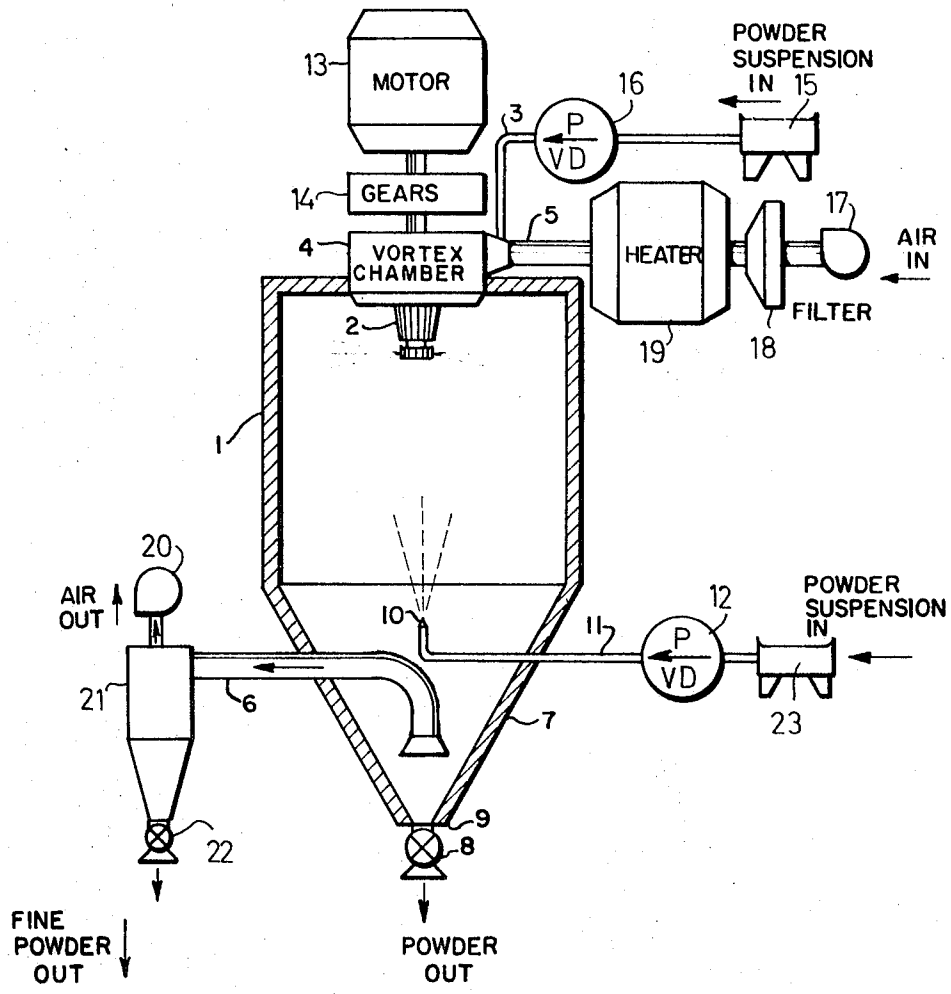
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SPRAY DRYING DEVICE AND METHOD FOR THE OPERATION OF SAME

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SPRAY DRYING DEVICE AND METHOD FOR THE OPERATION OF SAME

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ABSTRACT OF THE DISCLOSURE

A spray drying device for the production of powders from a liquid suspension comprising a drying chamber with a rotatable atomizer wheel and a set of atomizing nozzles disposed at an appreciable distance from the wheel and atomizing in a direction against the wheel.

The present invention relates to a spray drying device for the production of dry powders from material suspended or dissolved in a liquid by atomizing the material by means of two sets of atomization means disposed in a drying chamber and supplying drying air into the chamber.

It is known to employ two or more sets of atomization means, e.g. a double atomizer wheel or an atomizer wheel in conjunction with a set of atomizer nozzles for the atomization of two or more components inside a drying chamber, in that the components, in some way or other, are different and in the drying chamber, in some way or other, are to react with each other. It can be a question of chemically different substances, which are to react chemically with each other, or they can be substances which, in a chemical respect, can be identical or dissimilar, but which are different in other respects, e.g. possess a different particle size or a different concentration. One of the constituents may be a completely dry powder. In those cases in which it is not a question, or not solely a question of a chemical reaction, the object generally is to obtain an agglomeration of the particles originating from the various sets of atomizing means, and since both when a chemical reaction and an agglomeration is desired, a quantity of liquid must necessarily be present in the particles, the known devices are arranged in such a way that the atomization from the various sets of atomization means takes place in the same area.

Moreover, a device is known, in which the atomization takes place by means of two sets of nozzle atomizers pointing in opposite directions. However, the atomization from the one set in this case takes place from above through a fluidized layer of the powder material formed, the spray drying proper taking place in an area above this fluidized layer. However, the spray drying proper is in this case only a partial drying, while the final and essential part of the drying does take place in the fluidized layer. In this case, too, it is the intention to obtain an agglomeration that, essentially, takes place in the fluidized layer during the final drying.

The present invention aims at an entirely different task, viz to render possible a more certain and more varied adjustment of the particle size of the finished powder and, as the case may be, concurrently of the moisture content of same, while at the same time aiming at a more effective utilization of the drying chamber, and since it is thus not necessarily a question of a chemical reaction or an agglomeration, even if this is not out of question, this means that it does not necessarily have to be a question of different materials, but that it may very well be a question of merely different portions of the same dispersion being atomized through the two sets of atomization means.

The result aimed at is, according to the invention, obtained by the one set of atomizing means being constituted of a rotatable atomizer wheel and by the other set of atomizing means being constituted of an atomizing nozzle member which is disposed at an appreciable distance from the atomizer wheel and discharge the atomized liquid in the direction towards the atomizer wheel.

It has been shown that with such a spray drying device it is possible to obtain a powder in which the size of the powder particles can be adjusted with considerable accuracy around a desired mean value, while at the same time a desired dispersion of the powder particle size around the mean value can be obtained and especially a considerably greater dispersion than has hitherto been feasible. Moreover, it appears that for a drying chamber of a given dimension a significantly higher capacity can be achieved than is the case with the known devices. When the capacity is expressed in kg./hr. or the water that is being evaporated during the drying without any deleterious effects taking place, it has been proved that the capacity of the device according to the invention for a given drying chamber can be 30–35% greater than the capacity of the same drying chamber by the employment of only the one set of atomizing means or with the two sets of atomizing means disposed in the manner customarily used.

Furthermore, the invention relates to a method for the operation of a device as dealt with above and according to the invention this method is characteristic in that the two sets of atomizing means are regulated in such a way that the powder originating from one set acquires smaller particle sizes than the desired mean size, and the powder originating from the other one a corresponding larger one, while the powder originating from one of the sets acquires a higher moisture content than the one desired and the powder originating from the other set acquires a correspondingly lower moisture content.

By this means, in a simple manner, a desired mean size and a desired moisture content can be obtained independently from each other, and, at the same time, it is possible to regulate the spread around the mean size independent of it and this can be of importance, inter alia, in the ceramic industry.

The atomizer wheel can expediently be driven at a speed that is higher than the speed corresponding to the obtaining of the desired particle size, while the liquid is distributed approximately evenly between the atomizer wheel and the nozzles.

The invention can, with advantage, be applied in the production of dry-press powder of ceramic clay such as tile clay. Considerable difficulties are usually encountered here in obtaining a material of satisfactory compactness, however, it has been shown that these difficulties are completely obviated in the method according to the invention when the rotating atomizer is driven at a speed which imparts to the powder a particle size distribution over a range of approximately 20–200μ, while the atomizer nozzles are adjusted to the production of a powder having a particle size distribution over an interval from approximately 60 to approximately 400μ and the drying air being supplied in a quantity and at a temperature imparting to the powder originating from the rotating atomizer a moisture content of approximately 3%, and the powder originating from the atomizing nozzles a moisture content of approximately 7%.

If the suspension supplied is distributed approximately evenly between the nozzles and the atomizer wheel, the water content of the finished product is going to be approximately 5%, but, moreover, the distribution of the suspension supplied between the nozzle and the atomizer

wheel can be varied within wide limits, all according to the desired particle size distribution. In certain cases for instance, it is possible for the quantity supplied to the one set of atomizing means to go right up to 90%.

In the following, the invention is described in greater detail while referring to the drawing which shows diagrammatically an embodiment of the atomizing device according to the invention.

The drying device shown consists of a drying chamber **1** of normal shape, below the ceiling of which an atomizer wheel **2** is disposed. The atomizer wheel **2** is driven by a motor **13** through a variable gearing **14**.

The material to be atomized by means of the atomizer wheel **2**, is supplied from a container **15** through a variable delivery pump **16** and a pipe **3**.

Concentrically with the atomizer wheel **2**, an annular chamber **4** is disposed above the ceiling of the chamber which, at the bottom, communicates with the drying chamber **1** and has drying air supplied via a tangentially connected air supply line **5** which is connected with a fan **17** through an air filter **18** and a heater **19**. The air is removed at the bottom of the chamber by means of a fan **20** via an air discharge conduit **6** and a cyclone **21** for separating fine powder particles from the air. This powder is taken out at the bottom of the cyclone through a powder valve **22**.

The lower part **7** of the chamber is, in a customary manner, essentially conical, shaped as a truncated cone with a powder outlet or valve **8**.

The spray drying device as described so far corresponds fully to a normal spray drying device with a rotating atomizer. However, according to the invention, in the lowermost part **7** of the chamber, a little higher than the downwards-facing mouth **9** of the air discharge conduit **6**, an atomizing nozzle **10** is disposed, to which material to be atomized is fed from a container **23** via a supply pipe **11** under pressure by means of a variable delivery pump **12**. The container **23** may be the same as the container **15**.

The nozzle **10** is disposed centrally in the chamber **1** and atomizes in the upwards direction towards the atomizer wheel **2**. Instead of a single nozzle, several such nozzles may be disposed which, in such a case, are preferably placed symmetrically around the axis of the chamber.

It is possible, as often is the case with atomizing nozzles, to supply drying air via a conduit which terminates coaxially with the nozzle; however, with the employment of the nozzle in conjunction with the rotating atomizer stated in the invention, it has been proved to be expedient for the drying air supply to be a common one for the rotating atomizer and the nozzle or nozzles.

The nozzle is disposed at a considerable, axial distance from the rotating atomizer wheel **2**, and in the embodiment shown this distance is materially greater than half of the distance between the rotating atomizer **2** and the powder outlet.

The capacity of a spray drying device can be defined by the number of kg. of water which can be evaporated per hour during the drying process. The capacity is not a fixed quantity, since, inter alia, it depends on the particle size and water content of the finished powder, because these quantities are, inter alia determined by the quantity of heat supplied per unit of time with the drying air which, at the same time is determinative for the rate of evaporation. The maximum capacity in each individual case is the number of kg. of water it is possible to evaporate in the given circumstances without any harmful deposits forming on the walls or the ceiling of the drying chamber.

By means of a rotating atomizer, the maximum capacity obtained in each individual case is chiefly determined by the diameter of the drying chamber, because the noxious deposits in such a case are first and foremost formed on the wall of the chamber at the level of the atomizer wheel. In nozzle atomizers the dimensions of the chamber are also decisive, depending on the placing of the nozzles.

Looking at the atomizing device described without the nozzle **10**, it can be mentioned by way of example that a plant with a drying chamber having a diameter of 6 meters can, for instance, have a capacity of evaporating 1500 kg. of water per hour and about the same capacity can be achieved with solely a plurality of nozzles **10** in the same chamber.

When both the rotating atomizer and the nozzles are now present and it is imagined that no noxious deposit originating from the rotating atomizer is formed, it will be seen that a considerable, additional quantity of liquid can be supplied through the nozzles for evaporation without this changing the conditions on the walls of the chamber at the level of the rotating atomizer, and that an increase in the maximum capacity is consequently achieved without an increase in the dimensions of the chamber.

In the said example, in which the maximum capacity was the evaporation of 1500 kg. of water for each one of the two atomizer types, experiments show that by using both concurrently, a capacity of evaporating 2000 kg. of water per hour can be obtained.

As certain factors decisive for the capacity are, as mentioned, also determinative for the properties of the finished powder, it has hitherto often been necessary to make use of drying chambers having considerably greater diameters than called for with regard to the capacity desired, but by using the invention, it becomes possible to obtain a desired result with a drying chamber having a relatively small diameter. In the centrifugal atomization of ceramic clay suspensions for the manufacture of a dry press powder, the water content of the finished powder is very critical. If one attemps to dry the clay suspension in a centrifugal atomization plant having a diameter small than approximately 3 meters, it has proved impossible to obtain a sufficiently high moisture content in the powder, e.g. 5%. The resulting moisture of the powder will not exceed 1–2%, for if it is tried to raise the moisture of the powder by supplying a larger quantity of clay suspension in relation to the quantity of heat supplied, the strange thing happens that the powder removed from the drying chamber still contains only 1–2% moisture, but, at the same time, a part of the material forms very humid and sticky deposits on the walls of the chamber. The powder thus produced does not possess the desired properties, but by the simultaneous use of an atomizing nozzle that is operated to produce a larger particle size than the one desired, and by adjusting the feed rate in such a way that the powder originating from the nozzle acquires a moisture content higher than the one desired, the mean size of the resulting powder as well as the moisture content one will be able to impart the values desired while the non-homogeneous distribution of the moisture in the powder, which could well occur, has no adverse effect on the powder use.

The particle size and the moisture content are controlled by adjusting the supply to the two sets of atomizing means by means of the two variable delivery pumps **16** and **12**, and of the velocity of the rotating atomizer **2** by means of the variable gearing **14** as well as of the quantity of heat supplied by regulating the quantity and the temperature of air supplied from the heater **19**.

We claim:

1. A spray drying device for the production of dry powder from materials suspended or dissolved in liquid, comprising a drying chamber, said chamber being provided with means for the supply of drying air into the chamber and with an air outlet and a powder outlet, a first and a second set of atomizing means being disposed in said chamber, said first set of atomizing means comprising a rotatable atomizer wheel, said second

atomizing means comprising an atomizing nozzle member being disposed at a distance from said atomizer wheel amounting to approximately half the distance from said atomizer wheel to said powder outlet, said nozzle having its discharge directed toward said atomizer wheel.

2. A spray drying device as claimed in claim 1, said air supply means being common to said first and said second set of atomizing means and being disposed in the vicinity of one of said sets of atomizing means.

3. A spray drying device as claimed in claim 1, said drying chamber having a ceiling, said air supply means being disposed in said ceiling, said atomizer wheel being disposed at the vicinity of said ceiling, said air outlet being disposed below said nozzles.

4. A spray drying device as claimed in claim 1, including control means for the adjustment of the proportion of the quantities of liquid to be supplied to said atomizer wheel and said nozzles, respectively.

5. A method for the operation of a spray drying device having a drying chamber with a rotatable atomizer wheel and spray nozzles, an air inlet, an air outlet, a first liquid supply means for the supply of liquid to said wheel, a second liquid supply means for the supply of liquid to said nozzles, comprising adjusting said wheel and said nozzles and said first and said second liquid supply means and said air supply means in such a manner that powder deriving from liquid from said rotatable atomizer wheel acquires a particle size from approximately 20 to approximately 200μ which is smaller than the mean size desired and that the powder deriving from liquid originating from said spray nozzles acquires a particle size from approximately 60 to approximately 400μ which is a correspondingly larger size, supplying drying air in a quantity and at a temperature so that powder from said wheel acquires a moisture content of approximately 3% which is lower than that desired and the powder from said nozzles a correspondingly higher moisture content of approximately 7%, driving said atomizer wheel at a speed which is higher than the speed corresponding to that for obtaining the particle size desired, said liquid being distributed approximately evenly between said atomizer wheel and said nozzles.

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