



*Pure Water. Clean Air.  
Better World.*

Superior Sugar Refining  
with ISEP®/CSEP® Technology





## Decolorization of Raw Sugar

Decolorization is one of the most important unit operations in the production of sugar. In most countries, the decolorization of raw sugar is performed with the assistance of a range of media such as bone char, activated carbon, and ion exchange resins for the production of high-grade sugar products. However, in India, most units still use a simpler process to produce a lower-grade, plantation white sugar. The process commonly used in India involves the use of sulphitation and liming, which can lead to contamination of the final product with harmful sulphur dioxide. Product contamination also makes the sugar unacceptable in the world market, and Indian producers are forced to export raw sugar when surpluses are available. Additionally, the sulphitation process corrodes the equipment in sugar mills, and sulphur dioxide emissions produce major pollution.

Transformation of the Indian sugar processing industry requires the latest and most cost-effective technologies. In many cases, ion exchange resins offer the best capital and operating cost advantages for both large and small applications.

Calgon Carbon Corporation is a world leader in offering sugar decolorization and deashing technologies based on ion exchange. Calgon Carbon has supplied commercial plants for the cane and beet sugar industries using IonSEPARATOR (ISEP®) and ChromatographicSEPARATOR (CSEP®) simulated moving bed (SMB) technology. Calgon Carbon has joined forces with Orochem Technologies Inc. to offer these cost-effective and superior technologies to the Indian sugar industry. Orochem will act as Calgon Carbon's exclusive agent in India for providing complete technology, plant packages, and service.



## Benefits of Using ISEP® Ion Exchange Resin Technology for Decolorization

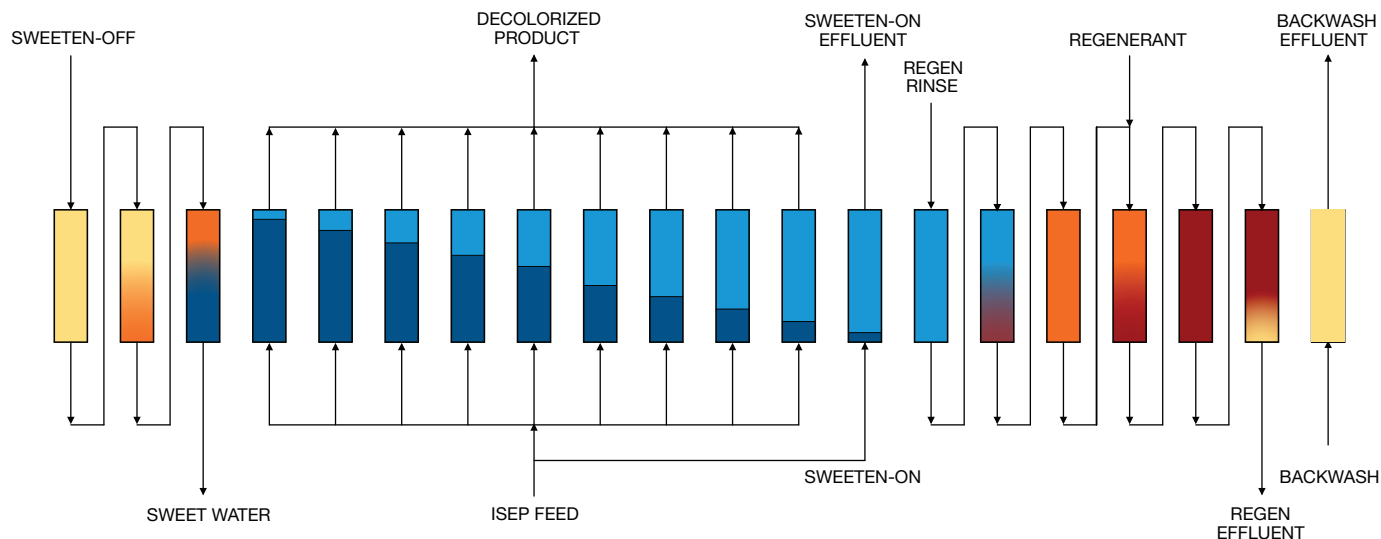
Decolorization can be accomplished using a number of different media, including activated carbon, bone char, and ion exchange resins. There are a number of factors that influence a refinery's decision to adopt a certain technology. Improvements in the efficiency of macroporous strong base anion (SBA) resins, along with lower capital and operating costs, have increased the acceptance of ion exchange technology for decolorization. In the case of cane decolorization, SBA resins can be used alone or in conjunction with carbon or bone char to treat the refinery juice after carbonatation and filtration. An ISEP® system treating this stream can contain a single resin or a combination of resins (acrylic and/or styrenic). Resin chambers can be configured to contain both resins in the same system.



Calgon Carbon has installed more than 450 continuous ion exchange ISEP®/CSEP® installations in more than 40 applications since 1990.



## Typical Decolorization ISEP® Process Flow Diagram



### Syrup Decolorization and Deashing Options in an ISEP®

Decolorization and Deashing are essential processes in the production of sugar. The high costs of some traditional decolorization and deashing systems and competitiveness of the sugar industry make it prudent to put new focus on the product quality and operating costs for these processes. The well-proven ISEP® continuous ion exchange technology offers the ultimate in flexibility for treating cane, beet, and corn syrups, compared to traditional fixed bed and other technologies. ISEP® systems have demonstrated significant reductions in resin inventory, chemical costs, water usage, waste volume, and system footprint. The rotary distributor continuously directs the feed, wash, regeneration, and rinse streams through the media cells so that all media is in active duty and advances through each operation one step at a time, with a step time proportional to the color removal load required.

The addition of a brine recovery system to the ISEP® decolorization system can further reduce the salt usage and waste volume by up to an additional 90%.

### ISEP® Continuous Ion Exchange Advantages

- Improved efficiency
  - Counter current contact
  - Counter flow regeneration
  - High ionic/color loading
- Reduced media inventory
  - No dormant media
- Reduced operating costs
  - Less media
  - Less water
  - Fewer chemicals
  - Less waste
- Steady-state operation
  - Consistent product and effluent quality
  - Concentrated products and effluents
- Reduced manpower — typically <1 operator per shift
- Reduced space requirements
- Chemical regeneration — a major cost reduction compared to thermal regeneration

## Operational Cost Comparison for a Typical Indian Decolorization System

Basis: 800 TPD Raw Sugar Plant Operational for an  
Average of 210 Days with Brine Recovery

	Refined Sugar Using Fixed Bed Ion Exchange Technology	Refined Sugar Using ISEP® Technology
Life of the Resin Used in the Process	4 years	4 years
Resin Required	55 cubic meters	18 cubic meters
Amortized Cost of Resins/Media	4,800,000	1,600,000
Cost of Sweetwater Evaporation, Rinse Water, Waste Water	10,200,000	4,000,000
Cost of Other Acids/Chemicals	6,400,000	3,200,000
Other Operational Costs	4,000,000	3,000,000
<b>TOTAL COSTS</b>	<b>25,400,000</b>	<b>11,800,000</b>
<b>PER TON COST</b> (@ 168,000 TPA of sugar produced)	<b>151.2</b>	<b>70.2</b>

**54% Lower Operating  
Cost Using an ISEP®**

Calgon Carbon and Orochem Technologies are the preferred solution providers for state-of-the-art continuous ion exchange systems for the Indian sugar market.

## Calgon Carbon's Rotary Valve Distributor Technology

One of the more advanced processing options is the continuous ion exchange technology. At the heart of this technology is a single, multi-port, rotating distributor valve that indexes at a specific rate using a minimum of moving parts. The multi-port distributor manages and directs all incoming and outgoing fluid streams in the various zones into and out of the appropriate sorbent media cells. The cells are either mounted directly onto the floor, where rotation is simulated, or to a turntable and indexed with the rotating portion of the rotary valve. The choice of either an ISEP®/CSEP® Rotary Valve or ISEP®/CSEP® IOV Rotary Valve for a particular application is determined by the following factors:

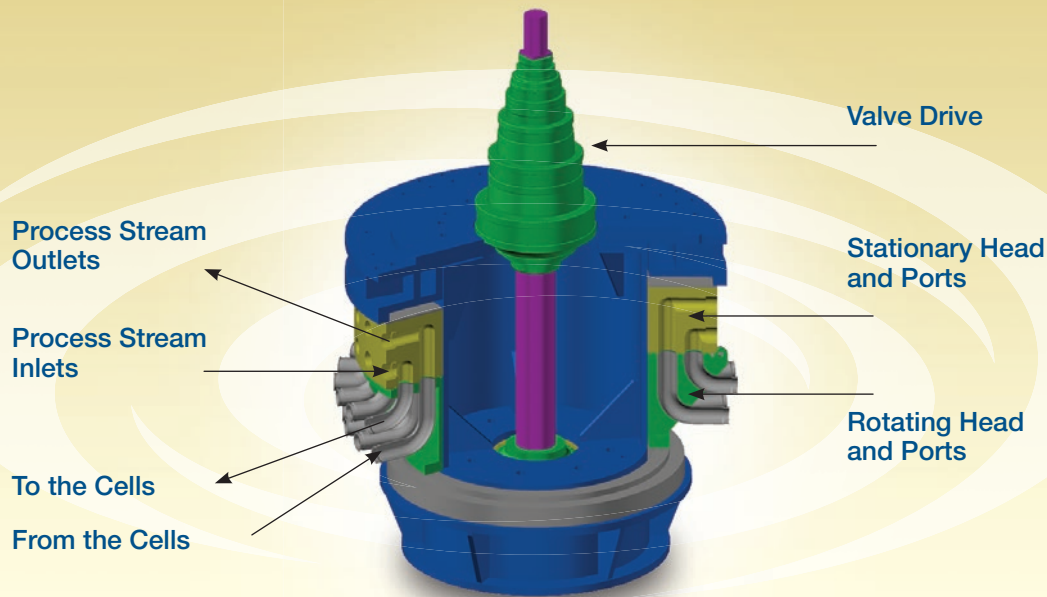
- Process design
- Flow rate
- Spatial considerations
- Overall benefit to customer
- Economics

The use of short beds allows for maximum media utilization and reduced pressure. No media sits idle in the cell, regardless of its state—exhausted or regenerated. This feature results in a much lower media inventory than there would be for a conventional ion exchange system. Counter-current and counter-flow regeneration and counter-current rinse water flow, along with low media volume, combine to reduce the amount of chemicals and effluent required to regenerate and clean the media.



# Rotary Valve Distributors

ISEP®/CSEP®



ISEP®/CSEP® IOV



## About Calgon Carbon

Calgon Carbon Corporation is an industry leader through unmatched innovations in the purification, separation, and concentration of liquids and gases. Throughout our history, Calgon Carbon has been a pioneer in creating new products, systems, and services from the infancy stages to global commercialization. As an industry forerunner in activated carbon, ultraviolet light disinfection/oxidation, and ion exchange technology, Calgon Carbon provides cutting-edge purification solutions in more than 700 distinct market applications, from purifying sweeteners and pharmaceuticals, air, and water, to separating gases and removing mercury emissions from coal-fired power plants.



Each year, hundreds of municipalities, government agencies, and food, biotech, chemical, and pharmaceutical manufacturers turn to Calgon Carbon to solve their purification challenges. Technical experts are available to help choose the most cost-effective methods to apply its technologies in air, water, process purification, food and beverage production, site remediation, and marine water treatment. Its goal is to help customers reduce the time and expense associated with maintaining purification systems. Protecting the environment is a vital responsibility. The quality of our lives depends on the purity of the air we breathe, the water we drink, and the food we eat. Calgon Carbon is dedicated to providing solutions to address environmental needs.

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## Calgon Carbon's Processing Solutions

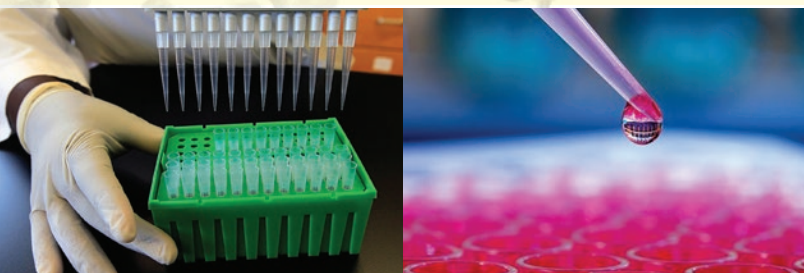
Calgon Carbon offers superior processing options using not only regenerable and non-regenerable ion exchange and adsorbent resins, but also silica gels, activated carbon, and molecular sieves based on the unique application. Since 1990, manufacturers and industries have discovered the exceptional value of Calgon Carbon's continuous ISEP®/CSEP® equipment technology for separating, recovering, purifying, and synthesizing materials. With more than 450 installations in more than 40 applications, ISEP®/CSEP® continues to prove that it is capable of solving complex processing problems economically.





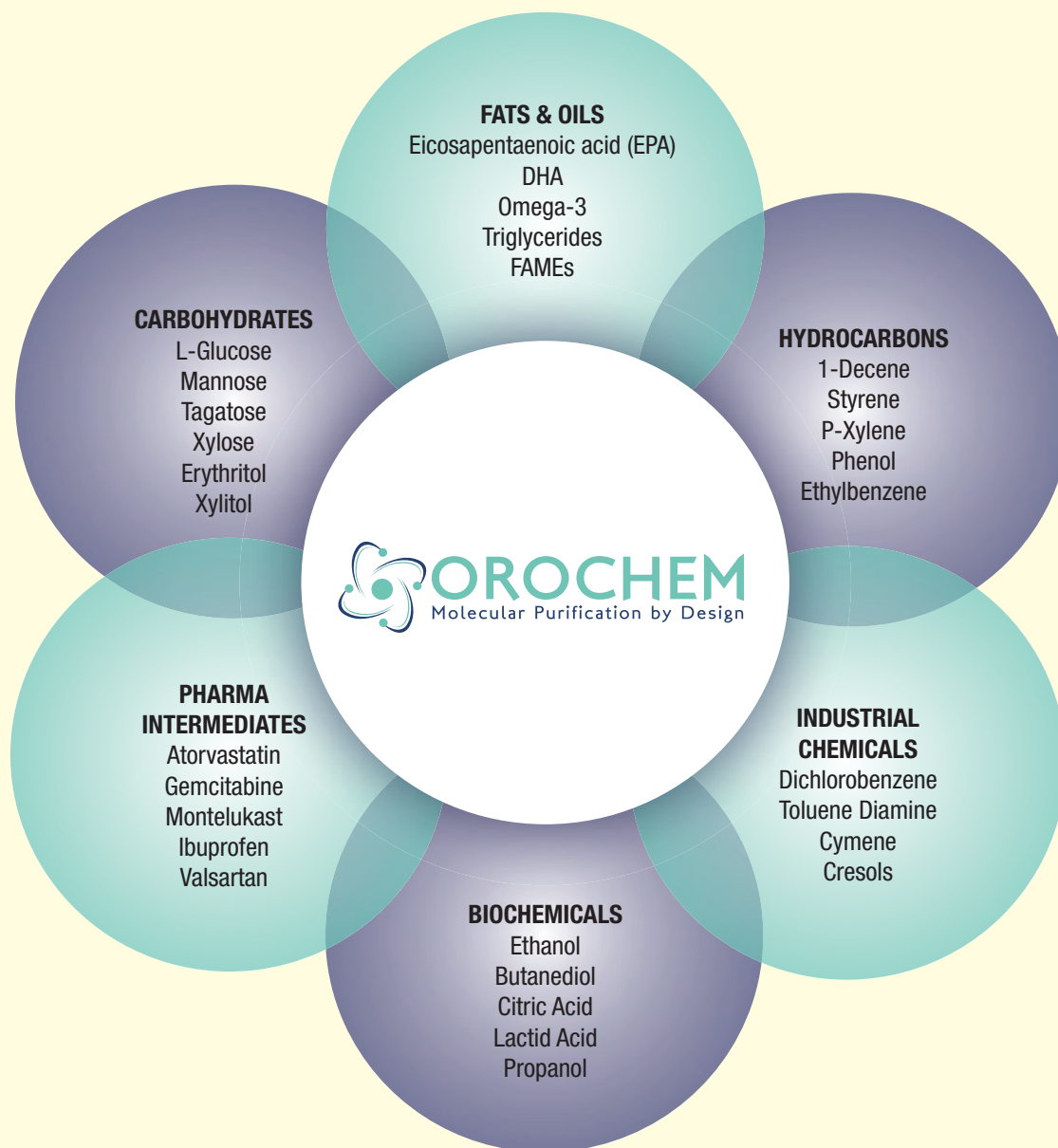
## About Orochem

Established in 1996, Orochem Technologies Inc. started as a biotech and chromatography company to manufacture unique sample prep technology “products” for the bioanalysis, drug discovery, and the genomics and proteomics markets. Backed with unique expertise in high throughput formats, membranes, and surface chemistries, Orochem was one of the first companies to translate the concept of pre-filters from single to high throughput formats, a concept now widely implemented for sample prep plates in the biotech and analytical markets. In 2001, Orochem manufactured the first commercially available protein crash and precipitation 96-well plate for bioanalytical processes. By 2006, with the acquisition of Column Engineering Inc., Orochem evolved to become a “full-service” provider for silica manufacturing utilized for analytical and preparatory chromatography. Orochem invests heavily into R&D in-house and owns strong intellectual property in stationary phases for achiral and chiral chromatography.



Orochem is recognized globally as an organization that conceives, develops, and installs some of the most technologically viable solutions for “highest purities” for industrial or “metric ton” scale purification for APIs, nutritional supplements, fatty acids, and specialty sugars. Orochem provides simulated moving bed (SMB) chromatography technology for the laboratory-scale, pilot-scale, and large-scale purification of commercially viable molecules for its customers around the world. Orochem India Private Limited can conduct a demonstration of the ISEP®/CSEP® technology processes at its facility in India on the client’s feedstock. It also has a team of technical service specialists who can install, operate, and train the clients’ engineers. Orochem’s products and services for simulated moving bed chromatography include synthesis and manufacture of stationary phases “tailored for specific separations,” a uniquely engineered SMB system, and the installation and commissioning of the SMB systems at customer sites with well-trained Orochem technical service engineers.

## Applications of Orochem's SMB Technology



Orochem Technologies, based near Chicago, Illinois, specializes in Simulated Moving Bed Chromatography (SMBC) for applications across the chemical industry. With a strong R&D focus, Orochem develops unique stationary phases that are selective for extraction of specific molecules of interest to the customers. Orochem designs, fabricates, and installs SMBC systems at customers' sites with strong emphasis on technology transfer and operations training. Orochem Technologies' subsidiary, Orochem India, supports all SMB development and installations in India and South Asia.



**Contact us at:**

**Orochem India Pvt Ltd**

Plot # R 588/1

TTC Industrial Area

Rabale, Navi Mumbai 401701

Phone: +91-22-27603569

Fax: +91-22-27603571

Email: [orochem@vsnl.net](mailto:orochem@vsnl.net)

**Calgon Carbon Corporation**

Ion Exchange Technologies

400 Calgon Carbon Drive

Pittsburgh, PA 15205

USA

Phone: 1-800-422-6700

Email: [info@calgoncarbon-us.com](mailto:info@calgoncarbon-us.com)

[www.calgoncarbon.com](http://www.calgoncarbon.com)

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