



No. 13-043514- -00012-0000

Fecha: 2014-12-15 16:41:22 Dep. 2020 DIR.NUEVASCR
Tra. 11 PATENTEIYII Eve: 379 FASENACIONALI
Act. 412 REPOSPRESRECU Folios: 64

Señor

SUPERINTENDENTE DE INDUSTRIA Y COM

E.

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REF:

Expediente 13-043-514

Recurso de reposición contra la Resolución 63053 de 22 de octubre de 2014, por la cual se niega una patente de invención.

TÍTULO:

MÉTODO Y COMPOSICIÓN PARA PRODUCIR AZÚCAR CLARIFICADA.

PUBLICACIÓN:

GACETA No. 668 del 31/05/2013 N° de publicación: 692.

SOLICITANTE:

RDM EMPREENDIMENTOS E PARTICIPAÇÕES S.A.

TRÁMITE:

RECURSO DE REPOSICIÓN

JOSÉ LUIS REYES VILLAMIZAR, mayor de edad, identificado como aparece al pie de mi firma, abogado en ejercicio, titular de la tarjeta profesional número 44655 del Consejo Superior de la Judicatura, conocido apoderado de la sociedad solicitante **RDM EMPREENDIMENTOS E PARTICIPAÇÕES S.A.** en el asunto de la referencia, de manera respetuosa, y dentro de los términos de ley, presento Recurso de Reposición contra la Resolución 63053 de 22 de octubre de 2014, por la cual se niega una patente de invención.

I. FUNDAMENTOS DEL RECURSO Y RAZONES DE INCONFORMIDAD.

Tal como se expondrá a continuación, y al contrario de lo que se afirma en la Resolución 63053 del 22 de octubre de 2014, se estima muy respetuosamente que la materia reivindicada en el expediente de la referencia sí involucra y demuestra un efecto técnico sorprendente frente a las revelaciones del arte anterior, circunstancia que determina, de suyo, la existencia de nivel inventivo y la patentabilidad intrínseca de la creación que nos ocupa.

1.1. Presentación de una solicitud de modificación de la solicitud en curso

Antes de dar respuesta al requerimiento de la referencia en el mismo orden planteado, me permito informar al Despacho que en la fecha, previa consignación de las tasas oficiales aplicables, mediante el empleo del formulario correspondiente, y con el fin de atender plenamente las sugerencias y objeciones del Señor Examinador, he modificado el capítulo reivindicatorio de la solicitud, cuyos términos no exceden el alcance planteado en la solicitud original y están plenamente soportados en la descripción inicialmente presentada.

Las modificaciones introducidas tienen el objeto de hacer mayor claridad en relación con el objeto reivindicado, buscan atender íntegramente las objeciones planteadas, y consisten, específicamente, en lo siguiente:

- i) Se han eliminado las reivindicaciones 54 a 61;
- ii) Aunque entendemos que limitar el alcance de la patente a los agentes quelantes específicos sería restringir indebidamente su ámbito de protección, ya que cualquier agente quelante conocido de la técnica sería eficaz, se ha limitado la reivindicación 13 (ahora 1), insertando el alcance de la reivindicación 20 y la expresión "o mezclas de los mismos" y se han eliminado las reivindicaciones 18-20.
- iii) En cuanto a los términos "uno o más", "al menos", "más cualquier etapa" y "en Diferentes Etapas", se han borrado dichos términos del capítulo reivindicatorio.
- iv) Con relación a las composiciones y kits, se han eliminado las reivindicaciones 52 y 53.
- v) Las reivindicaciones 44, y 47 a 49 han sido modificadas
- vi) La reivindicación 46 ha sido eliminada.
- vii) Se han eliminado las reivindicaciones 1 a 12 referentes a métodos.

A lo largo del presente recurso se hará referencia adicional a las modificaciones aquí referidas; se anota que las nuevas reivindicaciones han sido renumeradas a partir de la número 13 (primera reivindicación) y hasta la 51 (última reivindicación).

1.2. En relación con los documentos D1 (WO2009066316) y D2 (GB174027)

Según la Resolución 67313, el problema técnico de la invención es: "*¿Cómo modificar el método de producción de azúcar clarificada conocido en D1 para hacer que la decoloración del azúcar sea más eficiente?*".

Y la solución presentada por el solicitante es: *“un método para reducir el color del azúcar y/o cualquier intermediario del proceso para la obtención de azúcar, mediante la adición de un inhibidor de enzimas, uno o más sulfitos, metabisulfitos, bisulfitos, hidrosulfitos, o dióxido de azufre o una fuente de los mismos y un agente quelante, en cualquier etapa del proceso de obtención de azúcar clarificada.”*

El señor Examinador ha considerado que: *“la utilización de agentes reductores tal como el ácido sulfoxílico formaldehído y específicamente el sulfoxilato formaldehído de sodio, que hacen parte de la familia de compuestos propuesta por la presente solicitud, para aumentar la eficiencia en la decoloración de jugos de azúcar, ya está divulgada en el documento D2 que se refiere a que el uso de estos compuestos como agentes reductores en la producción de jugos de azúcar, permiten mejores resultados con respecto al brillo del jugo. (Pág. 1, líneas 64 a 68)”*, y concluye que la materia reclamada es obvia pues una persona versada en la materia, usaría agentes reductores del tipo ácido sulfoxílico formaldehído (D2) en el procedimiento divulgado de D1.

El solicitante considera que la resolución ha ignorado que el parámetro crucial para determinar si un proceso para reducir el color del azúcar es eficaz, es la estabilidad del color obtenido al aplicar ese proceso, pues la invención carecería de objeto si el color reducido en cuestión no pudiera mantenerse demostradamente en el tiempo.

Y ello es especialmente relevante en este caso, pues ninguno de los documentos D1 o D2 revela o sugiere siquiera un proceso para reducir el color del azúcar que otorgue estabilidad al color obtenido en el tiempo, parámetro que sí se verifica, demostradamente, al aplicar la materia aquí reivindicada.

Es más, D1 y D2 ni siquiera han debido ser considerados como arte anterior más cercano a la materia que revela la solicitud 13-043-514, pues mientras ésta resuelve el problema de lograr estabilidad temporal para el azúcar clarificado obtenido, aquéllos ni siquiera se plantean, ni mucho menos resuelven ese problema técnico, circunstancia que los hace inaplicables al examen que nos ocupa. Veamos:

i) En cuanto a D1, éste únicamente cita que el azúcar puede obtenerse por sus métodos, pero en ninguna parte de la descripción se hace referencia alguna a la estabilidad del color obtenido en el tiempo ni tampoco se presentan pruebas sobre este efecto técnico.

WO2009066316 (p. 7)
Various embodiments of this invention provide a method for manufacturing sugar from sugarcane. However, the embodiments are not limited and may be used in connection with various applications that will be described in later part of this specification. In general, the present invention provides an improved method for manufacturing sugar which includes steps of spraying or adding or dosing biocides during cane preparation (calling as cane sanitation) and milling (calling as mill sanitation), short-circuiting atleast one or both sulfitation steps of the conventional double sulfitation process and then treating sugarcane juice / syrup with two new formulations such as viscosity reducer and amine-based polymer for improving crystallization and for removing impurities, including decolorization of the sugar. The present invention utilizes two biocide formulations, namely Formula I and Formula II, to kill the microbes during cane sanitation and mill sanitation step.

ii) Por su parte, el documento D2, se refiere únicamente a la estabilidad del compuesto de formaldehído sulfoxilato de sodio en forma sólida, pero no a la estabilidad del color reducido del azúcar, que posiblemente ha sido proporcionada por el reactivo. Así pues, no se está hablando de la misma materia técnica, ni de una solución real al problema técnico planteado por la presente invención:

GB174027 - Process for decolorising liquids	
de color. This invention is an improvement in or a modification of that described in the said specification, and consists in the application in the said process of soluble salts of formaldehyde-sulphoxylic acid, such as sodium formaldehyde-sulphoxylate, as reducing agents. The use of these compounds presents the following advantages: 1. They are stable in solid state, in contradistinction with the salts of hydrosulphurous acid. 2. They are stable in solution and in most liquids; they are more soluble in water than the salts of hydrosulphurous acid are. p. 1, ln 25 a 40	tion of the solution. Moreover, in the application of the process to sugar juices, by the use of these compounds as reducing agents, a better result is obtained with regard to the brightness of the juice. This peculiarity is to be ascribed to the action of the formaldehyde of these compounds on the albuminous and pectinous substances contained in these juices, whereby such substances are converted into other compounds, insoluble in water, which can be removed from the solution simultaneously with the adsorbent. The following example illustrates the invention:— To 100 cc. of a molasses solution of 20 per cent. strength are added 1 gram of bone charcoal (carbo-animalis puriss Merck) and, after thorough boiling, 200 mgms. of sodium formaldehyde sulphoxylate. After filtration the colour of the liquid is paler than when the treatment is with bone charcoal alone, or with sodium formaldehyde-sulphoxylate alone. p.1., ln 60 a 90

En conclusión, los documentos D1 y D2 no se relacionan entre sí, por lo que un técnico medio versado en la materia ubicado en el momento de la presentación de la invención, no podría realizar la combinación de enseñanzas entre éstos, comparación únicamente posible si se hace un análisis retrospectivo, contrario a la técnica del derecho de patentes, que ignoraría la objetividad de dichas anterioridades y el contenido de la presente invención.

1.3. La materia reclamada no era obvia a la luz de D1 y D2

En la Resolución 63053 el examinador sostiene que:

- D1 revela los componentes 2 y 3 de la presente solicitud,
- Y que D2 revela el componente 1,
- Por lo que sería obvio para una persona experta en la técnica seleccionar estos componentes a partir de D1 y D2 a fin de obtener un método para reducir el color de azúcar como el reivindicado por la presente solicitud.

Sin embargo, el solicitante llama la atención del Despacho sobre el hecho que el componente 2 en D1 se revela como un agente de control de pH, y no como un importante agente reductor del color, por lo que un técnico versado en la materia no lo incluiría en la materia de D1, siendo motivado hacia otros fines por el mismo documento.

Además, en D1 no se hace referencia a la importancia del componente 2 en la reducción de color, y por consiguiente a la estabilidad de esta reducción de color. Esto implica que no existe motivación alguna para incluir dicho componente a partir de D1, ni a partir de D2, por lo que no se derivaría de forma obvia hacia la composición de la presente invención. En otras palabras, no sería obvio para una persona experta en la técnica el seleccionar el componente 2 de D1 con el fin de obtener la reducción de color con una mejor estabilidad en el tiempo, como en la presente invención.

En vista de tales enseñanzas, no sería obvio para un experto en la materia el combinar las enseñanzas de D1 y D2 dado que se refieren a un campo técnico diferente al de la presente invención, y dichos campos técnicos no guardan relación alguna entre sí, y no sugieren cual es la selección de los componentes 1, 2 y 3 que logran un efecto sorprendente o inesperado.

1.4. El efecto técnico logrado por la invención

La invención en consideración revela un proceso que proporciona una mejor estabilidad del color del azúcar durante el tiempo, como se puede ver en el ejemplo 8 (páginas 40 y 41 de la descripción), en donde consta que la clarificación del color de los azúcares ensayados se mantuvo estable durante un lapso de tiempo de seis meses.

Ejemplo 8

La presente invención no sólo trae como resultado menos color que la tecnología convencional, sino que también ocasiona una mayor estabilidad de color en el tiempo para el azúcar producido. El incremento de color para el azúcar almacenado se puede ver afectado por la temperatura del secado del azúcar, la temperatura del ambiente en donde se almacena el azúcar, la humedad del ambiente, entre otros. Para el presente Ejemplo, se prepararon sacos de azúcar de 50 kg con tecnología convencional y con la tecnología conforme la presente invención. El azúcar producida y probada se sometió a las mismas condiciones de almacenamiento, tales como los mismos tipos de bolsa, la misma temperatura del azúcar para el secado (40 a 42°C), y la misma temperatura y humedad durante el almacenamiento. La prueba se realizó durante seis meses de estabilidad en dos rangos de fecha diferentes, como se muestra a continuación en las Tablas 7 y 8, respectivamente. Para la producción de azúcar conforme la presente invención en los datos consignados en la Tabla 7, los productos químicos aplicados fueron 100 ppm, 100 ppm y 360 ppm de los Componentes 1, 2, y 3, respectivamente, en la entrada del último evaporador, y 100 ppm del Componente 2 en la salida del último evaporador. Con respecto a la Tabla 8, se utilizó el mismo método, pero los productos químicos utilizados fueron 50 ppm, 50 ppm y 60 ppm, de los Componentes 1, 2 y 3, respectivamente, y 50 ppm del Componente 2 en el segundo punto de entrada.

	Azúcar producida conforme la presente invención	Azúcar producida con tecnología convencional
Color inicial	138 UI	340 UI
Color final	149 UI	420 UI
Incremento de color	7,97%	23,53%

	Azúcar producida conforme la presente invención	Azúcar producida con tecnología convencional
Color inicial	112 UI	238 UI
Color final	119 UI	290 UI
Incremento de color	6,25%	21,85%

Como se muestra arriba, la presente invención también trae como resultado una reducción significativa e inesperada en el incremento del color para el azúcar que se almacena, lo que demuestra sus ventajas en el incremento de la estabilidad del color. Los componentes 1 y 3, en particular, contribuyen con esta estabilidad.

Finalmente se debe recalcar que, como bien comprende una persona experta en el arte, es posible efectuar innumerables modificaciones y variaciones a la presente invención, en base a las enseñanzas presentadas anteriormente, sin ir más allá del alcance de su protección, tal como se establece en las Reivindicaciones anexadas.

REYES & REYES

A B O G A D O S

Asombrosamente, se determinó que el color de los azúcares de la presente invención aumentó en una bajísima proporción entre **6% y 8%** después de 6 meses, mientras que el color de los azúcares del estado de la técnica se incrementó entre **21% y 24%**.

Lo anterior demuestra que la combinación de estos reactivos en un mismo proceso para la obtención del azúcar, además de no haber sido sugerida por las enseñanzas de D1 o D2, es sorprendente pues los resultados superan las expectativas que podría tener un experto en la materia a partir del estado de la técnica.

Cabe mencionar, por último, y en relación con la suficiencia de la descripción del proceso reivindicado, que éste comprende al menos un paso (el paso de añadir los componentes) y los pasos adicionales, subsiguientes, referidos al proceso de producción de azúcar, que resultan inherentes a la aplicación misma del proceso referido, razón por la cual se estima innecesario, como fundamento para sustentar la suficiente descripción, incluir pasos adicionales en el proceso reivindicado.

Así pues, en conclusión, se estima que el proceso reclamado no es obvio a la luz de las enseñanzas de los documentos D1 y D2, y se reitera que el mismo, además, demuestra un efecto técnico sorprendente e inesperado en cuanto a la duración del color del azúcar que se obtiene luego de su aplicación.

1.5. Intención de otorgamiento de la EPO

De otro lado, se desea mencionar que la oficina de patentes en Europa, el 21 de octubre de 2014, le comunicó al solicitante la intención de conceder de la solicitud de patente No. 11 748 871.8 – 1358 equivalente a la solicitud colombiana 12-043-514 (WO2012/019266) del solicitante **RDM EMPREENDIMENTOS E PARTICIPAÇÕES S.A.**, concepto que si bien no es vinculante para la oficina colombiana de patentes, sí demuestra la existencia de sólidos indicios sobre la patentabilidad de la presente invención, que corroboran los argumentos de mi representada.

II. PETICIONES

Con fundamento en los argumentos expuestos en el presente recurso, y de conformidad con el capítulo reivindicatorio modificado, el solicitante estima haber superado objeciones planteadas por el Despacho en la resolución que nos ocupa. Por ello, se solicita muy respetuosamente, como petición principal, la revocación íntegra de dicho acto administrativo y la emisión de otro que en su reemplazo conceda el privilegio de patente solicitado, de acuerdo con las reivindicaciones modificadas, o bien, como petición

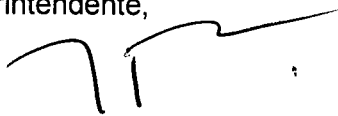
subsidiaria, que se ordene el envío del expediente y del nuevo capítulo reivindicatorio a la Dirección de Nuevas Creaciones de esa entidad, con el fin de que se practique un nuevo examen de fondo a la solicitud referida, de conformidad con el mencionado capítulo reivindicatorio modificado, y atendiendo los argumentos planteados en este documento.

III. ANEXOS

Adjunto para la inmediata referencia del Señor Superintendente, y ruego que se tenga como prueba al momento de resolverse el presente recurso, la comunicación de "Intención de Concesión" expedidas por la Oficina Europea de Patentes ("EPO") en el trámite de la solicitud equivalente allí tramitada.

De igual manera, para una mejor comprensión de las modificaciones introducidas en el capítulo reivindicatorio, me permito anexar, para fines ilustrativos, una versión adicional a la presentada hoy en escrito separado, con control de cambios, titulada, "Capítulo Reivindicatorio Modificado con Control de Cambios".

Señor Superintendente,



JOSÉ LUIS REYES VILLAMIZAR

C.C. 79.152.473 de Bogotá

T.P.A. 44.655 del C.S.J.

REIVINDICACIONES

13. Proceso para la producción de azúcar de color claro y/o cualquier intermediario de un proceso para la obtención de azúcar, CARACTERIZADO PORQUE comprende la adición, en etapas del proceso, de los Componentes 1, 2 y 3, en donde los componentes 1, 2 y 3 son:

Componente 1: clorito de sodio, tropolona, ácido beta-fluorocafeico, o una sulfoxilato; o una sal de la forma $M^+O-S(=O)-CH(OH)R$; o un ácido orgánico monobásico de azufre que tiene la fórmula general RSO_2H ; en donde M^+ puede ser un catión mono o multivalente, y donde R es H, alquilo C_1-C_{20} , alquilo ramificado C_1-C_{20} , alquilo C_5-C_6 cíclico, arilo, bencilo, o anillos heterocíclicos C_5-C_6 , y en donde R puede ser sustituido o no sustituido; o mezclas de los mismos, en donde dicho componente es adicionado en cantidades que varía entre 10 ppm a 400 ppm, por volumen del líquido sobre el cual adicionado,

Componente 2: uno o más de los sulfitos, bisulfitos, metabisulfitos, o dióxido de azufre o una fuente del mismo; en donde dicho componente es adicionado en cantidades que varían entre 10 ppm a 400 ppm, por volumen del líquido en el cual es componente es adicionado, y

Componente 3: un agente quelante seleccionado del grupo que consiste en DTMP (dietilentriamina penta (ácido metilénfosfónico)), ATMP (aminotris (ácido metilénfosfónico)), HEDP (1-hidroxi- 1,1 etiliden-difosfónico), EDTA.2Na (ácido etilén diamina disódico tetraacético), o EDTA.4Na (tetrasodio de ácido etilendiaminotetraacético) y sus mezclas, en donde dicho componente es adicionado en cantidades que varía entre 10 ppm y 400 ppm, por volumen del líquido en el cual el componente es adicionado

14. El proceso de la reivindicación 13 CARACTERIZADO PORQUE el Componente 1 se selecciona de formaldehído sulfoxilato de sodio, potasio formaldehído sulfoxilato, hidrosulfito de sodio, clorito de sodio, tropolona, y ácido beta-fluorocafeico, o mezclas de los mismos.

15. El proceso de la reivindicación 14 CARACTERIZADO PORQUE el componente 1 es formaldehído sulfoxilato de sodio.

16. El proceso de la reivindicación 13 CARACTERIZADO PORQUE el Componente 2 se selecciona de metabisulfito de sodio, metabisulfito de potasio, metabisulfito de calcio, metabisulfito de magnesio, bisulfito de sodio, bisulfito de potasio, bisulfito de calcio, bisulfito de magnesio, sulfito de sodio, sulfito de potasio, sulfito de amonio, sulfito de magnesio, sulfito de calcio, azufre, dióxido de azufre; y sus mezclas.

17. El proceso de la reivindicación 16 CARACTERIZADO PORQUE el Componente 2 es metabisulfito de sodio

21. El proceso de la reivindicación 20 CARACTERIZADO PORQUE el Componente 3 comprende HEDP.

22. El proceso de la reivindicación 13 CARACTERIZADO PORQUE el Componente 3 es una mezcla de agentes quelantes.

25. El proceso de la reivindicación 23 CARACTERIZADO PORQUE los componentes se adicionan al proceso en la misma etapa.

26. El proceso de la reivindicación 23 CARACTERIZADO PORQUE el componente 3, 1 y 2 se adicionan después de la molienda de la caña, durante o después del calentamiento, durante o después de sulfitación, durante o después de calcificación, durante o después de fosfatación, durante o después de la decantación, durante o después de la evaporación, durante o después de la ebullición, durante o después de la centrifugación, durante o después de la flotación del jarabe, durante o después de la remezcla del magma, o durante el refinado.

27. El proceso de la reivindicación 23 CARACTERIZADO PORQUE el Componente 3, 1 y 2 se adiciona en el punto de entrada de cualquiera de los evaporadores.

28. El proceso de la reivindicación 23 CARACTERIZADO PORQUE el Componente 3, 1 y 2 se adiciona corriente abajo del último evaporador.

29. El proceso de la reivindicación 23 CARACTERIZADO PORQUE el Componente 3, 1 y 2 se añaden al proceso a través de diferentes puntos de

entrada, de conexión, de adición o directamente a las unidades operativas del proceso.

30. El proceso de la reivindicación 29, CARACTERIZADO PORQUE el Componente 3, 1 y 2 se añaden al jugo entrante en las etapas del evaporador, o al jarabe transportado entre evaporadores o a los mismos evaporadores.

31. El proceso de la reivindicación 29 CARACTERIZADO PORQUE los puntos de entrada están situados en diferentes etapas del proceso.

32. El proceso de la reivindicación 29 CARACTERIZADO PORQUE los puntos de entrada se encuentran en la misma fase del proceso.

33. El proceso de la reivindicación 29 CARACTERIZADO PORQUE los tres componentes se añaden al proceso a través de un único punto de entrada como una mezcla, o por separado en el mismo punto, o en diferentes puntos del proceso.

34. El proceso de la reivindicación 29 CARACTERIZADO PORQUE se añaden los componentes 1 y 2 a través de un punto de entrada, de forma simultánea, con el Componente 3 añadirse por separado, en el mismo punto de entrada o en un punto de entrada diferente.

35. El proceso de la reivindicación 29 CARACTERIZADO PORQUE cada componente se puede añadir de forma independiente a través de más de un punto de entrada.

36. El proceso de la reivindicación 35 CARACTERIZADO PORQUE el componente 2 puede tener dos o más puntos de entrada en el proceso.

37. El proceso de la reivindicación 36 CARACTERIZADO PORQUE el Componente 2 se adiciona dos veces durante el proceso en diferentes puntos de entrada.

38. El proceso de la reivindicación 37 CARACTERIZADO PORQUE el Componente 2 se adiciona en el punto de entrada de la última evaporador y nuevamente corriente abajo del último evaporador.

39. El proceso de la reivindicación 37 o 38, CARACTERIZADO PORQUE la relación entre los diferentes puntos de entrada en ppm del componente 2 es de 1:20 a 20:1 entre los diferentes puntos de entrada en ppm.

40. El proceso de la reivindicación 35, CARACTERIZADO PORQUE el componente 3 puede tener dos o más puntos de entrada en el proceso.

41. El proceso de la reivindicación 40 CARACTERIZADO PORQUE parte del componente 3 es adicionado en el punto de entrada del primer evaporador, y la parte restante se añade en el punto de entrada del último evaporador.

42. El proceso de la reivindicación 40 CARACTERIZADO PORQUE parte del componente 3 se añade directamente a los primeros y últimos evaporadores, respectivamente.

43. El proceso de la reivindicación 40, CARACTERIZADO PORQUE el 50% del Componente 3 se añade en un punto de entrada y el 50% restante en otro punto de entrada.

44. El proceso de la reivindicación 43, CARACTERIZADO PORQUE la relación entre los diferentes puntos de entrada en ppm del componente 3 va desde 01:20 a 20:11.

45. El proceso de la reivindicación 13 CARACTERIZADO PORQUE los tres componentes se pueden añadir en cualquier orden durante el proceso.

47. El proceso de la reivindicación 46, CARACTERIZADO PORQUE el componente 1 se añade en cantidades que varían de 20 ppm a 100 ppm, de 50 ppm a 100 ppm, de 25 ppm a 75 ppm, y de 20 a 25 ppm por volumen del líquido sobre el cual el componente es adicionado.

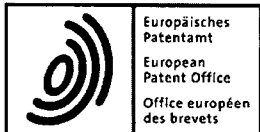
48. El proceso de la reivindicación 46 CARACTERIZADO PORQUE el componente 2 se añade en cantidades que varían de 50 ppm a 200 ppm, de 50 ppm a 150 ppm, de 50 ppm a 100 ppm, de 40 ppm a 50 ppm, y de 25 ppm a 75 ppm por volumen del líquido sobre el cual el componente es adicionado.

49. El proceso de la reivindicación 46, CARACTERIZADO PORQUE el

Componente 3 se añade en cantidades que varían de 60 ppm a 360 ppm, de 60 ppm a 180 ppm, de 20 ppm a 120 ppm, de 60 ppm a 120 ppm, de 50 a 100 ppm, y de 50 a 90 ppm por volumen del líquido sobre el cual el componente es adicionado.

50. El proceso de la reivindicación 13, CARACTERIZADO PORQUE la materia prima para la producción de azúcar se selecciona del grupo que consiste de la caña de azúcar, remolacha azucarera, sorgo sacarina o mezclas de los mismos.

51. El proceso de la reivindicación 50, CARACTERIZADO PORQUE la materia prima para la producción de azúcar es la caña de azúcar.



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Application No. 11 748 871.8 - 1358	Ref. 70509D32073	Date 21.10.2014
Applicant RDM Empreendimentos e Participações S.A.		

Communication under Rule 71(3) EPC

1. Intention to grant

You are informed that the Examining Division intends to grant a European patent on the basis of the above application with the text and drawings and the related bibliographic data as indicated below.

A copy of the relevant documents is enclosed.

1.1 In the text for the Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT
RO RS SE SI SK SM TR

Description, Pages

1-3	as published	
4-26, 30-34	filed in electronic form on	07-08-2014
3a, 27-29	introduction proposed by the Examining Division on	26-08-2014

Claims, Numbers

1-13	filed in electronic form on	07-08-2014
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Drawings, Sheets

1/5-5/5	as published
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With the following amendments to the above-mentioned documents proposed by the division

Description, Pages	9, 26, 30, 34
	Delete Previous: 35

16

Comments

* R. 42(1)b) EPC, p. 3a; Art. 84 EPC, p.9; R. 49(5) EPC, pages 27-29 correspond to p. 27-29 as published, p. 26 and 29; R. 48(1)c) EPC for pages 34 and 35;

1.2 Bibliographic data

The title of the invention in the three official languages of the European Patent Office, the international patent classification, the designated Contracting States, the registered name(s) of the applicant(s) and the other bibliographic data are shown on the **enclosed EPO Form 2056**.

2. Invitation

You are invited, **within a non-extendable period of four months** of notification of this communication,

2.1 to EITHER approve the text communicated above and verify the bibliographic data (R. 71(5) EPC)

(1) by filing a translation of the claim(s) in the other two official languages of the EPO

Fee code EUR

(2a) by paying the fee for grant including the fee
for publication:
minus any amount already paid (R. 71a(5) EPC):

007 915.00
0.00

Total amount: 915.00

(3) by paying additional claims fees under Rule 71(4) EPC;
number of claims fees payable: 0
minus any amount already paid (R. 71a(5) EPC):

016 0.00
0.00

Total amount: 0.00

Important: If the translations of the claims and fees have already been filed and paid respectively in reply to a previous communication under Rule 71(3) EPC, e.g. in the case of resumption of examination after approval (see Guidelines C-V, 6), **agreement as to the text to be granted** (R. 71a(1) EPC) must be expressed within the same time limit (e.g. by approving the text and verifying the bibliographic data, by confirming that grant proceedings can go ahead with the documents on file and/or by stating which translations of the claims already on file are to be used).

Note 1: See "Important notes concerning fee payments" below.

Note 2: Any overpaid "minus" amounts will be refunded when the decision to grant (EPO Form 2006A) has been issued.

2.2 OR, in the case of disapproval, to request reasoned amendments or corrections to the text communicated above or keep to the latest text submitted by you (R. 71(6) EPC).

In this case the translations of the claims and fee payments mentioned under point 2.1 above are NOT due.

The terms "amendment(s)" and "correction(s)" refer only to amendments or corrections of the application documents and not of other documents (e.g. bibliographic data, the designation of the inventor, etc.).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

2.3 Bibliographic data

Where you request a change or correction of bibliographic data in response to the Rule 71(3) communication, this will **not** cause the sending of a second communication under Rule 71(3) EPC. You will still have to pay the fees and file translations in reply to the Rule 71(3) communication in the case of 2.1 above, unless you also file a reasoned request for amendments or corrections in response to the Rule 71(3) communication (see case 2.2 above).

3. Loss of rights

If neither of the two possible actions above (see points 2.1 or 2.2) is performed in due time, the European patent application will be deemed to be withdrawn (R. 71(7) EPC).

4. Further procedure

4.1 In the case of point 2.1 above

- 4.1.1 The decision to grant the European patent will be issued, and the **mention of the grant** of the patent will be published in the European Patent Bulletin, if the requirements concerning the translation of the claims and the payment of all fees are fulfilled and there is agreement as to the text to be granted (R. 71a(1) EPC).

Note on payment of the renewal fee:

If a renewal fee becomes due before the next possible date for publication of the mention of the grant of the European patent, publication will be effected only after the renewal fee and any additional fee have been paid (R. 71a(4) EPC).

Under Article 86(2) EPC, the obligation to pay renewal fees to the European Patent Office terminates with the payment of the renewal fee due in respect of the year in which the mention of the grant of the European patent is published.

Note on payment of the designation fee(s):

If the designation fee(s) become(s) due after the communication under Rule 71(3) EPC, the mention of the grant of the European patent will not be published until the designation fee(s) has/have been paid (R. 71a(3) EPC).

- 4.1.2 After publication, the **European patent specification** can be downloaded free of charge from the EPO publication server <https://data.epo.org/publication-server> or ordered from the Vienna sub-office upon payment of a fee (OJ EPO 2005, 126).

Until 31 December 2013, each proprietor may request in writing to receive the certificate for the European patent together with one copy of the new patent specification only if the request is filed within three-month or the additional two-month period (R. 95(3) and (4) EPC). If such request has been previously filed, it has to be confirmed within the same period. The requested copy is free of charge. Any request or confirmation of a request filed after 31 December 2013 or after expiry of these periods will not be dealt with and the certificate will be delivered without a copy of the new European patent specification (cf. Notice from the European Patent Office dated 16 July 2013 concerning communication of the certificate for a European patent, OJ 2013, 418).

4.1.3 Filing of translations in the Contracting States

As regards translation requirements prescribed by the Contracting States under Article 65(1) EPC, please consult the website of the European Patent Office

www.epo.org → Law & practice → Legal texts, National law relating to the EPC

www.epo.org → Law & practice → All Legal texts → London Agreement

18

In the case of a valid extension or validation

As regards translation requirements prescribed by the Extension or or Validation States, please consult the website of the European Patent Office

www.epo.org → Law & practice → Legal texts, National law relating to the EPC

Failure to supply a prescribed translation in a Contracting State, or in an Extension or Validation State may result in the patent being deemed to be void *ab initio* in the State concerned (Art. 65(3) EPC).

4.2 In case of 2.2 above

If the present communication under Rule 71(3) EPC is based on an auxiliary request and, within the time limit, you maintain the main request or a higher ranking request which is not allowable, the application will be refused (Art. 97(2) EPC).

If the Examining Division gives its consent to the requested amendments or corrections, it will issue a new communication under Rule 71(3) EPC; otherwise, it shall resume the examination proceedings (R. 71(6) EPC).

5. Filing of a divisional application

Any divisional application relating to this European patent application must be filed directly with the European Patent Office in Munich, The Hague or Berlin and will be in the language of the proceedings for the present application, or if the latter was not in an official language of the EPO, the divisional application may be filed in the language of the present application as filed (see Article 76(1) and Rule 36(2) EPC). Any such divisional application must be filed while the present application is still pending and the time limit for filing divisional applications must be observed (R. 36(1) EPC; Guidelines A-IV, 1.1.1).

6. Important notes concerning fee payments

6.1 For all payments, please refer to the relevant **fee code(s)**.

6.2 Automatic debiting procedure

The fee for grant, including the fee for publication, and any additional claims fees due under Rule 71(4) EPC will be debited automatically on the date of filing of the translations of the claims, or on the last day of the period of this communication. However, if the designation fee(s) become(s) due as set out in Rule 71a(3) EPC and/or a renewal fee becomes due as set out in Rule 71a(4) EPC, these should be paid separately by another permitted way of payment in order not to delay the publication of the mention of the grant. The same applies in these circumstances to the payment of extension fees. For further details see the Arrangements for the automatic debiting procedure (AAD) and accompanying information from the EPO concerning the automatic debiting procedure (Annexes A.1 and A.2 to the Arrangements for deposit accounts (ADA) in Supplementary publication 4 - OJ EPO 2014).

6.3 Important information relating to fee amounts

Following any amendment to the Rules relating to Fees, the amount(s) mentioned in this communication may be different from the amount(s) **actually due on the date of payment**. The latest version of the Schedule of fees and expenses, published as a Supplement to the Official Journal of the EPO, is also available on the EPO website (www.epo.org) and can be found under www.epo.org/schedule-of-fees, which allows the viewing, downloading and searching for individual fee amounts, both current and previous.

Please note that procedural fees are usually adjusted every two years, on even years, with effect from 1 April.

6.4 Payments by cheque delivered or sent direct to the EPO are no longer accepted as from 1 April 2008 (see OJ EPO 2007, 626).

Examining Division:

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Enclosure(s): Text intended for grant (43 pages)

EPO Form 2056

Annex to EPO Form 2004, Communication pursuant to Rule 71(3) EPC

Bibliographical data of European patent application No. 11 748 871.8

For the intended grant of the European patent, the bibliographical data are set out below, for information:

Title of invention:

- VERFAHREN UND ZUSAMMENSETZUNG ZUR VERRINGERUNG DER FARBE VON ZUCKER
- METHOD AND COMPOSITION FOR REDUCING THE COLOR OF SUGAR
- PROCÉDÉ ET COMPOSITION POUR LA RÉDUCTION DE LA COULEUR DU SUCRE

Classification: INV. C13B20/08 C13B20/10 C13B20/00

Date of filing: 12.08.2011

Priority claimed: US / 13.08.2010 / USP373537

Contracting States*
for which fees have been paid:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU
LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Extension States*
for which fees have been paid:

Validation States*
for which fees have been paid:

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*) If the time limit for the payment of designation fees according to Rule 39(1) EPC has not yet expired and the applicant has not withdrawn any designation, **all Contracting States/Extension States/Validation States** are currently still deemed to be designated. See also Rule 71a(3) EPC and, if applicable, the above Note to users of the automatic debiting procedure.

21



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**) If two or more applicants have designated different Contracting States, this is indicated here.

~~METHOD AND COMPOSITION FOR REDUCING THE COLOR OF SUGAR~~FIELD OF THE INVENTION

This invention refers to a method for reducing the color of any intermediate of a process for obtaining sugar, and sugar and a process for the
5 production of low color sugar.

This invention also refers to the use of components and combinations thereof for reducing the color of sugar and/or any intermediate of a process for obtaining sugar.

BACKGROUND OF THE INVENTION

10 Sugar may be produced from a variety of raw materials such as sugar-cane, sugar-beets and saccharine sorghum, for example, which all present common problems with color reduction.

In sugar production processes based on sugar-cane, the cane is crushed, with the raw juice resulting from the crushing stage being treated by
15 the following stages: heating, sulfitation, liming, phosphatation and decantation, among others. The purpose of these stages is to reduce the color of the juice and also eliminate insoluble substances.

Next, the juice is concentrated in one or more evaporators. The resulting syrup is then boiled and allowed to crystallize in a crystallization pan
20 and centrifuged, thus producing sugar.

As is well known by a person skilled in the art, the efficiency of the sugar production process and color removal depends greatly on the quality of the crushed cane. In turn, sugar cane quality varies according to climate conditions, soil types, sugar cane varieties, maturity levels, length of time
25 between burning, harvesting and crushing, loading techniques, transportation and the operating conditions of the sugar mill.

A factor that directly affects sugar quality is color. Thus, during production, it is important to remove color, turbidity and solids in suspension in order to produce pale, high grade sugar. The quality of the sugar cane and its
30 variations, depending on the characteristics mentioned above, may result in darker coloring that must be removed.

Under any conditions, sugar cane has a variety of natural pigments that gives color to the sugar produced, such as flavonoids, which are

23

soluble and pass through the traditional process without being removed.

The amount of colored matter in sugar-cane juice is very low in terms of percentages, making only around 3% of non-sugar organic compounds in the juice. However, these compounds become more important due to their pronounced effect on the coloring of the juice and the end product: sugar.

As mentioned above, sugar production processes comprise several stages focused on color reduction, such as the heating stage, which helps with decolorization in three ways simultaneously: (a) when heating the juice resulting from the crushing process, undesirable micro-organisms are eliminated from the process and the juices consequently are sterilized; (b) during the juice color reduction stage (in the decanter), when heating the juice above its boiling temperature, gases and bubbles are eliminated from the sugar cane juice, making the decanter operation more efficient; and (c) higher temperatures are needed for chemical reactions to occur during processes, such as sulfitation, which is a stage also related to color reduction.

During the sulfitation stage, sulfur dioxide (SO_2) acts on the juice by means of oxidation, reducing its color through a reaction that prevents darkening between the reduction sugars and amino acids.

The liming stage (pH correction) is also intended to reduce the color as it reduces saccharose losses through inversion, sterilizing the juice and potentiating the effects of the polyelectrolytes to be dosed. The product most widely used as a pH correction technique is lime.

Decantation is the stage in the juice treatment process where color reduction is more visible. At this stage, color reduction occurs through mechanical actions, with the juice becoming paler through removal of insoluble compounds in a decanter. In order for this concentration of insolubles to occur, in addition to the liming stage, it is necessary to introduce polyelectrolytes, generally at the input point of the decanter, which neutralize the electrostatic repulsion forces among the particles, thus ensuring coagulation and flocculation.

It is common to find sugar cane juices that are deficient in phosphate, reducing their decanting capacity. Thus, it is a common practice to introduce phosphoric acid, for example, as phosphate supplement. The calcium phosphate crystals are precipitated out along with colored bodies. This stage is

24

known as phosphatation.

In addition to the stages mentioned above, depending on the quality of the sugar to be produced, other stages may also be added to the process in order to reduce the color, such as syrup flotation, magma remixing and refining.

5 Syrup flotation reduces the color and turbidity, by removing insoluble solids from the syrup that are suspended on the surface of the mixture, which are removed through mechanical means.

 At the magma remixing stage, the magma is recycled back through continuous centrifuges, removing more mother liquors. It must be noted that the
10 mother liquor is the darkest compound with the lowest purity in the process.

 It is worthwhile stressing that syrup flotation and magma remixing are processes that, in addition to requiring the installation of new equipment, outlays on input materials, heat energy and electricity, also reduce the recovery of sugar in the mill.

15 The refining stage is used to obtain refined and/or paler sugar, basically encompassing three operations: (a) dissolving the sugar to obtain liquor, and heating, (b) flotation of the liquor in a clarifier, with removal of undesirable materials from the surface, and (c) recrystallization. Color reduction occurs during the liquor flotation stage, which works on the same concept as
20 syrup flotation as described above.

 The high chemical, energy and equipment cost of the refining stage substantially affects the sugar processing efficiency and profitability. [insert page 3a]

 As described above, all traditional processes and known techniques for removing colored impurities during sugar production use physical
25 means (such as decantation, heating and centrifuging) to reduce color of the sugar produced. The few chemical processes used, such as sulfitation and phosphatation, for example, may result in mass losses during the sugar production process.

 Furthermore, the chemical and physical processes which are part
30 of the state of the art are not efficient. Traditional sugar mills are unable to easily produce crystal sugar with 150 UI (ICUMSA units) of color as established by the International Commission for Uniform Methods of Sugar Analysis through the processes for reducing color described above. The sugar produced by

WO2009/066316 relates to method for obtaining less coloured cane sugar with reduced microbial load. Various additives falling such as sulphur dioxide and chelating agents are used. The sugars produces have the very low sugar colour.

EP1788099 relates to the production of purified sugar from sugar beets by multiple filtration and sulfitation. Nanofiltration has effects similar to ion chelation and eliminates the coloured bodies formed during the purification resulting in a very low sugar colour value.

→ [cont. page 3]

26

these mills, known as Very High Polarization (VHP) sugar has up to 1000 UI. It must be stressed that even if low color sugar is achieved during production, the color of the sugar crystals increases over time.

It must also be considered that all the difficulties mentioned above may become even more significant, depending on the sugarcane variety, which is one of the factors with the strongest influence in the color reduction process. There are some varieties of cane, such as RB92579, that are highly productive but result in highly colored syrup. This color cannot be efficiently reduced through the existing processes described above.

Consequently, there is a need for sugar color reduction methods in sugar production processes whose output is stable, which might even shorten some stages of the process, and which are economically feasible.

BRIEF DESCRIPTION OF THE INVENTION

This invention includes a method for reducing the color of sugar and / or any intermediate of a process for obtaining sugar, characterized by the fact that the method comprises the addition of Components 1, 2 and 3, wherein the Components are:

Component 1: sodium chlorite, tropolone, , beta-fluorocaffeic acid, or a sulfoxylate; or a salt of the form $M^+O-S(=O)-CH(OH)R$; or a monobasic organic acid of sulfur having the general formula RSO_2H ; wherein M^+ can be a mono or multivalent cation, and wherein $R = H$, C_1-C_{20} alkyl, branched C_1-C_{20} alkyl, cyclic C_5-C_6 alkyl, aryl, benzyl, or heterocyclic C_5-C_6 rings, and wherein R can be substituted or unsubstituted; or mixtures thereof;;

Component 2: one or more of sulfites, metabisulfites, bisulfites, hydrosulfites, or sulfur dioxide or a source thereof; and

Component 3: at least one chelating agent.

This invention also includes a process for the production of low color sugar and / or any intermediate of a process for obtaining sugar, characterized by the fact that it comprises the addition, at stages of the process, of components 1, 2 and 3, wherein components 1, 2 and 3 are:

Component 1: sodium chlorite, tropolone, , beta-fluorocaffeic acid, or a sulfoxylate; or a salt of the form $M^+O-S(=O)-CH(OH)R$; or a monobasic organic acid of sulfur having the general formula RSO_2H ; wherein M^+ can be a

28

mono or multivalent cation, and wherein R = H, C₁-C₂₀ alkyl, branched C₁-C₂₀ alkyl, cyclic C₅-C₆ alkyl, aryl, benzyl, or heterocyclic C₅-C₆ rings, and wherein R can be substituted or unsubstituted; or mixtures thereof;

Component 2: one or more of sulfites, metabisulfites, bisulfites, hydrosulfites, or sulfur dioxide or a source thereof; and

- Component 3: at least one chelating agent.

The invention includes a low color sugar obtained by the above described method and process.

This invention includes a composition for reducing the color of sugar characterized by the fact that the composition comprises components 1, 2 and 3 as mentioned above.

This invention also includes a kit, characterized by the fact that it comprises Components 1, 2 and 3 mentioned above, in the same or different compartments.

This invention also refers to the use of the three Components mentioned above for reducing the color of sugar and / or any intermediate of a process for obtaining sugar.

This invention also refers to the use of two components for reducing the color of sugar and / or any intermediate of a process for obtaining sugar, the components being component 3 and component 1 or 2 disclosed above.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 presents a diagram of a sugar mill at a plant working with a traditional sugar production process.

Figure 2 presents a graph showing the effects of the technology of the present invention for several variations of Components 1, 2 and 3 in sugar processing.

Figure 3 shows, in an embodiment of the present invention, the locations for feeding Components 1-3 during sugar processing.

Figure 4 shows the application of the technology of the present invention on beet juice.

Figure 5 shows the application of the technology of the present

200

invention on molasses.

DEFINITIONS

As used in the present invention, the term "raw juice" represents the liquid obtained by grinding the sugar cane.

5 The term "decanted juice" refers to juice that has already run through a decantation stage.

The term "syrup" represents the liquid obtained after evaporating the juice to at least some degree.

10 The term "rich mother liquor" indicates the mixture resulting from washing the sugar mass during the centrifuging process.

The term "poor mother liquor" indicates the mixture that is expelled during the sugar centrifuging stage through centripetal force.

The term "liquor" indicates sugar dissolved in water during the refining process.

15 The term "magma" means a saturated sugar paste used as sugar crystals for crystallization.

The term "molasses" refers to the final mother liquor, which comes from the centrifugation of a mass of sugar comprised of syrup, mother liquor and sugar crystals, with low saccharose content comparatively with the other
20 mother liquors, which make its utilization in the process unviable.

The term "raw sugar" refers to sugar that has already been subjected to centrifuging or similar processing, even if further processing is conducted.

25 The term "refined sugar" refers to raw sugar which has subsequently been refined.

The term "mother liquor" is the liquid in which crystallized sugar is contained.

30 The term "intermediate of a process for obtaining sugar" includes all the terms described above and any other product that may be obtained during a process for obtaining sugar.

The term "sugar" shall encompass both raw sugar and refined sugar unless indicated otherwise.

DETAILED DESCRIPTION OF THE INVENTION

29

All ranges disclosed in this disclosure are deemed to provide support for any sub-ranges within those ranges and any points within those ranges.

All sugar test data presented in this application was conducted with cane raw sugar, unless indicated otherwise.

5 The method according to the present invention allows the reduction of the color of syrup or any intermediate of a process for obtaining sugar during sugar processing and the final raw sugar produced, as well as during the refining of sugar or any other additional step after obtaining the raw sugar, through the addition of at least Component 3 and Component 1 and/or 2.

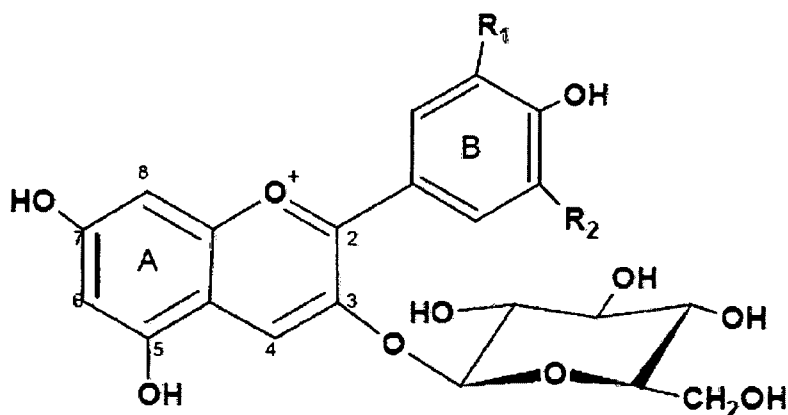
The raw material for sugar production is preferably but not limited to sugar cane (*Saccharum spp*) in many different varieties, such as RB92579, SP791011, RB001914, RB001915, RB98710, RB951541, RB001921, VAT90212, RB991536, RB011518, RB99395, RB011541, RB011549, RB011585, RB011514, RB011553, RB863129, RB971723, RB845210, RB845210, RB813804 and SP813250, for example. Any other source known in the art for sugar production may also be used, such as sugar-beets (*Beta ssp*) and saccharine sorghum (*Sorghum bicolor*), for example, as can be seen in Figure 4, which shows the use of the technology of the present invention in beet juice and demonstrate the reduction of color. The technology of the present invention applies to sugar cane varieties that, as mentioned, are highly productive but present problems with lowering the color of the juice, such as the RB92579 cane, as well as sugar-cane varieties that do not present problems with lowering the color, such as SP1011.

The present invention also comprises the use of the three
25 Components of the present invention, as well as the use of Component 3 with
Component 1 or 2 for reducing the color of sugar and / or any intermediate of a
process for obtaining sugar.

The Components act chemically in order to reduce the color and thus allow the production of syrup, raw sugar, and refined sugar.

30 CAUSES OF COLOR

There are various components in sugar cane that endow the juice with color, including flavonoids. A group of flavonoids that is important for coloring is the anthocyanins:



FORMULA I

The anthocyanins (Formula I) are one of the main causes of color in sugar production. Not only are the anthocyanin molecules colored, but they may also be subject to polymerization reactions triggered by polyphenol-oxidase (PPO) and peroxidase (POD) enzymes that generate for example, melanin and several polyphenol compounds that are strongly colored.

In addition to the anthocyanins, one of the causes of coloring during the sugar production processes is related to "impurities" in the sugar, in terms of the current technology, such as glucose, which may be subject to chemical reactions resulting in hydroxymethylfurfural (HMF). The polymerization of HMF generates, for example, melanoidin which is a strongly colored compound.

The Components added, as well as the principles involved in the present invention, will be explained in greater detail below.

COMPONENT 1

Examples of Component 1 include sulfoxylates, such as sodium formaldehyde sulfoxylate (CAS N° 149-44-00), and potassium formaldehyde sulfoxylate, and sodium hydrosulfite (CAS N° 7775-14-6). Component 1 can be a salt of the form $M^+O-S(=O)-CH(OH)R$, or a monobasic organic acid of sulfur having the general formula RSO_2H . M^+ can be mono and multivalent cations, including sodium, potassium, lithium, calcium, magnesium, barium, aluminum, iron, and zinc. $R = H$, C_1-C_{20} alkyl, branched C_1-C_{20} alkyl, cyclic C_5-C_6 alkyl, aryl, benzyl, and heterocyclic C_5-C_6 rings, and can be substituted or unsubstituted.

A preferred Compound 1 of $M^+O-S(=O)-CH(OH)R$ is when $M^+ = Na$ and $R = H$, which is sodium formaldehyde sulfoxylate. All test data in the

application was obtained using sodium formaldehyde sulfoxylate unless stated otherwise.

Component 1 can also include sodium chlorite, tropolone ^{and} beta-fluorocaffeic acid, ~~and ascorbic acid~~. Component 1 can be a mix of one or more

5 of the compounds disclosed herein for Component 1.

Not all the compounds in the sulfoxylate class are equally effective, however. For example, sodium hydrosulfite does not provide the same stability of color as sodium formaldehyde sulfoxylate. A test was conducted on raw juice decanted in the lab with polymers, lime, and phosphoric

10 acid. The sample was tested with and without Components 1-3. The results of the test are in Table 1 below. In this example, the chemicals used were 100 ppm of sodium formaldehyde sulfoxylate, 100 ppm of sodium metabisulfite (Component 2), and 360 ppm of HEDP (Component 3), and 100 ppm of sodium hydrosulfite, were indicated.

15

TABLE 1

Sample	Initial Color(IU)	Color After 1 hour(IU)	Color After 2 hours (IU)
Untreated	12,210	12,615	12,950
Treated with sodium formaldehyde sulfoxylate	11,123	11,004	11,119
Treated with sodium hydrosulfite	11,776	12,941	13,098
Treated with sodium formaldehyde sulfoxylate and Components 2 and 3.	8,303	8,529	8,724
Treated with sodium hydrosulfite and Components 2 and 3.	8,643	9,073	9,663

As can be seen, the performance of sodium formaldehyde sulfoxylate was better in both reducing color and maintaining color. In fact, the test where only sodium hydrosulfite was added, the color reversion resulted in more color than the untreated sample. Thus, the use of sodium hydrosulfite

20 (CAS N° 7775-14-6) provided improvement when combined with Components 2

and 3, but was not as effective as sodium formaldehyde sulfoxylate.

Sodium formaldehyde sulfoxylate is a powerful reducing agent, which works through inhibiting the polymerization of the anthocyanins that generate strongly colored polyphenols. Furthermore, the addition of sulfoxylate groups to the anthocyanins in Positions 2 and 4, as presented in Formula I, results in the formation of colorless sulfonic structures.

Component 1 reduces iron(III)-ions, inhibiting the formation of complex reactions of POD, which would oxidize phenolics to quinones that exhibit deep intense green and brown to black colors. In addition, it is believed that Component 1 also reduces the iron compounds found in sugar cane juice systems, thus blocking the carbonyl function of the amino acids and consequently lessening caramelization reactions. These caramelization reactions are polymerization reactions that also generate colored products.

Additionally, Component 1 helps disintegration of starch molecules through breaking down of starch 1→4 bonds into smaller units, which lessens the viscosity of the medium in which it is applied, fostering crystallization. The viscosity reduction is maintained through subsequent stages, resulting in lower color. The reduction of size of starch molecules and associated viscosity reduction results in lower color by improving crystallization in the boiling pans and improving the performance of the sugar centrifuges which separate the sugar from the mother liquors at the end of the process, in order to purify the sugar and lower its color.

Furthermore, by reducing the size of the starch molecules, this consequently lessens the turbidity of the liquid, thus lowering the color.

COMPONENT 2

Component 2 is selected among sulfites, including metabisulfites, bisulfites, sulfites, and hydrosulfites, such as the following compounds: sodium metabisulfite ($\text{Na}_2\text{S}_2\text{O}_5$) (CAS N° 7681-57-4), potassium metabisulfite ($\text{K}_2\text{S}_2\text{O}_5$) (CAS N° 16731-55-8), calcium metabisulfite (CaS_2O_5), magnesium metabisulfite (MgS_2O_5), sodium bisulfite (NaHSO_3) (CAS N° 7631-90-5), potassium bisulfite (KHSO_3) (CAS N° 7646-93-7), calcium bisulfite ($\text{Ca}(\text{HSO}_3)_2$), magnesium bisulfite ($\text{Mg}(\text{HSO}_3)_2$), sodium sulfite (Na_2SO_3) (CAS N° 7757-83-7), potassium sulfite (K_2SO_3) (CAS N° 10117-38-1), ammonium sulfite ($(\text{NH}_4)_2\text{SO}_3$) (CAS N° 10196-04-0), magnesium sulfite (MgSO_3) (CAS N° 7757-88-2), calcium sulfite

93

(CaSO₃) (CAS N° 10257-55-3), and sodium hydrosulfite (Na₂S₂O₄), or mixtures thereof. Sulfur dioxide can be used as well. Sulfur dioxide can be introduced in the form of sulfur or other sulfur dioxide sources, which may include some or all of the above-identified components.

5 For sugar production, Component 2 preferably includes sodium metabisulfite. All of the examples in the present application were conducted with sodium metabisulfite as Component 2.

Component 2 acts by blocking the carbonyl group of hexoses, and consequently reducing HMF formation. This Component is an auxiliary reducing
10 compound that also helps inhibit the action of the PPO and POD enzymes.

At high temperatures and low pH, Component 2 may be a source of SO₂ even if it is not SO₂. In the present invention, preferably, the temperature at which Component 2 is utilized is at less than 150°C, or less than 105°C, even less than 90°C, or around 65°C to manage the formation of SO₂.

15 The pH is preferably higher than 3, such as 4-8, and preferably 6-7, to also manage the formation of SO₂. While SO₂ can be used in the present invention, other compounds, such as sodium metabisulfite, are superior and therefore are better if not converted into SO₂. For example, since Component 2 is added as a liquid (Component 2 is a solid which is then dissolved in a
20 solvent), it can be pumped to the juice or syrup. If it converts to SO₂ quickly, SO₂ is a gas and would exit the solution quickly without having as much of an effect. Additionally, Component 2 will react with glucose carbonyls to form sodium hydroxysulphonate, which is a stable substance. This reaction precludes the formation of hydroxymethylfurfural (HMF). Otherwise, the HMF
25 would lead to the formation of melanoidin, which is a dark brown substance. While SO₂ may also block carbonyl groups, such reaction is not as stable and some reversion to sulfur dioxide will occur. The use of sodium metabisulfite and others leads to more stable compounds and less reversion, if any.

Similar to Component 1, Component 2 also helps reduce the size
30 of the starch molecules, resulting in the same improvements as mentioned above.

The use of Component 2 helps reduce or even eliminate the amount of SO₂ needed during sulphitation, depending on the final color

34

requirements for the sugar. Typically, 300 – 500 grams of sulfur are added during sulphitation per ton of crushed cane. When the present invention is utilized, the amount of sulfur can be reduced to 150 – 220 grams of sulfur per ton of crushed cane. With the use of sulfur, the amount of SO₂ normally generated is 200 – 330 grams of SO₂ per ton of crushed cane during sulphitation, and the use of the present invention can be combined with the generation of only 100 – 145 grams of SO₂ per ton of crushed cane.

COMPONENT 3

Component 3 is a powerful chelating agent that can form complexes with metals, including copper and iron, which are essential components of the PPO and POD enzymes, respectively, hence inhibiting the action of these enzymes. This Component is selected among any compound classified among the chelating agents.

Preferably, Component 3 is selected among chelating agents from the phosphonate family and the carboxylic acid family, and can also be part of the organic phosphoric acid family, and can be an aminopolycarboxylic acid, an amine, a polyamine, a hydroxycarboxylic acid, a hydroxylamine, a polyol, a salicylic derivative, acetyl acetates, Iron (II) compounds, oxines, and natural compounds. It can also be citric acid or its salts or ascorbic acid or its salts, or an EDTA salt. Some examples of Component 3 include aminopolycarboxylic acid and salts thereof, a hydroxycarboxylic acid and salts thereof, 2-aminoethylphosphonic acid (AEPN) and salts thereof such as sodium 2-aminoethylphosphonate (AEPN-Na), dimethyl methylphosphonic acid (DMMP) and salts thereof including sodium dimethyl methylphosphonate (DMMP-Na), 1-hydroxy ethylidene-1,1-diphosphonic acid (HEDP) and salts thereof such as monosodium, bisodium, or tetrasodium 1-hydroxy ethylidene-1,1-diphosphonate (HEDP-Na, HEDP-Na₂, and HEDP-Na₄), amino tris(methylene phosphonic acid) (ATMP) and salts thereof such as trisodium amino tris(methylene phosphonate) (ATMP-Na₃), ethylenediamine tetra(methylene phosphonic acid) (EDTMP) and salts thereof such as tetrasodium ethylenediamine tetra(methylene phosphonate) (EDTMP-Na₄), tetramethylenediamine tetra(methylene phosphonic acid) (TDTMP) and salts thereof such as tetrasodium tetramethylenediamine tetra(methylene phosphonate) (TDTMP-

35

Na₄), hexamethylenediamine tetra(methylene phosphonic acid)(HDTMP) and salts thereof such as tetrasodium hexamethylenediamine tetra (methylene phosphonate)(TDTMP-Na₄), diethylenetriamine penta(methylene phosphonic acid)(DTPMP) and salts thereof, phosphonobutane-tricarboxylic acid(PBTC) and salts thereof, N-(phosphonomethyl)iminodiacetic acid(PMIDA) and salts thereof such as sodium N-(phosphonomethyl)iminodiacetate (PMIDA-Na), 2-carboxyethyl phosphonic acid (CEPA) and salts thereof such as sodium 2-carboxyethyl phosphonate (CEPA-Na), 2-hydroxyphosphonocarboxylic acid(HPAA) and salts thereof such as sodium 2-hydroxyphosphonocarboxylate (HPAA-Na), amino-tris-(methylene-phosphonic acid)(AMP) and salts thereof such as trisodium amino-tris-(methylene-phosphonate)(AMP-Na₃), diethylenetriamine penta (methylene phosphonic acid)(DTMP) and salts thereof such as pentasodium diethylenetriamine penta (methylene phosphonate)(DTMP-Na₅), aminotris (methylene phosphonic acid) (ATMP), and salts thereof such as trisodium aminotris (methylene phosphonate)(ATMP-Na₃) EDTA or salt thereof, such as disodium ethylene diamine tetraacetic acid(EDTA.2Na), and tetrasodium ethylene diamine tetraacetic acid(EDTA.4Na); isopropenylphosphoric acid (IPPA) and salts thereof such as sodium isopropenylphosphonate (IPPA-Na); homo or co-polymers of isopropenylphosphoric acid, such as polyisopropenylisophosphoric acid (PIPPA) and salts thereof, co-polyacrylic acid- polyisopropenylisophosphoric acid and salts thereof; Nitrilotriacetic acid (NTA) and salts thereof such as sodium nitrilotriacetate (NTA-Na); (2-hydroxyethyl)ethylenediaminetriacetic acid (HEDTA) and salts thereof such as trisodium (2-hydroxyethyl)ethylenediaminetriacetate (HEDTA-Na₃; propylenediaminetetraacetic acid (PDTA) and salts thereof such as tetrasodium propylenediamineotetraacetate (PDTA-Na₄); diethylene-triaminopentacetic acid (DTPA) and salts thereof such as pentasodium diethylene-triaminopentacetate (DTPA-Na₅); ethylene-diamino-di (o-hydroxyphenyl)-acetic acid (EDDHA) and salts thereof such as disodium ethylene-diamino-di (o-hydroxyphenyl)-acetate (EDDHA-Na₂); ethylene-diamino-di (5-carboxy-2-bydroxyphenyl)-acetic acid (EDDCHA) and salts thereof such as disodium ethylene-diamino-di (5-carboxy-2-bydroxyphenyl)-acetate (EDDCHA-Na₂); ethyldiamino-di (o-hydroxy p-methyl-

phenyl)-acetic acid (EDDHMA) and salts thereof such as disodium ethyldiamino-di (o-hydroxy p-methyl-phenyl)-acetate (EDDHMA-Na₂); Ethylenediamine (EDA); Diethylenetriamine (DETA); Triethylenetetramine (TETA); Tetraethylenepentamine (TEPA); Tartaric acid (At) and salts thereof; 5 Citric acid (Cit) or salt thereof; ascorbic acid or salt thereof, Gluconic acid (Gluc) and salts thereof; Heptagluconic acid and salts thereof; Monoethanolamine (MEA); Diethanolamine (DEA); Triethanolamine (TEA); N-hydroxyethylethylenediamine (Hen); N-dihydroxyethylglycine (2-HxG); Sorbitol; Mannitol; Dulcitol; Salicylaldehyde; Salicylic acid and salts thereof such as sodium 10 salicylate; 5-sulfosalicylic acid and salts thereof such as sodium 5-sulfosalicylate; Trifluoroacetylacetone (Tfa); Thenoyltrifluoroacetone (TTA); Dipyridyl (Dipi); o-phenanthroline (Phen); Oxine; 8-hydroxyquinoline (Q; ox); Oxine-sulfonic acid; Lignosulfonates; Polyflavonoids; Humic substances; Algae extracts; Aminoacids and salts thereof; Pyroligneous extract; or mixtures thereof.

15 Preferably, Component 3 is selected among DTMP (diethylenetriamine (penta methylene phosphonic acid)), ATMP (aminotris (methylene phosphonic acid)), HEDP (1-hydroxy ethylidene-1,1 diphosphonic acid), EDTA.2Na (disodium ethylene diamine tetraacetic acid), EDTA.4Na (tetrasodium ethylene diamine tetraacetic acid); or mixtures thereof.

20 Component 3 may be used as a mixture of at least two chelating agents, or can comprise only one chelating agent. Preferably, Component 3 comprises HEDP. Component 3 can include any one or more of the compounds specified above, such as any one or more chelants.

This Component is added in order to avoid the reversal of color 25 reduction, as a certain amount of color returns to the sugar through the actions of the PPO and POD enzymes, thus guaranteeing low color quality for the sugar. The Examples of the present application utilized HEDP as Component 3 unless specified otherwise.

METHOD

30 The method of the present invention is directed towards the color reduction of sugar and any intermediate of a process for obtaining sugar, through the addition of components 1, 2 and 3 described above.

It is important to stress that the method of the present invention is

37

not limited to the raw sugar production process that will be presented in greater detail below, but may also be used at stages subsequent to raw sugar production, such as when to lighten sugar already produced at an earlier stage, such as previously produced raw sugar or refined sugar which color is to be subsequently reduced. For example, the Components can be added to the liquor obtained after raw sugar is dissolved in water during a refining operation. For clarity, such liquor (which is part of the refining process) is not the same as the VHP sugar liquor (which is part of the raw sugar processing process) or the "rich mother liquor" and "poor mother liquor", both of which pertain to the preparation of raw sugar, not refined sugar. In this application, the term "liquor" shall refer to that present during refining unless specified otherwise. Preferably, the Components will be added after the liquor is heated and before crystallization during the refining.

The present invention is also directed to sugar made with the method or process of the present invention using the Components. Such sugar may exhibit traces of Components 1, 2, and/or 3. For example, Component 1 may show traces of formaldehyde up to 500 parts per billion or even up to 1 part per million weight relative to weight of the sugar. Component 2 may be present in the form of sulfates, such as 100-2000 ppm (or any range within this range) of sulfates weight relative to the weight of the sugar. It should be noted that sulfitation during the clarification of sugar can also contribute to the total sulfates present. Component 3 may be present in the final sugar a range of about 2 ppm (weight of Component 3 relative to the weight of the sugar) to about 1500 ppm, although any sub-range within this 2 ppm – 1500 ppm range is deemed to be supported by the present invention, including about 6 ppm to about 330 ppm, about 6 ppm to about 240 ppm, about 8 ppm to about 240 ppm, about 6 ppm to about 150 ppm, about 3 ppm to about 75 ppm, about 6 ppm to about 40 ppm, about 3 ppm to about 30 ppm, and about 20 ppm to about 40 ppm, and about 20 ppm to about 30 ppm. At Example 7 below, the amount of residual HEDP of the resulting sugar was, on average, the following: 60 ppm HEDP used (4.4 ppm residual HEDP), 90 ppm HEDP used (32.7 ppm residual HEDP), 120 ppm HEDP used (49.7 ppm residual HEDP), and 180 ppm HEDP used (66.8 ppm residual HEDP). Component 3 can be added to two or more

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different locations, or just one location.

Components 1, 2 and/or 3 may be added at any stage of a process for the reduction of the color of sugar and /or any intermediate of a process for obtaining sugar. This comprises the preparation of syrup, the preparation of raw sugar from syrup, and the refining of raw sugar into refined sugar, among others. Components 1, 2, and/or 3 are effective to reduce the color of the syrup, the raw sugar, and the refined sugar, for example, and can be added, not only, but preferably, during the preparation of the syrup, during the preparation of the raw sugar, and during the preparation of the refined sugar.

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PROCESS

Figure 1 represents the overview of a sugar mill with a traditional sugar production process. This sugar mill uses a sugar production process based on sugar cane. However, the present invention is not limited to this raw material, and is applicable to processes of other raw materials, such as sugar-beets and saccharine sorghum or mixtures thereof.

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The use of two or more of the Components in, for example, syrup or any intermediate of a process for obtaining sugar prepared from sugar cane, sugar-beets, or saccharine sorghum is envisioned by the present invention to produce a reduced color sugar.

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The process of the present invention comprises the application of a set of input materials not used previously to reduce color of sugar and /or any intermediate of a process for obtaining sugar and enhance the quality of the final sugar produced, whether it is raw sugar or refined sugar. The technology of the present invention allows avoiding some additional sugar production stages, such as syrup flotation, for example, due to its ability to reduce color. Also, the present invention can reduce or eliminate the need for the use of SO₂ in a sulfitation stage.

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The sugar production process of the present invention includes the addition of at least Component 3 and Component 1 and Component 2. Thus, mixtures of Components 1, 2, and 3 will be utilized.

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Component 3 and Component 1 and/or Component 2 can be added at any stage of the sugar production process.

Component 3 and Component 1 and/or Component 2 may be

added to various points in the production of raw or refined sugar, including among others the following points: after grinding the cane, during or after heating, during or after sulfitation, during or after liming, during or after phosphatation, during or after decantation, during or after evaporation, during or after boiling, during or after centrifuging, during or after syrup flotation, during or after magma remixing, and during refining. In order to evaporate the juice (whether cane juice or otherwise), various numbers of evaporators may be used, with each evaporator constituting a stage of the process. The evaporators can be 1, 2, 3, 4, 5, or more evaporators connected in series. Preferably, at least two evaporators will be used, such as four evaporators.

Preferably, Component 3 and Component 1 and/or Component 2 are added at the input point of any of the evaporators, preferably the input point of the last evaporator, whereby the smallest possible quantities of the Components are added, in order to economize on chemical feedstock. In other words, the pipe which transmits the syrup to the last evaporator can be modified to receive Component 3 and Component 1 and/or Component 2. It is possible to add the Components directly to the evaporators, such as the last evaporator (as opposed to the syrup pipe leading to the last evaporator) but it is less expensive from an equipment standpoint to add them to the pipe which transmits the syrup. The components can also be added downstream of the last evaporator.

In an even more preferred embodiment, in addition to adding Components 1, 2 and 3 or Components 2 and 3 at the input point of the last evaporator (i.e., into the syrup which is being added to the last evaporator), Component 2 is optionally added a second time, preferably to the syrup exiting the last evaporator. Fig. 3 shows such a procedure. This is done since there may be some oxygen exposure after the first application of Component 2, and this additional exposure to Component 2 can result in less color.

This second addition of the Component 2 is also intended to ensure that any impurity that may remain in the sugar, depending especially on the conditions of the raw material used, do not result in a reversal of the color reduction of the sugar during storage.

Component 3 and Component 1 and/or Component 2 may be added to the process through different input points or feeder points or addition

points or directly to the operating units of the process. For example, they may be added to juice entering the evaporator stages, or to the syrup being transported from evaporator to evaporator, or to the evaporators themselves.

In one embodiment, the three input points are located at different
5 stages of the process. In another preferred embodiment, the input points are located at the same stage of the process. In yet another embodiment, the three Components are added to the process through a single input point as a mixture, or separately to the same point, or at different points of the process.

Optionally, two of the Components may be combined at the same
10 input point, such as Components 1 and 2 being added through one input point, simultaneously, with Component 3 added separately, at the same input point or at a different input point.

Each Component may be added independently through more than
one input point. Preferably, Component 2 may have two or more input points in
15 the process. Also preferably, Component 3 may have two or more input points in the process.

In another preferred embodiment of the present invention, up to
50%, or preferably 20% of Component 3 may be added at one input point, and
the rest at another input point. The ratio can be about 1:20 to about 20:1 and
20 about 1:10 to about 10:1, and about 1:5 to about 5:1 between the different input points in ppm.

In an even more preferred manner, part of Component 3 is added
at the input point of the first evaporator (i.e., into the syrup entering the first
evaporator), and the remaining portion is added at the input point of the last
25 evaporator (i.e., into the syrup entering the last evaporator). The addition can also be directly to the first and last evaporators, respectively.

This bifurcated addition of Component 3 may result in advantages
arising from other properties of Component 3, such as the fact that it is an anti-
scale agent. This addition helps clean the evaporators, thus reducing operating
30 costs. Thus, the Component 3 being added before the first evaporator (i.e., to the decanted juice being sent to the first evaporator) or to the first evaporator can help reduce the scaling in the evaporators while also helping to reduce the color of the syrup produced.

41

The three Components may be added in any order during the process.

Components 1, 2 and 3; or Components 1 and 3; or Components 2 and 3, may be added to the process in sufficient quantities to reduce color.

5 For example, the amount of Component 1 can be from about 5 ppm to about 5000 ppm, although any sub-range within this 5 ppm – 5000 ppm range is deemed to be supported by the present invention, including about 10 ppm to about 1000 ppm, about 10 ppm to about 750 ppm, about 20 ppm to about 750 ppm, about 10 ppm to about 500 ppm, about 20 ppm to about 500 ppm, about
10 20 ppm to about 100 ppm, about 50 ppm to about 100 ppm, and about 25 ppm to about 75 ppm, and about 20-25 ppm. These ppm values are the values of Component 1 by weight relative to the volume into which Component 1 is being added on a milligram per liter basis. For example, 1 ppm of Component 1 being added to syrup or any intermediate of a process for obtaining sugar, would be 1
15 mg of Component 1 per liter of syrup or any intermediate of a process for obtaining sugar. Since the volume at different points in the process may vary, the same ppm values at different points in the process may result in different absolute amount of chemical used. This description of ppm (i.e., that each ppm is 1 mg of the Component per liter of liquid into which it is added) shall apply to
20 all of the use of Components 1, 2, and 3 unless stated otherwise.

The disclosed amount of Component 1 above, and the amounts of Components 2 and 3 below, can be added to a process for raw sugar production or to a process that takes raw sugar and processes such sugar (such as by refining) into refined sugar with less color. If added during refining, the Components would be
25 added to the liquor which results from the dissolution of the sugar, and the ppm would be relative to the volume of the liquor. This will reduce the color of the liquor, which will result in lighter sugar upon recrystallization of the liquor.

The amount of Component 2 can be about 5 ppm to 5000 ppm, although any sub-range within this 5 ppm – 5000 ppm range is deemed to be
30 supported by the present invention, including about 20 ppm to about 1500 ppm, about 20 ppm to about 1000 ppm, about 20 ppm to about 750 ppm, about 20 ppm to about 500 ppm, about 50 ppm to about 500 ppm, about 50 ppm to about 200 ppm, about 50 ppm to about 150ppm, about 50 ppm to about 100 ppm,

42

about 40 ppm to about 50 ppm, and about 25 ppm to about 75 ppm. Component 2 can be added into one location or it can be added into two or more locations in the ppm amounts disclosed above in each location. Preferably, the addition into the two different locations are about the same in terms of ppm, although the ratio can be about 1:20 to about 20:1, such as 1:10 to 10:1 or 1:5 to 5:1 in terms of ppm. The preferred location for addition for Component 2 is both before and after the last evaporator. It has been found that this improves the color of the syrup and sugar produced.

The amount of Component 3 can be from about 5 ppm to about 5000 ppm, although any sub-range within this 5 ppm – 5000 ppm range is deemed to be supported by the present invention, including about 20 ppm to about 1000 ppm, about 20 ppm to about 720 ppm, about 25 ppm to about 720 ppm, about 20 ppm to about 500 ppm, about 60 ppm to about 360 ppm, about 60 ppm to about 180 ppm, about 20 ppm to about 120 ppm, about 60 ppm to about 120 ppm, about 50 to about 100 ppm, and about 50-90 ppm. Component 3 can be added to two or more different locations, or just one location.

COMPOSITION

The present disclosure is also directed to a composition comprising Components 1 and 2. This composition can then be added to the sugar processing in conjunction with Component 3 to reduce the color of sugar and /or any intermediate of a process for obtaining sugar. In other words, when Components 1-3 are applied in one point, it is possible to apply Components 1 and 2 together and Component 3 separately, rather than each component separately. Preferably, Components 1 and 2 are in liquid form, such as when dissolved in suitable solvents.

This invention presents several improvements to the known state of the art, such as the efficient color reduction of sugar regardless of the variety of sugar-cane used, with less loss of sugar mass, meaning that the industrial yield is better in terms of sugar output. Furthermore, this invention enhances the thermal efficiency of the sugar mill, in addition to requiring extremely low electricity consumption. No equipment needs to be installed for the additional stages in the sugar mill, with only the installation of small dosing lines and dosing pumps required, with this equipment being extremely simple, as is well

43

known to a person skilled in the art.

As already mentioned, the technology addressed by this invention may be applied at any stage of the conventional process, such as in the juice, the syrup or the molasses, which also constitutes an advantage of this invention. However, the application to the syrup going into any of the first through the last evaporators (application can also be directly to the evaporators), and/or the application to the syrup coming out of the last evaporator is preferred. Even more preferred is to add Components 1-3 or 1 and 3 or 2 and 3 to the syrup going into the last evaporator (or to the last evaporator directly), and to also add Component 2 to the syrup coming out of the last evaporator.

This invention may be understood more clearly through the following examples, which illustrate this invention, although without any limitation.

Unless indicated otherwise, in all examples, all the color measurements were done following the ICUMSA methodology. For example, the sugar samples were tested with ICUMSA Method GS9/1/2/3-8 (2005), the syrup, juice, and other liquid intermediates, were measured with ICUMSA Method GS 1/3-7 (2002). The Determination of polarisation, Brix and fibre in cane and bagasse was made with ICUMSA Method GS 5/7-1 (1994). A person skilled in the art would know how to reproduce them and use different ICUMSA methods, if necessary.

EXAMPLES

The following examples are designed to illustrate a particular realization of this invention. However, it must be understood that these examples are merely illustrative, and do not impose any limitations on the scope of the present invention, other than those presented in the appended claims.

EXAMPLE 1 – EFFECT OF THE VARIATION OF THE TYPE OF COMPONENT 3 ON COLOR REDUCTION EFFICIENCY

Example 1 verifies the possibility of using various types of chelating agents as Component 3. This way, syrup samples taken from the input point of the last evaporator (i.e., samples were taken from syrup being transported to the last evaporator) were collected and tested. In this particular

44

case, there were four evaporators, so the samples were taken from the syrup being transported between the third and fourth evaporators in a sugar processing facility. While the testing of the present invention on actual plant runs (i.e., adding Components 1, 2, and/or 3 to the plant) is believed to be more representative than adding Components 1, 2, and/or 3 to samples of syrup having been removed from the plant, the present testing of lab samples shows that different chelating agents behaved similarly in the lab samples and are therefore expected to also behave similarly when added to the plant. The untreated sample consists of raw syrup entering the last evaporator, with no Components added. The amounts of Components 1 and 2 remained constant at 50 ppm for the treated samples while the quantities of the different types of Component 3 varied, as shown in Table 2. At Table 2, the tests were normalized to compare the use of different amounts of Component 3. The use of HEDP resulted in a reduction of color in the syrup ranging from 9% to 16%. The use of DTMP resulted in 2% to 8% color reduction. The use of ATMP resulted in a -1% to 13% color reduction, depending on the amount. The use of EDTA2Na resulted in a 15% to 24% color reduction. The use of EDTA4Na resulted in 5% to 13% color reduction. Thus, as can be seen, the various chelants utilized generally showed reduction of color in the syrup, and are therefore usable in the present invention.

TABLE 2

PRODUCT 1(PPM)	PRODUCT 2(PPM)	HEDP (PPM)	ICUMSA @ 420NM	% REDUCTION	% REDUCTION (NORMALIZED)
0	0	0	9396		
50	50	0	8442	10%	
50	50	90	7655	19%	9%
50	50	120	7231	23%	14%
50	50	360	7128	24%	16%
PRODUCT 1(PPM)	PRODUCT 2(PPM)	DTMP (PPM)	ICUMSA @ 420NM	% REDUCTION	% REDUCTION (NORMALIZED)

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0	0	0	9396		
50	50	0	8442	10%	
50	50	90	8234	12%	2%
50	50	120	7985	15%	5%
50	50	360	7764	17%	8%
PRODUCT 1(PPM)	PRODUCT 2(PPM)	ATMP(PPM)	ICUMSA @ 420NM	% REDUCTION	% REDUCTION (NORMALIZED)
0	0	0	7996		
50	50	0	6945	13%	
50	50	90	6844	14%	1%
50	50	120	7006	12%	-1%
50	50	360	6019	25%	13%
PRODUCT 1(PPM)	PRODUCT 2(PPM)	EDTA2NA(PPM)	ICUMSA @ 420NM	% REDUCTION	% REDUCTION (NORMALIZED)
0	0	0	7996		
50	50	0	6945	13%	
50	50	90	5909	26%	15%
50	50	120	5657	29%	19%
50	50	360	5307	34%	24%
PRODUCT 1(PPM)	PRODUCT 2(PPM)	EDTA4NA (PPM)	ICUMSA @ 420NM	% REDUCTION	% REDUCTION (NORMALIZED)
0	0	0	7996		
50	50	0	6945	13%	
50	50	90	6588	18%	5%
50	50	120	6019	25%	13%
50	50	360	6056	24%	13%

EXAMPLE 2 – ANALYSIS OF THE COLOR REDUCTION OBTAINED WITH THE USE OF COMPONENTS 1, 2 AND 3 COMPARED TO THE USE OF EACH OF THE COMPONENTS

46

SEPARATELY OR TOGETHER

In order to verify the need for the presence of the three Components in the process of the present invention, a series of tests were conducted using different combinations of Components 1, 2, and/or 3.

5 A traditional sugar production process was utilized, and the use of Components 1, 2, and/or 3 was at the input point of the last evaporator (in this case, the fourth evaporator). In this process, three pumps control the addition of Components 1, 2 and 3. In order to observe the effect of adding a second dose of Component 2 to the process, a fourth pump controlled the addition of
10 Component 2 after the outlet of the last evaporator. Component 1 was added at a 50 ppm concentration relative to the syrup into which it was added (input of last evaporator). Component 2 was added at a 50 ppm concentration at application point #1 (input of last evaporator) and at a 50 ppm concentration at application point #2 (after outlet of last evaporator). Component 3 was added at
15 a 180 ppm concentration relative to the input of the last evaporator.

After adding the Components to a continuous production process, transmittance measurements were taken that gave rise to the color outcomes obtained in UI.

The findings are presented in Table 3 and are graphed in Figure 2.
20 Basically, untreated syrup was removed before any Components were added to the syrup going to the last evaporator. This is the baseline. Then, Components 1-3 were added to the plant before the last (fourth) evaporator but downstream of where the sample was taken. Component 2 was also added downstream of the last evaporator. Color measurements were taken downstream of the last
25 (fourth) evaporator downstream of the addition of Component 2. The results for the untreated syrup were compared with those of the treated syrup. The reduction in color when all of the pumps were turned off may be attributed to residual Components 1, 2, and 3 still being present from when the pumps for all 3 components were turned on.

30 As is clear from Table 3 and Figure 2, Components 1, 2, and 3, when used individually, varied from having essentially no effect, to reducing the color only a small amount. The use of both Components 1 and 2, but no Component 3, also did not result in appreciable reduction in color. The use of

47

Component s 1+3 or Components 2+3 resulted in noticeable decrease in color. The use of all three Components resulted in excellent color reduction. Based on the findings presented in Table 3, it is clear that the addition of the three Components together generates a color reduction that is far more marked than that noted when using only one of the Components or a combination of two of the Components. However, the use of Component 3 with any of the other two components also provides acceptable results. These results show that there is an unexpectedly good effect when Component 3 is used with any of the other two components, especially when used in combination with both of the other components.

TABLE 3

			PUMP OPERATION			Second component 2 application point	Test Blank	After treatment	Reduction Achieved
Components			Component 1	Component 2	Component 3	Component 2	Color UI	Color UI	
1	2	3	On	On	On	On	15972	12040	24.6%
-	-	-	Off	Off	Off	Off	16309	15282	6.3%
1			On	Off	Off	Off	16115	15238	5.4%
	2		Off	On	Off	On	15327	15691	-2.4%
		3	Off	Off	On	Off	15019	15507	-3.3%
1	2	3	On	On	On	On	15239	11804	22.5%
1	2		On	On	Off	On	15019	14932	0.6%
1		3	On	Off	On	Off	15150	13597	10.3%
	2	3	Off	On	On	On	15106	12932	14.4%
1	2	3	On	On	On	On	15830	12259	22.6%
-	-	-	Off	Off	Off	Off	16358	13866	15.2%

EXAMPLE 3 - ANALYSIS OF THE EFFICIENCY OF THE PRESENT INVENTION FOR COLOR REDUCTION AT DIFFERENT STAGES OF THE SUGAR PRODUCTION PROCESS

In order to verify the applicability of the technology of the present invention during different stages of the traditional sugar production process, the Applicant applied the invention to various samples taken from different locations along the sugar production process.

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Consequently, tests were conducted with the raw juice, the decanted juice, the syrup produced by each of the four evaporators used at the mill in question, the rich mother liquor and the poor mother liquor, as well as the VHP liquor and the molasses. Various samples of the above were taken from various locations of the sugar production process, and then were subjected to the procedure below.

The procedure was the following (exemplified only at one of the points, although the same procedure was used at all the others): 5% solutions in mass of Components 1, 2 and 3 were prepared through dissolving 5 g, 15.15 mL and 8.33 mL of Components 1 (purity 100%), 2 (33% aqueous solution) and 3 (60% aqueous solution), respectively, in 100 mL of water.

Then 12 L of syrup was taken from the 3rd evaporator in the production process (at a temperature of 90°C). 500 mL were added into each of several beakers, identified with a test number. The volumes of each Component were added to each beaker as set forth in Table 4, in compliance with the corresponding volumes. Each sample was heated to a boiling point (temperature of more than 100°C) and was then left to rest for ten minutes. Each sample was transferred to a 500 mL test tube, with the necessary measurements taken to obtain the color values (in UI), as explained above.

The experiments following this protocol were conducted at all the points mentioned above, with the results presented in Table 4 below. Although these laboratory data points are not as reliable as plant data, they are nonetheless useful in an internal comparison to show a similar effect.

TABLE 4

Tests	Component 1 (ppm)	Solution Concentration n (%)	Component 2 (ppm)	Solution Concentration n (%)	Component 3 (ppm)	Solution Concentration (%)	Color ICUMSA (420 nm)	Color Reduction %
		mL at 5%		mL at 5%		mL at 5%		
Raw juice							13,090	
Raw juice	50	0.5	50	0.5			18,601	-42%
Raw juice	50	0.5	50	0.5	90	0.9	14,720	-12%
Raw juice	50	0.5	50	0.5	120	1.2	13,932	-6%

Table 4

		Solution Concentration (%)		Solution Concentration (%)		Solution Concentration (%)	Color ICUMSA (420 nm)	Color Reduction %
Tests	Component 1 (ppm)	mL at 5%	Component 2 (ppm)	mL at 5%	Component 3 (ppm)	mL at 5%		
Raw juice							13,090	
Raw juice	50	0.5	50	0.5			18,601	-42%
Raw juice	50	0.5	50	0.5	90	0.9	14,720	-12%
Raw juice	50	0.5	50	0.5	120	1.2	13,932	-6%
Raw juice	50	0.5	50	0.5	360	3.6	12,040	8%
Decanted Juice							6,945	
Decanted Juice	50	0.5	50	0.5			6,395	8%
Decanted Juice	50	0.5	50	0.5	90	0.9	5,085	27%
Decanted Juice	50	0.5	50	0.5	120	1.2	4,836	30%
Decanted Juice	50	0.5	50	0.5	360	3.6	3,599	48%
1st Evaporator Syrup							6,785	
1st Evaporator Syrup	50	0.5	50	0.5			6,785	0%
1st Evaporator Syrup	50	0.5	50	0.5	90	0.9	5,358	21%
1st Evaporator Syrup	50	0.5	50	0.5	120	1.2	5,484	19%
1st Evaporator Syrup	50	0.5	50	0.5	360	3.6	4,582	32%
2nd Evaporator Syrup							8,553	
2nd Evaporator Syrup	50	0.5	50	0.5			8,097	5%
2nd Evaporator Syrup	50	0.5	50	0.5	90	0.9	6,224	27%
2nd Evaporator	50	0.5	50	0.5	120	1.2	6,657	22%

		Solution Concentration (%)		Solution Concentration (%)		Solution Concentration (%)	Color ICUMSA (420 nm)	Color Reduction %
Tests	Component 1 (ppm)	mL at 5%	Component 2 (ppm)	mL at 5%	Component 3 (ppm)	mL at 5%		
Syrup								
2nd Evaporator Syrup	50	0.5	50	0.5	360	3.6	5,923	31%
3rd Evaporator Syrup							6,577	
3rd Evaporator Syrup	50	0.5	50	0.5			6,400	3%
3rd Evaporator Syrup	50	0.5	50	0.5	90	0.9	5,782	12%
3rd Evaporator Syrup	50	0.5	50	0.5	120	1.2	5,610	15%
3rd Evaporator Syrup	50	0.5	50	0.5	360	3.6	4,968	24%
4th Evaporator Syrup							6,757	
4th Evaporator Syrup	50	0.5	50	0.5			6,420	5%
4th Evaporator Syrup	50	0.5	50	0.5	90	0.9	5,830	14%
4th Evaporator Syrup	50	0.5	50	0.5	120	1.2	6,112	10%
4th Evaporator Syrup	50	0.5	50	0.5	360	3.6	5,502	19%
Rich mother liquor							9,016	
Rich mother liquor	50	0.5	50	0.5			9,041	0%

		Solution Concentration (%)		Solution Concentration (%)		Solution Concentration (%)	Color ICUMSA (420 nm)	Color Reduction %
Tests	Component 1 (ppm)	mL at 5%	Component 2 (ppm)	mL at 5%	Component 3 (ppm)	mL at 5%		
Rich mother liquor	50	0.5	50	0.5	90	0.9	9,118	-1%
Rich mother liquor	50	0.5	50	0.5	120	1.2	9,770	-8%
Rich mother liquor	50	0.5	50	0.5	360	3.6	7,688	15%
Poor mother liquor							12,409	
Poor mother liquor	50	0.5	50	0.5			11,974	4%
Poor mother liquor	50	0.5	50	0.5	90	0.9	10,883	12%
Poor mother liquor	50	0.5	50	0.5	120	1.2	9,716	22%
Poor mother liquor	50	0.5	50	0.5	360	3.6	8,317	33%
VHP liquor							828	
VHP liquor	50	0.5	50	0.5			851	-3%
VHP liquor	50	0.5	50	0.5	90	0.9	613	26%
VHP liquor	50	0.5	50	0.5	120	1.2	526	36%
VHP liquor	50	0.5	50	0.5	360	3.6	548	34%
Molasses							21,657	
Molasses	50	0.5	50	0.5			23,031	-6%
Molasses	50	0.5	50	0.5	90	0.9	23,390	-8%
Molasses	50	0.5	50	0.5	120	1.2	24,246	-12%
Molasses	50	0.5	50	0.5	360	3.6	26,057	-20%

Tests	Component 1 (ppm)	Solution Concentratio n (%)	Component 2 (ppm)	Solution Concentratio n (%)	Component 3 (ppm)	Solution Concentration (%)	Color ICUMSA (420 nm)	Color Reduction %
		mL at 5%		mL at 5%		mL at 5%		
VHP liquor	50	0.5	50	0.5	120	1.2	526	36%
VHP liquor	50	0.5	50	0.5	360	3.6	548	34%
Molasses							21,657	
Molasses	50	0.5	50	0.5			23,031	-6%
Molasses	50	0.5	50	0.5	90	0.9	23,390	-8%
Molasses	50	0.5	50	0.5	120	1.2	24,246	-12%
Molasses	50	0.5	50	0.5	360	3.6	26,057	-20%

As can be noted from Table 4 above, the technology of the present invention, as applied consistently to different liquids from a sugar processing process, as able to reduce the color of the liquid.

It is important to note that in applying this method to molasses, it appears in Table 4 that the colors increased as the quantities of Component 3 increased. This was likely due to the fact that molasses is a very viscous liquid and with the addition of the Components of the present invention, the turbidity of the solution increased greatly, resulting in the color measurements giving high readings (as they are based on the solution transmittance). However, there is a visual reduction in color, as shown in Figure 5.

EXAMPLE 4

Tests were conducted at various points along the traditional sugar production process in order to verify the efficacy of the technology at different stages of this production process. The procedure was the same as in Example 3, except that the concentration of Components 1, 2, and 3 were 100 ppm, 100 ppm, and 360 ppm, respectively. Once again, these data points are comparable to themselves and not necessarily comparable to data from plant testing. However, all of the data points below, which were taken at different points of the sugar processing process except for molasses, show a color improvement. The results are presented in Table 5, below:

TABLE 5

53

	Test Blank	Dosed	Color Reductions
	COLOR UI	COLOR UI	%
Raw Juice	22,634	14,215	37%
Decanted Juice	7,963	4,261	46%
Outflow Juice from 1st Evaporator	14,763	5,946	60%
Outflow Juice from 2nd Evaporator	8,030	4,298	46%
Outflow Juice from 3rd Evaporator	6,281	4,394	30%
Outflow Juice from 4th Evaporator (syrup)	6,319	4,740	25%
Rich mother liquor	8,349	8,188	2%
Poor mother liquor	14,215	12,312	13%
VHP Sugar (syrup at 45 °Brix)	777	504	35%

The values obtained show clearly that the technology of the present invention may be applied at any of the above points of the sugar production process to result in color reduction.

EXAMPLE 5

5 Sugar was prepared according to conventional technology and also according to the present invention, to determine the differences. This was raw sugar (i.e., it was not refined). The standard sugar and the sugar made according to the present invention were made in the same plant. None of Components 1, 2, or 3 were used to prepare the standard sugar. Components

10 1, 2, and 3 were used to prepare the sugar according to the present invention. Specifically, Component 1 was sodium formaldehyde sulfoxylate, Component 2 was sodium metabisulfite, and Component 3 was HEDP. Components 1-3 were applied separately to the syrup entering the fourth (and last) evaporator. Component 2 was additionally applied to the syrup leaving the fourth (and last)

15 evaporator. Components 1-3 were used in the following amounts: Component 1, 50 ppm, Component 2, 50 ppm (application point #1) and 50 ppm (application point #2), and Component #3 was used at 180 ppm.

The preparation of the standard sugar showed an ICUMSA color for the raw sugar of an average of 309 (three samples tested at three different times).

The preparation of the sugar according to the present invention showed an ICUMSA color for the untreated syrup going into the fourth (and last evaporator) of 13012 (average of three tests at different times). Components 1, 2, and 3 were added downstream of the sample taken for testing but before entering the fourth (and last) evaporator. Component 2 was reapplied after the fourth evaporator. Downstream of that application, another sample of syrup was taken for color testing and resulted in a color of 9651 (average of three tests at different times). Thus, the present invention showed a reduction in syrup color of 25.8%. The sugar produced showed a color of 88 (average of three tests taken at three times). The sugar prepared according to the present invention thus showed a color reduction of 71.5% relative to standard sugar.

EXAMPLE 6

Sugar was made in a different trial. The procedure was the same as in Example 5 above, except that the amounts of Components 1-3 were twice those in Example 5, as follows: Component 1, 100 ppm, Component 2, 100 ppm (application point #1) and 100 ppm (application point #2), and Component 3 was used at 360 ppm. The preparation of the standard sugar showed an ICUMSA color for the raw sugar of an average of 620 (three samples tested at three different times).

The preparation of the sugar according to the present invention showed an ICUMSA color for the untreated syrup going into the fourth (and last evaporator) of 15,870 (average of three tests at different times). Components 1, 2, and 3 were added downstream of the sample taken for testing but before entering the fourth (and last) evaporator. Component 2 was reapplied after the fourth evaporator. Downstream of that application, another sample of syrup was taken for color testing and resulted in a color of 10,910 (average of three tests at different times). Thus, the present invention showed a reduction in syrup color of 31.3%. The sugar produced showed a color of 191 (average of three tests taken at three times). The sugar prepared according to the present invention thus showed a color reduction of 69.2% relative to standard sugar.

EXAMPLE 7

Sugar was made according to the present invention. The amount of Component 3 was varied to see the effect on the sugar color. The sugar

55

without any of Components 1-3 had a UI of 200. The standard was the syrup obtained before the addition of Components 1-3 before the last (fourth) evaporator. The final syrup is that obtained downstream of the adding of Component 2 after the fourth evaporator. The results are shown in Table 6 below.

TABLE 6

Product 1 (ppm)	Product 2 (ppm)	Product 3 (ppm)	Standard syrup (UI)	Syrup (Final) ICUMSA UI	Sugar ICUM SA	Syrup color reduc tion (%)	Sugar Color Reduc tion (%)
50	100	60	9441	8379	65	11.2	67.5
50	100	90	8577	6734	90	21.5	55
50	100	120	8422	6542	79	22.3	60.5
50	100	180	6054	5102	40	15.7	80

As shown above, all of the samples of syrup tested and the final sugar, showed significant improvement over the standard when Components 1-3 were utilized.

In the sugar obtained in this example, the amount of residual HEDP of the resulting sugar was, on average, the following: 60 ppm HEDP used (4.4 ppm residual HEDP), 90 ppm HEDP used (32.7 ppm residual HEDP), 120 ppm HEDP used (49.7 ppm residual HEDP, and 180 ppm HEDP used (66.8 ppm residual HEDP), as already mentioned above.

EXAMPLE 8

The present invention not only results in less color than conventional technology, but also results in greater stability of color over time for the sugar produced. The increase in color for stored sugar may be affected by temperature of the drying of the sugar, the temperature of the environment where the sugar is stored, moisture of the environment, and others. For the present Example, sugar sacks of 50 kgs were prepared with conventional technology and with technology according to the present invention. The sugar made and tested was subjected to the same storage conditions, such as the same type of bags, same temperature of sugar when dried (40 to 42°C), and

56

same temperature and humidity during storage. The testing was done for six months of stability on two different date ranges, as shown below in Tables 7 and 8, respectively. For producing the sugar according to the present invention in the data shown in Table 7, the chemicals applied were 100 ppm, 100 ppm and 360 ppm of Components 1, 2, and 3, respectively, at the input of the last evaporator, and 100 ppm of Component 2 at the output of the last evaporator. Regarding Table 8, it was the same method, but the chemicals used were 50 ppm, 50 ppm and 60 ppm, of Components 1,2 and 3, respectively, and 50 ppm of Component 2 in the second input point.

10

TABLE 7

	Sugar Produced According to the Present Invention	Sugar Produced with Conventional Technology
Initial Color	138 UI	340 UI
Final Color	149 UI	420 UI
Increase in Color	7.97%	23.53%

TABLE 8

	Sugar Produced According to the Present Invention	Sugar Produced with Conventional Technology
Initial Color	112 UI	238 UI
Final Color	119 UI	290 UI
Increase in Color	6.25%	21.85%

As can be seen above, the present invention also results in significant and unexpected reduction in increase of color for the sugar being stored, demonstrating its advantages in increasing color stability. Components 1 and 3, in particular, contribute to this stability.

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Finally, it must be stressed that, as well understood by a person

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CLAIMS

1. METHOD FOR REDUCING THE COLOR OF SUGAR, and/or any intermediate of a process for obtaining sugar, characterized by the fact that this comprises the addition of Components 1, 2 and 3, wherein the Components are:

Component 1: sodium chlorite, tropolone, , beta-fluorocaffeic acid, or a sulfoxylate; or a salt of the form $M^+O-S(=O)-CH(OH)R$; or a monobasic organic acid of sulfur having the general formula RSO_2H ; wherein M^+ can be a mono or multivalent cation, and wherein $R = H$, C_1-C_{20} alkyl, branched C_1-C_{20} alkyl, cyclic C_5-C_6 alkyl, aryl, benzyl, or heterocyclic C_5-C_6 rings, and wherein R can be substituted or unsubstituted; or mixtures thereof;

Component 2: one or more of sulfites, metabisulfites, bisulfites, or sulfur dioxide or a source thereof; and

Component 3: at least one chelating agent.

2. METHOD, according to Claim 1, characterized by the fact that Components 1, 2 and 3 may be added at any stage of a process for the reduction of the color of sugar and/or any intermediate of a process for obtaining sugar.

3. METHOD, according to Claim 2, characterized by the fact that Components 1, 2 and 3 are added to the preparation of syrup, to the preparation of raw sugar from syrup, or to the refining of raw sugar into refined sugar, among others, in a process for obtaining sugar.

4. PROCESS FOR THE PRODUCTION OF LOW COLOR SUGAR, and/or any intermediate of a process for obtaining sugar, characterized by the fact that it comprises the addition, at stages of the process, of Components 1, 2 and 3, wherein Components 1, 2 and 3 are:

Component 1: sodium chlorite, tropolone, beta-fluorocaffeic acid, or a sulfoxylate; or a salt of the form $M^+O-S(=O)-CH(OH)R$; or a monobasic organic acid of sulfur having the general formula RSO_2H ; wherein M^+ can be a mono or multivalent cation, and wherein $R = H$, C_1-C_{20} alkyl, branched C_1-C_{20} alkyl, cyclic C_5-C_6 alkyl, aryl, benzyl, or heterocyclic C_5-C_6 rings, and wherein R

58

can be substituted or unsubstituted; or mixtures thereof;

Component 2: one or more of sulfites, metabisulfites, bisulfites, or sulfur dioxide or a source thereof; and

Component 3: at least one chelating agent.

5 5. PROCESS, according to Claim 4, characterized by the fact that Components 1, 2 and 3 may be added at any stage of a process for the reduction of the color of sugar and/or any intermediate of a process for obtaining sugar.

10 6. PROCESS, according to Claim 5, characterized by the fact that Component 3 and Component 1 and Component 2 are added after crushing the cane, during or after heating, during or after sulfitation, during or after liming, during or after phosphatation, during or after decantation, during or after evaporation, during or after boiling, during or after centrifuging, during or after syrup flotation, during or after magma remixing, or during refining.

15 7. PROCESS, according to Claim 4, characterized by the fact that the three Components may be added in any order during the process.

8. PROCESS, according to Claim 4, characterized by the fact that the raw material for sugar production is selected from the group consisting of sugar cane, sugar-beets, saccharine sorghum or mixtures thereof.

20 9. LOW COLOR SUGAR, characterized by the fact that it is obtained from the method as described in one of claims 1 to 3 or the process as described in one of claims 4 to 8.

25 10. COMPOSITION, for reducing the color of sugar, characterized by the fact that it comprises Components 1, 2 and 3 as defined in claim 1.

11. KIT, characterized by the fact that it comprises Components 1, 2 and 3 as defined in claim 1, in the same or different compartments.

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12. USE OF THREE COMPONENTS, characterized by the fact that this is for reducing the color of sugar and / or any intermediate of a process

59

for obtaining sugar, wherein the three Components are:

Component 1: selected from one or more of sodium chlorite, tropolone, beta-fluorocaffeic acid, or a sulfoxylate; or a salt of the form $M^+O-S(=O)-CH(OH)R$; or a monobasic organic acid of sulfur having the general
5 formula RSO_2H ; wherein M^+ can be a mono or multivalent cation, and wherein $R = H$, C_1-C_{20} alkyl, branched C_1-C_{20} alkyl, cyclic C_5-C_6 alkyl, aryl, benzyl, or heterocyclic C_5-C_6 rings, and wherein R can be substituted or unsubstituted; or mixtures thereof;

Component 2: one or more of sulfites, metabisulfites, bisulfites, or
10 sulfur dioxide or a source thereof; and

Component 3: at least one chelating agent.

13. USE OF TWO COMPONENTS, characterized by the fact it is for reducing the color of sugar and / or any intermediate of a process for obtaining sugar, wherein the Components used are Component 3 and
15 Component 1 or 2, as follows:

Component 1: is selected from one or more of sodium chlorite, tropolone, beta-fluorocaffeic acid, or a sulfoxylate; or a salt of the form $M^+O-S(=O)-CH(OH)R$; or a monobasic organic acid of sulfur having the general
20 formula RSO_2H ; wherein M^+ can be a mono or multivalent cation, and wherein $R = H$, C_1-C_{20} alkyl, branched C_1-C_{20} alkyl, cyclic C_5-C_6 alkyl, aryl, benzyl, or heterocyclic C_5-C_6 rings, and wherein R can be substituted or unsubstituted; or mixtures thereof;

Component 2: one or more of sulfites, metabisulfites, bisulfites, or
sulfur dioxide or a source thereof; and

25 Component 3: at least one chelating agent.

DIAGRAM OF A SUGAR MILL

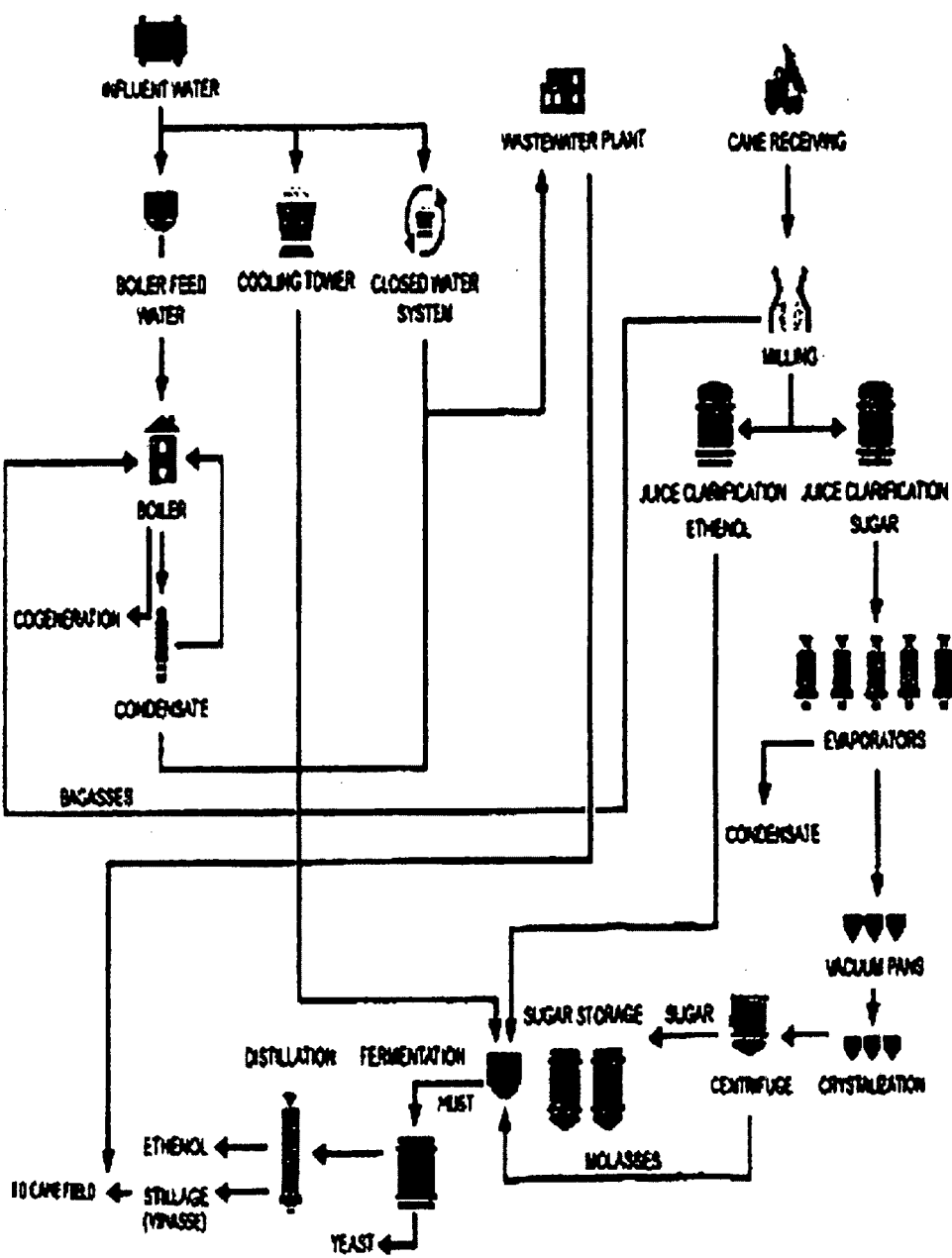


Fig. 1

2/5

61

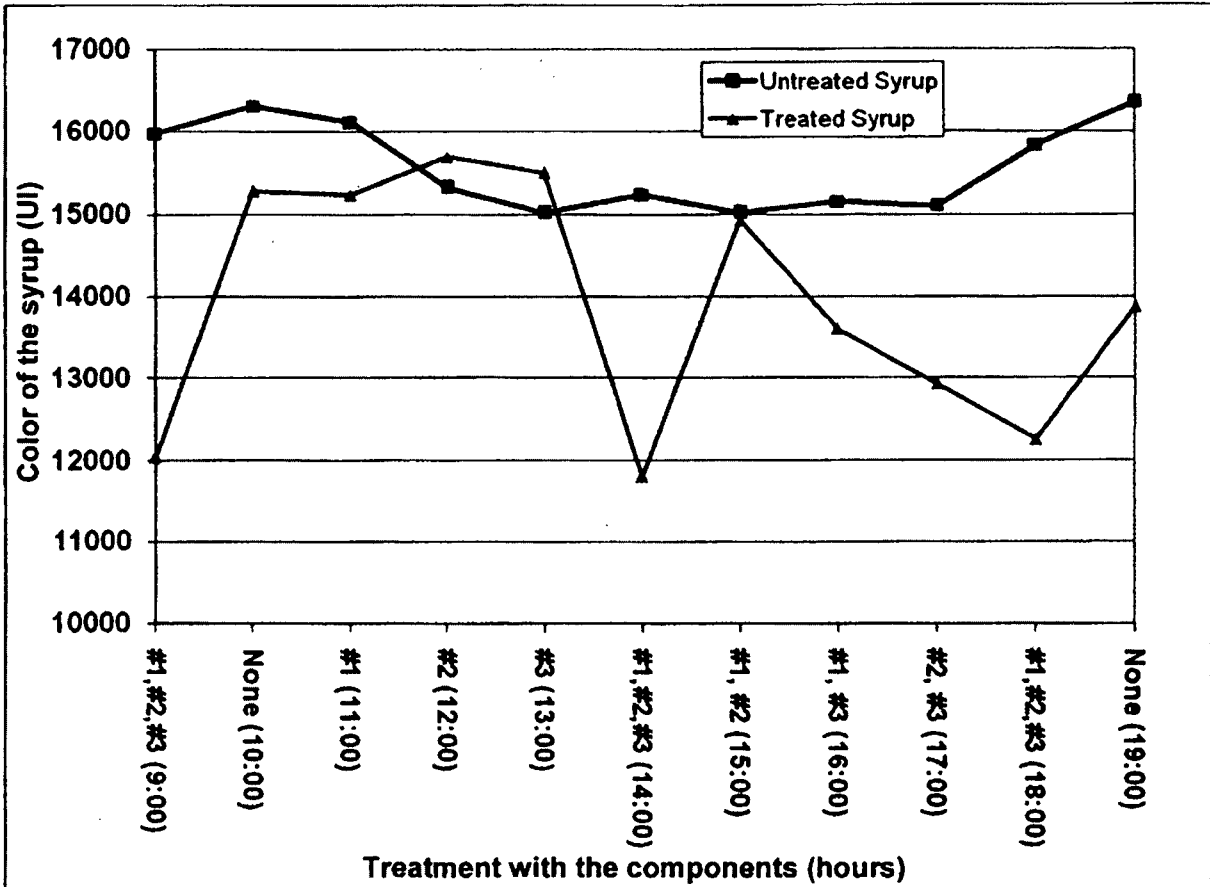


Fig. 2

62

3/5

PRODUCTS APPLICATION POINTS

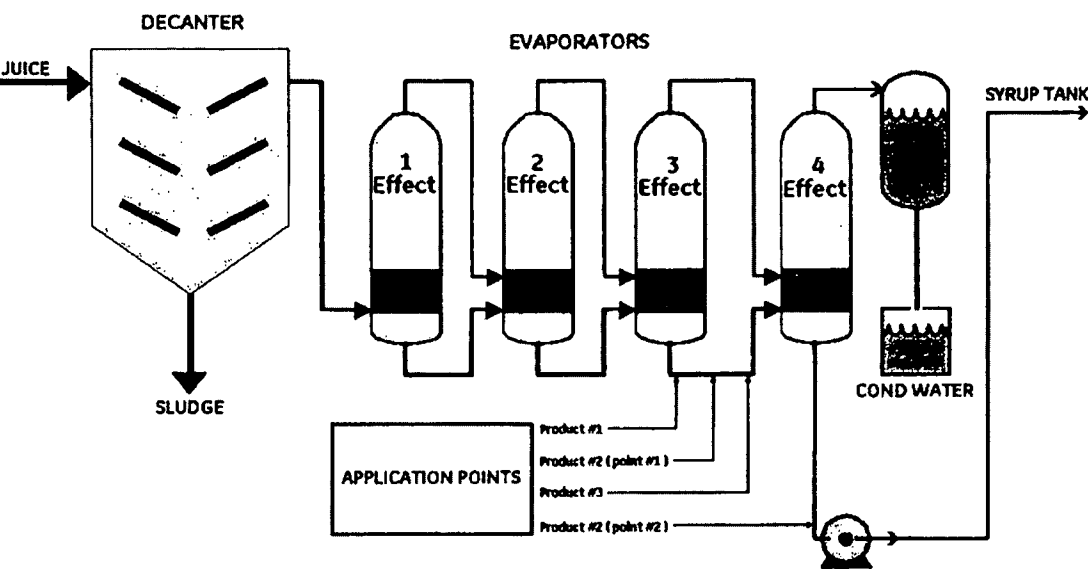


Fig. 3

4/5

63

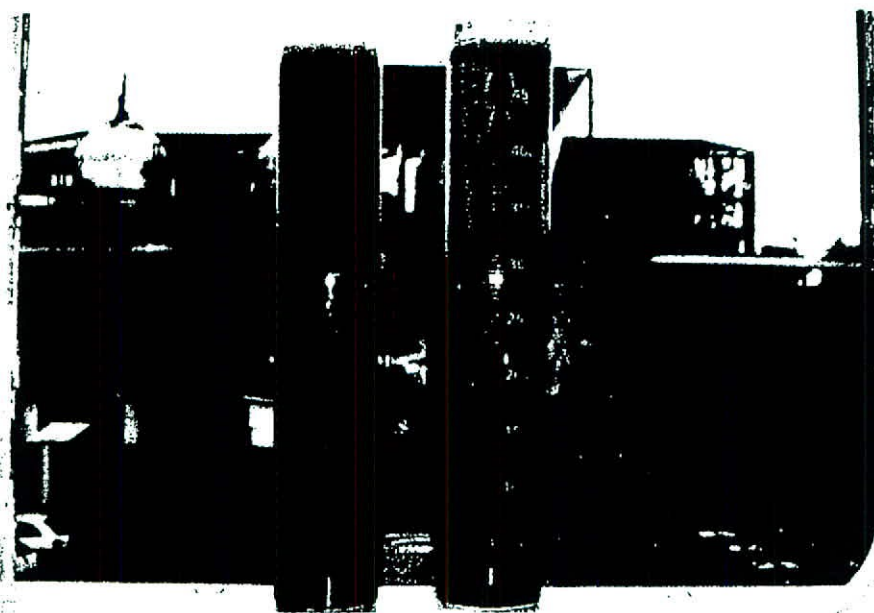


Fig. 4

5/5

64



Fig. 5