pulverulent material in a liquid substantially as hereinbefore described with reference to the accompanying drawing.

5. A solution when produced by a method according to any of Claims 1 to 4.

6. An apparatus for continuously dissolving a pulverulent material in a liquid which comprises a chamber having an upper opening which is provided with a feed duct for the pulverulent material and a liquid spraying nozzle substantially coaxial with the duct said nozzle being adapted to direct liquid and entrained pulverulent material on to the inner surface of the chamber, an outlet pipe at the lower part of the chamber, and means for recycling solution from the chamber to a supply channel arranged around the upper opening of the chamber and from which solution can flow along the inner surface of the chamber.

7. An apparatus according to Claim 6 in which means are also provided for recycling solution from the outlet pipe to a nozzle discharging into the chamber below the normal liquid level in the chamber.

8. An apparatus according to Claim 6 or 7 in which the edge of the chamber opening is notched.

9. An apparatus according to any of Claims 6 to 8 in which the supply channel is fed tangentially.

10. An apparatus according to any of Claims 6 to 9 in which the supply channel is equipped with baffles to ensure a regular distribution of the solution around the supply channel.

11. An apparatus according to any of Claims 6 to 10 in which the supply channel is fed by a pipe branching out of a final discharge pipe from the chamber.

12. An apparatus for continuously dissolving a pulverulent material in a liquid substantially as hereinbefore described and illustrated with reference to the accompanying drawing.

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opening and runs in a thin layer along the inner surface of the chamber 1.

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6. An apparatus for continuously dissolving a pulverulent material in a liquid which comprises a chamber having an upper opening which is provided with a feed duct for the pulverulent material and a liquid spraying nozzle substantially coaxial with the duct said nozzle being adapted to direct liquid and entrained pulverulent material on to the inner surface of the chamber, an outlet pipe at the lower part of the chamber, and means for recycling solution from the chamber to a supply channel arranged around the upper opening of the chamber and from which solution can flow along the inner surface of the chamber.

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