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PROCESS FOR PRODUCING REFINED SUGAR

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This invention relates to a process and means for treating the raw juices of the sugar cane and saccharine matter from other sources such as sugar beets, sugar maple, etc., and refers particularly to novel ways and means for clarifying and refining the same in order to produce refined raw sugar, refined table syrup or refined vinegar.

The main object of my invention is to manufacture sugar, table syrup or vinegar from sugar cane juice or other saccharine material by means of an inexpensive, simple and expeditious process.

Another object is to utilize a predetermined group of steps, conditions and chemical substances in treating the cane juice and the like so as to obtain uniformly the same dependable clarification of the juice and efficiency of operation.

A further object and particular advantage of the invention is to have a process of the character indicated which makes it possible by a mere matter of choice during operation, to obtain sugar, table syrup or vinegar as the end product.

Yet another object is to introduce a method and means for reducing the percentage of scum produced by causing the same to be more dense and of different character, as well as more completely separated and precipitated than heretofore, and reducing the period of evaporation from crude juice to finished product by free working of the juices and syrups so as to eliminate incrustations in evaporator tubes or vacuum pan coils so as to obtain maximum benefit of the heating employed and reduction of the amount of fuel used, and simultaneously obtain a maximum output of sugar, invert sugar or vinegar from the crude juice.

It is also an object of the invention to use special apparatus adapted for carrying out the process in a very efficient manner so as to enhance its advantageous features and facilitate operation and production.

Further objects and the various advantages inherent in the nature, practice and results of my invention will appear more fully in appropriate detail as this specification proceeds.

In the accompanying drawing forming part hereof,

Fig. 1 is a diagrammatic arrangement of the special apparatus particularly designed for carrying out the present process to the best advantage according to the invention.

Fig. 2 is an enlarged sectional view of a portion of the same apparatus termed a syphon sub-

Consider tank.

In these views, the same reference numerals indicate the same or like parts.

With the foregoing objects in view, as well as others not mentioned, and also in order to eliminate many of the disadvantages inherent in old processes in this art, it is now proposed herein to depart from certain accepted and commonly used principles and methods. Hence, in proceeding to describe my invention, the juice of the sugar cane will be considered as representing a 10 general class of saccharine substances, and lends itself admirably to a complete disclosure of the invention in practical form.

In a sugar mill provided with typical cane crushing machinery, the juice expressed from the cane is thus the raw material with which I shall specifically deal herein, and forms the starting material for the practice of my invention. Therefore, the raw cane juice, as it comes from the sugar mill 1 is delivered directly to a container or tank 2 through a pipe 3 and shown in Fig. 1, known as “Peurtado’s juice purifying tank.” The capacity of the same may be 500 to 2,000 imperial gallons or more, or any capacity desired, and the juice is delivered to said purifying tank in its normally cold condition. When this tank or container is about one quarter full, while the cane juice coming from the mill is actively entering the tank, a chemical mixture termed “Nickelilor” is introduced and mixed with the cold juice in such manner as to obtain a churning and consequently mixing effect, due to the incoming juice by its motion virtually stirring the contents of the tank. The mixture referred to as entitled “Nickelilor” consists of Bacea glucoside (CaH12O12), 35 in powder form, with or without tannin (CaH12O12), silicious diatoms of about .25 specific gravity, and one or more of the chemical compounds in the class including phosphoric acid (H3PO4), hydrochloric acid (HCl), sulphuric acid (H2SO4), sulphurous acid (H2SO3), citric acid (C6H8O7), acetic acid (C2H5OH), oxalic acid (H2CO3), tartaric acid (C4H6O6), sodium hydrosulphite (NaHSO3), sulphate of alumina (Al2(SO4))3 and calcium oxide (CaO), in some what varying proportions, according to the chemical constitution of the juice by test. The mentioned Bacea glucoside may be prepared from the bark of the bastard cedar tree (Guazuma tomentosa) H. B. and K.

When mixing the mentioned “Nickelilor” the same is added to a typical tank of cane juice in the approximate proportions of 400 grains avoirdupois of Bacea glucoside powder or tannin to each one hundred gallons of juice, 450 grains of
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cious diatoms of 25 specific gravity, and 400 grains of phosphoric acid and/or any one of the other compounds of the above mentioned class. This mixture may, of course, be added in any other manner desired and in other proportions, as found preferable in practice.  

The cane juice or sugar solution thus initially treated is then passed through a pipe 5 to a juice heater or defecator 4 and passed upward from the same to a group of steam heated clarifiers 6, 7, through a pipe 6 and brought therein to a boiling temperature of about 80° C. or less, with the result that the natural and other so-called impurities in the juice are rendered insoluble and caused to rise to the surface of the liquid by the combined action of the heat and the added mixture "Nickisifor" so as to form a blanket or curd, known in the art as scum. At this stage, every precaution must be taken to allow this scum to boil in or "break in" with the hot liquid, and must under no circumstances be eliminated, brushed off or skimmed off from the boiling liquid as is ordinarily done in current methods of sugar making.

From this point onward, a slight variation in the subsequent treatment of the boiled juice may be resorted to in accordance with the end product desired, whether this is to be refined raw sugar, table syrup or vinegar.

In the first case, when vacuum pan made raw sugar is to be produced, the heated, that is, boiling liquid is neutralized with lime by treating the same with an aqueous solution or mixture of calcium oxide (CaO) in the form of a lime cream in the proportion of 2.4 to 3.2 oz. avoidiropulos of such cream to each one hundred gallons of juice or sugar solution, more or less, according to actual test with litmus paper or phenolphthalein, so that the liquid as a result is left either neutral or only faintly acid in reaction. This liming is, of course, done very cautiously in order to avoid over-licening of the sugar solution, but when this step is completed, the liquid is in proper condition for subdivision for the purpose of completely separating a clear brilliant liquid from the impurities or scum.

In order to accomplish this, the limed liquid is allowed to descend through pipes 8, 9, etc., into a series of special containers 9, 9, beneath the clarifiers, known as "Peurtado's syphon subsiders," one of which is shown more in detail in Fig. 2 with reference to the interior structure thereof, which type of apparatus is particularly well adapted for the separation of the clear sugar solution from the impurities, which is the next step in the process. The subsiders are interiorty provided with a plurality of spaced, rigid, angular baffles 10, 10, etc., which control the sedimentation in the apparatus, the baffles being also spaced a short distance above the bottom of the latter. In one end of the subsider is a juice outlet pipe 11, to which is attached a ball joint 12 by which a float or syphon pipe is connected to pipe 11, while adjacent to the open upper end of pipe 11 is a rigidly attached float 13 adapted to support said upper end of pipe 13 just below the surface of the liquid so as to syphon off or decant the clear liquid as far as possible above the bottom liquid which contains the scum or impurities in the form of sediment, and pass the same through pipe 11 to a storage tank 16 for the clarified juice.

When the treated liquid has been caused to descend into any one or all of said syphon subsiders, it is at most allowed to remain about twenty minutes in order to allow the impurities to settle among the baffle, after which the clarified solution is decanted as stated, while the sediment is drained off through pipes 15, 15 to filter presses 17 below the same and the clarified liquid thus received by the filter presses is then allowed to expel all remaining crystalizable sugar solution through pipes 18, 18 to a juice receiver 18, whence the juice is passed through a pipe 20 to the storage tank 16 already containing the bulk of the clarified juice. The impurities in the form of presedate are removed from the filter presses and may be used for fertilizer, etc. From the storage tank 16, the clear juice may finally be led by pipe 21 to vacuum pan evaporators 22 and evaporated to dryness and crystallized.

If the sugar to be produced is to be open battery made, the raw cane juice initially treated with the mentioned mixture termed "Nickisifor," is transferred directly to the steam clarifiers 6, 6, and the heat turned on until the juice boils and the scum broken in or boiled in as before, and also limed as described, the process then being continued at this stage and the juice delivered, as already mentioned, to the subsider and left therein at maximum, for a period of twenty minutes because the scum subsides rapidly, settling by virtue of the increased specific gravity of the same brought about by the addition of the "Nickisifor." The subsequent purification may proceed as previously described, or the liquid may be filtered on masse.

When the clarified juice has been obtained, the same may be evaporated and concentrated into sugar by the known open battery system of boiling sugar, but in general the process up to the concentration of the clarified juice is practically the same as previously described for production of sugar by the vacuum pan method.

In case refined table syrup is to be produced, the initially treated juice, which contains the impurities or scum in boiled-in form, is now treated further to invert the sucrose in solution and thereby prevent sucrose from crystallizing out in the final syrup. This inversion is readily and economically accomplished by adding to the clarified juice, fermented can juice twenty-four hours old, more or less, in the proportion of ten pounds avoidiropulos of such fermented or sour juice to every fifty pounds of initially treated juice, and the resulting liquid boiled in the clarifiers 6, 6 until the density becomes about 28° Baumé and the pD 4.5.

When the stated density and concentration have been attained, the acids in the boiling juice are neutralized by liming the latter in similar fashion to that followed in producing the refined sugar. In other words, to each one hundred imperial gallons of boiling juice is added from 2.4 to 3.2 ounces avoidiropulos of an aqueous solution of calcium oxide in the form of lime cream, more or less, as indicated by litmus or phenolphthalein test, so as to leave the treated juice neutral or faintly acid in reaction. At this stage, the juice is quite thick, and liming is, of course, done cautiously, to avoid over-licening, as before.

The heat in the clarifiers is discontinued and the thick hot juice either filtered on masse or transferred to the subsiders 9, 9 through pipes 70, 70, 8, 8, etc., and retained in the subsiders a sufficiently long period to allow the additional impurities to settle or subside to the partitioned lower portions of the subsiders. It is also possible to simply leave the treated juice undisturbed in the
clarifiers, so that the scum settles to the bottom and the clear juice then decanted.

In any case, the resulting thick, clear juice is now ready for evaporation into a refined table syrup consisting substantially of invert sugar (C₆H₁₂O₆) of any density desired by drawing the same off through pipes 11, 11 and 22 from the scum in the subsidaries, for example, and evaporating by the triple effect system in the evaporators 21, 21, etc. (without vacuum pan), or following the open battery system of boiling sugar as used in the described process of producing sugar. The scum with its residual juice is passed to the filter presses 17, 17 and the juice recovered passed along with the bulk of the juice produced to the tank 16 and then to the evaporators, while the press cake resulting from the scum is, of course, used for fertilizer as before. The finished syrup or invert sugar is run off from the evaporators to storage tanks and allowed to fine automatically by resting about twenty-four hours preparatory to being run off into containers such as bottles, cans and barrels for the market, and labeled in any manner desired, for example, with the fanciful name or mark "Jucana". When cold, the finished juice is not only thick, but clear and brilliant, and preferably has a density of 41.6° Baumé and polarizaton of 40° and over.

When the end product is intended to be refined, the initially treated juice containing the boiled-in scum is boiled in the clarifiers with 1% of hydrochloric acid in order to invert the sugar then to be boiled into the mixture, heating the mixture sufficiently to cause coagulation to occur to form, further treating said mixture by adding a mixture of lime and water in sufficient quantity to neutralize the acids present, boiling in the scum in the liquid in order to obtain a purified juice capable of being worked up at will in conventional manner.

The Scum with its residual juice, which consists in heating the raw juice in the presence of Baceeda glucoside in finely divided form, silicious diatoms and a reagent capable of cooperating with the Baceeda glucoside and silicious diatoms in coagulating the impurities in said juice into a scum which tends to settle when boiled into the juice, said reagent comprising at least one of a plurality of defecants capable of forming with said Baceeda glucoside and silicious diatoms a scum which settles when boiled into the mixture, heating the mixture sufficiently to cause coagulation to occur to form, further treating said mixture by adding a mixture of lime and water in sufficient quantity to neutralize the acids present, boiling in the scum in the liquid in order to obtain a purified juice capable of being worked up at will in conventional manner.

2. The process for purifying raw saccharine juices, which consists in heating the proportions of about 100 gallons of the raw juice to about the boiling point of water in the presence of about 400 grains of hydrochloric acid in finely divided form, about 450 grains of silicious diatoms having a specific gravity of 0.25 and about 400 grains of a reagent capable of reacting with the Baceeda glucoside and silicious diatoms so as to coagulate the impurities in said juice into a scum which tends to settle when boiled into the juice, said reagent comprising at least one of a plurality of defecants capable of thus cooperating with the Baceeda glucoside and silicious diatoms to form said settling scum, further treating said juice mixture by adding a mixture of lime and water in sufficient quantity to neutralize the acids present, boiling in the scum in the liquid in order to effectively neutralize the acid present and to concentrate said scum, discontinuing the heating so as to allow the scum to settle to the bottom of the juice, and then decanting the juice above the level of the settled scum in order to obtain a purified juice capable of being worked up at will in conventional manner.

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