



Dow Water and Process Solutions

# The Dow Separability Advisor™

Indexing Chromatographic Separations of Sugars, Sugar Alcohols, and Impurities with Dow Resins



## Introduction

Chromatography using ion exchange resins is a well-established purification process in the sweetener industry. Sweeteners separated by Dow chromatography resins include caloric sweeteners such as beet sugar and starch syrups, sugar alcohols, carbohydrate derivatives, oligosaccharides, and non-nutritive sugars. Learn how Dow resins separate many of these sweeteners from each other and from common contaminants.

## How the Separations Work

Chromatography resins are supplied in two different ionic forms – potassium and calcium. Potassium-form resins (DOWEX MONOSPHERE™ 99 K/350, for example) separate sugars by size-exclusion – meaning that they allow smaller sugars to enter the resin bead, while excluding larger ones. The larger, excluded sugars travel through the resin bed faster than the smaller sugars which get slowed down by the resin beads. Salts and other ionic compounds are also ionically-excluded from the beads, purifying the sugars.

Calcium-form resins (DOWEX MONOSPHERE 99 Ca/220, for example) separate sweeteners by affinity to the calcium ion. Depending on the special orientation of chemical groups in the sugar, the sugar may form stronger or weaker intermolecular complexes with calcium. Sugars that form stronger complexes with calcium will move slower through the resin bed, while sugars that bind more weakly will move faster. Separation is achieved through differential affinity of the sweeteners to the calcium ion.

## Sugar Separability

Dow chromatography resins were tested for their ability to separate different pairs of sweeteners, derivatives, and contaminants. This was done through pulse testing, where pulses of these different compounds were sent through a packed bed of various resins and separability was measured in terms of resolution coefficient – "R-value". The R-value provides insight as to whether the resin has the separation power needed for effective industrial-scale chromatography. An R-value of zero means two compounds are inseparable, while an R-value of one or higher means perfect separation. Glucose-fructose separations, commonly practiced industrially in the production of high fructose corn syrup, have an R-value of 0.4.

The bubble chart in Figure 1 depicts how well various pairs of sweeteners, derivatives, and contaminants separated using Dow resins in terms of the resolution coefficient. The entire Dow separation resin product line, spanning different water retention capacities, ionic forms, and particle sizes, was tested for performance in Figure 1. Larger bubbles indicate higher chromatographic resolution and a more complete separation. The legend on the right side of the figure depicts what a typical chromatogram would look like at different bubble sizes. In this plot, over 82.9% of the separations tested have R-values greater than 0.4 (better than industrially-practiced glucose-fructose purification), indicating that most of the tested compound combinations can be effectively separated with Dow resins.

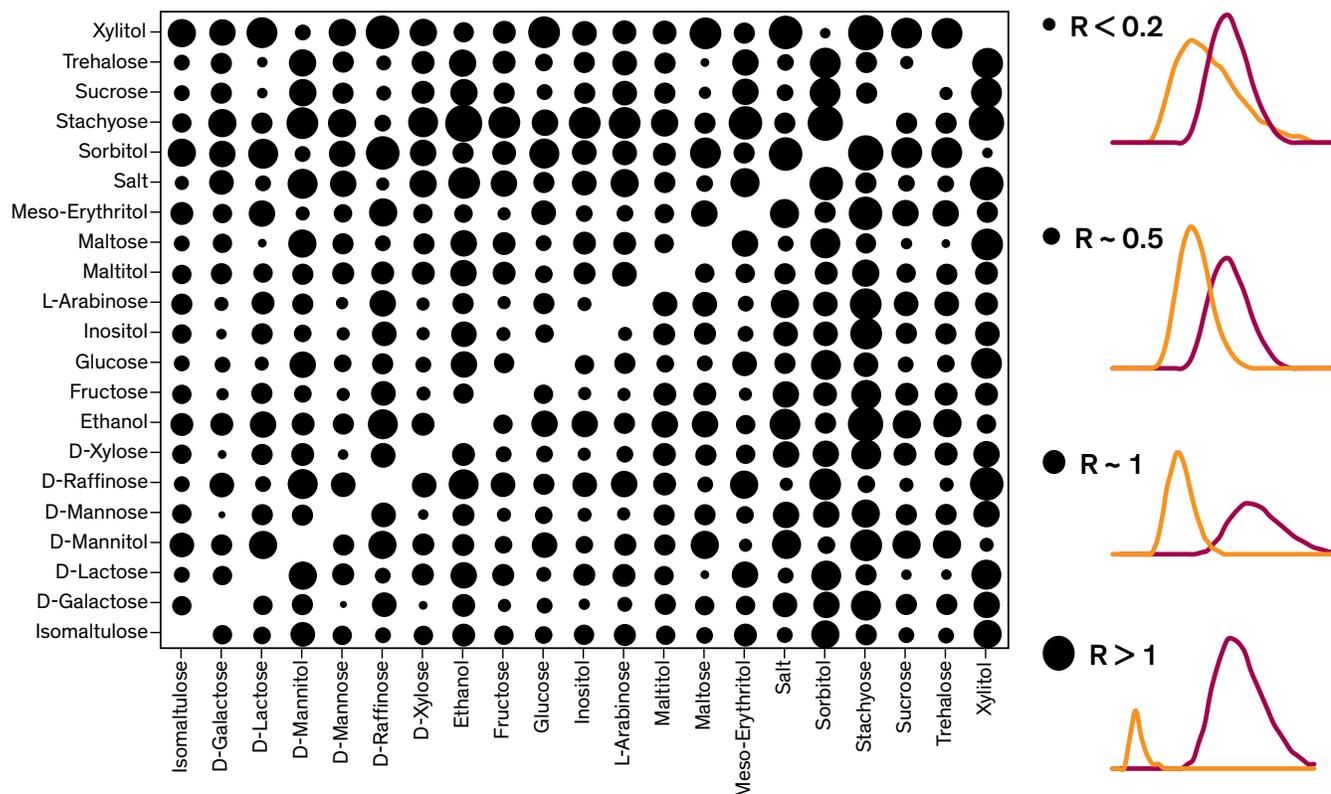


Figure 1: The Dow Separability Advisor™ Bubble Chart for the Separation of Sugars and Sugar Alcohols

### Other Considerations

Knowing the separability of your sweeteners on Dow resins is only the first step to creating an effective, economical industrial chromatography process. Your specific process conditions, feedstocks, and goals must all be considered. Contact Dow to discuss your purification needs, and let us help you identify the right resin for your separation. We would be pleased to use our knowledge to help you achieve your process goals.

### Dow Chromatography Resins

Table 1 below lists the DOWEX MONOSPHERE™ 99 Chromatography Resin product line. Dow offers chromatography resins with uniform particle sizes from 220 – 350 µm in diameter. The resins are offered at a variety of water retention capacities for achieving different separations and most are available in both potassium and calcium ionic forms.

| Chromatography Resin     | Product Features  | Typical Applications   | Average Particle Size (µm) | Water Retention Capacity (H) | Ionic Forms |
|--------------------------|---|--|----------------------------|------------------------------|-------------|
| DOWEX MONOSPHERE™ 99/350 | <ul style="list-style-type: none"> <li>• Low pressure drop</li> </ul>   | <ul style="list-style-type: none"> <li>• Beet sugar</li> </ul>   | 350                        | 58 – 62%                     | K           |
| DOWEX MONOSPHERE 99/320  | <ul style="list-style-type: none"> <li>• Standard “workhorse” product</li> </ul>  | <ul style="list-style-type: none"> <li>• HFCS</li> <li>• Beet sugar</li> <li>• Dextrose</li> </ul>   | 320                        | 58 – 61%                     | Ca, K       |
| DOWEX MONOSPHERE 99/310  | <ul style="list-style-type: none"> <li>• Reduced operating costs</li> </ul>   | <ul style="list-style-type: none"> <li>• HFCS</li> <li>• Sugar alcohols</li> <li>• Beet sugar</li> </ul>   | 310                        | 60 – 64%                     | Ca, K       |
| DOWEX MONOSPHERE 99/280  | <ul style="list-style-type: none"> <li>• Good for difficult separations</li> <li>• Reduced separator water usage</li> </ul>               | <ul style="list-style-type: none"> <li>• HFCS</li> <li>• Sugar alcohols</li> <li>• High purity fructose</li> <li>• Polyols</li> </ul>  | 280                        | 57 – 61%                     | Ca, K       |
| DOWEX MONOSPHERE 99/220  | <ul style="list-style-type: none"> <li>• Exceptional performance in shallow-bed separators</li> <li>• Operating cost reduction</li> </ul> | <ul style="list-style-type: none"> <li>• High purity fructose</li> <li>• Sugar alcohols</li> <li>• Polyols</li> <li>• Difficult to separate and high-value sweeteners</li> </ul> | 220                        | 51 – 55%                     | Ca          |



# DOW DIRECTOR<sup>SM</sup> Services – Comprehensive support for the food and beverage processing industries.

At Dow, we are committed to doing everything possible to support our food and beverage processing customers. That's why, whenever you choose DOWEX MONOSPHERE<sup>TM</sup> Chromatography Resins, we offer expert support from our ion exchange technical service and development teams.

Dow also offers a full range of DIRECTOR<sup>SM</sup> Services to help you achieve exceptional performance from your resin, system and plant operations. DIRECTOR Services place our extensive knowledge and experience at your disposal. These services can complement your R&D innovation team, lighten the burden of your system start-up and staff training, and support the ongoing operation and maintenance of your system.



Contact DOW  
DIRECTOR<sup>SM</sup> Services



## Regulatory Compliance

The resins featured here may be subject to food contact application restrictions in some countries. For country-specific food contact compliance statements, regulatory datasheets and information on dietary rules, please contact [Dow's customer information group](#).

**Request a Sample of Dow Ion Exchange Products**  
Small orders of Dow ion exchange resins, polymeric adsorbents, chelating resins and copolymers can be ordered online through the Octochem website.

Request a  
Sample Online



Dow has a fundamental concern for all who make, distribute, and use our products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products – from initial concept and research to manufacturing, selling, using, disposing, and recycling each product.

### Water & Process Solutions

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**WARNING:** Oxidizing agents such as nitric acid attack organic ion exchange resins under certain conditions. This could lead to anything from slight resin degradation to a violent exothermic reaction (explosion). Before using strong oxidizing agents, consult sources knowledgeable in handling such materials.

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