THERMAX

CHEMICALS



Cane Sugar Refining by Tulsion® Resins

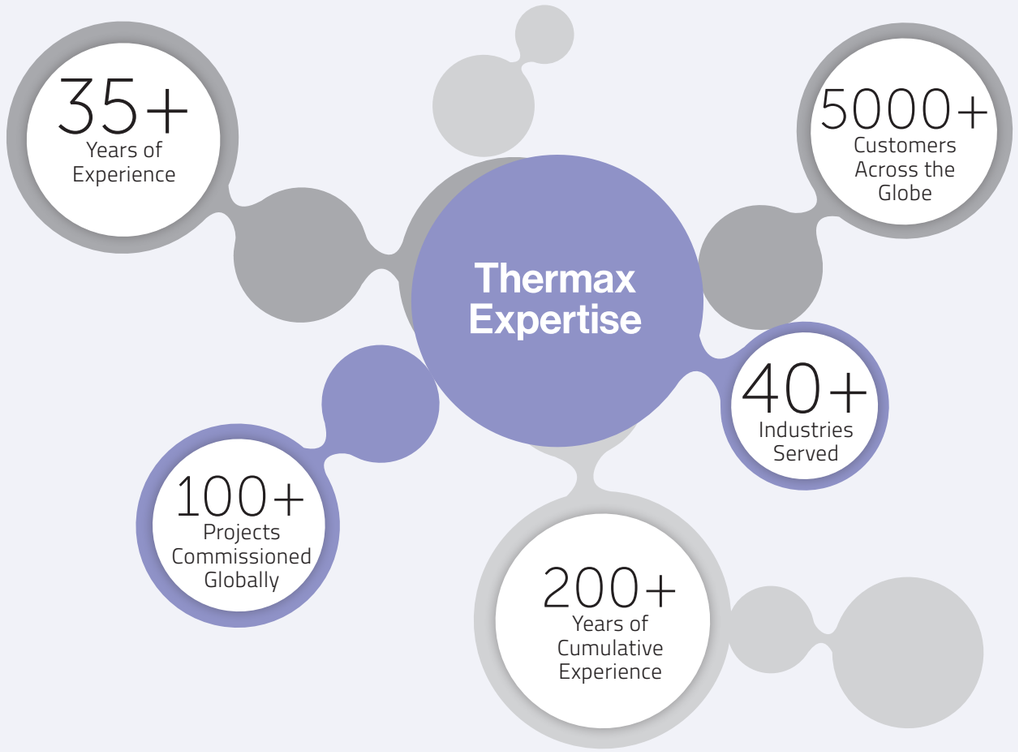
Welcome to Thermax - an engineering company providing sustainable solutions in energy and environment. The company's vision for the future is firmly anchored in the belief that to stay competitive, companies need to adopt sustainable development practices.

The systems, products and services developed by Thermax help industry achieve better resource productivity and improve bottom lines, while maintaining a cleaner environment. Even as we convert costs to profits, we help to protect the environment in our own ways. A win-win for industry and the society at large.

Thermax's business portfolio includes products for heating, cooling, water and waste management, and specialty chemicals. The company also designs, builds and commissions large boilers for steam and power generation, turnkey power plants, industrial and municipal wastewater treatment plants, waste heat recovery systems and air pollution control projects.

Thermax Chemicals is Asia's leading manufacturer of Tulsion® ion exchange resins.

Our business is about providing 'effective customer solutions' through innovation and development, service and co-operation, reliability, commitment, and customer-centricity. Our dynamic teams focus their energy and resources to offer the very best solutions for customers' needs.



Why Tulsion® Ion Exchange Resins?

Better Quality at Cost-Effective Value

Water treatment is traditionally one of the largest applications in the field of ion exchange resins; however, it has now evolved to various speciality applications. Hence, we believe in developing and offering customised solutions to our customers, which are efficient, economical and provide value for money.

To date, a number of customers seeking solutions for industrial, municipal, domestic and wastewater related problems have benefited from Thermax products and services.

Product Customisation

Our research and development team consists of highly experienced professionals in the field of ion exchange resins and speciality polymers, who can understand the depth of customer requirements and provide customised solutions in complete accordance with customer expectations.

On Time Technical Support

Our technical support team ensures quick response time to our customers and connects them to our product management team, who can understand their problems, troubleshoot and provide optimal solutions.

Manufacturing Excellence

Our resin manufacturing plant at Dahej, Gujarat, India is a fully automated plant with state-of-the-art DCS system and latest digital technologies. We use clean fuel and modern air scrubbing units that are environment friendly. Every batch of Tulsion® ion exchange resins is manufactured under carefully controlled process parameters and follows a rigorous quality assurance protocol. We have already commenced the Phase–II of our Dahej facility to cater to the growing global market demand.

Thermax has two other manufacturing facilities at Paudh, Maharashtra, India and Jhagadia, Gujarat, India for ion exchange resins and performance chemicals respectively.

Value Added Services

At Thermax, we offer free-of-cost plant audits, design proposals, post sales technical support, and a very efficient and experienced research and development team that understands customer requirements to the last detail.

Thermax Chemicals is committed to complying with stringent global quality standards and respects the environment. Ion exchange business unit is ISO 9001: 2015, ISO 14001: 2015 and ISO 45001: 2018 certified. Many of the Tulsion® resins are also certified for Halal, Kosher and REACH.

Overview

Sugar Refining with Tulsion® Resins:

Due to the rise in demands for white crystalline sugar, white sugar manufacturing plants have shifted from the conventional method of sugar whitening to ion exchange resin-based technology. Previously, sulphitation process was used where lime and SO_2 gas were employed for color removal which was harmful, but now ion exchange-based technology is adapted which offers numerous advantages over the conventional method. Apart from color, raw sugar also contains reducing sugars (glucose and fructose), inorganic ash (mainly calcium and potassium salts) and other organic matter which includes gums, amino acids, essentially from the cane. These impurities must be removed from the sucrose during refining.

Refined sugar manufacturing is a process which involves juice extraction, boiling and clarification as main steps. After the clarification process, 50-60% color is removed but the syrup still has some amount of color left in it. This color is removed using ion exchange resins. By Tulsion® premium-grade resins, sugar syrup is further polished to get color index of less than 200 ICUMSA and directed for evaporation, drying and final packing. The mechanism of removing coloring bodies through ion exchange can be represented as:

$$RN^{+}(CH_3)_3\,Cl^{-} + CA \blacktriangleright RN^{+}(CH_3)_3\,A^{-} + CCl$$

A-Anionic impurities or color compounds I
R-Resin-Styrenic ring I Cl-Exchangeable chlorides

Apart from the cane sugar refining method, VHP (Very High Polarity Sugar) is also used as raw material in refining procedures due to its high polarization. This raw sugar is melted and mixed with water which allows customers to refurbish it into various types of sugar for consumption.



Typical Process Quality Parameters In Tulsion® Decolorization Resins

Parameters	Input Liquid Sugar Quality	Output liquid sugar quality
Brix %	50 to 60	50 to 60
%DS (Sucrose)	99.5	99.5
Color (ICUMSA)	350 to 400	<120
pH	7.2 to 8.5	6.8 to 8
Temperature (^{O}C)	60 to 65	50 to 60
Invert sugar % (W/W)	<0.5	<0.5

Note: These are typical guidelines, actual parameters will be as per input feed quality.

Tulsion® Resins Comparison

Tulsion® A-722 MP (Styrene Base)	Tulsion® A-30 MP (Acrylic Base)
This styrenic base resin can effectively be used at high temperature (60-80^{O}C) that is normally encountered in a sugar refinery.	This acrylic base resin can be used effectively at high temperature (60-80^{O}C) for decolorization of sugar syrup.
It can generally be used for decolorization of sugar solutions having 100-800 ICUMSA inlet color.	Due to its acrylic matrix and high porosity, it can be used for treatment of dark colored sugar liquors having 800 to 2000 ICUMSA inlet color.
Excellent physical properties and good regeneration.	Less energy costs as thermal regeneration is not required.

Typical Characteristics Of Tulsion® Resins

Characteristics	Tulsion® A-722 MP	Tulsion® A-30 MP	Tulsion® A-722 MP FG	Tulsion® A-30 MP FG
Screen size USS (wet)	16 - 40	16 - 40	16 - 40	16 - 40
Particle size	0.4 to 1.2 mm	0.4 to 1.2 mm	0.4 to 1.2 mm	0.4 to 1.2 mm
Total exchange capacity	1.0 meq/ml (min)	0.8 meq/ml (min)	1.0 meq/ml (min)	0.8 meq/ml (min)
Moisture content	60 ± 3%	70 ± 3%	60 ± 3%	70 ± 3%
Effective size	0.6 - 0.8	0.5 - 0.65	0.6 - 0.8	0.5 - 0.65
Backwash settled density	670 to 720 g/l	690 to 740 g/l	670 to 720 g/l	690 to 740 g/l
pH range	0 to 14	0 to 14	0 to 14	0 to 14

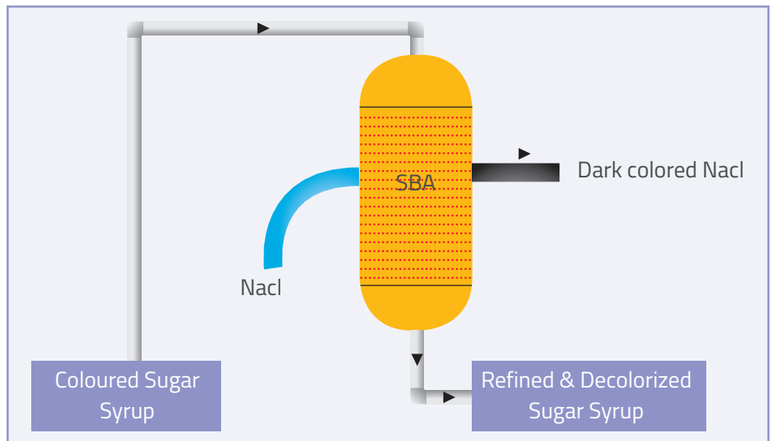
Thermax food grade resins- Tulsion® A-722 MP FG & Tulsion® A-30 MP FG meet FDA guidelines for USA & REACH certified for EU. These products are Halal certified for various islamic countries and manufactured in compliance with Kosher production and packaging rules. Thermax has dedicated manufacturing facility at Dahej, Gujarat for manufacturing ion exchange resins where ISO and other standards associated with quality management are stringently followed.

Typical Operating Conditions For Tulsion® Resins

Parameters	Unit	Values
Resin bed depth (Minimum)	mm	1000
Operating temperature (Max.)	^{0}C	80
Service flow rate	BV/hr	2 to 5
Regenerant		NaCl+NaOH
Regenerant concentration	%	10 % NaCl+0.2 %NaOH
Regeneration level	g/l	160 to 250 g/l NaCl
Regeneration time	min	60
Slow rinse	BV	2
Fast rinse	BV	5 (max)

Recycle and Recovery of Brine

Regeneration of resin is carried out using 10% NaCl solution (Brine). After regeneration, some amount of brine waste is generated where waste disposal is a critical issue. To cater this, nano-filtration technology is selected which can approximately recover 80-85% of NaCl. After recovery, this salt can be mixed with fresh salt for regenerating resin thereby decreasing the waste rejection by 70-80%.



Tulsion® Resin Schematic For Sugar Refining

Scheme Selection for Tulsion® Resins

Inlet Feed Color (ICUMSA)	Stage Type	Number of Columns	Resin Configuration
< 200	One stage	One	Tulsion® A 722 MP
200 – 400	Two stage	Two	Tulsion® A 722 MP -> Tulsion® A 722 MP
400 – 1000	Two stage	Two	Tulsion® A 30 MP -> Tulsion® A 722 MP
1000 – 2000	Three stage	Three	Tulsion® A 30 MP -> Tulsion® A 30 MP -> Tulsion® A 722 MP

Note: All the products are food grade (FG).

Case Study

Case:

One of the largest sugar refineries in Thailand was using the acrylic macro-porous type strong base anion resin in the primary column and styrene type anion resin in the secondary column for de-colorization of 60° brix sugar melt. The plant was operated continuously in lead-lag operation, with columns fed with sugar melt having a color level of 600 ICUMSA, but the customer desired better sugar de-colorization results with lesser color level.

Solution:

Thermax proposed to replace both streams with Styrenic-Styrenic macroporous strong base resin, replacing the existing Acrylic-Styrenic configuration.

Result:

The suggested configuration was helpful in substantial savings on resin cost and resulted in better-treated syrup volume of the desired color level < 150 ICUMSA. Based on the pilot trial results, the customer replaced the entire quantity of the existing supplier's resin with Thermax Tulsion® A-722 MP.

Refined Sugar Applications

Only refined sugar is consumed throughout the world except few Asian and African countries. Some end-users such as soft-drink manufacturers, dairy industries, pharmaceutical industries, beverages, confectionery etc. like to use special grade refined sugar. The specifications vary slightly from customer to customer. Other applications include: sweets and baked goods, bread toppings, breakfast foods, canned goods and diet foods.



Advantages

Economical:

Ion exchange sugar decolorizers are economical. This method is cheaper and effective than those of traditional granular carbon or bone char methods.

High flow rates:

This method can be operated at much higher flow rates. Thus, the less heavy vessel is needed for given liquor flows. Also, shorter retention times reduce sucrose degradation during de-colorization.

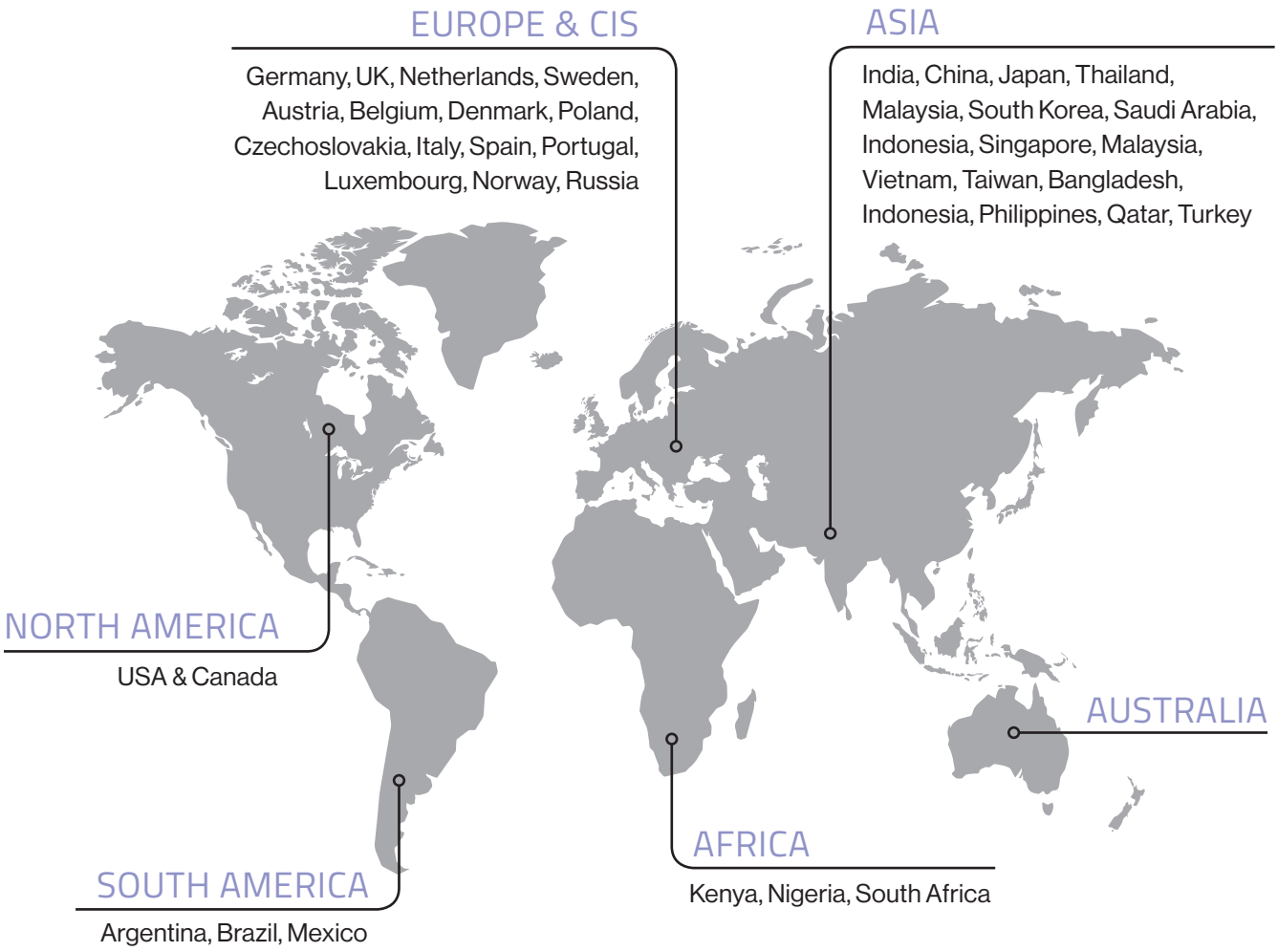
Easy operation:

The resin process is easily handled and can also be automated. The regenerant and resins are contained inside a closed vessel, so the process is more hygienic than other decolorization processes.

Low operational costs:

As brine is cheap, regeneration cost is low. Hence, resin decolorization is a low-cost alternative to traditional methods such as activated carbon or bone char.

Customer Reach



THERMAX

Sustainable Solutions in Energy & Environment

Registered Office

Thermax Limited
D-13, MIDC Industrial Area, R D Aga Road,
Chinchwad, Pune 411019, India
enquiry@thermaxglobal.com
Customer Care: 1800-209-0115

Corporate Office

Thermax House
14 Mumbai-Pune Road,
Wakdewadi, Pune 411 003
+91-20-66051200/25542122
+91-20-25541226

Thermax Inc.
16200 Park Row, Suite 190 Houston,
Texas 77084,
USA

Thermax Europe Limited
2 Studio Court, Queensway Bletchley,
9th Floor, Jl H.R Rasuna Said
United Kingdom

Thermax Limited
Chemical Divison, Environment House,
90-92, BG Block, MIDC, Bhosari,
Pune - 411026, India.

In case of any queries, you can contact us at : Phone: +91 20 6715 6000 , Email: enquiry@thermaxglobal.com

thermaxglobal thermax_global thermaxlimited thermaxglobal thermaxmedia

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