CONTINUOUS INVERT SUGAR PROCESS

ABSTRACT: A syrup containing invert sugar and sucrose, preferably a 50-50 mixture, is made on a continuous basis by mixing an acid with a solution of sucrose, allowing partial inversion to take place in a first inversion zone, passing the partially inverted sugar syrup into a second inversion zone having an automatic level control wherein the optical rotation of the sugar syrup leaving the second zone is measured by a polarimeter and the flow of material from the first zone to the second zone is controlled, based on the polarimeter reading of the effluent from the second zone. After leaving the second zone, the solution is neutralized so that inversion does not proceed further.
CONTINUOUS INVERT SUGAR PROCESS

SUMMARY OF THE INVENTION

In many applications of sugar, it is highly desirable to provide a syrup which contains both ordinary sugar and invert sugar. For instance, by providing an approximately 50-50 mixture of the two sugars, one achieves about maximum solubility so that a minimum of water is present as compared with syrups containing other proportions of invert sugar and sucrose. Such highly concentrated solutions are highly desirable since the minimum amount of water need be shipped and also in many formulations, such as in candy making, where ultimately the water content must be reduced to a very low level, it is obviously more economical to start with the highest possible concentration of sugar. Additionally, a 50-50 mixture of invert sugar and sucrose forms a syrup so concentrated that the growth of micro-organisms is inhibited, so that there is essentially no spoilage problem.

Heretofore in preparing such sugar solutions it has been customary to prepare the solution on a batch basis by blending invert syrup with melted granulated syrup. In accordance with the present invention, a continuous process is provided by a unique system of control so that ordinary granulated sugar is rapidly and continuously converted into a sugar syrup containing both invert sugar and ordinary sugar. Preferably, for the reasons given above, the finished syrup contains about 50 percent of each sugar, said syrup containing about 77 percent solids (76.2 percent rds). This, of course, is an optimum product containing the maximum percentage of sugar which will not crystallize at normally encountered temperatures and which will not ferment. However, it will be obvious to those skilled in the art that the process of the present invention is capable of yielding sugar syrups containing other percentages of the two sugars as well as syrups having a lesser total solids content.

In inverting sugar it is important to provide close control of the reaction and particularly to provide for slowing the reaction down rapidly when the desired degree of inversion is achieved. Thus, an object of the present invention is to provide a process for making a 50-50 sucrose-invert sugar syrup containing about 77 percent solids.

Another object of this invention is to provide a continuous process wherein such a syrup can be made from ordinary sucrose.

Still another object of this invention is to provide a simplified process largely having automatic process controls, requiring the minimum amount of labor or other supervision. Another important aspect of the invention is to provide a precise process control system which is rapid to respond.

In general, the objects of the present invention are achieved by carrying out the inversion in one or more zones wherein the percentage of inversion of the effluent is measured and used to control the amount of fresh material flowing into the zone. Preferably the inversion is carried out in two separate zones wherein a first zone is used as a primary inversion zone by mixing therein melted sucrose and acid. The inversion is carried on in the first zone under automatic control to something less than the ultimate desired inversion and the solution is then passed to a second inversion zone in which addition of acid is carried out. An automatic control system is provided on the outlet of the second inversion zone and the flow of material into the second inversion zone is controlled by the amount of invert sugar in the effluent. Since flow out of the zone is controlled by an automatic level valve, it is obvious that if the material is introduced into the second zone at a high rate, the residence time will be short and the amount of added acid low, and vice versa. Thus control of the rate at which liquid is added to the second tank provides a convenient way to control the degree of inversion. Since this type of control provides for an immediate flow of fresh dilution material into the zone, precise control is achieved and the reaction does not go beyond the desired point. After leaving the second zone, the sugar syrup now being at the desired degree of inversion is neutralized wherever it can be cooled and stored.

The reaction could be done in a single tank or it could be carried out in three or even more tanks. In general, the larger the number of tanks, the greater the reaction rate and thus the throughput for the total volume involved. As the number of tanks increases, the control equipment becomes more expensive and two reaction tanks has been found to be an effective compromise between tank utilization and the expense of control equipment.

BRIEF DESCRIPTION OF THE DRAWING

FIGS. 1A and 1B of the drawing are a flow diagram of a plant embodying the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A melted sucrose stock having a sugar content of about 75.2 rds is first prepared. For this purpose, water is introduced through line 2 and mixed with steam through line 4 to produce a hot water stream 6, a portion of which is introduced through line 8 to premelt manifold 10 where white sugar is added from bins 12. A screw conveyor 14 moves the wet sugar into melt column 16 where additional water is added through line 18 to maintain a density of approximately 76.2 rds. Column 16 is equipped with an agitator 20 and by the time the sugar has reached the bottom of the column, it has been completely dissolved or melted. A small amount of water is now added through line 22 to reduce the density to about 75.2 rds and the melted sucrose of the desired density is passed through line 24 into a holding tank 26.

The melted sucrose is passed into a primary inversion tank 28 and at the same time hydrochloric acid is added through line 30 from an acid drum 32 which is controlled by a pH controller 34 to maintain a pH in the tank 28 from about 1.7 to 2.3 or preferably about 2.1. Tank 28 is provided with an agitator 29 and a steam jacket 31. An automatic level control valve 36 maintains the desired level in tank 28. The residence time in the primary inversion tank is about 15 to 40 minutes and the temperature is maintained at around 72° C. The reaction rate could be increased by lowering the pH and/or raising the temperature, but it is important that the rate not be too high as this could produce a colored product. During this period from 30 to 35 percent of the sugar is inverted.

The material in tank 28 is now passed through line 38 into a secondary inversion tank 40. The secondary inversion tank 40 is substantially the same as the primary inversion tank 28 and output from this tank is taken through line 42 and the rate at which the material flows out is controlled by a level valve 44. In other words, a constant level will be maintained in the tank 40 and the amount of material flowing out of the tank will depend upon the amount flowing into it. The outlet line 42 is provided with a polarimeter 46 which is used to control inlet valve 48 in line 38. The polarimeter is set so that if the amount of invert sugar leaving through line 42 is less than 50 percent, valve 48 will close down, causing a greater holding time in tank 40 and this condition will prevail until the invert content has been brought up to the desired 50 percent. On the other hand should the invert content go over 50 percent invert sugar, then valve 48 would open more, bringing in more of the lower invert solution and allowing a shorter residence time and thus the amount of inversion taking place in tank 40 would be reduced to the extent necessary to reduce the fluent down to 50 percent invert sugar.

When the material is withdrawn through line 42 it is passed to the tank 50 where sodium carbonate is added through line 52 from tank 54. The sodium carbonate neutralizes the acid, causing the inversion reaction to immediately cease. According to the preferred operation of the process, the syrup in tank 50 contains approximately 50 percent sucrose and 50 percent invert sugar and has 77 percent solids (76.2 rds). The sugar syrup is withdrawn through line 54, passed through a heat
exchanger 56 where it is cooled and then may be withdrawn for use through lines 58 or 60 or stored in tank 62.

It will be apparent that a novel process has been provided which is largely automatic in operation whereby one can prepare invert sugar solutions on a continuous basis. Although the invention has been described in terms of providing a 50–50 invert-sucrose syrup of high solids content, it will be apparent to those skilled in the art that higher or lower percentages of inversion can be obtained if desired and also that less concentrated syrups can be produced by the continuous process described.

We claim:

1. In a continuous process for converting sucrose at least partly to invert sugar wherein there are at least a first and a second inversion zones for converting sucrose to invert sugar, the improvement comprising providing a continuous process for producing a predetermined amount of invert sugar in the product by maintaining a constant level of sucrose and invert sugar in the second inversion zone continuously measuring the invert sugar content leaving the second inversion zone, employing the amount of said inversion to regulate the flow of sucrose and invert sugar entering the second inversion zone, said flow being inversely proportional to the residence time in the second inversion zone, thus controlling the amount of inversion in the second inversion zone.

2. The process of claim 1 wherein the sugar is converted from sucrose to 30–35 percent of invert sugar in the first inversion zone and is converted to about a 50–50 mixture of sucrose and invert sugar solids in the second inversion zone.

3. The process of claim 1 wherein the final product has about 77 percent solids.