Cation Resin Color Can Make A Difference

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A “salt-and-pepper” configuration has its uses.

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There are many ion exchange resins available, possessing different chemical, physical and operational properties. They can also differ in appearance because of these properties.

Strong acid cation resin that is used in softening and demineralizing applications is available in a light, golden-amber color or a jet-black color, and practically every shade in-between. How does color affect the performance and efficiency of the resin? What color resin should a dealer specify?

Sulfonation and color

When cation resins are manufactured, they undergo a sulfonation reaction. There are several ways to do this — different concentrations of sulfuric acid, sulfur tri-oxide gas, or chlorosulfonic acid can be used. Each has different advantages and varying costs.

Chlorosulfonic acid makes a very light-colored cation resin. Concentrated sulfuric acid tends to make a dark-colored resin, especially when a solvent is used, because the acid reacts with the solvent.

The dark-colored matter is measured in less than parts per million, but it is sufficient to leave the resin in a permanently charred condition as a black resin. It is virtually identical to the lighter-colored material. The charring effect results from a very minute reaction on the polymer and does not interfere with the chemical properties at all.

For a given cation resin, different batches can have different colors. Batch-to-batch variation of so-called black cation resins can range from amber all the way to jet-black due to the normal variations from one batch to another. But experience has shown that cation resin color has no noticeable effect on performance.

Some water treatment providers have preferences for one color cation over another, if for no other reason than consistency. Some prefer the lighter-amber cation resin because the presence of dirt or perhaps fouling can be determined visually. Others prefer the black cation so their service people can’t confuse the cation resin with anion resin that may be present in the dealership.

The answer to the question of whether the color of the resin makes a difference in softening operations is a simple one: It doesn’t!

The question of cation color in a demineralizer gets a bit more complicated. Some companies prefer the dark cation resin for a two-bed demineralizer so the installers do not confuse or mix the cation and anion resins. Otherwise, the color of the cation in a separate two-bed configuration makes no difference, certainly not in terms of performance.

Mixed-bed ion exchangers

The use of different-color resins takes on more importance, and can serve a definite purpose, when operating a mixed-bed ion exchanger.

A mixed-bed unit uses a mixture of cation and anion resins when in service. These two media are intimately mixed to enable the cation resin beads and anion resin beads to be completely diffused among one another.

Regeneration of a mixed-bed unit requires a complete separation of the cation and anion resin components so that acid can be applied to the cation resin and caustic applied to the anion resin.

Strong-base gel anion resin is almost always light amber in color when new. The advantage of a black or darker cation resin in this instance is apparent. A visual determination of effective cation/anion separation of the mixed bed is indispensable for most units (at least those that have sight glasses!).

Telling the difference

The concept of using black cation resin in mixed beds gained popularity in the 1970s when personnel working for service deionization (DI) companies needed a method of telling when the separation was complete during the backwashing separation step of their mixed-bed regeneration.

The use of a black cation allowed an immediate visible difference between the cation and anion layers.

Previous to the introduction of the black cation resin, amber-colored resins were often used, which initially offered some difference between the cation and the anion layers. However, as the anion resins were used, they would pick up enough colored organics to become more amber or brown-colored, which eliminated much of the visible difference between the cation and anion layers.

The introduction of black cation resin into the existing float with amber-colored cation resin produced two visible benefits. First, the black cation itself is easily differentiated from the anion resin, because of its jet-black color. Secondly, when introduced into a float that previously had amber cation resin, it produced a salt-and-pepper effect in the cation layer. After backwash, a solid-color layer of anion could be seen over a salt-and-pepper layer of cation resin.

In this situation, it was necessary to train the operators to understand that as long as the anion resin was a solid color, the separation was finished.

Changing colors

Since the 1970s, there have been changes in the way resins are produced that affect the color aspect. Anion resins are no longer made the same way. The catalysts used during manufacture have changed in almost all cases.

The catalyst controls the nature of the synthesis process to an extent that today's anion resins tend to develop a darker color on use — more than their counterparts did 20 years ago. This is primarily due to the difference in the catalyst that is used for the chloromethylation step. This is especially true for type 2 strong base anion resins that

can become quite dark as they are used.

Operators who “stick to a single product in their floats” are fooling themselves, because over the years the products themselves have changed. Today, the problem of seeing the separation between the anion and the cation is made more difficult by these newer darker-colored anion resins.

In some cases, depending on the nature of the water, it might be easier to see the separation by having a light-colored cation resin or use the salt-and-pepper approach by having black and light cation mixed together in the float. Each situation is unique and depends upon the source water and the resins used in the geographic area serviced by the plant.

Colors as tools

Black cation resins are a valuable tool to assist the visual determination of the backwash separation step of a mixed-bed unit. It is not as important to have a dark cation resin for separate two-bed DI units, but if the service DI plant regenerates both kinds of deionizers, it makes sense to standardize on the dark cation resin so the mixed-bed part of the operation can “borrow” resin if necessary.

Some larger service DI organizations use the black cation resin for all the DI operations and use the amber cation resin for softening applications.

Remember that there is no difference in any aspect of capacity, life, crosslinking, or efficiency between the black and the amber cation resins.