COUNTERFLOW: PROCESSES, PATENTED FOR LEWATIT®

With the ion exchange resin technology, products and processes are directly and inseparably linked. For this reason, it is entirely logical that the pioneer of fundamentally new ion exchange products should also have assumed a pioneering role in the development of new processes. The countercurrent process was born. Invented and patented by the Lewatit® scientists and chemists, the principles of countercurrent operation represent a significant improvement over the co-current process. It has since been repeatedly perfected, optimized and diversified! Today's Lewatit® countercurrent processes are the farthest developed, the longest tested and the most thoroughly proven. Several thousand units have so far been built using this technology, and the figure is rising constantly.

LEWATIT® TURNS EVERYTHING UPSIDE DOWN

Because no further significant optimization was possible with the co-current technology, the Lewatit® experts began searching for new approaches, and they came up with this completely new design. What they did, quite literally, was to turn things upside down, and this proved to be the key step towards a new solution: With the Lewatit® Counterflow-technology, the regenerant flows through the resin bed in the opposite direction to the feed solution. The special feature of the Lewatit® countercurrent technology is the upflow exhaustion and the downflow regeneration. Upflow exhaustion avoids any compaction of the resin bed and ensures optimal distribution of the treated product flow. With downflow regeneration, the resin lies on the bottom nozzle plate. This prevents reclassification of the resin bed and thus eliminates the possibility of destroying the polishing layer, which exerts a major influence on the quality. The regenerant level is reduced (potential savings of well over 50 %!), and the quality of the treated solutions is significantly improved.

The most popular counterflow processes mostly invented by LANXESS are:

- Fluidized bed
- Rinsebed
- Liftbed
- Multistep
- Counter-current-counter-pressure
FLUIDISED BED: ALL CLEAR: A FLOATING SOLUTION

The Lewatit® fluidized bed system is a special countercurrent technology that works with upflow exhaustion and downflow regeneration. The process has been patented for Lewatit® as a further logical development of the basic principle of countercurrent technology.

The resin "floats" between the upper and lower nozzle plates of the column. Between the resin layer and the upper nozzle plate is a layer of inert resin. The interior of the unit is deliberately small, just about large enough to accommodate the changing volume of the resin between exhaustion and regeneration.

**The advantages for the user are:** greater efficiency in regeneration, less regenerant chemicals, maximum utilization of the tank volume and lower water consumption.
The Rinsebed system is suitable for small to medium-sized units with a diameter of up to 2000 mm. The units have a collector system just above the mid-point. The treated water is removed through this system. Immediately above the collector system is a perforated plate. The holes in this plate should be large enough to allow the resin beads to pass through it.

The column is filled until the resin covers the perforated plate which divides the unit into a lower, active chamber and a so-called top layer (200-350 mm). After backwashing, the finest beads return to the top layer which adsorbs certain ions during rinsing or if the regenerant is diluted with raw water.

This resin layer is responsible for producing the high-quality water required for rinsing and dilution.

Advantages of the Rinsebed process:

- internal backwashing
- raw water can be used for regeneration or to rinse cation resins
- decationised water can be used for regeneration or to rinse anion resins
- suitable for small, single units
LIFTBED: A GOOD IDEA: TWO CHAMBERS

The Lewatit® liftbed process is based on the fluidized bed principle. Each unit consists of at least two chambers separated from one another by an additional nozzle plate. The chambers are connected to each other by lift pipes (for transferring the resin).

The lower chamber is only partly filled with resin (approx. 1/3 of the total) and has enough freeboard for internal backwashing.

This saves space, and means that no external rinse tank is needed.

Other advantages include: the high operating capacity, the fact that it is also suitable for water with a very high salt content, and that it can be used in cases of inadequate raw water pretreatment. On top of this, of course, it has all the other benefits of the fluidized bed system.
MULTISTEP: MULTI-TALENTED

The multistep system, which has also been patented for Lewatit®, is an innovative, highly variable process that boasts many economic and ecological advantages. Its main asset is that many kinds of demineralization can be performed in one single unit. The column can be filled simultaneously with several ion exchange resins for different functions.

Furthermore, these different resins can be regenerated with their own particular chemical regenerants (e.g. hydrochloric acid and caustic soda solution) without any cross-contamination occurring.

Other key benefits include: low investment costs, small space requirement, lower regenerant demand than with mixed-bed units, exhausted components that can be regenerated separately, a system that is insensitive to load fluctuations or ionic changes of the influent water, and easy automation of the unit. In many cases, the multistep process is an extremely efficient alternative to the mixed bed technology.
COUNTERFLOW-COUNTER-PRESSURE

This process requires a collector system about half way up the unit. For technical reasons, this is covered by an approx. 200 mm deep inactive resin layer (active resin). Air or water is used to create a pressure drop in this resin layer which holds the active resin bed in place during upstream regeneration and elution.

Rinsing with fully demineralised water (or decationised water in the case of cation resins) can be performed in the same direction as exhaustion (downflow) at high speed. Fully demineralised water is needed to rinse anion resins, but decationised water is sufficient for cation resins. It is important to make sure that the fine polishing layer in the resin bed is not exhausted or destroyed prior to operation in order to ensure that the counter-current process produces the high-quality water required of it.

Advantages

- better water quality
- lower regenerant requirement
- lower water consumption
- high availability because of short regeneration cycle