United States Patent

Reid et al.

[15] **3,637,402**

[45] **Jan. 25, 1972**

[54] PROCESS OF MAKING AERATED SHORTENING

[72] Inventors: **Edward J. Reid**, Brea; **Perry W. Morgan, Jr.**, Fullerton, both of Calif.

[73] Assignee: **Hunt-Wesson Foods, Inc.**, Fullerton, Calif.

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[52] **U.S. Cl.** ..... **99/118 R**, 99/122 R

[51] **Int. Cl.** **A23d 5/02**

[58] **Field of Search** 99/118, 122, 123

[56] **References Cited**

UNITED STATES PATENTS

2,882,165	4/1959	Dalziel et al.	99/118
2,882,166	4/1959	Clarke	99/118
3,095,305	6/1963	Kearns	99/118
3,142,971	8/1964	Morgan et al.	99/122 UX

FOREIGN PATENTS OR APPLICATIONS

645,446	7/1962	Canada	99/123
735,734	8/1955	Great Britain	99/118

Primary Examiner—Joseph M. Golian

Attorney—Harris, Kiech, Russell & Kern

[57] **ABSTRACT**

A process for making an aerated shortening, preferably a shortening containing about 20 to 26 percent gas by volume. A process utilizing the conventional chilling and agitating such as is obtained in Votator A and B units, in which the liquid fat and gas mixture is initially pressured to a relatively high pressure to place the gas in solution, and in which the pressure is then reduced by about half to convert at least a portion of the gas in solution to dispersed gas prior to chilling and agitation, permitting subsequent processing at lower pressure. A process in which the chilled and agitated stream is subjected to shear-type agitation with recirculation prior to packaging.

11 Claims, 3 Drawing Figures

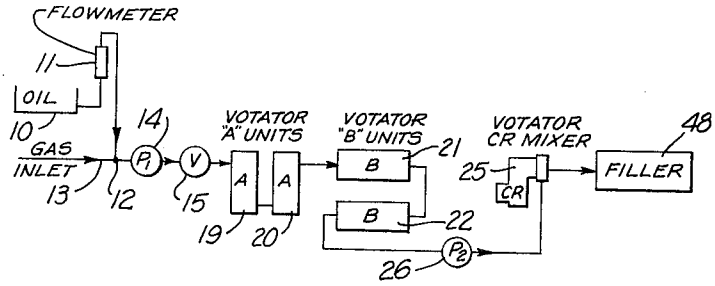


FIG. 1.

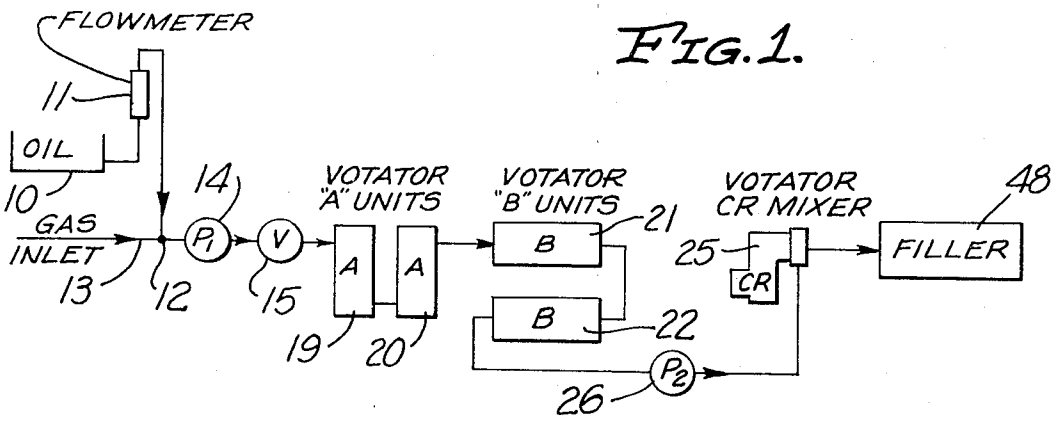
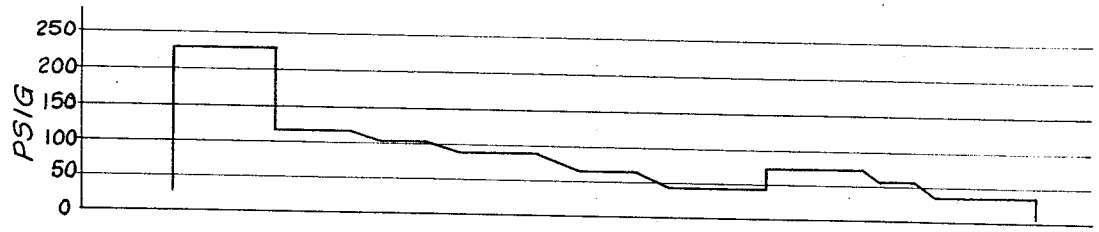


FIG. 2.



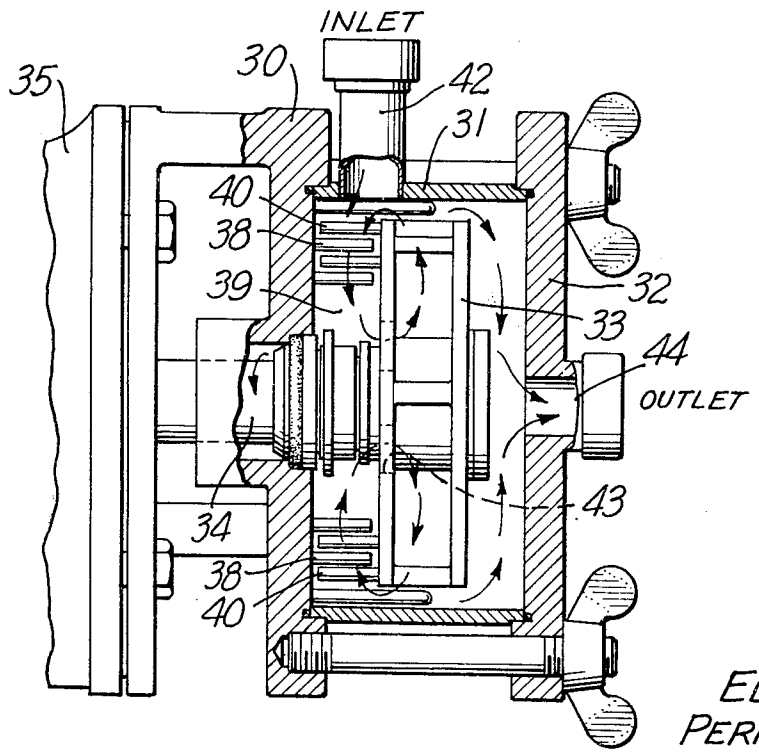


FIG. 3.

INVENTORS
EDWARD J. REID,
PERRY W. MORGAN, JR.
BY THEIR ATTORNEYS
HARRIS, KIECH, RUSSELL & KERN

PROCESS OF MAKING AERATED SHORTENING

This invention relates to an improved process for making an aerated shortening containing a relatively large volume of gas, typically in the range of 15 to 32 percent gas by volume and preferably in the range of about 20 to about 26 percent gas by volume.

Liquid fats have been aerated with a gas, such as air or nitrogen, to produce a plastic shortening for a considerable period of time and by means of a number of related processes. In general, the liquid fat and gas are mixed, subjected to a high pressure, chilled and agitated to produce crystallization, and packaged. The primary purpose of the aerating process is to improve the appearance of the shortening. In a properly aerated shortening, the gas is uniformly dispersed in very small bubbles resulting in a white opaque appearance.

Conventional processes for producing aerated shortening are described in the patents to Dalziel et al. U.S. Pat. No. 2,882,165 and Clarke U.S. Pat. No. 2,882,166. A process for producing an aerated shortening with a higher gas content is described in the patent to Kearns U.S. Pat. No. 3,095,305. These prior art processes operate at relatively high pressures, at least in the initial stages, primarily for the purpose of maintaining the gas in solution in the liquid fat. As indicated in the prior art, considerable difficulty has been encountered in obtaining a uniform product when using a relatively high level of gas.

It has been found that a good aerated shortening can be obtained even though the process is operated at a lower pressure with the gas dispersed rather than dissolved in the liquid fat. It has also been found that the quality of the end product can be improved by a final shear-type mixing with substantial internal recirculation above atmospheric pressure prior to packaging. The final mixing serves to uniformly disperse the gas throughout the shortening to achieve a fine dispersion of occluded gas in the solidified shortening.

In the prior art processes, the mixture of oil and gas is subjected to a high pressure, typically in excess of 200 p.s.i.g., and is rapidly chilled, as by passing through a Votator A unit. The mixture is then agitated or worked to produce crystallization, as by passing through a Votator B unit. The shortening is then ready for packaging, as by a Kiefer filler machine. In one prior art process, the pressure on the stream leaving the Votator B unit is reduced substantially to atmospheric and an additional mixing in another Votator B unit is performed prior to packaging.

In the process of the invention, the mixture of liquid fat and gas is initially pressurized to a relatively high pressure, as in the prior art processes. Then, prior to the chilling and agitating steps, the pressure is reduced to about half the initial pressure, with the usual chilling and agitating steps being carried out at this lower pressure. In a further feature of the invention, the chilled and agitated shortening stream is further agitated by shear mixing between relatively moving elements in a mixer unit with a major portion of the stream being recirculated past the moving elements, preferably at above atmospheric pressure, prior to packaging.

Other advantages, features and results of the invention will more fully appear in the course of the following description. The drawing shows and the description describes a preferred embodiment and preferred operating ranges of the present invention.

In the drawings:

FIG. 1 is a flow diagram of a system for producing aerated shortening and incorporating a preferred embodiment of the present invention;

FIG. 2 is a chart illustrating typical pressure levels along the system of FIG. 1; and

FIG. 3 is a view, partly in section, illustrating a preferred structure for the mixer unit of FIG. 1.

Referring to FIG. 1, the liquid fat or oil flows from a storage container **10** through a flow meter **11** to a point **12** in the system where it is mixed with the gas in line **13**. The oil and gas mixture is pressurized to a relatively high pressure by a pump

14, typically a positive displacement pump of conventional design. The stream then passes through a pressure-reducing device, typically a throttling type globe valve **15**, and then into the chilling unit. A typical chilling unit is the Votator A unit, and in the preferred embodiment illustrated, two Votator A units **19, 20** are operated in series. A Votator A unit consists essentially of a cylindrical tube about 10 inches in diameter with an external jacket cooled by ammonia. A rotor only slightly smaller than the tube, typically about 9 inches in diameter, is positioned within the tube and carries scrapers which scrape from the inner surface of the tube, the thin film of solid material produced by the chilling. The Votator units are described in detail in Bailey "Industrial Oil and Fat Products," Interscience Publishers, Inc., New York, 1945, pages 702–709.

The stream then passes through an agitator or mixing unit which produces crystallization of the product. A typical agitator unit is the Votator B unit and, in the embodiment illustrated, two Votator B units **21, 22** are connected in series. A Votator B unit typically may have a cylindrical housing about 13 inches in diameter with a plurality of stationary fingers extending into the interior. A rotor is provided with a plurality of fingers which extend outward between the stationary fingers, providing a shearing action. Crystal nuclei are formed in the A units, with the major portion of the crystallization occurring in the B units.

In the preferred embodiment of FIG. **1**, the stream is subjected to a further mixing operation of a particular nature in a mixer unit **25**, with the stream preferably being pressurized by another pump **26** prior to entering the mixer **25**. The purpose of the pressure increase is to obtain a uniform product flow to and from the mixer **25**. The actual pressure is not critical at this point and normally is below 100 p.s.i.g. The mixer unit **25** provides an intense shear-type agitation of the product between relatively moving elements and at the same time provides for recirculation of the product through he mixing elements. The mixer unit **25** should be a high-shear mixer with a high level of recirculation. A typical device suitable for use as a mixer unit **25** is the Votator CR mixer, and one of these devices is illustrated in FIG. **3**.

A housing is formed of a body member **30**, a sleeve **31** and an end plate **32**. An impeller **33** is supported within the housing on a shaft **34** which is driven by a variable speed motor **35**.

A plurality of fingers **38** project into a zone **39** between the body member **30** and the impeller **33**. Another plurality of fingers **40** are carried on the impeller **33** and project into the zone **39** between the fingers **38**.

The product stream enters through in inlet **42** into the periphery of the zone **39** and is subjected to intense shear mixing between the fingers **38, 40**. The product stream flows as indicated by the arrows through openings **43** in the sidewall of the impeller **33**, into the central portion of the impeller. The impeller action moves the product to the periphery where a substantial portion of the stream reenters the mixing zone **39** providing the desired recirculation. A portion of the product stream flows toward the end plate **32** and out the outlet **44**.

The product stream flows from the mixer unit **25** to a filler **48** which may be a conventional automatic packaging device such as the Kiefer Vari-Visco filling machine. The Kiefer filler has a compensating cylinder in the filler head designed for operation at high inlet pressures. This compensating cylinder is omitted in the present system which utilizes a relatively low inlet pressure.

The system of FIG. **1** may be operated as follows:

A blend of partially hydrogenated soybean oil (65–125 I.V.) nearly fully hydrogenated cottonseed oil (0–40 I.V.) is mixed with nitrogen and is pressured to about 230 p.s.i.g. The gas-to-oil ratio is selected to provide an aerated shortening containing about 23 percent gas by volume. The addition of monodiglycerides, methyl silicones, lecithin and other additive agents does not substantially change the basic blend of this process. The pressure on the mixture is then reduced to about 115 p.s.i.g. by flowing the stream through a partially

open valve or other restriction. The initial pressurizing places substantially all of the gas in solution in the oil and the subsequent pressure reduction converts a substantial portion of the gas in solution to entrained or dispersed gas. It appears that about 50 percent of the gas is converted in the pressure reduction step.

The initial pressure should be high enough to place as much gas in solution as possible and it has been found that the minimum pressure which will produce acceptable results is about 210 p.s.i.g. The pressure on the stream as it enters the A units should be as low as possible, while being high enough to produce flow of the stream through the equipment. It has been found that the minimum pressure at the input to the A unit which will produce acceptable results is about 90 p.s.i.g. This pressure reduction across the valve **15** preferably is in the order of half the incoming pressure.

Heretofore it has always been thought necessary to put all of the gas in solution and maintain it in solution during chilling in the A-units. This requires pump pressures and pressure in the A-units in the range of 210 to 300 p.s.i.g. It is unexpected that a good aerated shortening can be produced by chilling a mixture of oil and entrained gas.

The stream passes through the A-units with a residence time of a few seconds, typically about 15 seconds for both units. The chilling operation produces crystal nuclei and usually a small amount of crystallization. The temperature the stream entering the A-units may be about 113° F. and the temperature of the stream leaving the A-units may be about 52° F.

The chilled stream from the A-units passes into the B-units where crystallization is largely completed with a residence time in the order of 3 minutes for both units. In this particular example, the rotors of the A-units are turned at 400 r.p.m. and the rotors of the B-units at 90 r.p.m. There is some pressure drop in each of the A-units and each of the B-units, as indicated in FIG. 2. The pressure drop across the A-units results from viscosity increase and from flow through passages of relatively small cross section. The pressure drop across the B-units results principally from viscosity increase due to solidification.

The stream from the B-units is then pressured to about 75 p.s.i.g., passes through the CR mixer and on to the filler. It appears that some crystallization occurs in the mixer but this is not significant and is not the purpose of this mixing step. The rotor of the mixer turns at about 420 r.p.m. and the pressure drop across the mixer occurs primarily at the inlet and outlet couplings rather than in the mixing step itself. The temperature of the stream leaving the B-units is about 68° F. and the temperature leaving the CR mixer is about 74° F. the optimum rotor speed for a particular mixer may be determined by operation of the system. When the speed is too low, good dispersion of the gas is not obtained. When the speed is too high, the mixing produces a substantial temperature rise in the mixture and gas is driven out of the stream.

The filler operates in the conventional manner, filling containers intermittently but without interrupting the flow of the aerated shortening during shifting. This is achieved by bypassing the stream to a tank so there is no significant fluctuation in pressure of the product ahead of the filler. Some crystallization usually occurs in the containers subsequent to the filling step. The resulting aerated shortening has a good texture and an excellent appearance with no voids or streaks.

Aerated shortenings are produced containing dispersed gas in the range of 15 to 32 percent gas by volume and the present process is particularly adapted for use in production of aerated shortenings with gas in the range of about 20 to about 26 percent by volume. The process is applicable to the various liquid fats commonly used for producing shortenings. These materials may be classified as having a solid fat index (SFI) at 70° F. in the range of 10 to 60 percent and an SFI at 104° F. in the range of 2 to 25 percent. The preferred range of SFI for the process is 15 to 25 percent at 70° F. and 6 to 12 percent at 104° F. The various edible fats or oils may be utilized, including vegetable oils, animal fats, marine oils and combinations of these oils or fats. The words oil and fat are used interchangeably and each is construed to include the other.

An operating range and a preferred range for pressures and temperatures at various points in the process are set out in table I.

TABLE I

Location	Operating Range P(psig)	Operating Range T(° F.)	Preferred Range P(psig)	Preferred Range T(° F.)
Between pump **14** and valve **15**	210–300	105–130	220–250	110–115
Between valve **15** and A units	90–140	105–130	100–120	110–115
Between A and B units	50–150	50–60	50–100	50–55
Between B units and pump **26**	25–75	65–80	25–50	68–72
Between pump **26** and CR mixer	50–150	65–80	25–100	68–72
Between CR mixer and filler	0–75	65–80	0–50	70–75

The mixing step produced by the mixer **25** between the B-units and the filler serves to improve the dispersion of the gas in the solid material. This mixing step serves to reduce the average size of the gas particles and reduce the range of size variation of the gas particles. This substantially reduces the tendency of the larger particles to coalesce and form voids during subsequent storage of the packaged shortening.

We claim:

1. A method of making aerated shortening wherein to about mixture of liquid fat and gas is chilled and crystallized with agitation, including the steps of:

aerating liquid fat with about 15 to 32 percent by volume of gas to form an aerated gas mixture,

pressurizing the mixture to a relatively high pressure greater than about 210 p.s.i.g. sufficient to place substantially all the gas in solution in the mixture;

reducing the pressure on the mixture to an intermediate pressure in the range of about 90 to about 140 p.s.i.g. to convert a portion of the gas in solution to dispersed gas prior to the chilling and agitation steps, with the mixture having sufficient gas to produce a shortening containing aerated gas in the range of about 15 to about 32 percent by volume;

2. A method as defined in claim **1** wherein sufficient gas is mixed with the liquid fat to produce a shortening containing aerated gas in the range of about 20 to about 26 percent by volume.

3. A method as defined in claim **1** wherein the mixture is initially pressured to a relatively high pressure in the range of about 210 to about 300 p.s.i.g.

4. A method as defined in claim **3** wherein the pressure on the mixture is reduced to an intermediate pressure in the order of about half the high pressure.

5. A method as defined in claim **1** wherein the mixture is initially pressured to a relatively high pressure in the range of about 220 to about 250 p.s.i.g.

6. A method as defined in claim **2** wherein the mixture is initially pressured to a relatively high pressure in the range of about 210 to about 300 p.s.i.g. and the pressure is reduced to an intermediate pressure in the range of about 90 to about 140 p.s.i.g.

7. A method as defined in claim **1** in which the reduction in pressure is obtained by flowing the mixture through a restriction position in the line between the pressurizing unit and the chilling unit.

8. A method as defined in claim **1** including the step of further agitating the shortening after the aforesaid chilling and crystallizing steps by shear mixing between relatively moving elements in a mixer unit and recirculating a major portion of the stream past the moving elements.

9. A method as defined in claim 8 including the step of pressurizing the mixture prior to the further agitating step, to about the aforesaid intermediate pressure.

10. The method according to claim 1 including the steps of subjecting the aerated shortening following chilling to an intense shear-type agitation between relatively moving elements while establishing in such chamber a closed circulation of the crystallized aerated shortening between such relatively moving elements, the intensity of the shear-type agitation being of predetermined value so that good dispersion of the gas in the crystallized aerated shortening is attained and the temperature is not substantially raised to drive out the dispersed gas from the shortening; and

withdrawing from said chamber a stream of intensely mixed aerated shortening completely crystallized except for incidental crystallization in the ultimate containers.

11. An improved process for preparing for packaging an aerated shortening as part of a process in which a stream of liquid fat is mixed with a gas to form an aerated gas mixture, pressurized to a relatively high pressure, and chilled to form crystals and produce a stream of crystallized aerated shortening, with the stream being at an existing pressure and composed of aerated shortening with the gas substantially in the dispersed state and the crystallization being practically complete, the stream of aerated shortening containing about 15 to about 32 percent gas by volume, which improved process includes the steps of:

aerating liquid fat with about 15 to about 32 percent by volume of gas mixture;

pressurizing the mixture to a relatively high-pressure between about 220 and 250 p.s.i.g. to place substantially all the gas in solution in the mixture;

reducing the pressure on the mixture to an intermediate pressure between about 90 and about 140 p.s.i.g. for converting a portion of the gas in solution to dispersed gas prior to the chilling and agitation steps;

chilling and agitating the mixture to produce crystallized aerated shortening;

pressuring said stream of crystallized aerated shortening;

passing the pressurized stream through a chamber and therein subjecting the crystallized aerated shortening into an intense shear-type agitation between relatively moving elements while establishing in such chamber a closed circulation of the crystallized aerated shortening between such relatively moving elements, the intensity of the shear-type agitation being of predetermined value so that good dispersion of the gas in the crystallized aerated shortening is attained and the temperature is not substantially raised to drive out the dispersed gas from the shortening; and

withdrawing from the chamber a stream of intensity mixed aerated shortening completely crystallized except for incidental crystallization in the ultimate containers.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,637,402 Dated January 25, 1972

Inventor(s) Edward J. Reid and Perry W. Morgan

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 2: Line 37, "he" should read --the--;
Line 67, after "I.V.)" insert --and--.

Col. 3: Line 14, "This" should read --The--.

Col. 4: Line 33, after "wherein" delete --to about-- and insert --a--;
Line 37, after "mixture" change "," to --;--;

Line 47, after "percent by volume;" insert as a new paragraph
--chilling the mixture under said intermediate pressure to produce aerated shortening.--
Line 61, after "250 psig", delete the period and insert --and the pressure is reduced to an intermediate pressure in the range of about 100 to 120 psig.--
Line 64-66, after "psig" add a period and delete the remaining portion of claim.

Col. 6: Line 24, "the" should read --said--;
Line 24, "intensity" should read --intensely--.

Signed and sealed this 15th day of August 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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