

GOOD QUALITY SUGAR TECHNICAL ASPECTS

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ABSTRACT

Production of sparkling white sugar crystal is always prime target of a Production Manager while handling a sugar factory. In order to make good quality sugar PM has to concentrate over many factors which may disturb the color and quality of sugar during processing which includes, in coming color in cane itself, coloring in cane juice due to decomposition of its constituents, coloration due to iron salts, formation of color due to non-sugar reactions, coloration due to high temperature and storage of sugar bags. Precautions and practical steps to produce good quality sugar are included in the paper as supply of fresh and quality cane, proper beating and scrapping of all vessels before start of every cane crushing season, temperature control and proper storage of sugar bags in godown etc.

INTRODUCTION

Although operating a sugar plant, the Production Manager has to deal with many challenges during working as maintaining optimum cane crushing rate, struggle to get good sugar recovery (%), overall sugar losses and production of good quality sugar. But production of good quality sugar is always a Prime Target for a Chemist handling a sugar factory. This paper is designed to identify the important parameters to produce good quality sugar, point out the incoming color in cane, formation of color in raw juice during milling and processing and its effect on the quality of sugar and what remedial actions are to be taken to minimize these effects.

Incoming Color in Cane

The organic non sugars are the coloring matters in sugar cane and raw cane juices. Color in cane juice may have two origins:

a) Coloring matters from the cane itself

1. Chlorophyll
2. Anthocyanin
3. Saccharetin
4. Tannins

b) Chemical decomposition

Coloration in juice due to decomposition of its constituents by the action of lime and heat or both.

Coloration of the juice due to presence of soluble iron salt (ferric) from the equipment used because of reaction with polyphenols. Coloration due to reaction of non-sugars with other substances.

Coloring Matters from the Cane Itself

The rind cells of sugar cane stalks contain a mixture of two coloring matters,

chlorophyll & anthocyanin

Whereas the fiber of the cane contains saccharetin, the top and eyes of the plant contains tannins.

Chlorophyll

It is a harmless coloring matter because It is insoluble in water and has no reaction with lime and acid. It is in colloidal form and removed from raw juice in shape of mud without affecting the color of the juice.

Anthocyanin

It is soluble in the juice. During milling, it passes into the cane juice giving dark color to the juice. The pigment is precipitated by

excessive liming during defecation.

Saccharetin

It is found in the fiber of the cane. In raw juice, there are fine particles of bagasse carrying saccharetin. It is colorless but when juice is limed its color becomes yellow. It is therefore important to remove as much of cushion from the juice as possible, so that saccharetin is prevented from entering in the clarified juice. Although it is a harmless pigment and becomes colorless again in acidic media below 7 ph.

Tannins

It is soluble in water and juice. It is of green color but when it reacts with iron salts present in the juice becomes dark in color. Tannins is dangerous as it disturbs the color of sugar, so it is important to clean all the vessels from inside, including tanks, evaporators, pans, centrifugals etc, by hammering, beating, scraping, followed by oiling and liming before start of every cane crushing season.

Coloring of Juice Due to Decomposition of Its Constituents

At high temperatures above 200 °C, sucrose and two reducing sugars; Glucose and Fructose are caramelized and assume a dark color. So in order to achieve juice of light color, high temperature should be avoided. The color of sucrose and reducing

sugars in acid solutions is not so strong as in natural solution but acid causes inversion in sucrose. In an alkaline media, there is no fear of inversion but RS decompose at high temperature and high pH, forming harmful dark decomposed products followed by an increase of lime salts. So any prolonged treatment of juice at high temperature and high pH should be avoided.

Coloration of Juice Due to Iron Salts

During treatment of juices, massecuites and molasses constantly come in contact with inner metallic iron surface such as evaporators, tanks, crystallizers, juice heaters, and centrifugals etc. and tend to darken the color due to absorption of iron salts because of its reaction with polyphenols. Fe₂O₃ (ferric oxides) are dark in color and have harmful influences on the color of sugar. A number of chemicals can be used to remove harmful action of ferric such as:

1. Sulfurous acid
2. Phosphoric acid
3. Activated Carbon
4. Bone Char
5. Ion exchange discoloration
6. CARBOUA products of FRSW series

By treating the juice with sulfurous acid the ferric acid is reduced to ferrous state which is a colorless substances.

Coloration Due to Reaction of Non-Sugars and Other Substances

The most important are classed into two portions

Polyphenols

These include tannins and saccharatin. These polyphenols react with iron (ferric) and oxygen in alkaline solution and form dark colored products.

Amino Compounds

The cane juice contains nitrogenous substances such as albuminoid, ammonia, amino acids and amides. These compounds react with reducing sugars and form colored compounds

Coloring in Sugar Due to Other Reasons

Recirculation of molasses at pan station. Significantly color of sugar increased during pan boiling when unnecessary molasses recirculates at the pan station, especially when c-massecuite is boiled at low purity and high temperature (Maillard reaction). Ignorance to wash/clean centrifugal screens and sugar dryer is also one of the causes to increase the color of sugar.

Products of super heating

Sometimes caramel is formed on the surface of the pan calandria tubes and coils, which causes coloration in the massecuite, so it is essential to clean the pan

thoroughly well with steam after every strike dropped.

Coloration Due to Storage of Sugar in Godown

Color of sugar increased during the storage when it is not stored properly. Parameters to store sugar in a warehouse to avoid color formation in sugar are appended as under:

Keep sugar temperature at 38°C during bagging before

storage. Maintain humidity below 60% in warehouse. Keep pile height to a practical minimum. Pack sugar in a moisture tight packaging. Protect the bottom layer of the bags, providing the floor by means of plastic sheet, pallets and grating etc. Cover stacks with plastic sheets to keep the bags clean and protect sugar from ambient air. Keep proper distance between the stakes

Storage Time & Temperature of Sugar

In order to avoid color formation in refined white sugar its storage time is experienced to be about 11-12 months at 30-35°C temperature. Above this period of time and temperature color of sugar will increase by 10-80%.

White Refined Cane Sugar Standards

Sr. No.	Characteristics	Value	Sr. No.	Characteristics	Value
1.	Polarization at 20 °C	99.80 Min	7.	Magnetic particles	4 mg/kg
2.	Color	Max 45 - 60 ICUMSA	8.	AS	1 ppm
3.	Ash content	0.04% Max	9.	OS	2 ppm
4.	Moisture	0.04% Max	10.	CU	3 ppm
5.	Reducing sugar	0.05% Max	11.	Appearance	Sparkling white
6.	SO ₂	1-5 mg/kg			

Practical Considerations

In order to produce “sparkling white sugar crystals” following precautions can reduce formation of color in the juice and sugar.

Keeping in view the quality of the cane; that fresh, clean, top and trash free cane is delivered. Dark colored quality cane must be avoided. Clay and mud coming with the cane can increase ash % in the juice.

More quantity of crush-crush in raw juice means circulation of more coloring matter in

boiling house, so all efforts are to be made to reduce it.

Use proper polyelectrolyte at Clarifier to get +94 clarity of the clarified juice. Excessive liming of raw juice must be avoided, otherwise more lime salts will be formed and ash % will increase.

Avoid excessive heating and pH of the juice, massecuite and molasses. Temperature of juice must not exceed 120 °C. Please note that this is the last limit of the temperature, to avoid caramelization.

Boiling temperature of pans must not increase above 63 °C, otherwise there will be danger of Maillard reactions.

All the inner portions of all vessels must be cleaned and white washed /oiled before start of crushing season.

Periodic cleaning of centrifugal screens is necessary.

In order to improve the quality of refined sugar, keep A-sugar color in between 700-850 IU

B and C- seed purity must be kept reasonably high 93-95°

to avoid recirculation of colors at pan station.

Maintain the sugar at a temperature of 38 °C at the time of sugar bagging.

Use proper chemicals for the treatment of juices and liquor.

CARBOUA products of FRSW series proved to be very useful for improving refined sugar colors, reducing turbidity,

Reducing circulation of sugar in process house, enhancing boiling house efficiency as well as process house capacity. These products can be used at Talo Clarifier, pan station and at Liquor Carbonatation process.

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