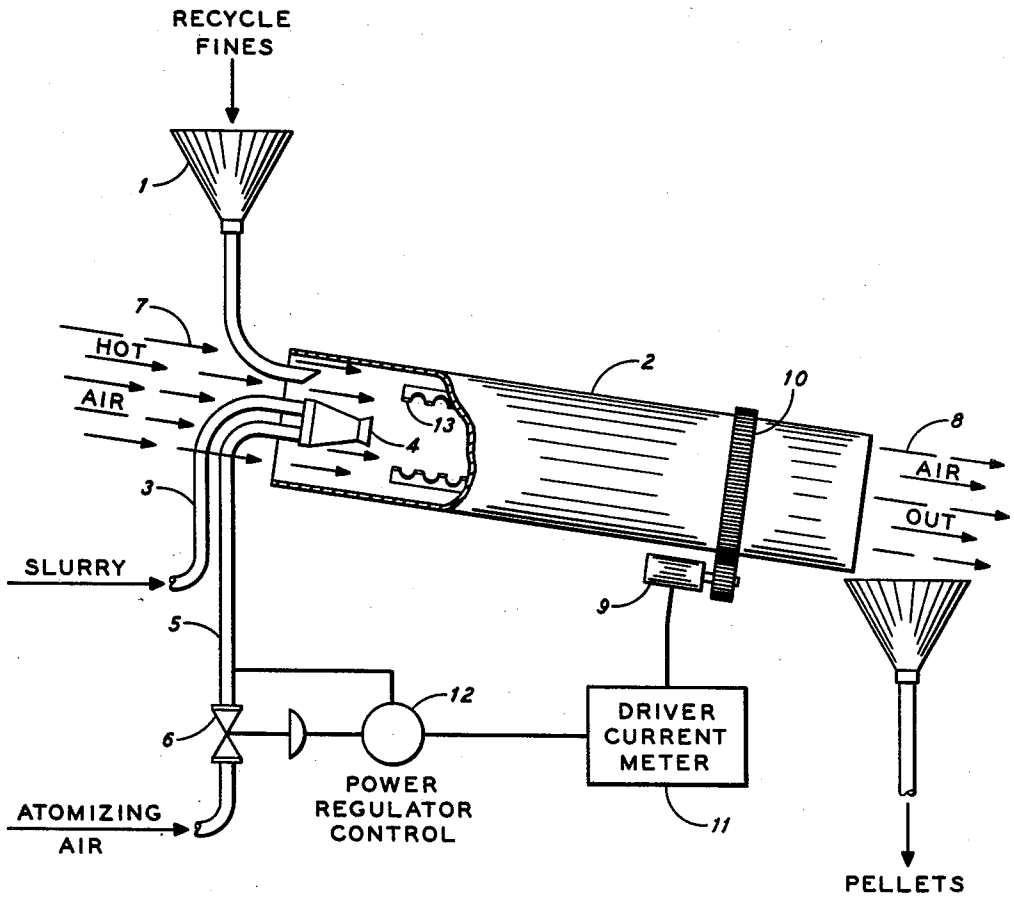
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APPARATUS FOR CONTROL OF PELLET SIZE BY RELATING WORK LOAD TO ATOMIZER PRESSURE

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APPARATUS FOR CONTROL OF PELLET SIZE BY RELATING WORK LOAD TO ATOMIZER PRESSURE

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The present invention relates to an improved apparatus for preparing pellets of relatively infrangible or fracture resistant materials. More particularly, this invention relates to a novel method of controlling the mean size distribution in the production of pellets of fracture resistant materials.

Granular particles of a small, defined size range may be prepared from dispersions, i.e., slurries or solutions, in a continuous process. The equipment is comprised of a rotating drum equipped with lifters on its wall, a hot air source and an atomizer and will be referred to as a pelletizer. Hot air, a slurry or solution spray and pulverized recycled products, fines or nuclei, are introduced at one end and travel concurrently down the drum. Recycled solid particles fall in a dense shower across the drum, being raised and evenly distributed by the lifters on its wall. The spray droplets impinge on these particles. As the particles carrying the slurry droplets fall through the hot air stream, the solvent, a vaporizable liquid, is evaporated, and the particles reach the drum wall with a dry outer surface. The pitch of the drum and flow of the hot gas act to move the particles toward the outlet side of the drum.

An illustration of a comparable apparatus is found in U.S. Patent No. 2,926,079, which is known in the industry as a spherodizer.

It is relatively impossible to obtain pellets all having the same size by this method. Nor is such a condition necessarily desirable, since pellets of undesired size may be ground and returned to the drum as fines. Desirably then, a mean size distribution should be obtained which optimizes the desired size and provides sufficient improperly sized pellets to be ground to fines.

During the operation of the above-described apparatus, the conditions often fluctuate. Particularly difficult is the problem of controlling the solvent content and density of the dispersion. Variations in the composition of the dispersion will affect the droplet size which in turn affects the mean distribution of the pellet size.

The drum of the apparatus is very long, often between 40 to 60 feet, and is capable of accommodating over 20,000 pounds of material. The time in which a particle moves through the drum will depend on the pitch of the drum, the particle's size and other operating conditions, but will generally be in excess of 10 minutes, usually in excess of 20 minutes.

The operator cannot see into the drum because of the denseness of the shower of fines. He must, therefore, wait until particles come out of the drum to be appraised of the improper functioning of the apparatus 20 or more minutes before. He must then adjust the conditions, usually the pressure at the atomizing nozzle, until pellets of the proper distribution are obtained. This requires great sensitivity on the part of the operator in deciding the extent of the change. Moreover, during the period of time in which the operator was unaware of the undesirable size distribution, and while adjustments are being made, tons of material may be formed which are commercially unusable and, when excess moisture causes the material to agglomerate, may even result in the shutting down of the apparatus.

It has now been found that a proper pellet size distribution may be maintained by making the pressure at the atomizing nozzle responsive to the work load in rotating the drum. When the flow of solids through the drum is being maintained relatively constant, then any increase in the work load in rotating the drum at a constant speed may be offset by an increase in pressure at the atomizing nozzle; a decrease in work load may be countered with a decrease in pressure.

The current or power fed to the driver motor varies directly as a function of the work load, which in turn is a function of the pellet size distribution being produced. In any apparatus, a relationship may be determined between the atomizing air pressure and the power or current input to the driver motor, for maximizing the desired size distribution. By means of a meter, an operator may manually change the atomizing air pressure in relation to changes in the work load, determined by ammeter or wattmeter readings or, preferably, the atomizing air pressure may be varied automatically.

During operation of the pelletizer, it is important that the weight of solids introduced into the pelletizer be approximately equal to the weight of solids being removed. The rate at which the fine particles and slurry is introduced should be maintained in relation to the removal of the solid pellets from the pelletizer. Under optimum conditions, there will be sufficient oversized and undersized pellets, which when pulverized, will maintain a constant feed of fine particles. If there is an insufficient amount of undesired size pellets, then pellets of the desired size should be diverted to the pulverizer in order to maintain the material balance.

In order to describe the novel method and apparatus further, reference is now made to the accompanying drawings.

FIG. 1 represents an elevated view, partly in section, of an apparatus for carrying out the process described herein.

Solid particles are fed from feeder **1** into the drum **2**. A slurry containing fertilizer raw materials is fed through line **3** and sprayed into the drum onto the fines through nozzle **4**. The atomizing air pressure is introduced into the nozzle **4** through line **5**, the pressure being regulated by valve **6**. Hot air is blown into the drum at **7** and exits at **8**.

The drum **2** is of a conventional rotary design, being belt (or gear) driven by means of motor **9** and belt (or gear) **10**. The power fed to motor **9** is metered by a driver current meter **11** which is connected to a power regulator control **12**. Variations in current activate the power regulator control **12** which actuates the valve **6** varying the atomizing air pressure at nozzle **4**.

In operation, slurry is continuously sprayed into the drum **2** through nozzle **4**. The drum rotates at a suitable speed to shower the fines, which are raised by the lifters **13**, through the spray of slurry and the hot gases are continuously blown through the drum **2** for distilling off the solvent of the slurry, leaving the desired coated pellets. Should the mean pellet size decrease or increase, the work necessary to turn the drum and lift the nuclei and pellets will decrease or increase respectively, resulting in a change in power to the motor **9**. The change in power will actuate the valve control which will reduce or increase the pressure producing larger or smaller spray droplets, respectively.

The work load in turning the drum is related to the power or current input to the driving motor. Various devices may be used to convert an electric signal to pneumatic operation, for example, a Foxboro Dynalog. Because of the comparatively slow response of the change in power requirement to variations in the atomizing pressure, some adaptation of a commercial instrument might be necessary.

The relationship between the power necessary to turn the drum and the atomizing air pressure may be determined in a variety of ways. A number of settings may be made and the product size distribution determined at each setting. The relationship between the current reading and atomizing air pressure may then be determined graphically and a plot made which would indicate the optimum settings for a desired distribution.

A less arduous procedure is to use the formula:

$$P_{Air}=k_1(I_{Driver}-k_2)$$

where P_{Air} is the atomizing air pressure, I_{Driver} is the driver motor current and k_1 and k_2 are constants, which provides a convenient approximation. The values of P_{Air} and the corresponding values of I_{Driver} are observed under two conditions under manual control. These values are inserted into the above equation, which may then be solved for k_1 and k_2. If k_2 is small compared to I_{Driver}, the simpler equation $P_{Air}=k_1I_{Driver}$ is obtained.

Pellets of various materials may be prepared, as long as the material forms a relatively infrangible pellet. Because of the continued raising and dropping of the pellets, it is necessary that the material does not powder as a result of this mechanical action. Except for this one limitation, pellets of many different materials may be prepared. Commercially this pelletizer is now used mainly for complex fertilizers but other materials are well adapted to its use, e.g., detergents, high density insecticides, catalysts, etc.

Fertilizer pellets were prepared using an ammeter, indicated heretofore as a driver current meter (11) in FIGURE 1, and manual control of the atomizing air pressure. The amperage was maintained in the range 58–62 amps. by varying the pressure in the range 65–70 p.s.i.g. Continued production of the desired distribution was maintained for greater than 24 hours, whereas prior to this, production had been frequently reduced after periods of 6 hours, due to gross deviations from the desired size distribution. This meant that 300 tons of the desired pellets were produced without interruption, where previously only about 75 tons were produced before interruption. The deviations also overload the recycle system, as well as reduce the yield of the desired size pellets.

As will be evident to those skilled in the art, various

modifications on this process can be made or followed, in the light of the foregoing disclosure and discussion, without departing from the spirit or scope of the disclosure or from the scope of the following claims.

I claim:

1. In an apparatus for preparing pellets of a fracture resistant material which comprises a rotating drum equipped with lifters on its wall, means for rotating said drum at a constant rate, means for introducing fines into the drum, an atomizer for spraying droplets of a dispersion of the fracture resistant material onto the fines as they fall from the lifters across the drum, pressure means operably connected to said atomizer for controlling the size of the droplets, means for moving said coated fines through said drum, and means for drying the coated fines with hot gas traveling concurrently with the coated fines through said drum, the improvement which comprises means for varying said atomizer pressure responsive in direct relation to the work load of said rotating means.

2. In an apparatus for preparing pellets of a fracture resistant material which comprises a rotating drum equipped with lifters on its wall, means for rotating said drum at a constant rate, means for introducing fines into the drum, an atomizer for spraying droplets of a dispersion of the fracture resistant material onto the fines as they fall from the lifters across the drum, pressure means operably connected to said atomizer for controlling the size of the droplets, means for moving said coated fines through said drum, and means for drying the coated fines with hot gas traveling concurrently with the coated fines through said drum, the improvement which comprises maintaining the pellets in a relatively constant size distribution with means for metering the work load in rotating said drum and means for varying the atomizing pressure in direct relation to variation in the work load, said atomizer pressure varying means being operably connected to said metering means.

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