Lewatit® Ion Exchange Resins – All-around Solutions for Chemical Processes

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Time- and application-tested products with a high potential for innovation

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Chemical processes comprise the steps of processing chemical starting materials, synthesizing the products, isolating the generated materials from the reaction mixture and subsequent purification. In the broader context of industrial processes, the steps also include detoxifying waste streams to protect the environment and recovering valuable materials. The ion exchange resins from the extensive Lewatit® product range from LANXESS Deutschland GmbH have been put to use successfully in all of these important steps.

Researchers and production and application technicians of the LANXESS Ion Exchange Resins business unit have tailored the ion exchange resins’ characteristics as catalysts or selective adsorbents for demanding and, in some cases, exotic reaction conditions to meet our customers’ specific requirements. Ion exchange resins have been designed and modified for customized process solutions. Their use today extends far beyond that of softening or demineralizing water and has moved profitably into new and demanding areas of application.

Several dozen different processes have been used successfully for years. New product development is constantly driven forward by the diverse range of products and processes available, increasingly strict environmental requirements, rising raw material prices and an increasing scarcity of resources. Ion exchange resins offer a high potential for innovation in a range of applications. They enable processes involving complex chemistry to be configured with relatively simple apparatus.

The following actual examples from a range of industries provide impressive illustrations of the resins’ wide applicability. Most of these processes have already been implemented on an industrial scale, although some are still at the pilot stage:

**Purification of organic liquids:**

As well as demineralizing and deacidifying organic solvents such as alcohols, ketones, polyethers, petrochemical C4-C5 fractions and natural gas condensates, organic components can also be removed from organic liquids by means of special binding mechanisms. For example, one forward-looking application for Lewatit® is the removal of glycerin from biodiesel or the recovery of noble metal catalysts. Catalysis of organic reactions: As immobilized acids, ion exchange resins catalyze the synthesis of bisphenol A, MTBE, TAME, phenol alkylates and esters, for instance. Furthermore, they can also support the splitting of disaccharides or esters, such as methyl acetate.
Purification of chemicals:

Various types of impurities can be removed from concentrated brines (NaCl, NaNO₃, KCl, MgCl₂), sodium hydroxide solution, hydrazine, ammonia, chromate solution and hydrogen peroxide, among others, and also from organic liquids such as alcohols, biodiesel or C4-C5 fractions. Ion exchange resins can thus have a positive effect on the lifetime and quality of a wide range of electrolyte solutions, such as those used in electroplating.

Acid recovery:

Even highly dissociated acids with concentrations of up to 30 percent can be freed of impurities (such as metal ions) using Lewatit®, thus enabling cycles of consistent quality in etching baths.

Metal recovery:

The enrichment, isolation and purestate preparation of a wide range of metals is possible on scales both large (e.g. mines) and small (e.g. secondary flows in chemical processes). The selectivity of ion exchange resins is exploited to enrich and concentrate specific metal ions from process streams.

Wastewater treatment:

Selective exchange resins enable the removal of heavy metals from wastewater streams. Alkali metals and alkaline earth metals, which are much less problematic in environmental terms, are not affected and remain in the water. Threshold values with residual concentrations in the ppb range can be maintained in situations where simple precipitation methods generally fail. Alongside the separation of heavy metals, ion exchange resins and adsorber resins can also be used for the selective removal of boron, ammonia, cyanide, fluoride and a range of organic compounds.

Groundwater purification:

Groundwater contaminants such as cyanide, chromate, nitrate, heavy metals, arsenic, organic impurities, ammonia and fluoride can be removed using Lewatit®.

Waste air purification:

Acidic ion exchange resins adsorb alkali gases such as NH₃, while alkali ion exchange resins adsorb acidic gases, such as HCl and SO₂. Systems for purifying small gas streams are already in use in clean rooms.

Soil purification:

Lewatit® can be used to bind and immobilize heavy metal contaminants in the soil. This prevents toxic substances from being leached into the groundwater or taken up by plants.

A modular system for customized ion exchange solutions

The selectivity of the functional groups integrated into the resin beads is generally the key to
how the application functions. The appropriate chemical group must be selected from some
twelve possible options. Furthermore, loading the resin with metal ions such as palladium, iron,
zinc, calcium and aluminum represents further ways of controlling the reaction and binding
possibilities in the resin.

The efficiency of the process can also be controlled via the inner (pore structure) and outer
resin structure (particle size distribution). Thus, the introduction of ion exchange resins with a
narrower particle size distribution, known as monodisperse resins, was a key milestone in
product optimization. New production techniques and corresponding improvement of both the
outer and inner structure of the resin beads enabled improved exchange reaction kinetics and
osmotic stability of the material. Success was achieved via higher usable capacities, a higher
selectivity in separation processes and also a longer resin life expectancy.

While the first generation of monodisperse resins generally had bead diameters of 0.5-0.6 mm,
further developments are aimed at producing specific monodisperse grades with larger or
smaller particle sizes. Smaller beads are particularly attractive for processes in which fast
kinetics, high usable capacities and sharply defined reaction zones are necessary. Coarser
grains are particularly interesting for hydrometallurgical applications, where technical
requirements related to pressure drop are preeminent. Further, a controlling effect on the
selectivity of reactions can be achieved via the degree of substitution and cross-linking on the
polymer structure.

With over 100 products, LANXESS offers a range of ion exchange resins that can be used as
a modular system to create individually tailored solutions. Collaboration is an attractive option
for customers because it offers both the range of high quality products and the ability to work
one-on-one with our expert chemists and process technicians in the applications laboratory.