Ion Exchange in the Sugar Industry

ResinTech® Inc.
INNOVATIONS IN ION EXCHANGE

Decolorization is an important step in the processing of raw sugar. Ion exchange resin technology offers numerous advantages over conventional purification methods for producing white and refined sugar.

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Introduction

Commercial sugar production and manufacturing is a complex process that has evolved over the last 1,500 years. The ancient process of crushing the sugar cane and cooking the obtained juice to get sugar crystals, produced less than 1 kilogram (kg) per metric ton. Modern methods have an average productivity of 106 to 120 kg per metric ton.

The sugar industrial process starts with the milling where the sugar cane is crushed producing a liquid called “Thin Juice”. This juice has a high sugar and contaminant content so chemical biocides are added to delay sucrose content decay. After this process, the juice is neutralized with lime to a pH of 6 to 7 to flocculate and precipitate sediments and fibers. (The alkaline pH is linked to color formation).

The clarified and neutralized thin juice, with a sugar content of 8 °Bx*, is evaporated to concentrate it to 60 to 65 °Bx. In the subsequent raw sugar cooking process, it is seeded with sugar crystals to promote raw sugar crystallization. The crystallized sugar is then centrifuged to remove water content, resulting in raw sugar with a purity level of 96 to 98% and a color c ontent between 600 to 4,000 ICUMSA.**

Raw sugar has limited industrial applications, therefore most of it is further refined to a level of 99.96% purity and color less than 25 ICUMSA.

*Degrees Brix (symbol °Bx) is the sugar content of an aqueous solution. One degree Brix is 1 gram of sucrose in 100 grams of solution and represents the strength of the solution as percentage by mass.

**The ICUMSA color scale is used to measure the grade and quality of the sugar. The color of sugar directly relates to the degree of refining – raw sugar being dark brown in color while highly refined sugars are white in color.

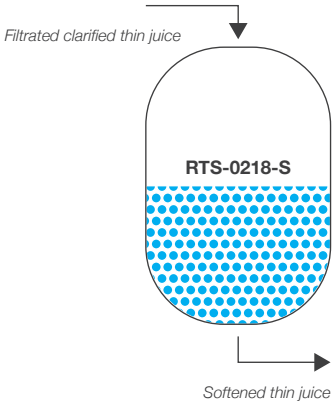
Applications

SUGAR JUICES SOFTENING/DECATIONIZATION

Thin juice ion exchange softening positively affects downstream operations, eliminating the need for descaling evaporators and improving the efficiency of heat transfer while improving boiling characteristics and resulting sugar quality. It is important to note that cane juice is typically “harder” than beet juice and can require larger softening systems and more regenerant.

The **RTS-0218-S** is a gel type strong cation resin designed with a unique polymer structure that integrates high exchange capacity with fast kinetics. This provides a rapid ion exchange reaction with very low calcium leakage and high iron retention. The RTS-0218-S is manufactured in standard gaussian distribution bead size and uniform bead particle size (UPS) when lower pressure drop is required.

Sugar Juices Softening/Decationization:



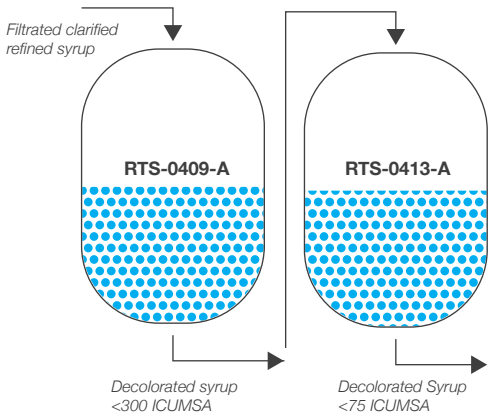
Product Name	Resin Type	Form	Water Retention	Total Capacity	Advantages
RTS-0218-S	PS/DVB/Gel	Na	45 - 50%	2.00 eq/L	Higher resistance to iron fouling

CANE SUGAR REFINED SYRUP DECOLORIZATIONATION

Ion exchange resins offer greater operational efficiency and improved process hygiene than either powdered or granular carbon. They are rapidly becoming the media of choice for cane sugar refiners seeking to remove color from liquid or crystal sugar products. Strong base type 1 anion resins in the chloride form remove color by ion exchange or adsorption.

ResinTech's strong base anions **RTS-0409-A** and **RTS-0413-A** are adsorbent resins with aliphatic polymeric structures that provide the fastest and most efficient adsorption and desorption of organic color forming molecules during the service and regeneration process, respectively. Their controlled Gaussian bead-size distribution work particularly well with the color forming hydrophilic molecules present in highly concentrated sugar syrups. The resins are designed to operate under high chemical and mechanical stress conditions such as high-colored sugar syrups decolorization.

Cane Sugar Refined Syrup Decoloration:



Product Name	Resin Type	Form	Water Retention	Total Capacity	Advantages
RTS-0409-A	PS/DVB/Macroporous	Cl	48 - 55%	1.35 eq/L	Higher resistance to organic fouling
RTS-0413-A	PS/DVB/Macroporous	Cl	60 - 65%	1.20 eq/L	Higher resistance to temperature

REFINED SUGAR SYRUP SOFTENING/DECATIONIZATION

Scaling is a widespread inconvenience occurring during the evaporation process in the refinery. Iron is a common color-forming precursor in refined sugar processes. Ion exchange softening of the refined sugar syrup helps to achieve continuous refining operations and eliminates the need for de-scaling. It also helps to capture soluble iron present in the syrup, minimizing any iron-related color forming in the sugar crystals.

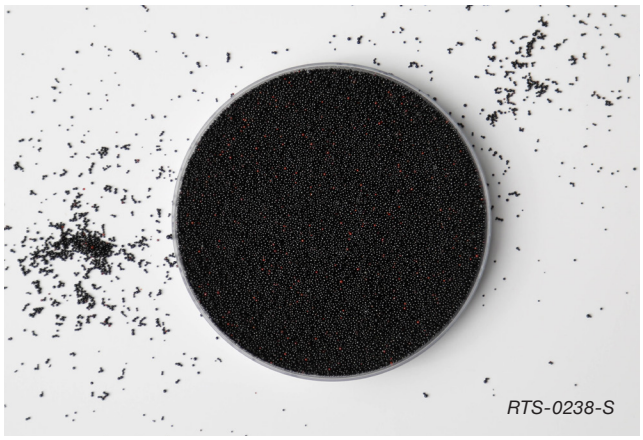
The **RTS-0228-S** is a strong cation macroporous resin. Its unique sponge-like polymer structure allows fast kinetics with high tolerance to iron fouling. The RTS-0228-S has a very high exchange capacity and high resistance to mechanical and osmotic stress. This ensures a high-quality refined syrup softening and decationization process with low pressure drop and long operating life.

Product Name	Resin Type	Form	Water Retention	Total Capacity	Advantages
RTS-0228-S	PS/DVB/Macroporous	Na	41 - 46%	2.20 eq/L	Resistance to extreme oxidation

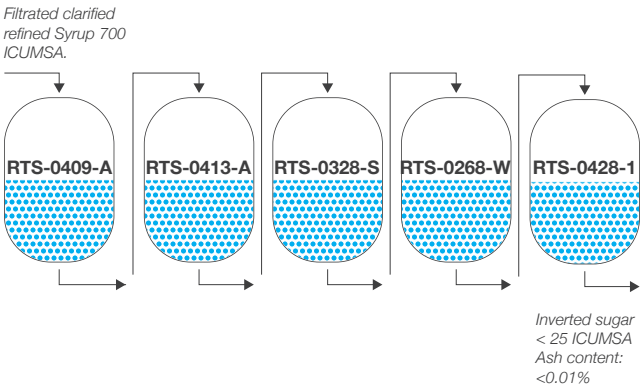
SUCROSE INVERSION

Sucrose inversion separates sucrose into a solution of glucose and fructose. The resultant solution contains about one third glucose, one third fructose, and the remaining third is sucrose.

The **RTS-0238-S** is a controlled acidity resin that provides a uniform sucrose inversion process. The RTS-0238-S has a macroporous structure that facilitates a complete and fast reaction by allowing efficient ionic transfer throughout the bead structure.



Cane Sugar Refined Syrup Demineralization with Inversion:



Product Name	Resin Type	Form	Water Retention	Total Capacity	Advantages
RTS-0238-S	PS/DVB/Macroporous	H	65 - 73%	1.00 eq/L	Controlled inversion ratio

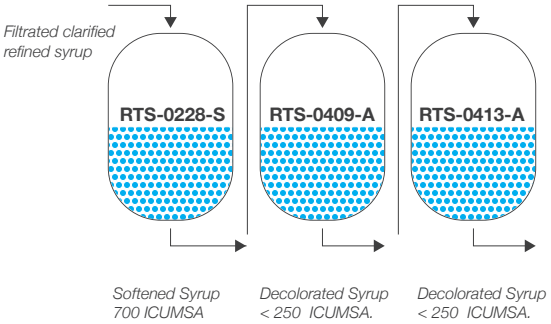
SUCROSE DECATIONIZATION

Sucrose decationization is the initial step for the total syrup demineralization with inversion. This step requires a controlled acidity to provide stability to the sucrose inversion process. It also removes strong cations present in the syrup, which is the first step to the complete ash removal, resulting in a controlled sucrose inversion containing 33% sucrose, 33% glucose, and 33% fructose stable solution.

The **RTS-0268-W** is a weak acid cation resin with a hyper-reticulated polymer structure and extensive macroporous area that allows efficient and fast exchange kinetics. This avoids the formation of HMF*. The RTS-0268-W has a very high mechanical/osmotic resistance that ensures a long service life.

*Hydroxymethylfurfural (HMF), is an organic compound formed by the dehydration of reducing sugars.

Cane Sugar Refined Syrup Softening + Decolorization:

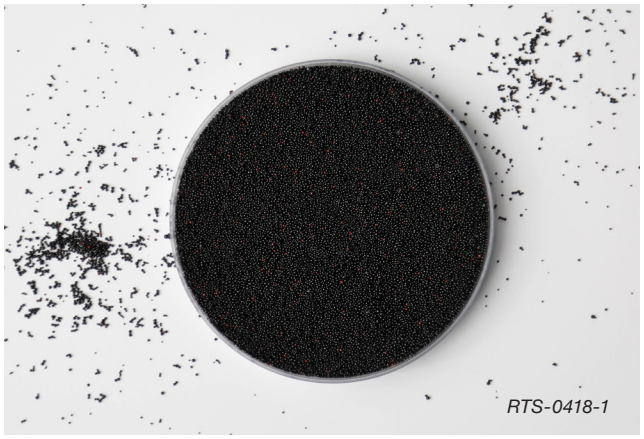


Product Name	Resin Type	Form	Water Retention	Total Capacity	Advantages
RTS-0268-W	PA/DVB/Macroporous	H	50 - 55%	1.70 eq/L	High capacity

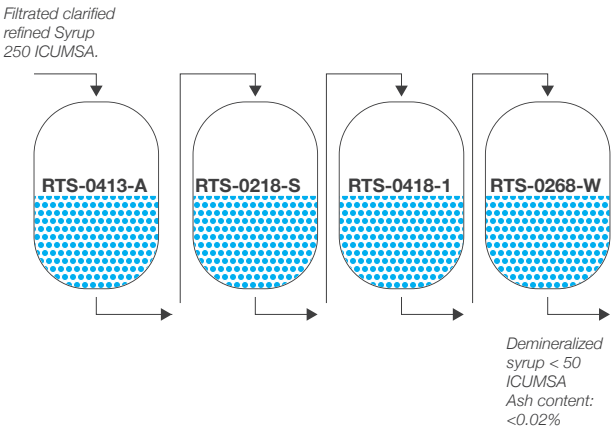
SUCROSE ACID NEUTRALIZATION (DEMINERALIZATION)

Decationized sucrose and/or inverted sugar acid neutralization is the second step of the total demineralization process bringing the ash content in the fluid to less than 0.01% and the remaining color below 35 ICUMSA.

A standard demineralization process with inversion benefits from the use of the ResinTech **RTS-0428-1** because of its high acid neutralization capacity and fast kinetics. For inverse demineralization without inversion it is recommended to use **RTS-0418-1** followed by RTS-0268-W.



Cane Sugar Refined Syrup Demineralization without Inversion:



Product Name	Resin Type	Form	Water Retention	Total Capacity	Advantages
RTS-0418-1	PS/DVB/Macroporous	Cl	53 - 59%	1.60 eq/L	Controlled neutralization ratio
RTS-0428-1	PA/DVB/Macroporous	Cl	52 - 63%	1.80 eq/L	High capacity
RTS-0438-2	PS/DVB/Macroporous	Cl	58 - 63%	1.10 eq/L	Controlled neutralization ratio
RTS-0448-W	PA/DVB/Macroporous	OH	52 - 63%	2.70 eq/L	Extremely high neutralization
RTS-0450-W	PS/DVB/Macroporous	OH	53 - 60%	1.45 eq/L	Medium neutralization ratio

Industry-leading Technical Support

Our legendary technical support team combines the world's leading IX scientists, most sophisticated laboratory, and advanced ion exchange simulation technology to solve the most challenges water quality dilemmas. We can conduct a detailed analysis of your influent or effluent, model your application's environment in a "virtual" setting, and provide product or process recommendations to ensure optimal water treatment operations for virtually any use case. Reach out to us for help at **techsupport@resintech.com** or scan the qr code below.

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