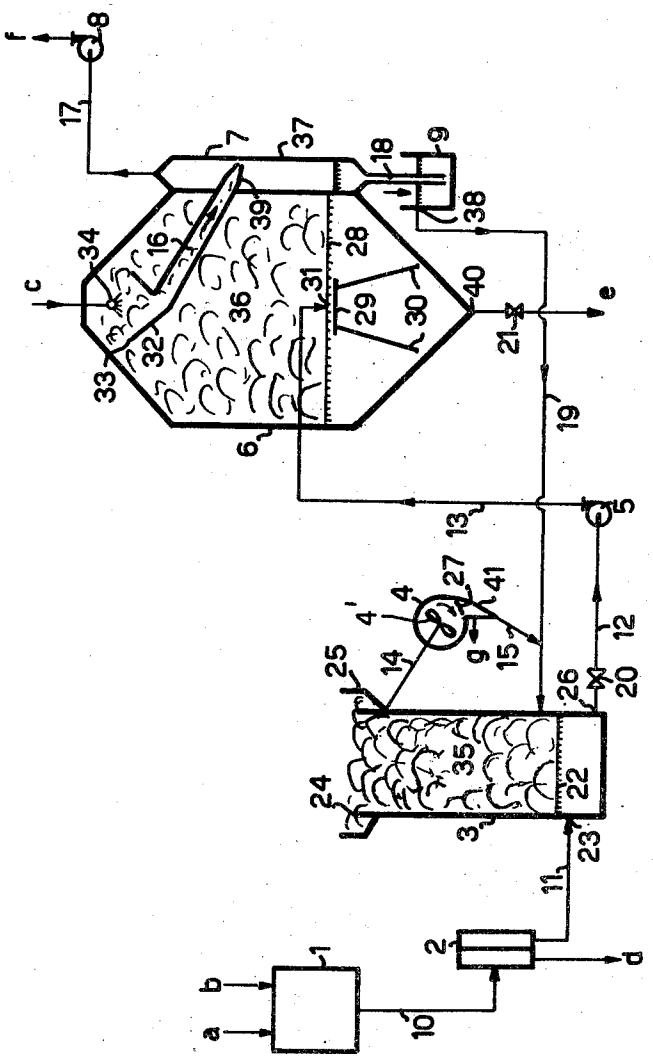
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REMOVAL OF FROTH

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REMOVAL OF FROTH

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The present invention relates to the treatment of liquid material containing soluble albumen and air and more particularly to the separating and breaking down of froth formed in such treatment. More specifically, the invention is concerned with separating and breaking down the froth formed in the treatment of suspensions of grated and screened potatoes.

As is well known, a considerable amount of difficulty is experienced from froth in the manufacture of potato starch. This is particularly so in those cases where the potatoes are grated with the addition of only small amounts of water and then screened in centrifugal screens. In such cases, the suspension formed has a high specific gravity and contains both coarse and fine air bubbles. The bubbles are difficult to remove from the suspension; and upon removal, large quantities of stiff froth, which is difficult to break down with conventional froth breakers, e. g., vacuum or other type, are formed.

Accordingly, the principal object of the present invention is to provide a novel process and apparatus for eliminating the difficulties referred to above.

Further objects of the invention will also be apparent from the following detailed description thereof.

The invention is based upon the discovery that the difficulties previously encountered in dealing with froth as abovementioned are wholly or mainly attributable to the presence together of fine and coarse air bubbles. More specifically, it has been found that if coarse and fine air bubbles (hereinafter referred to as coarse and fine froth, respectively) are removed separately from the liquid under treatment, such removal and the subsequent breaking down process are greatly facilitated.

Hence, the present method can be broadly described as comprising the removal of the coarse and fine froth separately from the liquid material undergoing treatment in two successive steps by first removing the coarse froth and then the fine froth, and thereafter separately breaking down the thus-removed coarse and fine froth. This method, as well as apparatus particularly adapted for carrying out the invention, are more specifically described below.

According to the invention, the fine froth is preferably broken down with the aid of a vacuum, while the coarse froth is broken down without a vacuum by subjecting the same to shocks as, for example, by forcing the froth against a plate or the like with a fan or equivalent means.

In the preferred manner of separating the froth, the liquid material, for example, a potato suspension containing coarse and fine froth, is supplied to a first zone or vessel from which it is continuously discharged at a lower level than the supply so as to establish a downward liquid current. At the same time, the rate of liquid supply and discharge, and the liquid level, are so adjusted with respect to the cross-sectional area of the vessel, and depth thereof, respectively, that the fine froth moves downwardly and discharges from this first zone with the liquid whereas the coarse froth builds up above

the liquid level and can be removed in de-watered condition from the top of the vessel.

The liquid discharged from the first zone, and now containing only fine froth, is then supplied to a second zone or vessel from which the liquid discharge again takes place continuously at a lower level to establish a downward current. As in the first zone, the rate of liquid supply and the liquid level are adjusted with respect to the cross-sectional area and depth of the vessel, respectively, so that the liquid discharge therefrom is substantially free of air bubbles and the froth builds up at the top of the vessel in substantially de-watered conditions. This froth is then passed to a froth breaker, preferably with the aid of clean water, or at least water which is albumen-poor.

For the treatment of a suspension of grated and screened potatoes, it is preferred to select the size of the first vessel in relation to the supply of material to be treated so that the suspension obtained from at least 80 hl. and no more than 120 hl. of potatoes passes into the vessel per hour for every m.^{2} of the upper surface of the liquid in the vessel, the liquid level being from 2 m. to 2.5 m. below the overflow brim of the vessel, i. e., the froth overflows from said zone at from 2 m. to 2.5 m. above the liquid level in the zone.

For the second zone or vessel, it is preferred that this be dimensioned to give an upper liquid surface of such area that suspension from not more than 20 hl. of potatoes passes into the vessel per hour for every m.^{2} of such surface, the overflow brim for the fine froth being from 2 m. to 2.5 m. above the liquid level. Thus, in this embodiment, the liquid surface area in the second vessel in which the fine froth is separated off is at least four times as large as the surface of the liquid in the first vessel in which the coarse froth is separated off. Preferably, it is five to six times as large.

The invention is more specifically described below by reference to the accompanying drawing which diagrammatically shows a preferred apparatus for carrying out the purposes of the invention.

The apparatus shown includes a potato grater **1**, a centrifugal screen **2**, a tank **3** for separating off coarse froth, means **4** for breaking the coarse froth, a pressure pump **5**, a vessel **6** for separating off fine froth, means **7** for breaking the fine froth, a suction pump **8**, and a liquid tank **9**. Conduits **10** to **19** connect the aforementioned devices while the elements **20** and **21** represent valves in conduit **12** and the liquid discharge from tank **6**, respectively.

In use, potatoes and water are supplied to the grater **1**, at *a* and *b*, respectively. Water is also supplied at *c* to vessel **6**. At *d*, the coarse components, mainly fibers, separated off in centrifugal screen **2**, are discharged, while the discharge of the de-frothed potato starch suspension and of the air takes place at *e* and at *f* and *g*, respectively.

In the grater **1**, the potatoes are finely grated and mixed with water, thus producing a suspension consisting essentially of starch particles, fibers, and slightly diluted fruit water. For this grating operation, a grater as described in German patent specification No. 188,153 may be used. Subsequently, the fibers are separated, as indicated above, at *d* from screen **2**. The latter is preferably a centrifugal screen as described in British patent specification No. 681,043 since with such a screen the fibers can be removed in a highly de-watered state.

In separating off the fibers, in the manner described above, a considerable amount of froth is formed in the suspension. Accordingly, the suspension and associated froth are subsequently conveyed from screen **2** to tank **3** by means of conduit **11**. Tank **3** is open at the top, for a purpose hereinafter apparent, and serves as the first zone in which the coarse froth is removed.

The liquid level in tank **3** is kept a little above the

mouth of feed opening 23 and preferably about 2½ m. below the overflow brim 24 through suitable regulation of discharge valve 20. A trough 25, provided around tank 3, collects whatever coarse froth 35 overflows, the thus-collected froth being fed through conduit 14 to froth breaker 4.

As illustrated, the discharge aperture 26 of tank 3 is positioned near the bottom of the tank. Consequently, the suspension in tank 3 flows downwardly and bubbles of froth above a certain general size rise while bubbles below such size go along with the downwardly flowing suspension.

Above liquid level 22, the coarse froth is de-watered to such an extent that the froth which flows over into collecting trough 25 can be broken down without difficulty in froth breaker 4. As shown, the froth breaker is of conventional type and includes an encased fan 4' which is so constructed that it forces the froth against a plate 27 positioned within discharge passage 41 thus breaking down the froth. The liquid thus removed in froth breaker 4 is then returned to the tank 3, at a point above the level 22 of the liquid therein, by means of conduits 15 and 19. Air liberated from the froth is discharged through an aperture *g* provided in discharge passage 41.

The cross-sectional area of tank 3 is, for example, one square meter per hundred hl. of potatoes treated per hour. The choice of cross-sectional area is of importance, for if it is too small with respect to the quantity of froth in the vessel at any particular time, coarse froth is insufficiently separated from the suspension. On the other hand, if this cross-sectional area is too large, the tank is too expensive. In addition, further difficulties might be caused by rising of fine froth in the tank along with the coarse froth.

In connection with the preceding, it is to be noted that it is the quantity of potato passing through the tank in a given time which determines the selection of the appropriate dimensions for the tank. The quantity of water employed, i. e., the concentration of the suspension, is of secondary importance in this connection since although the use, for example, of larger quantities of water involves a higher rate of passage of the suspension through the tank at a given rate of treatment of the potato content, it is found that the velocity at which froth is separated off is about inversely proportional to the concentration of the suspension. The depth of tank 3 in relation to the suspension level is also an important factor and should be such that the overflowing froth is sufficiently de-watered, since the presence in the froth of too large an amount of albumen is a hindrance to breaking down the froth.

The liquid discharged from the first zone (tank 3) and free of coarse froth, is fed by means of valve 20, conduits 12 and 13, and pump 5 to the second treating zone, namely, closed tank 6, for removal of the fine froth therefrom. Since the frothy liquid fed to tank 6 is difficult to pump, pump 5 should be amply dimensioned. The liquid level 28 in vessel 6 is kept close above the plate 29, which is fixed in the vessel 6 by the rods 30. The outlet opening 31 of conduit 13 is disposed close above plate 29, so that currents which would interfere with the rising of the small froth bubbles are avoided. In the top of vessel 6, an overflow funnel 32 is provided whose brim 33 is abou 2½ m. above the level of the liquid. Over the overflow funnel 32 there is a sprayer 34 which is provided with water through *c* for a purpose hereinafter discussed.

The cross-sectional area of the vessel 6 is over one m.² per 20 hl. of potatoes treated per hour. Hence, the sectional area of vessel 6 is about five times as large as the sectional area of tank 3. This area is needed for realizing a complete separation of the fine froth 36 from the suspension. On its way from the liquid level 28 to the brim of the funnel, which is 2½ m. higher, the fine froth is de-watered, with the result that only a negligible amount of soluble albumen is left therein. It will be appreciated that distances of less than the abovementioned 2½ m. between the liquid level and brim 33 of funnel 32 can also be used although, for best operations, the distance is as specifically stated.

The de-frothed starch suspension is discharged at *e* through discharge opening 40. On the other hand, the fine froth, which gets into the funnel 32, is led into the froth breaker 7 via conduit 16, by means of the water issuing from sprayer 34 and under the influence of the depression generated by vacuum pump 8. Froth breaker 7 comprises a closed vessel 37, connected at its upper end with pump 8 by means of conduit 17 and at its lower end with tank 9, by conduit 18. As shown, the discharge opening 38 connecting tank 9 with conduit 19 is higher than the bottom opening of conduit 18, so that a water seal is formed in tank 9.

Conduit 16 ends in a nozzle 39, which is positioned within vessel 37 and terminates adjacent a wall thereof. As a result, the froth flows out of nozzle 39 against the wall at a high speed, thus being broken down. Froth breakdown is also promoted by the depression prevailing in vessel 37. The liquid recovered in this manner flows back into tank 3 through conduit 18, tank 9, and conduct 19. Air separated off is discharged at *f* by pump 8, via conduit 17.

With an arrangement as above described, the capacity of pump 8 should be at least one m.³ of moist air per 2 hl. of potatoes treated per hour. This pump 8 also serves to maintain the pressure in vessel 37 at a maximum of about 0.9 kg./cm.², tank 9 being situated sufficiently lower than the vessel 37 to maintain this depression.

It will be appreciated that various modifications may be made in the invention as described herein without in any way deviating therefrom. Hence, the invention is not limited by the foregoing description and should be determined by the scope of the following claims wherein we claim:

1. In the treatment of a liquid material containing soluble albumen and air by a process involving the continuous formation of both coarse and fine froth, removal of said froth from the liquid material and subsequent breaking down of the removed froth, the improvement which comprises removing the coarse and fine froth separately from said liquid material in two successive zones by first removing said coarse froth in one zone and then removing said fine froth in the other zone and thereafter separately breaking down the thus-removed coarse froth and fine froth by forcing both said coarse froth and said fine froth against a rigid surface.

2. The process of claim 1 wherein the fine froth is broken down by forcing same against a rigid surface while maintaining said froth under reduced pressure.

3. The process of claim 1 wherein the removal of froth in each zone is effected by continuously supplying the liquid material to be de-frothed to said zone, continuously discharging said material therefrom at a lower level than the supply whereby a downward liquid current is established and the froth to be removed rises in said zone, and overflows therefrom in de-watered condition.

4. The process of claim 1 wherein the removal of froth in each zone is effected by continuously supplying the liquid material to be de-frothed to said zone, continuously discharging said material therefrom at a lower level than the supply whereby a downward liquid current is established and the froth to be removed rises in said zone, and overflows therefrom in de-watered condition at a distance of from 2 m. to 2.5 m. above the liquid level in the zone.

5. The process of claim 1 wherein the removal of froth in each zone is effected by continuously supplying the liquid material to be de-frothed to said zone, continuously discharging said material therefrom at a lower level than the supply whereby a downward liquid current is established and the froth to be removed rises in said zone, and

overflows therefrom in de-watered condition at a distance of substantially 2.5 m. above the liquid level in the zone.

6. The process of claim 1 wherein the fine froth removed from the other zone is conveyed to the breaking down step with water which is albumen-poor.

7. The process of claim 3 wherein the liquid material treated is a suspension of grated and screened potatoes.

8. The process of claim 3 wherein the liquid material treated is a suspension of grated and screened potatoes, said suspension is supplied to the first zone at the rate of at least 80 hl. and not more than 120 hl. of potatoes, per hour, for each m.^{2} of the liquid surface in said zone and said coarse froth is removed by overflow from said zone at from 2 m. to 2.5 m. above the liquid level in said zone.

9. The process of claim 8 wherein said suspension with coarse froth removed therefrom is supplied to the second zone at the rate of no more than 20 hl. of potatoes, per hour, for each m.^{2} of the liquid surface in said zone and said fine froth is removed by overflow from said zone at from 2 m. to 2.5 m. above the liquid level in said zone.

10. Apparatus for removing and separating froth from liquid materials containing same which comprises a first vessel adapted to remove coarse froth from said liquid material while leaving the fine froth therein, a second vessel adapted to remove fine froth from said liquid material after removal of the coarse froth therefrom, each of said vessels having a liquid inlet and an outlet with the outlet of the first vessel connecting with the inlet of the second whereby liquid material may be successively passed therethrough, the outlet of each vessel being located below the inlet thereof whereby liquid material passing therethrough has a downward current and froth, coarse in said first vessel and fine in said second vessel, rises upwardly in the vessel and overflows therefrom, separate overflow means associated with each of said vessels for collecting the froth rising therein and overflowing therefrom and separate froth breaking means operatively connected with each vessel for separately breaking down coarse and fine froth, each of said last mentioned breaking means comprising a rigid surface and means for forcing the froth against said surface.

11. Apparatus as claimed in claim 10 wherein the means for breaking down said coarse froth includes an encased fan having a plate associated therewith against which said froth is driven by said fan and the means for breaking down said fine froth comprises an at least partially evaporated vessel and means for forcing said fine froth against a wall of said vessel.

12. Apparatus as claimed in claim 10 wherein each of said overflow means is positioned to receive froth overflow from 2 to 2.5 m. above the level of liquid material passing through said vessels.

13. Apparatus as claimed in claim 10 wherein the overflow means associated with said second vessel includes an overflow funnel communicating with the froth breaking means operatively connected with said second vessel, said funnel having a froth inlet within said vessel, and water spraying means positioned over said inlet to assist in feeding froth within said funnel to said froth breaking means.

14. Apparatus as claimed in claim 10 wherein the cross-sectional area of said second vessel at the level of the inlet thereof is at least four times as great as the corresponding area of said first vessel.

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U. S. DEPARTMENT OF COMMERCE

PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,800,459 July 23, 1957

Cornelis Dijksman 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 6, line 11, for "evaporated" read --evacuated--.

Signed and sealed this 25th day of March 1958.

(SEAL)
Attest:
KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents