

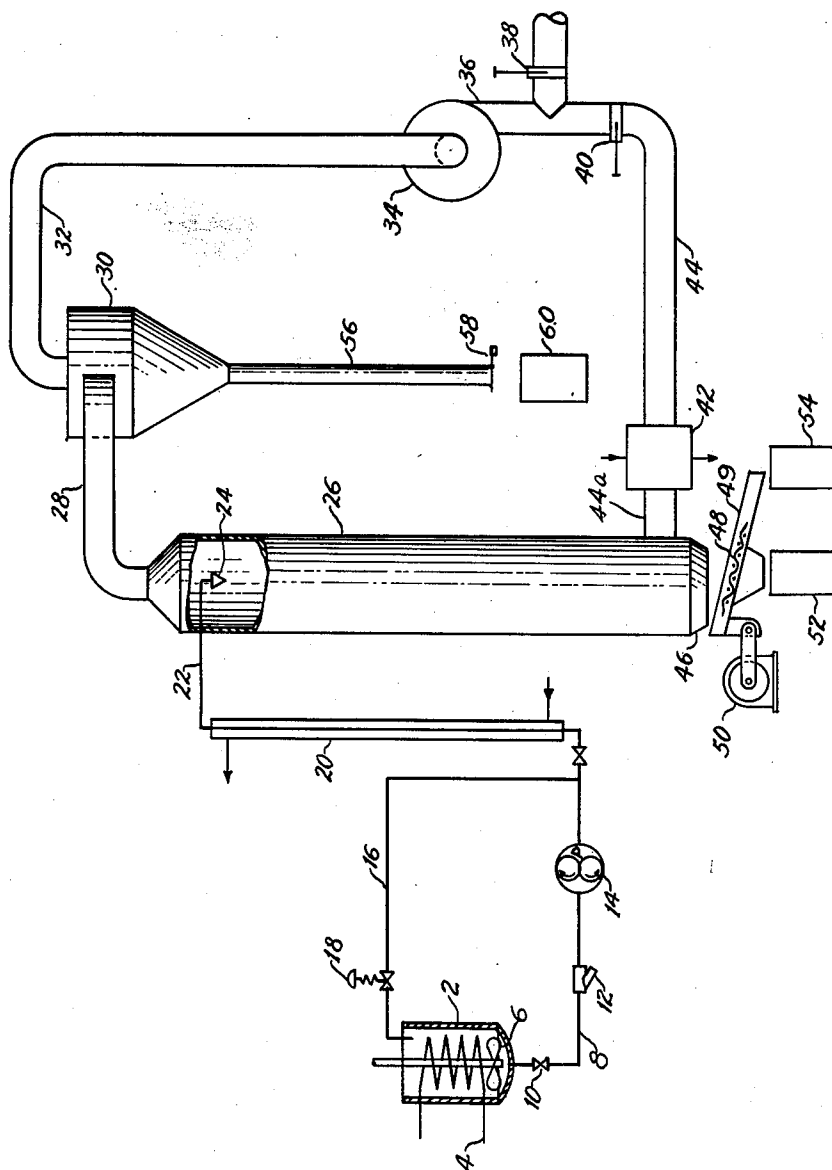
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SPRAY COOLING NORMALLY SOLID FATTY ACID HYDROXY ESTERS

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SPRAY COOLING NORMALLY SOLID FATTY
ACID HYDROXY ESTERS

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This invention relates to processes for the preparation of normally solid fatty acid hydroxy esters in particle form by spray cooling.

It is an object of this invention to provide an improved method for the preparation of normally solid hydroxy esters of fatty acids in particle form by spray cooling.

It is a further object of this invention to provide a process for such preparation of normally solid fatty acid hydroxy esters in particle form which is characterized by improved efficiency of heat transfer and capacity for handling relatively large amounts of material.

It is a still further object of this invention to provide a method for the spray cooling of fatty acid hydroxy esters whereby the average size of the resultant product may be simply and effectively controlled to conform substantially with predetermined size limitations.

Further objects and advantages of the present invention will be apparent from the accompanying description and drawing.

The process of the present invention comprises spraying molten normally solid fatty acid hydroxy esters of polyhydric alcohols into a current of moving gas which serves the dual function of cooling and solidifying the molten esters and of separating the sprayed material as to size during the cooling operation.

In order to understand the method by which the objects of the invention are accomplished, reference is made to the apparatus shown in the accompanying drawing which is adapted for the practice of the invention.

In operating the apparatus shown, material to be processed is introduced into the feed tank 2, where it is melted, if not already in the molten state, and maintained in a fluid condition by the use of steam coils 4. Agitation is accomplished by motion of paddles 6 and serves to maintain the fluid material in a thoroughly homogeneous condition. The material flows from the tank into the pipe 8 at a suitable rate, with the valve 10 open, and is divested of solid foreign substances in passing through strainer 12. The pump 14, which is of the positive-displacement type, serves to elevate the fluid pressure in the line, and is provided with a by-pass line 16 and relief valve 18 for regulating line pressure on the discharge side of the pump. Heat exchanger 20 is included in the system for the purpose of maintaining the material to be sprayed at substantially constant temperature, so as to assist in insuring consistent conditions of spraying.

Upon leaving the heat exchanger the fluid ma-

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terial is delivered through pipe 22 to spray nozzle 24, whereupon it is divided into fine droplets and dispersed into the interior of the vertical, cylindrical, elongate spray tower 26.

Air or other suitable gaseous cooling medium is utilized to cool and solidify the droplets of fluid which issue from the spray nozzle. Whenever the following discussion is limited to the use of air as a cooling medium, it is to be understood that other relatively inert gases and gaseous mixtures are equally adapted to the function of cooling the sprayed esters.

In operation of the apparatus, cool air is introduced into the bottom of the spray tower and caused to flow upward through the tower, the sprayed ester moving downward through the air and being cooled thereby. It will be noted that the air, in traveling such a path is subject to substantial unidirectional flow. The term unidirectional, as used here, is not intended to mean streamline flow, as turbulent flow conditions are desired more often than not in carrying out the process. The strong upward movement of the air in this case serves, however, in addition to increasing the cooling effect upon the sprayed ester, to entrain the finer particles of ester and carry them from the top of the tower via duct 28, whereby the mixture of air and fines is conveyed to a centrifugal dust collector 30, and the suspended fine particles of product removed therefrom.

Air leaves the centrifugal separator by duct 32 and enters the blower 34, which imparts increased pressure to the body of air at its discharge duct 36, thereby causing motion of the air in the system, which may be controlled by varying the energy input to the blower. The duct 36 is provided with adjustable dampers, or registers 38 and 40, for causing the air discharged from the compressor to be wholly or partially returned to the bottom of the spray tower through cooler 42 and ducts 44 and 44a, or discharged at the dampers to the atmosphere. When damper 40 is closed, with damper 38 open, the compressor discharges to the atmosphere and air is forced into the bottom of the column through open end 46 by atmospheric pressure. This mode of operation is carried out most effectively when the atmosphere is at a temperature sufficiently low to provide the requisite cooling effect.

When atmospheric temperature is so high as to give an inadequate cooling effect, or where it is desirable to fix the cooling rate, for example upon having particular flow conditions in view, the

damper 38 may be maintained in a closed position, and damper 40 opened so as to subject the air to closed cycle conditions, the cooler 42 serving to extract heat from the air to bring it to a desired temperature before entering the tower. Conditions of operation may also be modified by leaving damper 40 open and opening damper 38 to such degree as to cause a desired mixture of atmospheric and recycled air to flow up through the tower.

It will be apparent to one skilled in the art that the control of the properties of the air entering the tower which is afforded in the present process makes possible conditions of air flow ranging from near streamline to extreme turbulence, that high and low initial air temperatures may be employed, and that by virtue of the adaptability to varying degrees of mixed flow of atmospheric and recycled air, humidity, and consequently specific heat of the cooling medium may to a considerable extent be predetermined.

Where the atmospheric air is excessively humid to an extent which is undesirable, partial recycling serves to reduce the humidity of the air in the tower by dehumidification of the recycled portion in passing through cooler 42. Similarly, where excessive dehumidification takes place in the cooler under total recycling conditions, atmospheric air may be utilized to an extent necessary to increase the water content of the air to a desired degree. On dry days, direct humidification may be effected by placing humidifying means such as pans of water, saturated wicks or other vapor generators near the air entrance to the spray column, thereby supplying water to increase the capacity of the air for accepting heat from the ester to be cooled.

Average particle size may be controlled by altering the capacity of the spray nozzle and the degree of pressure used in pumping the fluid ester, smaller nozzles and higher pressures yielding finer droplets. The sprayed material may be divided generally into three classifications as to size: that which falls between predetermined limits which define a desired size range, that which is undesirably large, and that which is undesirably small, the last often called "fines," or "dust."

Under single fluid atomizing conditions, which are preferred in the process, the proportion of oversize particles formed is relatively small, and the proportion of fines, or dust may vary, for example from 5 to 50% of the material sprayed, in the case of certain products. In order that a product of a desirable size range be produced in the process, the air rate may be chosen so that all or most undesirably small particles formed on spraying will be carried from the tower by the upward moving column of air. The desirable and oversize particles may then drop from the opening 46 upon the screen 48 which is caused to vibrate by vibrating mechanism 50. Particles of the desired size may pass through the screen and be deposited thereby in finished product drum 52, while oversize material is not passed through and may descend the chute 49, which comprises a unitary member with the screen 48, so as to be placed in drum 54 with material intended for remelting or for use where precision of product size is of little consequence.

Undersize particles which are carried upwards from the tower with the air through duct 28 are separated from the air in the centrifugal separator 30, and drop through column 56, being

discharged through counterweighted gate 58 into drum 60. The fines thus collected may be remelted or used where size is not critical, as in the case of oversize material. In some cases it may be particularly desirable to produce an extra fine product, in which event rates and critical variables of the process may be adjusted so as to produce a maximum of fines which may be collected in drum 60, with all other products being remelted or otherwise disposed of. It is also possible to produce, in one operation, several size classes of sprayed material, each of which may constitute a satisfactory range for various purposes.

Where the process is carried out as herein described, under conditions of well-balanced equilibrium, it may be seen by those skilled in the art that zones are formed in which cooling of the fluid ester, solidification of the ester and cooling of the solid ester take place. Adjustment of air flow and spraying rate, as described, may be utilized to cause the zones to occupy the desired relative volume proportions of the tower for maximum heat transfer efficiency, and the desired separation of fines.

While the discussion here has been limited to the use of a system employing counter current flow conditions, the process is not limited thereto, and parallel flow may be utilized effectively in carrying out the method of the invention. The apparatus shown in the figure may be altered so as to carry out the process under conditions of parallel, or concurrent flow by interchanging ducts 28 and 44a with respect to entrance to the tower, and by simply providing suitable baffle plating at the point where the air leaves the bottom of the tower in order to prevent excessive entrainment of the product with the exit air, while nevertheless effecting the desired separation of the fines from the larger sized material.

A simple and effective construction for accomplishing parallel flow cooling by modification of the apparatus shown in the drawing comprises an arrangement in which communication is provided between the bottom of the tower and the inlet side of the centrifugal separator 30 by an annular chamber surrounding but not obstructing the open end of the tower, and in which communication is provided by means of a duct between the top of the tower and the cooler 42.

The nozzle pressure used in carrying out the present invention may vary from 80 to 200 pounds per square inch, gage, for best results, depending upon the material to be sprayed. The air velocity may preferably vary between 300 and 600 feet per minute. It is generally preferred that the ester be introduced to the spray nozzle at a temperature slightly above its melting point.

The parallel flow technique of operation is generally preferred in the case of materials which are subject to decomposition or other deleterious effects when subjected to high temperatures in molten condition, and may be used with particular advantage where it is desired to reduce the temperature of the molten material rapidly so as to forestall such undesirable effects.

An example of the invention is included describing typical practice in accordance with the invention, and is included to illustrate and not to limit the invention:

Under countercurrent spraying conditions, in an apparatus of the type shown in the drawing, 450 pounds per hour of glyceryl monostearate

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ester containing approximately 55% mono-ester, 30% di-ester, and the remainder impurity, and supplied, at a temperature of 150° F. and a pressure of 140 p. s. i. gage, to a spray nozzle, from which issues a conelike spray having a vertex angle of approximately 30°. The spray tower is 2.5 feet in diameter and air at room temperature and dew point 50° F. is introduced into the bottom of the tower at the rate of 2100 cubic feet per minute. The resulting product comprises fine particles having the following approximate sieve analysis:

	Percent
Through 20 mesh -----	35
Through 40 mesh -----	55
Through 60 mesh -----	5
Finer than 60 mesh -----	5

Of three additional runs, the amount of fines expressed as percent of the total feed were as follows for the air rates given:

Air rate	Fines, percent
2300 cubic feet per minute -----	46
1900 cubic feet per minute -----	17
1500 cubic feet per minute -----	7

Having thus described a limited number of forms of our invention, it should be understood that we do not wish to be narrowly bound except as defined in the appended claims.

We claim:

1. The process which comprises spraying molten, normally solid fatty acid hydroxy ester in fine droplet form into a current of moving

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gas at lower temperature to cool and solidify the ester, the contact of the respective materials forming zones of cooling and solidification, and the rate of motion of the gas being such as to carry undesired small particles therewith away from said zones.

2. The process of producing normally solid fatty acid hydroxy esters in particle form of predetermined range of sizes which comprises pumping a stream of said esters which are at a temperature only slightly above the solidification point under controlled pressure to a nozzle adapted to divide said stream into molten droplets which are predominantly within said size range, contacting said droplets as soon as formed with a current of humid air at lower temperature to solidify said droplets, and utilizing said current of humid air to effect classification of solidified particles into fractions of predetermined range of sizes.

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