

United States Patent

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[54] **PROCESS OF PRODUCING CELLULOSE ACETATE
FLAKE BALES**
2 Claims, No Drawings

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ABSTRACT: Process for producing a bale of cellulose acetate flake having a density of 30 to 40 pounds/cubic foot which is stable to mechanical stress and in which flake properties are unimpaired including the steps of feeding a predetermined mass of cellulose acetate having a moisture content of at least four percent into a zone, compressing said mass under a pressure between about 1,200 and 2,500 p.s.i. in said zone into a bale and maintaining said compression for at least 5 seconds.

PROCESS OF PRODUCING CELLULOSE ACETATE FLAKE BALES

Cellulose acetate flake is an important article of commerce. In the production of cellulose acetate, the wood pulp or other cellulosic source is generally purified, acetylated and then isolated in flake form. This flake is then re-dissolved in a suitable solvent such as acetone and extruded to form fiber or film in a manner well known in the art.

The fabrication of useful articles from this acetate flake is commonly performed in the industry at locations far removed from the place where the flake itself is produced. Since cellulose acetate flake is a fairly bulky material having an ordinary density of about 10 to 14 pounds per cubic foot, freight, handling and storage charges amount to a significant factor in the over-all cost. It is highly desirable to increase the density of the cellulose acetate flake package. The flake bale should be rigid enough to withstand handling and shipping and yet able to be readily solubilized in extrusion solvent such as acetone.

The efficient production of fiber and films of high quality requires that the flake be clean and unaltered in the final solution and free of oil and dirt. During shipment and storage, the conventional bulky acetate packages can readily be contaminated.

It is an object of this invention to produce a bale of high density acetate flake which can withstand the mechanical stresses encountered during handling and shipping. It is a further object that the cellulose acetate flake in this densified bale be free from significant surface glazing and have substantially the same properties when fabricated into useful articles as flake which has not been densified. Still further, the bales should be compact enough to avoid significant contamination during shipment and storage. Additionally the bales must readily break up into easily soluble flake. Further, the bales should be capable of being shipped in bags requiring no strapping and without significant crumbling or other harm. As still a further object, this densification should be capable of being performed rapidly and inexpensively and with substantially no contamination.

Various methods have been attempted to produce such densified acetate flake packages including extrusion dies, rolls, vibrating equipment and auger packing—but without success. Methods which achieve package stability have also tended to adversely affect flake quality such as to lower the plugging value and raise the solutioning time.

These objects have now been realized by the method of this invention which broadly comprises subjecting cellulose acetate flake to critical conditions of compression to attain and temporarily maintain a critical density and then ejecting the bale which then stabilizes.

More specifically, cellulose acetate flake, preferably having a moisture content of at least four percent, is subjected to a face pressure between 1,200 and 2,500 psi from one direction to produce a bulk density of between about 40 and 50 pounds per cubic foot and this pressure and density is maintained for at least 5 seconds. Upon ejection the block grows and a final stable bulk density of between about 30 and 40 pounds per cubic foot is attained.

An apparatus capable of producing the stable densified acetate flake bale of this invention comprises a compression chamber or zone, preferably having a substantially rectangular cross-section, a first vertical compression ram, the face of which at the end of the stroke provides the top of said chamber, a second ram (hereinafter called the ejection ram) which operates at right angles to the first ram, the face of said second ram forming another side of said chamber, and a third ram (hereinafter called the side ram) which operates at right angles to the first ram, and in direct opposition to the second ram, and forms still another side of said chamber. The chamber or zone should be so dimensioned that the height of the densified bale in the chamber, *i.e.* the dimension along the axis of compression, is the smallest dimension of said bale.

The following exemplifies the operation of such an apparatus. A predetermined weight mass of the acetate flake is fed into the chamber by chute, belt, or equivalent means, such

methods of introduction being well known in the art. The compression ram commences its downstroke while the other two rams remain stationary. This compression ram "over-travels" into the flake mass up to the point that the necessary pressure develops to achieve a bulk density of between 40 and 50 lbs/cu. ft. The rams are then held at this position for a dwell period of at least 5 seconds and then the compression ram and side ram retract simultaneously. As soon as the compression ram has withdrawn clear of the compression chamber, the ejection ram is actuated to push the block from the compression chamber. When the ejection ram reaches the end of its travel, it reverses immediately and also actuates the side ram for quick return to position, ready for another chamber filling.

Upon ejection, the block tips and drops into a receiving chamber which aligns with the bagging spout. The newly formed block is advanced into the bagging spout by means of a pneumatically operated ram, for example, and simultaneously forces one of the blocks already in the spout into a bag placed over the spout. This cycle sequence can be automatically controlled by means of interlocking limit switches. The apparatus can be easily modified so as to chamfer or bevel the corners to further insure against the corners breaking during handling.

The bale or block springs back or "grows" to a slight extent upon ejection to result in a final or "ejected" block density of between 30 and 40 lbs. per cubic foot. The bulk density of the block is on the order of three times as dense as the bulk density of the feed flake. These flakes are stable to the mechanical stresses normally encountered during handling and shipping. Blocks having final bulk densities below about 30 lbs. per cubic foot are unstable, *i.e.* they tend to break-up and crumble during normal handling and shipping. When ready for use, these bales can be mechanically crushed and solutioned with stirring.

Three significant parameters in the production of the stable acetate bale of this invention are (1) the applied pressure, (2) the density during the dwell period, and (3) the dwell period or time during which said pressure and density are maintained. The applied face pressure should be between 1,200 and 2,500 psi. Pressures above about 2,500 psi tend to alter the flake such as to adversely affect its properties upon subsequent dissolution and extrusion. Pressures below about 1,200 psi are not sufficient to effect a final bale densification of at least 30 lbs/cu. ft. within a reasonable operating time. The pressurized bulk density should be between 40 and 50 psi. Failure to observe this condition has consequences similar to that of the pressure conditions.

The dwell time should be at least 5 seconds. It has not been found possible within the confines of the above first two parameters to practically achieve final block densities of at least 30 lbs/cu. ft. with a dwell period below about 5 seconds. There is no danger in maintaining a longer dwell period though economics would dictate the shortest possible period. The optimal dwell period is dependent on the other parameters. At increased pressures one can employ shorter dwell periods. Similarly, at lower pressures one should employ longer dwell periods. The rate of compression also affects the necessary dwell periods. With a slower rate of compression, a smaller dwell time is required, and conversely with a faster compression, a greater dwell time is required.

As previously noted, the blocks upon ejection from the compression zone tend to "grow" or increase in depth. The lateral forces during compression are well contained and substantially relieved prior to ejection. Thus the lateral growth after ejection is slight and the final cross-section is similar to that of the compression chamber. Even with a given total weight of acetate flake and with a given apparatus, the variation in block depth, however, can be appreciable. Factors influencing the latter variations include (1) the dwell period, (2) the moisture content of the flake, (3) the absolute amount of pressure applied and (4) the flake characteristics. Thus by regulating the above parameters, one can produce by the process of this invention bales of selected depth. One of the disadvantages of processes which involve bagging is that it is difficult to achieve a tight fit. In my process however, the bale

can be placed in an initially loose bag. Since the bale growth continues for a few days, the bale causes a final tight fit. Of course the size of the bag is selected with this growth in mind.

While I do not wish to be limited by my theory of the phenomenon underlying this invention, it appears that under the above critical combination of conditions, the mass of cellulose acetate flake compacts so that the flake fibrils interlock without actually yielding. If the conditions are too mild, *i.e.* below the values specified for the critical combination, substantial portions of the flake fibrils do not undergo stable interlocking. This interlocking does not alter the flake properties and is substantially reversibly undone on dissolution. On the other hand, if the conditions are too harsh, *i.e.* above the values specified for the critical combination, the flake fibrils apparently yield, resulting in glazing and deleterious alteration of the flake properties.

The following example illustrates the process of our invention.

EXAMPLE

A total of 73.5 pounds of cellulose acetate flake having a moisture content of four percent is fed into a press of the type described above. The ram stroke is begun compressing the flake into a chamber having a rectangular cross-section of 15 inches x 26.5 inches. The face pressure is 1,800 psi at a block height of 7 inches and this pressure is maintained for 7 seconds, and then the block is ejected. The density in the chamber is 45.5 pounds/cubic foot as computed by:

$$\frac{7" \times 15" \times 26.5"}{1728}$$

$$= 1.6 \text{ cubic feet (volume of acetate flake)}$$

$$\text{Density} = \frac{\text{Weight}}{\text{Volume}} = \frac{73.5}{1.61} = 45.5 \text{ lbs./cu. ft.}$$

Upon ejection the blocks grow to 9 inch depth or a final density of 35.5 ft³ as similarly computed. This densified bale can be shipped in a strapless burlap bag without crumbling. Upon mechanical crushing and stirring in acetone, the bale acetate has a plugging value and solutioning time equivalent to that of the loose feed flake.

Tobacco filter plugs, prepared in the conventional manner from cellulose acetate tow spun in known manner from an acetone solution of this densified acetate flake, have equivalent properties to those similarly prepared from conventional acetate flake. Their cost of production is less, however, due to the saving in freight and handling charges and in the greater ease of spinning due to less contamination from dirt and oil.

Numerous variations of the above processes and products will be apparent to one skilled in the art within the spirit of the present invention.

I claim:

1. The process of producing a stable bale of cellulose acetate flake having a density of between about 30 and 40 pounds per cubic foot, characterized by substantial freedom from contamination and further characterized by said flake having substantially the same properties upon dissolution as dissolved cellulose acetate flake of ordinary density, comprising the steps of feeding a predetermined mass of cellulose acetate flake having a moisture content of at least four percent into a zone, compressing said mass in said zone under a pressure between about 1,200 and 2,500 psi into a bale having a bulk density of between about 40 and 50 pounds per cubic foot, maintaining said bulk density for at least 5 seconds and then ejecting said bale.

2. A process according to claim 1 wherein the dimension of said bale along the axis of said compression is the smallest dimension of said bale.