SIZE DOES MATTER

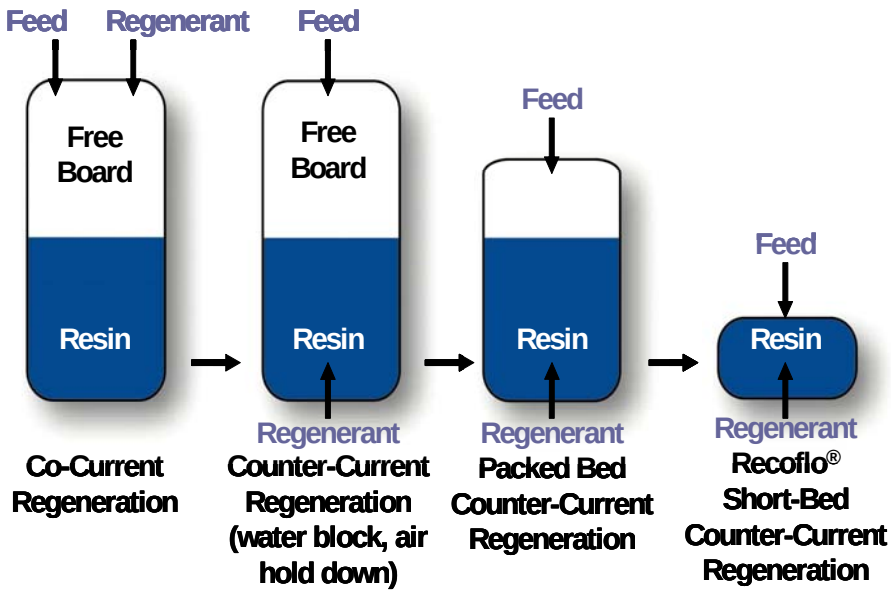
Evolution of Counter-Current Ion Exchange for Industrial Water Treatment

By Lisa Hausz, *MBA*
Eco-Tec Inc.

Bigger is not always better, and this concept is also true for industrial water treatment systems. Historically, water treatment systems consisted of large components with big footprints, convoluted piping and wiring, complex installations, and incompatible peripheral components—all of which contribute to increasing operating and maintenance costs. Integrating various compact components for industrial water treatment provides ease in operation with direct impact to the bottom line. With advanced, space-saving technology, power plants and other industrial facilities can easily install new or upgrade existing water treatment systems for more capacity, less waste, and more output.

SMALL IS THE NEW BIG: *ION EXCHANGE EVOLUTION*

Advances in ion exchange technology have taken an evolutionary approach to improving industrial water treatment efficiencies. A key function of ion exchange is the regeneration of the resin, and over the past few decades, advances have been made that move ion exchange from co-current regeneration to counter-current regeneration. Co-current regeneration consists of feed and regeneration occurring from the same point, either an up flow or down flow process.



Efficiencies were realized, however, by using counter-current regeneration. This process provides backwash regeneration that eliminates many of the inefficiencies related to co-current regeneration, and offers increased capacity and improved product quality. The evolution from co-current to counter-current was later enhanced by the reduction of free board, resulting in a packed-bed column. Still offered today by leading manufacturers, the packed-bed counter-current ion exchange technology produces high purity water with greater control over the regeneration process than its large column predecessor.

The evolution in ion exchange technology now moves industrial water treatment from packed bed to short or compressed bed technology. The efficiencies realized with both the counter-current process and packed bed columns are even greater with a compressed resin bed column. The compressed resin offers faster regeneration and high volume purity water from a compact design.

THE ESSENCE OF COMPRESSED BED DESIGN

Decreased equipment size and increased efficiencies are derived from multiple features of compressed bed technology such as short bed height, small resin volume, low resin exchange loading, fine mesh resin, and shorter cycle times. These features result in higher throughput, lower operating costs, less waste, less space requirements, fast installation and commissioning, and simple maintenance processes.

The resin beds of the compressed bed technology are 3 to 6 inches (~7.5 – 15 cm) in depth requiring significantly less resin volume compared to the resin requirements of conventional counter-current columns. In addition to less volume, the design enables lower resin exchange loading, using only up to 15% of the total exchange capacity of the resin. By using only the most accessible exchange sites, exchange kinetics are enhanced. This process enables easy regeneration and virtually eliminates resin swelling and shrinking, reducing resin attrition.

The combination of high flow rates, low exchange loading, and compressed resin beds results in short cycle times for both service and regeneration. While conventional systems are typically on-stream for 10-20 hours and require several hours for regeneration, compressed bed technology is on-stream for less than 30 minutes and regenerates in less than seven minutes. The shorter cycles provide a continuous supply of demineralized water with only one unit.

The major components for industrial water may consist of filtration, reverse osmosis, and demineralization. With compressed bed technology, the major components require 50-70% less headroom and 30-50% less floor space than conventional systems.

THE BOTTOM LINE: A SMALL PACKAGE WITH BIG SAVINGS

The distinctive design and operation of compressed bed ion exchange technology provide lower operating costs. The compressed bed consumes significantly less chemicals than co-current or packed bed ion exchange systems. Compressed bed resin life can be up to five years or more depending on feed water quality. Additional savings are attributed to low resin replacement costs through lower inventory needs of the compressed bed, and the lack of resin loss from backwash or breakage, as is typical of both co-current and packed bed systems.

The highly efficient regeneration and resin rinsing of compressed bed systems result in reduced water and chemical consumption and subsequent waste generation. Typical compressed bed systems produce considerably less waste than the deep bed co-current systems.

Through the utilization of common components, piping, wiring, and high quality technical standards, integrating compressed bed water treatment technology can easily reduce space requirements, freeing up floor space for additional profit-generating equipment. A small footprint with big efficiencies, the compressed bed technology offers reduced operations, maintenance, and installation costs all of which directly add to bottom line profitability.