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Protecting a Beverage Brand

Resin Selection Determines Juice Quality

Imagine your customer sitting down for breakfast with his family. Bread is buttered, eggs are scrambled and juice is poured. But when he takes a sip of the fruit beverage, he notices something is wrong with the color, flavor or odor.

No matter how loyal your customers are to your brand, it only takes one bad experience for them to switch to another. And a quick glance at a grocery shelf proves that there is no shortage of selections. While the beverage industry is one of the most profitable, it is also one of the most competitive. Seemingly inexhaustible supplies of new product introductions featuring new brands, flavors and tastes make it difficult to distinguish one product from the other. For this reason, consistent beverage quality, color and taste can be the determining factors for manufacturers competing for customer attention and loyalty.

Ion exchange is the reversible interchange of ions between a solid (ion exchange material) and a liquid in which there is no permanent change in the structure of the solid. With the variety in beverages currently on the market, however, it is crucial to select the correct resin for the specific application.

Selecting Resins

While resins often are used to control a range of factors from acidity, color and odor, to salt content, flavor and shelf life, they also can be used to isolate and purify a variety of additive or valued products such as amino acids (e.g. MSG, L-lysine) or flavor components such as small peptides or nucleosides. In most cases, the goal is to remove or reduce a specific component or class of components from the mix while leaving the bulk of the process stream unaltered. Due to the diverse and sometimes complex chemical nature of the stream to be processed, however, these types of applications can be quite challenging.

Often the biggest initial obstacle to the purification process is identifying and quantifying the components to be removed or reduced from a particular stream. As an example, reducing acidity by removing an organic acid fraction from a wine stream can be accomplished using a weak base anion resin, and pH measurements can be made to define success. The reduction of "nitrogen components" from a stream may enhance shelf life by reducing color from aging, but if too many or the "wrong" components are removed, the desired flavor also may be affected.

Different Resins for Different Reasons

Examining three different applications demonstrates the importance of selecting the correct resin for thorough and accurate beverage purification.

Grape juice. Grape juices contain about 10 percent carbohydrates in the form of sugars. Compared to other juices, grape juice is considered bland, making it a good feedstock for blending with other juices to make fruit drinks and carbonated beverages. It also serves as a sugar additive to grape must for the fermentation of wines. While purifying grape juice can be approached in a number of ways, most often the objective is to have a white grape juice that is made via passing the clarified juice over a series of ion exchange resins to remove salts, organic acids and nitrogenous materials. The resultant juice feed also may be passed over an adsorbent resin or carbon bed to remove color and reduce odors.

Figure 1 outlines how resins may be staged for the treatment of a grape juice feedstock. The strong acid cation resins are applied in the H^+ form, the weak base resin in the free base form and the strong base anion resin in the Cl^- form. The strong acid cation resin is used in the H^+ form to exchange with the K^+, Ca^{2+} and Mg^{2+} ions found in the juice. The cation resin also removes the nitrogenous compounds, which can be major contributors to off flavors and browning of products.

Next, the weak base anion resin is applied to remove free acidity, organic acids, etc., and also may remove some color bodies depending on the feedstock. At this point, the juice is fairly mineral free and some of the color bodies have been removed.

Depending on how the juice is to be used, the feed stream can be taken for evaporation at this point or processed through an adsorbent resin or carbon bed to further reduce color or odor components. However, in order to maintain plant flexibility in handling a wider range of incoming juice feed streams, the preferred method is for the process flow from the weak base resin to be passed through a strong base anion resin in the Cl^- form for color body removal. This is followed by a second strong acid cation bed to pick-up nitrogenous materials that may have leaked through the other resin beds.

About the Author
Daryl Gisch, Ph.D., is with the Liquid Separations Specialties group at The Dow Chemical Co. As a supplier of products and services for the separation sciences for more than 50 years, Dow has assisted many beverage manufacturers in selecting the correct resin for their particular application and providing technical support throughout the beverage purification process. For more information on proper resin selection for beverage processing, contact your regional Dow sales representative at 800-447-4369.

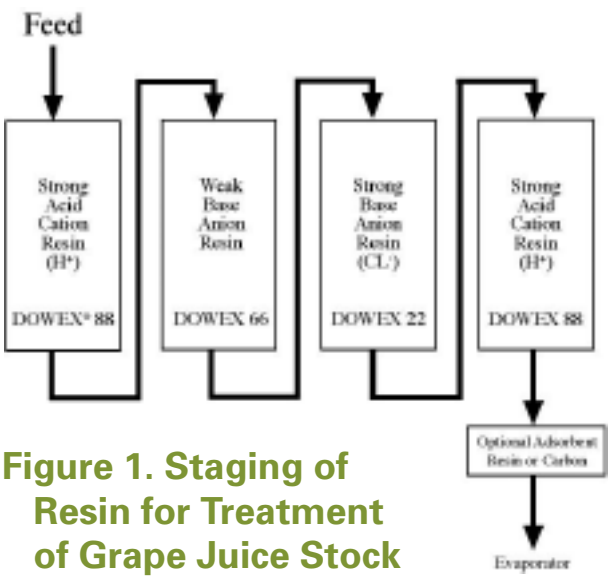

Figure 1. Staging of Resin for Treatment of Grape Juice Stock

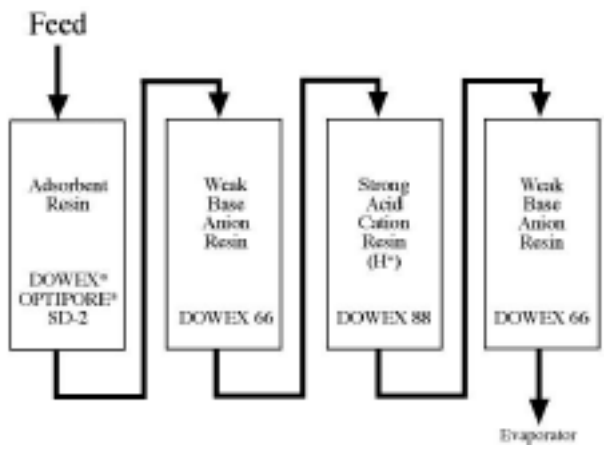

Figure 2. Adsorbent Removes Color Bodies and Color Body Precursors

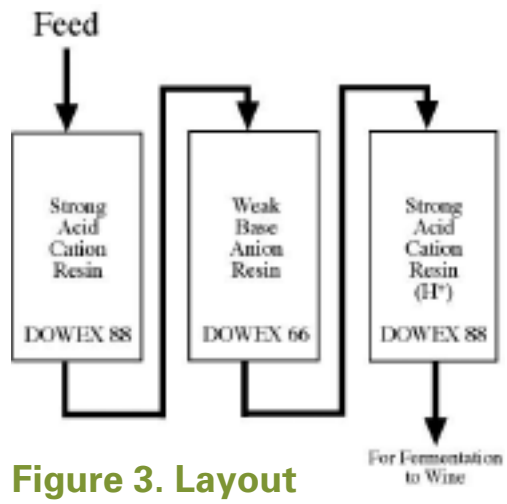

Figure 3. Layout of a Wine Must Treatment Plant

A final adsorbent polish sometimes is used with carbon or adsorbent resin. The demineralized, "decolored" juice is then sent to an evaporator to concentrate the sugar content to that required of a blended juice.

Apple and pear juice. Apple and pear juice products offer a unique challenge as they contain a class of color bodies called polyphenolics. These are responsible for the rapid browning color that often is seen when an apple is cut and left standing. In juice production, these color bodies are formed after extraction, either enzymatically or by rapid oxidation during exposure to air. Once extracted, an apple or pear juice stream contains about 12 percent sugars (glucose, sucrose and fructose).

As the first step, the stream is passed through an adsorbent to remove the existing color bodies and remove the organic color body precursors (Figure 2). From the adsorbent, the stream is passed through a weak base anion resin in order to remove free acidity and a smaller portion of color components, which may have slipped through the adsorbent bed. The strong acid cation resin in the H^+ form is applied to exchange out the K^+, Ca^{2+} and Mg^{2+} ions and to strip out a good portion of the nitrogenous-containing materials. The second weak base anion resin column removes mineral acidity and provides a final color removal. The resulting stream then can be sent to an evaporator for concentration to use as a canning syrup or a juice for blending.

Wine must. Surplus wine grapes can be processed via ion exchange resins to reduce the salt and organic acid fractions, while purifying the glucose and fructose sugars for fermentation. Figure 3 outlines a typical layout for a wine must treatment plant. Such a system typically would apply a strong acid cation resin, followed by a weak base anion resin for deashing. This then would be followed by a bed of strong acid cation resin, in the H^+ form, for pH adjustment. Color formation in the treated product can occur upon storage or at fermentation if the pH of the product is too high. For this reason, cross regeneration of the resins is required and application of HCl as the regenerate rather than NaCl is suggested.

If a lighter colored wine is required, the sugared stream can be decolorized using an adsorbent, which typically can remove approximately 50 percent of the color. Currently, decolorization is not done for most wine must streams, as consumer demand for red wine is greater than that of white wine.

Ready to Pour

Fruit juice and wine purification needs can be quite diverse, depending on the chemical compounds found in the beverage and the desired end-use applications. Just like the variety of beverages on the market, there is no "one size fits all" solution to beverage purification. Selection of an appropriate resin or combination of resins must be carefully balanced with a rigorous analysis of the substance, the impurities you desire to remove and the flavors or colors you want to diminish or enhance.

The use of ion exchange technology is a crucial component in beverage processing, as well as in many other specialty applications including food, dairy, sweetener streams and multiple chemical and industrial applications. Beverage purification, in particular, is a complex but necessary process, and it is the proper use of ion exchange that ensures the quality and consistency that create brand assurance and overall commercial success. WQP