How to lower Color in raw sugar and refine process

Part 1: Raw Factory

E.M. Sarir, B.R.Pabon,
Carbo-Solutions International, USA
Color in Sugar

One of the greatest difficulties faced by sugarcane technicians is the lack of knowledge about the types of colorants present in sugar and the mechanisms used by the most frequently used color removal technologies.

Determination of the types of color present in raw sugar is important when choosing and operating raw & refinery processes, as different processes may remove or not different types of color compounds.
Color in Sugar

• Color present in sugar are a complex mixture of organic compounds from different sources
• Color can be classified into:
  • Natural color from sugar cane
  • Colorants formed during processing
  • Most of these color compounds hydrophobic anionic compounds with a wide range of molecular weights.
• Color precursors initially are colorless but degrades with heat producing colored compounds as caramels and hydroxymethyl furfural
Color in Sugar

• The formation of colored compounds in sugar processing is associated with physical changes: pH, temperature, reaction time and auto catalytic effects (Bento and Sa, 1998).

• Thermal treatment of reducing sugars in presence of amino acids and proteins in aqueous phase causes colored compounds to appear in a few minutes and the darkening increases with retention time (Knerr et al., 2001).
Color in Sugar

There are generally recognized four colorant types in sugar:

- plant pigments
- Melanoidins
- Caramels
- Alkaline degradation products of fructose (ADF)
- Last three are factory produced color pigments.

Color formation is imminent and progressive as the materials are processed, once the cane has been harvested. The enzymatic browning occurs since harvesting and other color formation process continues until sugar storage and molasses.
## Color in sugar across process

<table>
<thead>
<tr>
<th>Process Stage</th>
<th>Temperature</th>
<th>pH</th>
<th>Main color mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milling Extraction</td>
<td>20 - 50</td>
<td>5 to 7</td>
<td>Enzymatic browning / pigments extraction</td>
</tr>
<tr>
<td>Purification</td>
<td>50 - 95</td>
<td>7 to 8,5</td>
<td>Alcaline degradation of reducing sugar</td>
</tr>
<tr>
<td>Evaporation</td>
<td>80 - 110</td>
<td>6.5 to 7,5</td>
<td>Caramelization and Maillard reaction</td>
</tr>
<tr>
<td>Crystallization</td>
<td>50 - 70</td>
<td>6 to 7</td>
<td>Caramelization and Maillard reactions</td>
</tr>
</tbody>
</table>
Sugar Cane Pigments

Sugar cane juice contains many color compounds as chlorophyll, carotenes, xanthophylls and anthocyanins. The quantity of color compounds in juice is very small (less 0.2%).

However they are very important because of their pronounced effect on juice and sugar color.
Sugar Cane Pigments

The type and quantity of these pigments and colorants depends on: cane variety, management practices and environmental conditions.

Among the natural cane pigments, chlorophyll, xanthene and beta carotene are insoluble and are easily removed during clarification.

Flavonoids are soluble and pass through process to sugar (Bento 2003)
Flavonoids

FLAVONOIDS (from the Latin word flavus meaning yellow, their color in nature) are a class of plant metabolites. Chemically, flavonoids have the general structure of a 15-carbon skeleton, which consists of two phenyl rings (A and B) and heterocyclic ring (C).

The FLAVONOIDS are are all ketone-containing compounds, and as such, are anthoxanthins (flavones and flavonols). Over 5000 naturally occurring flavonoids have been characterized from various plants and are main responsible for flower coloration.

<table>
<thead>
<tr>
<th>Structural formula</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Structural formula" /></td>
<td>Luteolin, Apigenin, Tangeritin</td>
</tr>
<tr>
<td><img src="image2" alt="Structural formula" /></td>
<td>Quercetin, Kaempferol, Myricetin, Fisetin, Galangin, Isorhamnetin, Pachypodol, Rhamnacin, Pyranoflavonols, Furanoflavonols,</td>
</tr>
</tbody>
</table>
Flavonoids

The plant pigments are principally phenolics and flavonoids, which make up about two thirds of the color in raw sugar (Smith and Paton, 1985).

The phenolics are generally uncolored, but are oxidized or react with amines or iron to form colorants during processing.
Flavonoids

Flavonoids are polyphenols that exist in the cane plant and are involved in enzymatic browning reactions.

Plant pigments tend to have low to medium molecular weights (MW < 1000), but are highly ionized, particularly at high pH values.

Hence they have high indicator values (IV = color at pH 9 divided by color at pH 4) (Davis 2001).
Caramels

These are compounds formed from thermal degradation of sucrose, with high Molecular weight that increase with time and temperature as a result of increasing polymerization. They have only a slight charge and are not pH sensitive.

Caramelization is the removal of water from a sugar, proceeding to isomerization and polymerization of the sugars into various high-molecular-weight compounds.
Caramels

Compounds such as di-fructose anhydride may be created from the monosaccharides after water loss.

Fragmentation reactions result in low-molecular-weight compounds that may be volatile and may contribute to flavor. Polymerization reactions lead to larger-molecular-weight compounds that contribute to the dark-brown color.
Alkaline degradation products of fructose (ADFs)

ADF are formed, as their name suggests, from thermal decomposition of fructose mainly, and glucose to a lesser extent, under alkaline conditions.

Reaction products are brown-colored and acidic in nature, leading to inversion of sucrose and further color formation.

The exact mechanisms are unclear, but amines are known to be involved (Carpenter and Roberts, 1976).

These compounds are usually uncharged with medium to high MW.
Color Precursors

These are compounds which, while not colored themselves, but undergo reactions that form color during processing.

Include amino acids, simple phenolic compounds, and 5-hydroxy-2-methyl furfural (HMF), the last being formed from acidic decomposition of fructose.
Enzymatic Browning

- Enzymatic browning is a biochemical process in which sugar cane and many vegetal tissue take on a brown color when exposed to oxygen during cane preparation and milling.

- Enzymatic browning occurs when cane tissue is exposed to air resulting in a brown colored pigment, melanin, being produced as a result of a series of biochemical reactions.
Enzymatic Browning

- Phenolases which are enzymes found outside the cell wall come in contact with colorless phenols which are found inside the cell causing the brown color to appear.

- A naturally occurring enzyme called polyphenol oxidase acts as a catalyst to speed up the process which can occur rapidly at warm temperatures when the pH is between 5.0 and 7.0.
## Sugar color compounds properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Monomeric</th>
<th>Intermediate</th>
<th>Polymeric</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Composition</strong></td>
<td>Mainly flavonoids</td>
<td>Factory colourants, eg. ADF</td>
<td>Factory colourants, eg. caramels, melanoidins</td>
</tr>
<tr>
<td><strong>Molecular weight</strong></td>
<td>&lt; 1000</td>
<td>1000 - 2500</td>
<td>&gt; 2500</td>
</tr>
<tr>
<td>(MW)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ion</strong></td>
<td>Neutral at low pH</td>
<td>Cationic below pH 5, Anionic above pH 6</td>
<td>Cationic below pH 5, Anionic above pH 6</td>
</tr>
<tr>
<td><strong>Polarity</strong></td>
<td>Least polar</td>
<td>Intermediate</td>
<td>Polar</td>
</tr>
<tr>
<td><strong>Indicator value (IV)</strong></td>
<td>5 - 40 Sensitive</td>
<td>3 - 4 Intermediate</td>
<td>1 - 2 Insensitive</td>
</tr>
</tbody>
</table>

*Proc S Afr Sug Technol Ass (2001) 75*
Proper decolorization technology must consider
- Capital cost
- Operational cost
- Color removal effectiveness
- Process flexibility
- Environmental impact

- Generally, combinations of processes are usually required to produce the best quality sugar and lower sugar losses.
Color removal in sugar mills

The purpose of the color removal operations in sugar mills is the production of premium white sugar or the production of low-color raw sugars that reduce processing costs during refining.

There is renewed interest in the sugarcane sugar sector to produce a high quality raw grade sugar or plantation white sugar at a sugar factory.
Color removal in sugar mills

This is motivated by the need for increased factory revenue and the fact that refining costs are directly associated with raw sugar quality.

In addition, sugar refiners have raised their standards for raw sugar pol values and color to approach those for HP (high polarization) and VHP (very high polarization) sugars.
Color removal in sugar mills

- Production of high quality white sugar and low color raw has a large economic advantage.

- Increasingly with green cane harvesting on the rise around the world, and factories having to process poor quality sugarcane at times, invariably results in difficulties to obtain low color sugar with technical and economical disadvantages.
Direct White sugar

• Many attempts has been done to develop a simple and economical decolorization process to remove colored impurities in cane syrups leading to directly production of VHP, raw premium or even direct plantation white.
Technologies for color reduction

Common process for raw sugar color removal:

- Sulphur compounds
- Hydrogen peroxide
- Ozone & Chloride treatments

Although these treatment steps retard color formation they cannot eliminate it from sugar.

Those treatments has adverse effects: higher sucrose inversion, environmental impact, hazard conditions, increase in maintenance cost and sulphur residual in sugar and molasses.
Technologies for color reduction

- Double curing of C massecuite
- Membrane filtration or Ion exchange treatment for juice
- Boiling Scheme modifications

- Majority of this tech has not been successful adopted due its high capital investment requirements and/or operational aspects (High energy consumption, high maintenance cost).
Juice and syrup sulphitation

• Sulphur dioxide (SO2) has been satisfactory used for centuries in third world countries to produce plantation white sugars.

• Process is carried out by injecting SO2 into the raw juice to a level of about 400 ppm SO2.

• Factories using juice and syrup sulphitation has reported 25% less color in syrup and raw sugars.
Sulphitation problems

• Higher sucrose inversion, increase on evaporators scaling, corrosion in pipes and process equipment, environmental and health concerns.

• USFDA currently has a 10 ppm limit on residual sulphur dioxide allowed in food products.

• Sulphitation as use of oxidative decolorant agents has very little or no effectiveness for caramels and glucose fructose degradation products elimination (3).
**Syrup clarification**

Syrup clarifiers use air flotation, very fine impurities are floated off, the process involves primary flocculation with phosphoric acid and lime, polymer addition to increase size of flocs and physical capture of the micronized air bubbles within the flocs.
Syrup clarification

Flotation reduces syrup viscosity with good benefits at boiling stage, removes 80-90% of turbidity in raw syrup, but only and slight color removal is noticed (5-10%) and is necessary to add decolorant polymers to increase decolorization.

- Analysis of the sugar produced during a single trial at factory

<table>
<thead>
<tr>
<th>Sample</th>
<th>Pol</th>
<th>Moisture (%)</th>
<th>Purity (%)</th>
<th>Colour, (IU)</th>
<th>Ash (%)</th>
<th>M.A. (mm)</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar from untreated syrup</td>
<td>99.68</td>
<td>0.08</td>
<td>99.76</td>
<td>639 (257)</td>
<td>0.08</td>
<td>0.83</td>
<td>0.22</td>
</tr>
<tr>
<td>Sugar from clarified syrup</td>
<td>99.62</td>
<td>0.08</td>
<td>99.70</td>
<td>620 (215)</td>
<td>0.04</td>
<td>0.66</td>
<td>0.28</td>
</tr>
</tbody>
</table>

Note: The values in parentheses are for the colour and ash in the affined crystal.

SYRUP CLARIFICATION FOR PLANTATION WHITE SUGAR TO MEET NEW QUALITY STANDARDS R.J. STEINDL and W.O.S. DOHERTY 2005
Alternative Boiling Procedures

Sucrose crystallization at vacuum pans can be performed using different boiling schemes, choice of boiling procedure is determined by syrup purity and required quality for sugar.

Most common boiling schemes are: two boiling system, three boiling system, double magma and Very High Pol (VHP) scheme, VHP produces the lowest sugar color.
Alternative Boiling Procedures

- Many raw sugar factories are adopting double magma or VHP boiling schemes in order to improve the quality of their sugar.

- Color reduction sometimes is not high enough and process modification involves high capital investment.

- New boiling process consumes more energy and evaluation of overall sugar recovery must be done.
Boilings systems

Three Massecuite boiling systems

Double Magma
Operational controls

It is often thought that color removal can only be achieved by the addition of chemicals or new processes.

However, the major causes of high-color sugars can be solved through a strict operational control of equipment and adjustment of the parameters for critical variables.
Cane Quality

The primary source of color in sugar is the processing of damaged cane and high levels of impurities.
Cane Quality

The first step in sugar color improving program should include:

- Reduce residence time for cane before crushing
- Reduce top, leaf and trash form cane
- Reduce cane deterioration
- Cane Cleaning systems
Minimize the extraction of pigments

Too hot imbibition water must be avoided (90C)
Too hot water increases pigments and waxes extraction
Remove bagacillo accumulated over Trommel sieves and DSM filters
Polysaccharides control

- Polysaccharide affects all purification stages
- Elongated crystal breaks into fine particles plugging centrifugal mesh
- High viscosity interferes good crystallization procedures
Operational controls

Display hourly results for all to see
Visual displays are often simpler to understand than figures
It also keeps the following shift informed of the current situation
Mechanical / Electrical can make adjustments
Operational controls

This could raise questions or initiate investigations as to why is the quality is varying from one hour to the next?”
Operational controls: Evaporation

- Avoid excessive high temperature for juice in evaporator
- Steam desuperheating
- Control of residence time in high temperature evaporation
- Color and color precursor profile across evaporation
Avoid sugar inversion

Reducing sugars are more prone to participate in complex chemical reactions producing colored compounds as Maillard reaction.
pH Control

Cane juice with low pH undergoes a rapid inversion of sucrose. In the same manner, at high pH and heat alkaline degradation of the hexoses occurs.

It is mandatory to implement proper automatic pH control systems in the purification of juices and syrups

- Avoid over liming of juice and syrup
- Avoid caustic contamination during evaporators cleaning
Boiling Control

Massecurites having excessive amount of very fine crystals tend to clog the holes of the centrifugal meshes causing high color sugar and other operational problems.

Sugar crystal conglomerates traps molasses inside and increase the color of sugar.
Boiling Control

The conditions of circulation of the vacuum pans should be improved by installing mechanical circulators and jigger tubes. It is highly advisable to use tools to measure & control the crystallography of sugar during seeding and boiling.

Crystal Size Analysis for Massecuites
Centrifugals

Drip gates passing raises sugar color
Poor centrifuge meshes in addition to increasing the purity of molasses generate high color sugar. Centrifugal screens must be free of sugar crystal at the end of each purge cycle.
Centrifugals
Centrifugal inspection

The efficiency of the washing water in the centrifuges must be permanently monitored.

Water Temperature, Water pressure, nozzles array and cleaning.

Stroboscope lamp use is highly recommended.
High performance decolorants HPD

Cationic decolorants can be successful used to reduce color of mixed juice and syrup at raw sugar production process.

HPD are engineered process aids added to mixed juice or syrup to inhibit color formation reactions and remove colorants and color precursors.
High performance decolorants HPD

HPD are intended to high color removal in sugar mills & replace juice and syrup sulphitation process in plantation white production.

High active chemical radicals traps colorants for further removal during juice clarification with the mud or floated scum.

HPD are food grade liquid products with high advantages in safety handling and lower environmental impact.
High performance decolorants HPD

HPD product is dosed continuously to mixed juice tank after juice liming, dosage varies from 20-40 ppm basis crushed cane.

Comparative study for one year in Colombian sugar mill demonstrated it is possible to replace traditional juice sulphitation.
## HPD for juice sulphitation replacement

### Table 1 Juice sulphitation replacement at Providencia Sugar Mill Colombia 2012 (6)

<table>
<thead>
<tr>
<th></th>
<th>Mixed Juice Color (UI)</th>
<th>Clarified Juice Color (UI)</th>
<th>Raw Syrup Color (UI)</th>
<th>Clarified syrup Color (UI)</th>
<th>Juice Color removal %</th>
<th>Syrup Color removal %</th>
<th>Dosage (kg/ MT cane)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphitation</td>
<td>17004</td>
<td>14149</td>
<td>15350</td>
<td>14258</td>
<td>16.57</td>
<td>6.18</td>
<td>0.103</td>
</tr>
<tr>
<td>HPD</td>
<td>16907</td>
<td>14005</td>
<td>14556</td>
<td>13632</td>
<td>17.12</td>
<td>6.23</td>
<td>0.013</td>
</tr>
</tbody>
</table>
## HPD for juice decoloration in Ecuador 2015

### Table 2 HPD (MAJ-1) at Ingenio La Troncal Ecuador 2015

<table>
<thead>
<tr>
<th></th>
<th>Mixed Juice (A)</th>
<th>Clarified Juice (Blank) (B)</th>
<th>Mixed Juice + HPD 20 ppm (C)</th>
<th>Mixed Juice + HPD 40 ppm (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purity (%)</strong></td>
<td>79,26</td>
<td>80,6</td>
<td>80,4</td>
<td>80,76</td>
</tr>
<tr>
<td><strong>pH</strong></td>
<td>5,83</td>
<td>7,39</td>
<td>6,6</td>
<td>6,51</td>
</tr>
<tr>
<td><strong>Color UI</strong></td>
<td>9914</td>
<td>7321</td>
<td>6420</td>
<td>6232</td>
</tr>
<tr>
<td><strong>Turbidity UI</strong></td>
<td>34463</td>
<td>2826</td>
<td>2969</td>
<td>2857</td>
</tr>
<tr>
<td><strong>Conductivity</strong></td>
<td>4,1</td>
<td>3,97</td>
<td>3,92</td>
<td>4,0</td>
</tr>
<tr>
<td><strong>mS/cm</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Color Removal %</strong></td>
<td></td>
<td>26,15</td>
<td>35,24</td>
<td>37,14</td>
</tr>
<tr>
<td><strong>Turbidity Removal %</strong></td>
<td></td>
<td>91,8</td>
<td>91,38</td>
<td>91,71</td>
</tr>
</tbody>
</table>
HPD for juice decoloration
Color Precipitants (CP)

High performance color precipitants are macro molecular chain polymers with strong cationic charge.

CP are designed to allow its application in juice, raw syrup or vacuum pans. This liquid product contains strong activated adsorbent radical group which can destabilize and trap impurities and then remove them from the pan reducing color transfer during crystallization.
Color precipitants

Color precipitants physical & chemical properties as very low viscosity and high water solubility allows easy and complete elimination on the centrifugation stage.

HPD improves molasses separation during centrifugation and therefore less washing time is required when product is used in the Pans.

HPD dosage is low (100-300 ppm basis sugar) and do not generate solid waste.
Color precipitants

S type 5 DOSING CALCULATIONS

C. Vacuum Pans Dosing

- Brixing
- 85% level
- 60% level
- Feeding

A and B Vacuum Pans

S type 5

300 ppm on strike solids
20.0 kgs. FRS-J6/strike
95% Dilution

23609.2 liters
23609.2 liters
23609.2 liters
23609.2 liters

94436.8 liters water

936.84 liters slurry/strike

Mixing Pail-
(manual mixing by hand)

50 m³ Strike Volume
1.45 tons/m³
72.5 tons massecuite/strike
92 Brix
66.70 tons solids/strike

USA Tel: +1-310-927-7125; Fax: +1-310-559-5449;
Email: info@carbo-solutions.com; Web: www.carbo-solutions.com
Carbo Solutions International  @carbosolutions
Color precipitants

- Color precipitant can be added directly to raw syrups or A, B massecuite vacuum pans, because it is a liquid product of low viscosity can be easily added both syrup and massecuites using conventional metering pumps.
Case Study I Brazil

HPD Products were tested in 18,000 tones per day Brazilian sugar mill, dosage on syrup clarification as a possible technical alternative and/or eventual replacement of the conventional processes currently practiced.

In 2014/2015 crop season sugar factory conducted industrial scale test, using in the process the color precipitant CUA ST5.
Case Study I Brazil

Brazil color precipitant test was focused on:

- A stable production of sugar Type 3A (ICUMSA color lower than 180 IU)
- Increase sugar production based in better factory recovery (higher exhaustibility of final molasses).
- Dosage of HPD product on industrial scale test was carried out through a metering pump, which feed product from a portable tank and applied it directly in the syrup after last evaporator.
- Dosing rate was kept constant in 260 ppm basis on produced sugar.
Case Study 1 Brazil

Table 3 Color precipitant ST5 Test Usina Brazil 2014

<table>
<thead>
<tr>
<th></th>
<th>Traditional Process</th>
<th>Color precipitant at syrup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Precipitant dosage (ppm)</td>
<td>0.0</td>
<td>260.0</td>
</tr>
<tr>
<td>Sugar color (UI)</td>
<td>165.0</td>
<td>148.0</td>
</tr>
<tr>
<td>Centrifugal Washing time (sec)</td>
<td>16.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Overall factory recovery</td>
<td>74.6</td>
<td>78.5</td>
</tr>
<tr>
<td>50 kg sugar bags/ton cane</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Final molasses / 50 kg sugar bag</td>
<td>41.0</td>
<td>33.0</td>
</tr>
<tr>
<td>Final Molasses purity %</td>
<td>58.6</td>
<td>57.4</td>
</tr>
<tr>
<td>B Sugar color UI</td>
<td>2881.0</td>
<td>2792.0</td>
</tr>
</tbody>
</table>
Case Study I Brazil
Case study II Colombia

Colombian sugar mill produced Plantation white sugar (Color less 180 UI) recycling run off from refinery process. No sulphitation.

Sugar with color up 150 must be commercialized as standard C white sugar with considerable lower price.

Color precipitant ST5 was added: 400 ppm on A massecuites, 50 ppm on B massecuites and 100 ppm on raw syrup sucrose basis.

Use of color precipitant and adsorbed technologies allowed direct production of special plantation white sugar less 150 UI without any back boiling from refinery.

Centrifugals washing water was reduced 25% with less molasses production.
## Case study II Colombia

### Table 4 Color precipitant ST5 Test Ingenio San Carlos Colombia 2014

<table>
<thead>
<tr>
<th></th>
<th>Traditional Process</th>
<th>Color precipitant at syrup and pans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Precipitant dosage (ppm)</td>
<td>0.0</td>
<td>550.0</td>
</tr>
<tr>
<td>Sugar color (UI)</td>
<td>200.0</td>
<td>122.0</td>
</tr>
<tr>
<td>Centrifugal washing time (sec)</td>
<td>12.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Commercial yield (Ton sugar/Ton cane)</td>
<td>11.08</td>
<td>11.09</td>
</tr>
<tr>
<td>A type sugar (% total production)</td>
<td>12.0</td>
<td>67.0</td>
</tr>
<tr>
<td>Steam reduction %</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>B Sugar color UI</td>
<td>4962.0</td>
<td>3538.0</td>
</tr>
<tr>
<td>B Sugar turbidity UI</td>
<td>797.0</td>
<td>517.0</td>
</tr>
</tbody>
</table>
Conclusion

One of the greatest difficulties faced by sugar cane technicians is the lack of knowledge about the types of colorants present in sugar and the mechanisms used by the most frequently used color removal technologies.

Color present in sugar are a complex mixture of organic compounds that come from different sources, these can be classified into: natural color and color formed during processing.

There are generally recognized to be four types of color present in sugar: plant pigments, melanoidins, caramels and alkaline degradation products of fructose (ADF). The last three are factory produced color pigments.
Conclusion

The choice of more suitable de-colourization system for sugar must consider a complete approach: capital cost, operational cost, color removal effectiveness, process flexibility and environmental impact.

Major causes of high-color sugars can be solved through a strict operational control of equipment and adjustment of the parameters for critical variables.

Decolorants can be successful used to reduce color of mixed juice and syrup at white & raw sugar production process.

Color precipitants Color can be added directly to raw syrups or A, B massecuite vacuum pans reducing color transfer during crystallization.
CONSULTANCY THAT DELIVERS RESULTS

FEASIBILITY STUDIES
A feasibility study's main goal is to assess the economic viability of any proposed business.

LIQUID SUGAR
Need a liquid sugar plant? We can assist you in the full installation, commissioning and product development.

SUGAR CAKING
Quality problems like sugar caking can be a thing of the past. Your sugar can be conditioned to be free flowing all the way to your customer.

PROCESS BOTTLENECKS
CarboSolutions can assist you in debottlenecking your process, whether it's carbonation, phosphatation or other.

ENERGY MANAGEMENT
CarboSolutions conducts energy audits for a wide range of food industries – sugar mills, sugar refineries and glucose plants.

ACID BEVERAGE FLOC
Having ABF problems? CarboSolutions can assist your team to take steps to mitigate this problem once and for all.

PROJECT MANAGEMENT
CarboSolutions supplies project management services to sugar, water treatment, liquid sugar and sugar agriculture.

SUGAR AGRICULTURE
Whether it's beet or sugar cane, CarboSolutions can help you with yield and other productivity issues.

ENVIRONMENTAL MANAGEMENT
Whether it is an environmental impact study, a water or air pollution issue, you are in secure hands.

Global Reach with Local Commitment!
THANK YOU FOR YOUR ATTENTION!

For more information, please contact us at:

E-mail:
info@carbo-solutions.com
sales@carbo-solutions.com

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