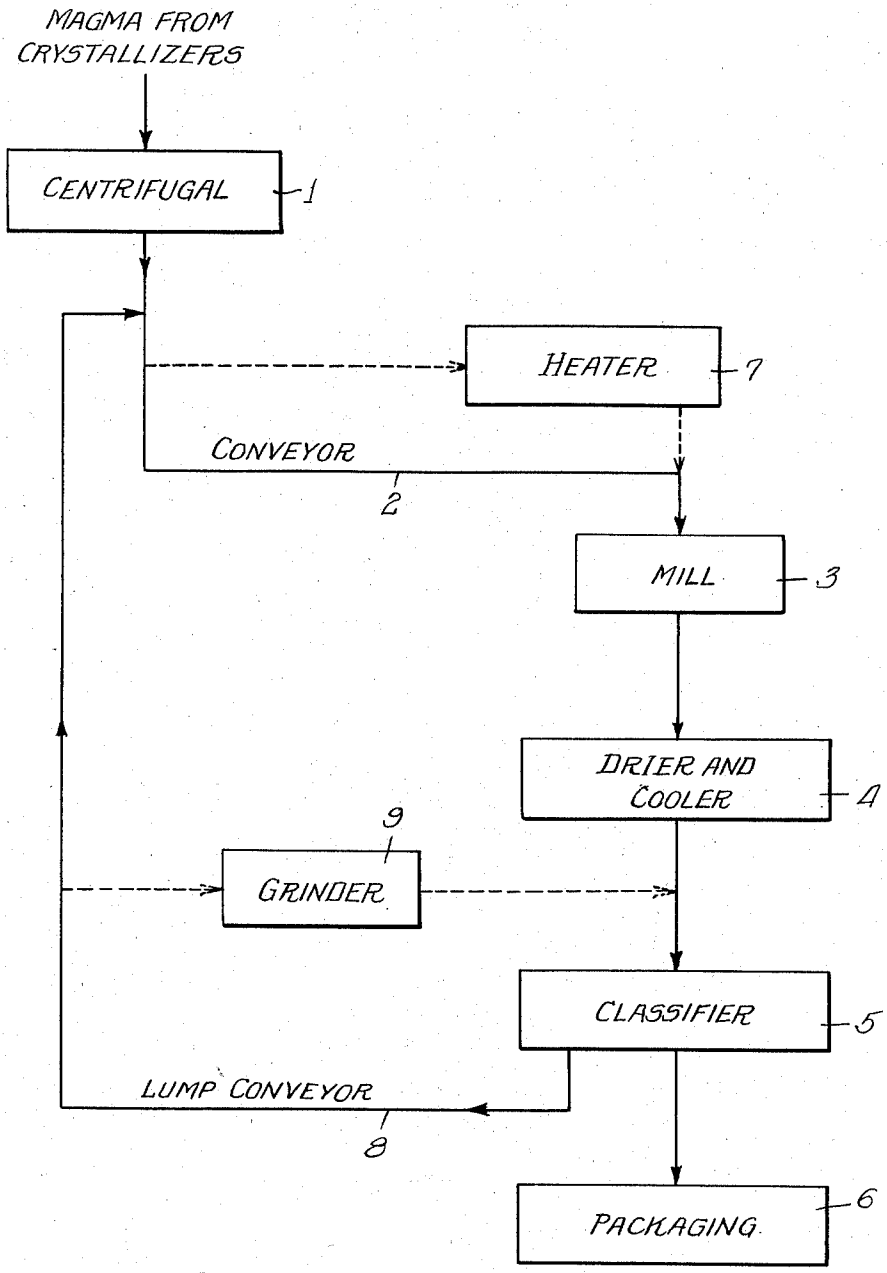
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MANUFACTURE OF DEXTROSE CONTROLLING PARTICLE SIZE

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MANUFACTURE OF DEXTROSE CONTROLLING PARTICLE SIZE

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This invention relates, as indicated, to the manufacture of dextrose controlling particle size, and more particularly to the preparation of larger sized particles of dextrose. By the term "larger sized particles" is meant those which will pass U.S. No. 16 mesh, but will not pass U.S. No. 100 mesh.

It is usual in the industry to treat dextrose as follows. Dextrose is ordinarily crystallized in motion and then centrifuged to remove the mother liquor. The remaining cake is washed with water in a centrifugal to remove residual mother liquor and is allowed to spin until there is essentially no further liquid removal.

Dextrose cake is plowed out of the centrifugal basket into some conveying means which takes it directly to the driers. The material entering the drier is almost without exception very lumpy, that is, having a good percentage of particles larger than U.S. No. 16 mesh, which is normally considered the largest size desirable for commerce. It also contains a large quantity of very fine loose crystals.

After drying the material is graded into the resulting granulations by various means such as screening or air classification. The dry lumps are ground and returned to the dry stream for grading.

This process has several disadvantages. There is very little control over particle size, except by dry grinding, which will only produce smaller particles. Thus, there is no chance to increase the percentages of larger sized particles. Also, dry grinding produces dust. When dry dextrose is ground many crystal edges are apparently broken off and an undesirable amount of very fine material is produced. A certain amount of such material is carried along into the large particle sizes and creates an undesirable dust condition. Thirdly, lumps do not dry well due to their size and the inherent difficulty of removing moisture from lumps. In large lamps, some will be one and one-half inches to three inches in size, there is a definite case hardening effect and the center of the lump may actually melt due to the inability of the moisture to escape. A further disadvantage in the customary procedure of drying is that particles made in this manner tend to fracture easily.

It is, therefore, an object of this invention to increase the proportion of larger sized particles in the manufacture of dextrose.

It is a further object to reduce the dust usually associated with the larger sized particles.

It is a still further object of the invention to produce harder and more durable particles.

It is a yet further object of the invention to improve drier efficiency.

Another object of the invention is to use a system that permits a considerable range of control over the size of the particles.

It is still another object of the invention to reduce the lump recycling load.

To the accomplishment of the foregoing and related ends said invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these

being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

Further objects and advantages of this invention will become evident as the description proceeds.

Broadly stated, this invention relates to the steps in the process for the manufacture of dextrose which comprises forming particles of the proper size prior to the drying operation.

In this specification and the examples which follow, materials which pass U.S. No. 16 mesh and are retained on U.S. No. 100 mesh screens are cited as examples of the particle sizes most desired. However, it is to be understood that particles of any desired size at least as large as those retained on U.S. No. 100 mesh screen may be produced without departing from the scope of this invention.

More particularly, this invention relates to the process for the manufacture of dextrose, which comprises centrifuging the magma to separate the sugar and mother liquor, reducing the larger lumps of sugar and compacting finer particles into small agglomerates such as, for example, by milling to a size to pass an U.S. No. 16 mesh and will not pass an U.S. No. 100 mesh, and then drying such sugar.

In the drawing is shown a flow sheet of the process embodying the invention.

The liquor containing dextrose is prepared by the acid hydrolysis of starch. It is usual in the industry to crystallize in motion the dextrose-containing liquor, as is described in U.S. Patent No. 1,471,347, or one of the many variations, modifications, or improvements thereof.

SEPARATION

After crystallization, the resulting magma is subjected to a separation operation to remove the mother liquor (hydrol or first greens) from the dextrose hydrate, such as in centrifugal 1.

The remaining cake is washed with water to remove residual mother liquor, and then is allowed to spin until there is essentially no further liquid removal. Dextrose hydrate cake remaining in the centrifuge will be a relatively hard-packed mass containing from about 12% to about 20%, more usually from 14% to 16%, moisture, including the 9.08% theoretical water of crystallization and about 5% to 7% or 10% of surface moisture. The process of this invention may be conducted at whatever maximum moisture content it is possible for the cake to contain without melting. The tendency is to centrifuge as much moisture from the cake as is possible. Centrifugal cake although compacted is quite soft and very friable as compared to the dry dextrose hydrate.

The centrifugal cake is plowed out of the centrifugal basket into some conveying means, such as a scroll conveyor 2, which takes it to the next operation.

The cake, leaving the centrifugal is very lumpy, that is, having a good percentage of particles larger than U.S. No. 16 mesh, normally considered a larger size than desirable for commerce. It also contains a large quantity of very fine, loose crystals. This is what one would expect from a microscopic examination of the crystal sizes in the crystallizer magma going to the centrifuge which reveals that the majority of crystals are smaller than U.S. 100 mesh.

REDUCING AND COMPACTING

In carrying out the process of the invention it is necessary prior to drying, to form the particles into the size ultimately desired in the final product. This step includes a treatment of the undried centrifugal cake, such as by milling, extrusion, and the like.

The centrifugal cake when it leaves the centrifuge is

usually 60° F. to 90° F. It has been discovered that greater control over the particle size can be obtained by increasing the temperature of the undried centrifugal cake before it is milled or extruded. This is accomplished by a heater 7 which may be employed in the process.

Any type of heating device may be employed, such as a heated conveyor that will heat undried dextrose without melting it to any great extent. This means the heater must operate with a reasonable low temperature differential to insure that the cake being warmed will not melt too much.

The heating of the cake might alternatively be accomplished by spraying steam either into the centrifugal basket or into the conveyor or by introducing, such as by spraying, onto the cake, a hot syrup of dextrose.

The upper limit of heating is determined by the point at which the sugar becomes too sticky to handle, usually between 145° F. to 150° F., at 15% moisture content. The usual temperature range is broadly from about 110° F. to about 150° F., preferably from about 125° F. to 145° F.

It should be understood that the process may be conducted without the heating step, but the increased temperature offers many unexpected advantages to the process if employed.

The centrifugal cake is then subjected to treatment which comprises forming at least 55% by weight, preferably at least 65% by weight, and most desirably at least 70% by weight, of the undried centrifugal cake into particles of a size which will pass an U.S. No. 16 mesh, but will not pass an U.S. No. 100 mesh.

Any sizing device may be employed for this operation that will reduce the undried centrifugal cake to a size to pass an U.S. No. 16 mesh screen, and also compact the fine material into a larger size that will not pass through an U.S. No. 100 mesh, such as a mill, or an extrusion apparatus 3. Suitable devices include a sawtooth crusher or an extruding device which passes the material through apertures, for example, U.S. No. 16 or 20 mesh screen, which will produce particles which will pass an U.S. No. 16 mesh and be retained on U.S. No. 100 mesh screen.

DRYING

The material is next fed to a drier 4, usually a hot air rotary type, and is ordinarily dried to approximately 8% moisture in the case of a dextrose hydrate, which is below theoretical moisture content of dextrose monohydrate, 9.08% by weight.

After the drying operation, the material is graded in classifier 5 to various sizes by means such as screening or air classification, before the packaging operation 6.

Oversized particles which are separated in the classifier 5 may be returned by lump conveyor 8 to the undried centrifugal cake conveyor 2 for reprocessing or milling, or optionally can be dry ground at 9 and returned for classifying. Dry grinding, however, produces dust and should, therefore, be avoided, if possible.

The following specific example is given to illustrate a typical prior art process.

Example I

The magma from the crystallizers was centrifuged. The centrifugal cake was conveyed to the drier without first milling. It analyzed:

	Percent by weight
Lumps:	
On U.S. No. 16 mesh	33
Larger particles:	
On U.S. No. 40 mesh	11
On U.S. No. 100 mesh	33
Smaller particles:	
On U.S. No. 150 mesh	12
Thru U.S. No. 150 mesh	11

The following specific examples are given to illustrate results which may be obtained in following the process and principles of this invention, but should not be construed as limiting the scope thereof, except as defined in the appended claims.

Example II

The magma received from the crystallizers was centrifuged to remove the mother liquor. The undried centrifugal cake was then milled through a "Mercer-Robinson" type sawtooth crusher having one-eighth inch saws and one-fourth inch spacers. After being milled, the centrifugal cake was dried and analyzed:

	Percent by weight
Lumps:	
On U.S. No. 16 mesh	25
Larger particles:	
On U.S. No. 40 mesh	13
On U.S. No. 100 mesh	42
Smaller particles:	
On U.S. No. 150 mesh	12
Thru U.S. No. 150 mesh	8

Example III

The magma received from the crystallizers was centrifuged to remove the mother liquor. The undried centrifugal cake was then extruded through an U.S. No. 16 mesh screen and then dried. The product analyzed:

	Percent by weight
Lumps:	
On U.S. No. 16 mesh	0
Larger particles:	
On U.S. No. 40 mesh	26
On U.S. No. 100 mesh	56
Smaller particles:	
On U.S. No. 150 mesh	14
Thru U.S. No. 150 mesh	4

Example IV

The magma received from the crystallizers was centrifuged. The undried centrifugal cake was then heated to 125° F., and then milled through a "Mercer-Robinson" sawtooth crusher. The product analyzed:

	Percent by weight
Lumps:	
On U.S. No. 16 mesh	15
Larger particles:	
On U.S. No. 40 mesh	13
On U.S. No. 100 mesh	61
Smaller particles:	
On U.S. No. 150 mesh	10
Thru U.S. No. 150 mesh	1

Example V

The magma received from the crystallizers was centrifuged. The undried centrifugal cake was then heated to 130° F., and then milled through a "Mercer-Robinson" sawtooth crusher. The product analyzed:

	Percent by weight
Lumps:	
On U.S. No. 16 mesh	7
Larger particles:	
On U.S. No. 40 mesh	13
On U.S. No. 100 mesh	70
Smaller particles:	
On U.S. No. 150 mesh	0
Thru U.S. No. 150 mesh	1

Example VI

The magma received from the crystallizers was centrifuged. The undried centrifugal cake was then heated to

135° F., then milled through a "Mercer-Robinson" sawtooth crusher. The product analyzed:

	Percent by weight
Lumps:	
On U.S. No. 16 mesh	14
Larger particles:	
On U.S. No. 40 mesh	38
On U.S. No. 100 mesh	47
Smaller particles:	
On U.S. No. 150 mesh	1
Thru U.S. No. 150 mesh	0

Example VII

The magma received from the crystallizers was centrifuged. The undried centrifugal cake was then heated to 141° F., and then milled through a "Mercer-Robinson" sawtooth crusher. The product analyzed:

	Percent by weight
Lumps:	
On U.S. No. 16 mesh	27
Larger particles:	
On U.S. No. 40 mesh	54
On U.S. No. 100 mesh	18
Smaller particles:	
On U.S. No. 150 mesh	1
Thru U.S. No. 150 mesh	0

One of the theories which has been developed to explain the unexpected control of particles size by the process of this invention is as follows. The larger particles are made up of agglomerates (conglomerates, mounted grain, married grain, rolled grain). The larger particles are greater than 100 mesh, while crystals in the magma are principally smaller than 100 mesh. To obtain larger particles, it is, therefore, necessary to form agglomerates. As there are fewer agglomerates in the magma, and as those that exist are small, these agglomerates are formed principally in the process after crystallization. It is believed that the application of heat dissolves a portion of the dextrose in the water which is present, making an adhesive syrup which tends to stick the fine particles together into agglomerates. Reducing the centrifugal cake to a smaller size, by extending it through a No. 16 mesh screen also compacts the smaller particles to larger sized agglomerates. The mill employed for reducing the size of the centrifugal cake has the same effect of forming agglomerates of the smaller sized particles.

In the drawing and specification, there have been set forth a preferred embodiment of the invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation. The substitution of equivalents is contemplated, as circumstances may suggest or render expedient, without departing from the spirit or scope of this invention, as further defined in the following claims.

We claim:

1. In the process for the manufacture of dextrose wherein a liquor containing the dextrose is subjected to a crystallization operation followed by the removal of the mother liquor resulting in the formation of a sugar cake, the steps which comprise: forming a mixture of sugar cake of dextrose with a small amount of adhesive

syrup of dextrose by heating said sugar cake to a temperature in the range from about 110° F. to 150° F. and for a period short of substantial melting, said sugar cake of dextrose having lumpy particles and a large quantity of fine loose particles at a moisture content of about 12% to about 20% by weight, said adhesive syrup being formed in amounts at least sufficient to compact said fine loose particles but not in amounts sufficient to make said mixture too sticky for handling; reducing and compacting sufficient proportions of said lumpy and fine particles of said sugar cake into particles of sizes such that when dried at least 55 percent by weight will be retained on U.S. 100 mesh screen and will pass a U.S. No. 16 mesh screen; and then drying said particles to a moisture content below 9.08% by weight.

2. In the process for the manufacture of dextrose wherein a liquor containing the dextrose is subjected to a crystallization operation followed by the removal of the mother liquor resulting in the formation of a sugar cake, the steps which comprise: forming a mixture of sugar cake of dextrose by heating to a temperature in the range from about 110° F. to 150° F. and for a period short of substantial melting with a small amount of adhesive syrup of dextrose by admixing steam with said sugar cake, said sugar cake of dextrose having lumpy particles and a large quantity of fine loose particles, said adhesive syrup being formed in amounts at least sufficient to compact said fine loose particles but not in amounts sufficient to make said mixture too sticky for handling; reducing and compacting sufficient proportions of said lumpy and fine particles of said sugar cake into particles of sizes such that when dried, at least 55 percent by weight will be retained on U.S. 100 mesh screen and will pass a U.S. No. 16 mesh screen; and then drying said particles to a moisture content below 9.08% by weight.

3. In the process for the manufacture of dextrose wherein a liquor containing the dextrose is subject to a crystallization operation followed by the removal of the mother liquor resulting in the formation of a sugar cake, the steps which comprise: heating the sugar cake of dextrose having lumpy particles and a large quantity of loose fine particles at a moisture content of about 12% to about 20% by weight to a temperature within the range from about 110° F. to about 150° F. and for a period short of substantial melting; reducing and compacting sufficient proportions of said lumpy and loose fine particles into particles of sizes such that when dried at least 55 percent by weight will be retained on U.S. 100 mesh screen; and then drying said particles to a moisture content below 9.08% by weight.

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CERTIFICATE OF CORRECTION

Patent No. 2,901,382 August 25, 1959

Robert G. Rohwer et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, lines 43 and 44, for "extending" read -- extruding --.

Signed and sealed this 8th day of March 1960.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON

Commissioner of Patents