

PARTNER

PROJECT



ION EXCHANGE RESINS:
FROM BEADS TO BRIGHT SOLUTIONS

LANXESS
Energizing Chemistry



For Lewatit® customers:

BENEFIT FROM A PARTNERSHIP THAT INCLUDES KNOW-HOW TRANSFER AND A FULL RANGE OF SERVICES!

"A tailor-made solution for every project!" That is the Lewatit® concept for ensuring that our partners – in this case our customers – enjoy economic success, and it is also a challenge that our Lewatit® team is always delighted to take on, in whatever form it takes. For us it is a question of providing our partners with convincing answers to the most diverse range of problems. These problems may involve the treatment of potable water, the separation of individual components in the food industry, or the extraction of valuable materials in hydrometallurgy. Whatever the issue involved, Lewatit® is the product that comes up with the right answer in over 500 applications – supported by our specialists with their extensive technical knowledge. We are a committed and highly motivated team.

Lewatit® is seen as an innovator and a key driver in the development of new and efficient high-performance ion exchange resins. These products have paved the way for completely new fields of application by opening up new dimensions in terms of performance. Lewatit® comes wrapped in a convincing package: it is an all-embracing solution concept consisting of the product itself plus full technical support. Lewatit® stands for supreme expertise. Through this optimal technical constellation, our partners can be sure of receiving the solution with the maximum economic benefit.

This problem-solving competence has been made possible among other things by considerable ongoing expenditure on research and development and also by our major strategic investments, such as the construction of a new production plant in Bitterfeld, Germany, and our acquisition of Sybron Chemicals Inc., through which we have now also strengthened our presence on the US market. We also invest on a permanent basis in the quality and quantity of our Lewatit® support services. This makes it possible to operate a system of knowledge transfer with our customers that is unmatched in its intensity anywhere else in the world of ion exchange resins.

We have chosen the title "The Lewatit® Partner Project" to symbolize this expressly customer-oriented approach and to provide a signal that communicates the new dynamism and attractiveness of the traditional Lewatit® brand. It also documents the future-oriented Lewatit® philosophy, namely that the customer is, for us, not only a buyer but a partner whom we are fully committed to helping achieve market success. We provide state-of-the-art ion exchange resins and adsorbers and we use tailor-made processes, geared specifically to the particular application. In addition, we offer our partners an exemplary form of customer support with a wide variety of practical services. It is a package of offerings that sets new standards! Welcome to the "Lewatit® Partner Project".

Dr. Michael Zobel heads the ION EXCHANGE RESINS business unit of LANXESS Deutschland GmbH, a leading chemical company with production plants and branches throughout the world. LANXESS is a global player with around 18,700 employees in more than 50 companies operating in all the key economic regions. An efficient organizational structure ensures maximum dynamism and flexibility. The company is divided into four segments: Performance Chemicals, Chemical Intermediates, Engineering Plastics and Performance Rubber. The

Performance Chemicals segment – which also embraces the Ion Exchange Resins business unit – brings together LANXESS's user-oriented business activities in the field of specialty chemicals. It offers a broad range of process and functional chemicals for a variety of industries throughout the world. In 2004, the Performance Chemicals segment posted sales of € 1,910 million (based on the combined financial statements).

The Lewatit® laboratories
are permanently on the go,
monitoring quality and
developing new solutions.





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A modular structure has been set up for the Lewatit® products and services to ensure that they comply with the customers' many different wishes. The "Lewatit® Partner Project" – a system of individually accessible modules.



The name Lewatit® stands for pioneering ideas, innovation and patented progress. Monoplus is the latest state-of-the-art product development.



Lewatit® high-tech products for customized water treatment in numerous applications. For example, for the trouble-free, low-maintenance operation of a complex industrial plant.



Ion exchange resins in the food industry: Specially developed Lewatit® grades with an enormous spectrum of applications and performance.



Ion exchange resins for the chemical, pharmaceutical and biochemical industries, for metal extraction, electroplating, electrical engineering – ideal solutions for even the most difficult reaction conditions.



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ANNEX

MADE-TO-MEASURE MODULES FOR MADE-TO-MEASURE SUCCESS.

MODULE: PRODUCT QUALITY

Lewatit® is one of the world's leading brands of ion exchange resins. It comprises an exceptionally wide range of high-performance products for all kinds of applications. The extensive portfolio of exchange resins, adsorbers and functional polymers has been divided into three main segments in line with the principal customer applications: water, food, and catalysis plus chemical processes.

MODULE: APPLICATION TECHNOLOGY

On the one hand, we have the right choice of product. On the other, we have its use in the right process. Product plus application technology: two symbiotically linked success factors. The Lewatit® success principle for perfect solutions. The “product” module and the “process” module as one, in an all-embracing concept!

The Lewatit® Partner Project

Good products

– is good.

**Good products plus good
application technology**

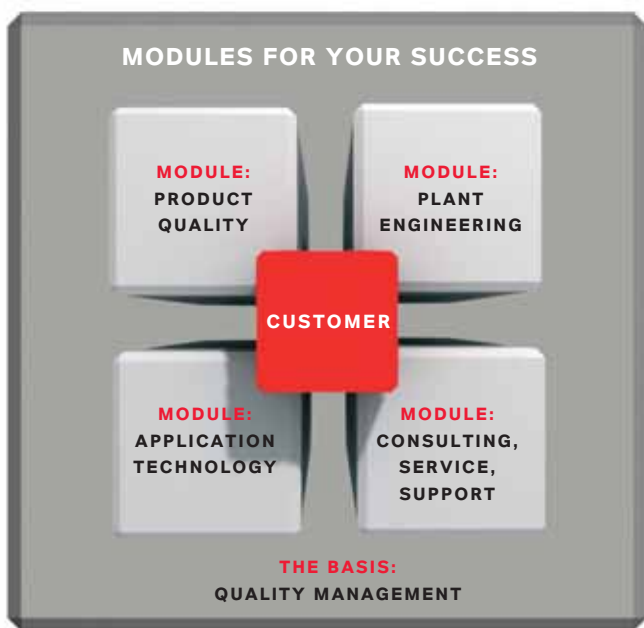
– is better.

**The perfect combination
of all components**

– is best.

The ideal tool for this

**– Lewatit®-
consulting.**



MODULE: PLANT ENGINEERING

An all-embracing approach will necessarily also involve a consideration of the treatment plant. The more seamlessly the ion exchange resin(s), the process and the unit are regarded as a single concept in the initial planning and design, the more effective the overall result will be, and the easier it will be to comply with the relevant specifications. The Lewatit® strategy involves close cooperation with planners, engineering offices, plant engineers/ OEMs, universities, associations and other institutions.

MODULE: CONSULTING, SERVICE, SUPPORT

The wide variety of demands made on ion exchange resin technology and the individual parameters for the optimal integration of exchange or separation processes into production cycles underscore the importance of qualified consulting by an experienced partner from the very beginning.

The Lewatit® service package includes full support during the planning, consulting and evaluation stages. With certain projects, our technical service team can also be on hand during the start-up of a plant – and afterwards, too.

THE BASIS:

LEWATIT® QUALITY MANAGEMENT

Lewatit® products and services are always customer-oriented. That is why they are so broadly accepted and so successful. An important factor for achieving this high performance is our effective quality management system.

A combination of clearly defined processes and structures, plus a set of internally binding guidelines, regulations and procedures gives our customers the assurance of having, in Lewatit®, a partner that can perform at the very highest level – reliably and continuously.



**OUR PARTNER'S SUCCESS
IS ALSO A MEASURE
OF THE QUALITY
OF OUR SERVICES**



MODULE:
CONSULTING, SERVICE, SUPPORT

In addition to the product quality, application technology and plant engineering modules, Lewatit® partners can also call on a wide range of services and support offerings that are geared entirely to their individual needs and the local conditions.

**LEWATIT® – A HIGH PROFILE
THROUGH PROFESSIONALISM.**

The high professional quality of the consulting services and the broad spectrum of technical services are two factors that make Lewatit® quite unique.

With a concept that is consistently geared to meeting customers' expectations, the Lewatit® team enjoys a uniquely high profile among the suppliers of ion exchange resins.



A CASE OF FINDING THE OPTIMAL SOLUTION.

The ion exchange technology plays a key role in the overall structure of a production process, so it is very important to take advantage of all the available opportunities for consulting before making an investment decision. It is a matter of identifying the optimal solution from a technical, operational and economic point of view. That is precisely where the skilled Lewatit® experts come in. Experts with a wealth of experience to share with their partners.

BETTER CONSULTING, BETTER PERFORMANCE.

With its consulting services, the Lewatit® department provides the technical advice that companies want. The analysis results and recommendations are an important factor in helping Lewatit® customers take the necessary decisions. From the small planning office to the global plant engineering company, Lewatit® partners use the consulting services as a module for their own success – whether they are planning a new plant, optimizing an existing process or trying out a new technical solution. With the growing pressure of structural reorganization in many companies, dependable access to external sources of expertise is becoming increasingly important for many enterprises.

CONSULTING – ALWAYS WORTHWHILE.

Everyday industrial practice shows that expert advice is not only required for specialized applications like the use of resins in process solutions for removing aldehydes or mercaptans. Even with standard applications in the water segment, better results can be achieved through accurate analysis and the drawing of the right conclusions. It also makes for more reliable compliance with legal regulations – relating, for example, to the prevention, reduction and recycling of waste. The repeated use of rinsewater (by passing it through an ion exchange demineralization unit), for instance, can reduce water consumption by 95 % and at the same time optimize the quality of the water used for the rinsing process.

EASY TO REACH IN THE EVENT OF A PROBLEM.

For operators of ion exchange units, it is important to know that Lewatit® experts can be contacted quickly should a serious malfunction occur. Schedules are drawn up to ensure effective troubleshooting in emergency situations.



MODULE:
CONSULTING, SERVICE, SUPPORT

ALWAYS AT THE READY.

For the Lewatit® team, consulting expertise is not just a marketing tool but an integral part of the brand philosophy. However, consulting also requires communications. Apart from the use of electronic media, personal presence is also very important. Lewatit® provides the personal touch with a team of 70 consultants who operate locally as direct contact partners. They are specialists who serve as expert discussion partners for commercial, product-specific and technical matters. The management is based at the Leverkusen headquarters, customer-oriented and structured according to different areas of application. With comprehensive, more specific projects, the relevant technical service manager can be called in anywhere in the world.

RESEARCH AND DEVELOPMENT.

There is virtually no other brand in the field of ion exchange for which research, development and analytics are actively carried out to such a vast extent as with Lewatit®. Lewatit® is represented with its own labs in all the key economic regions of the world, with the laboratories in Japan, the United States and particularly the central laboratory in Leverkusen playing the main roles. Scientists work, for example, on modifying the fine details of the resins to align their properties even more precisely to specific applications. They are also constantly involved in the development of new resin grades to tap completely novel fields of application.

PREVENTION IS ESSENTIAL!

Another important task for the Lewatit® laboratories involves testing resins that are currently in use in order to obtain data about their present level of performance. This is becoming an increasingly important service from the customer's point of view.

Through reliable preventive analysis, it is possible to accurately determine the remaining service life of a resin, thus enabling an imminent



resin replacement to be budgeted and performed in good time. Without the right investment planning, companies risk delaying the necessary replacement too long, and this can have serious negative effects on production processes. Such malfunctions generally have considerable economic consequences. The Lewatit® team has optimized the procedure for performing “precautionary examinations” of the resins and has made them very customer-friendly. The administration and form-filling processes can be carried out unbureaucratically, conveniently and quickly through Web support.

ANSWERS TO SPECIFIC QUESTIONS.

It is inevitable that with the constant changes in technical developments and the legislative environment, questions concerning the use of ion exchange resins will be raised again and again. Lewatit® experts are on hand to help, for example with matters involving official regulations, specific legislation in certain countries or regions, application-related topics, the disposal of ion exchange resins, wastewater and solid waste, design problems, resin changeovers, regeneration, and changes in raw water conditions. They can also answer questions on costing, amortization etc.

INFORMATION, EXCHANGE OF OPINIONS, EXCHANGE OF EXPERIENCE.

The Lewatit® philosophy is to consistently encourage dialogue between all the parties involved in ion exchange resin technology. This covers a whole host of people, including the users, plant designers and builders, OEMs, the authorities, the chemical industry and universities and associations, and can involve the organization of symposia, technical conferences, lecture sessions and presentations. The Lewatit® experts also attend trade fairs and participate in organized virtual meetings on the Internet giving current reports on trends and developments in front of a global auditorium.

Apart from this, a whole range of other information material is available, including brochures, datasheets and other printed media.



MODULE: **CONSULTING, SERVICE, SUPPORT**

RELIABLE DELIVERY – BOTH QUANTITY AND QUALITY-WISE.

The increasing number of Lewatit® ion exchange resins available for specific applications is making the range of Lewatit® products and services ever more attractive. But while this may be a tremendous benefit for customers, it makes enormous technical and logistic demands on internal management. After all, the main goal will always be to ensure that, in close coordination with the customers themselves, they will be supplied with the products they want, at the agreed time, in the specified quality and wherever they may be located.

TWO ROUTES TO THE CUSTOMER.

The reliable supply of Lewatit® ion exchange resins to customers is ensured by two logistics systems that complement each other perfectly.

Firstly the straight route, in which partners are supplied direct, and secondly through a comprehensive network of distributors, ideally located to supply Lewatit® customers.

THREE PRODUCTION PLANTS ON TWO CONTINENTS.

LANXESS has tackled production constraints head-on – with the aid of investments running into millions of dollars. Alongside the modernized high-performance facilities at the company's main site in Leverkusen, a second Lewatit® plant has been built from scratch at a central location in the middle of Europe.

In Bitterfeld, in the eastern part of Germany, a wide range of versatile Lewatit® grades are manufactured using state-of-the-art processes. They are produced in very large quantities and in consistently high quality. The focus in Bitterfeld is on the monodisperse ion exchange resins belonging to the Lewatit® MonoPlus line. A new polymer silo park enables the company to supply a large number of product variants at short notice, significantly enhancing product availability for customers. A further step taken in 2005 to optimize delivery reliability was a 50 % increase in the storage area for ready-for-delivery Lewatit®



Prospects for the future:
The Lewatit® plant in Bitterfeld.
Production and logistics, optimized
for maximum flexibility to benefit
the customer.

products. This provides greater logistic flexibility for customers. The capacity expansion projects with the silo park and warehouse are a response to the constantly increasing demand on the world market for Lewatit® products, and confirmation of the future-oriented strategy to make Lewatit® increasingly attractive for customers by building on its own strength throughout the world.

Through the takeover of Sybron Chemicals Inc. with the entire Ionac® product range, the Ion Exchange Resins business unit now has an ideal strategic alignment in the United States. The acquisition has had a definite positive effect for customers particularly on the American and Asian markets.

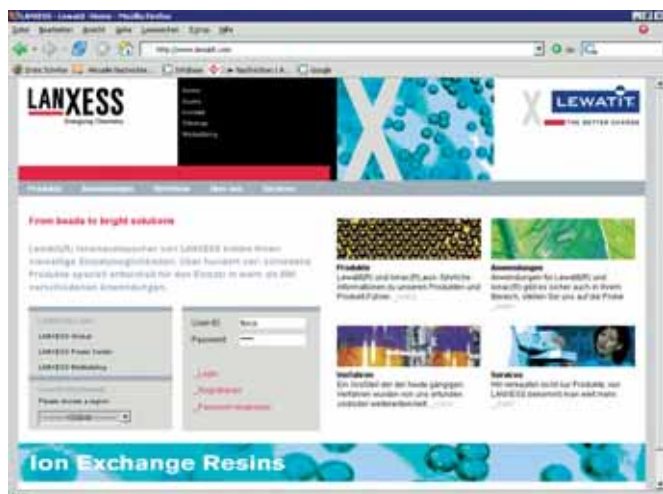
WWW.LEWATIT.COM SERVICE AROUND THE CLOCK, AROUND THE WORLD.

The highly user-oriented Lewatit® website features numerous practical tips, technical advice, information and interactive offerings for customers in all fields of application. It also adds significant value to their practical work. The major elements of the services needed in day-to-day operation are thus immediately available to Lewatit® partners at any time.

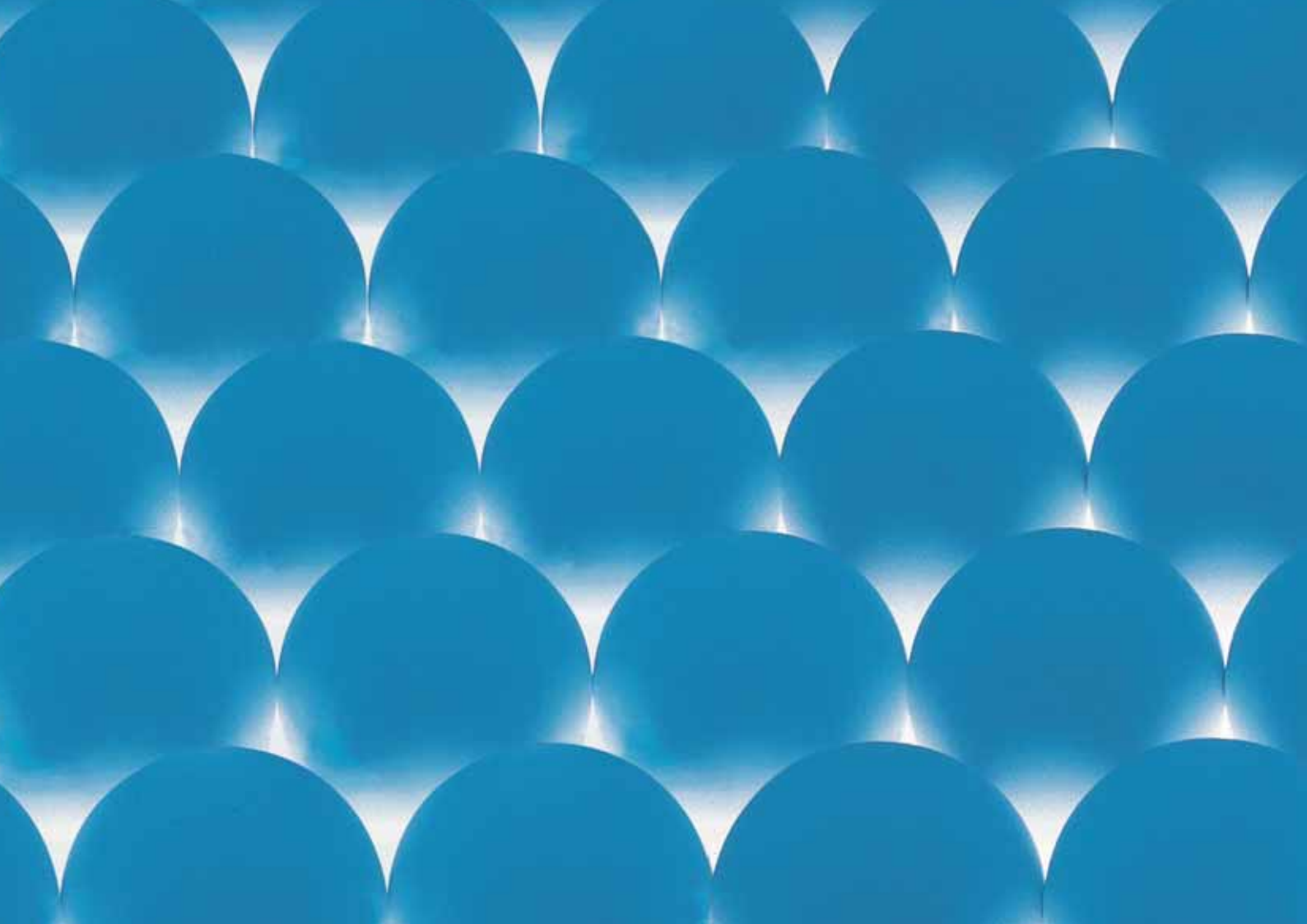
The straightforward design of the website makes for clear and direct navigation as it is based on the structure of the LANXESS Ion Exchange Resins business unit. Apart from general information about the business unit itself, the website also contains details of products, applications, processes and services. A personal password opens up a broad spectrum of additional information for customers.

Under “Products” and “Applications”, for example, there are detailed descriptions of the more than one hundred different resin grades marketed under the brand names Lewatit® and Ionac® for over 500 different applications. Such data can be easily and directly downloaded. The extranet also offers Lewatit® partners the possibility of identifying the optimal products for a specific application through a highly detailed interactive product scout. Products can be selected by four different criteria: industry segment, application, type (gel or macroporous) and chemical characteristics.

The Lewatit® website also features an extremely comfortable, accurate and constantly updated plant design software, oriented specifically to the demands of the practitioner. Apart from a wealth of industry-specific information, it also offers download possibilities for brochures, presentations and useful tools. There are also electronic forms to support and simplify the submission of specimens for resin testing.



Practical information about the Lewatit® Internet site can be found on a separate information sheet (enclosed on page 31), or you can work through the site step by step from the homepage.



LEWATIT®: PACEMAKER WITH MONOPLUS™.



MODULE:
PRODUCT QUALITY

NEW APPLICATIONS FOR THE TINY BEADS WITH THE BIG BENEFITS.

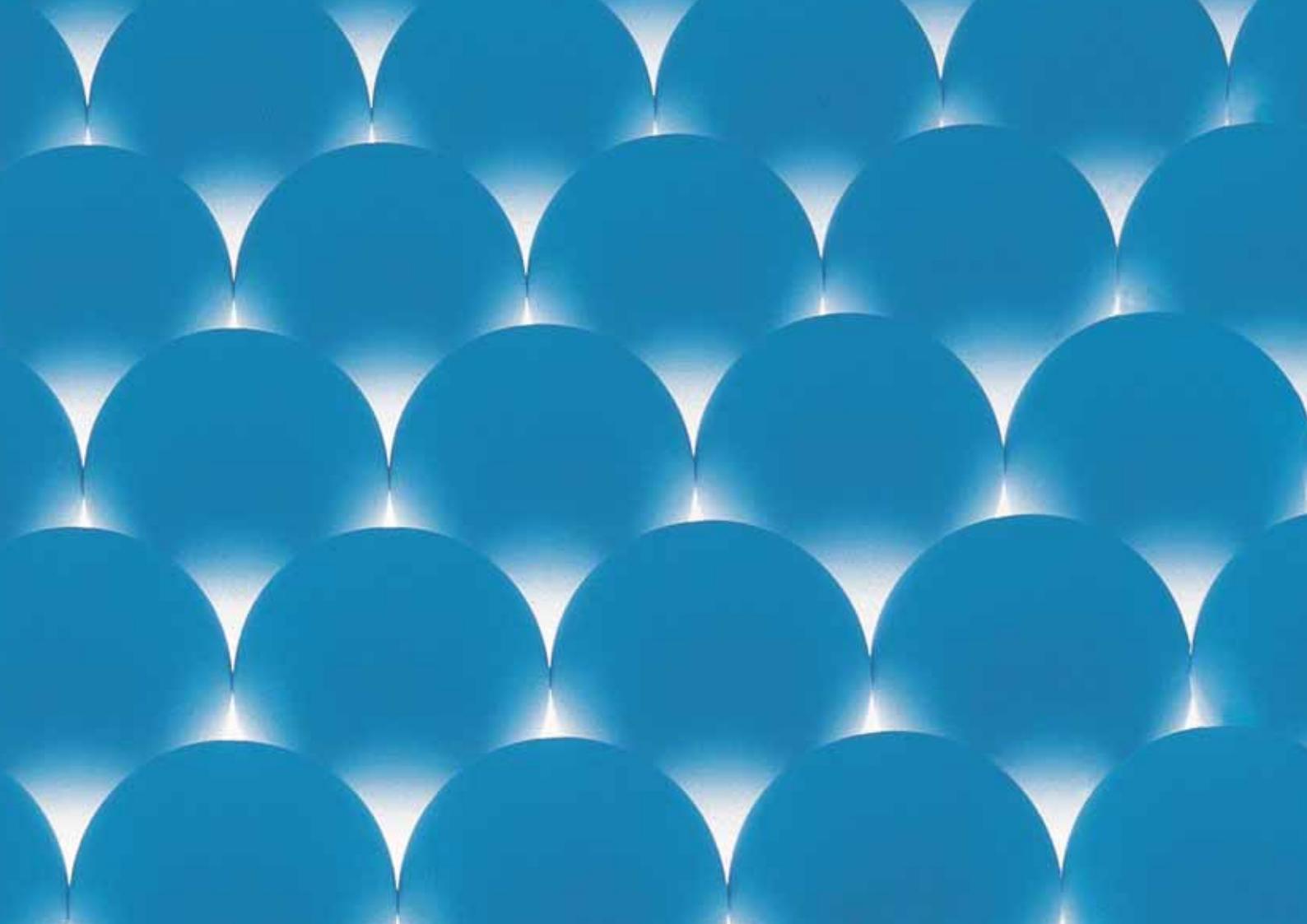
MONOPLUS – A QUESTION OF EFFICIENCY.

The specifications laid down for the quality of the media being treated and for the efficiency of the selection processes are becoming stricter all the time. In all industries and in all sectors. As the range of applications expands, so there is an increasing need for specialized, higher-performance ion exchange resins and adsorbers. The Lewatit® team has come up with the innovative answer: The current generation of selective monodisperse resins is now available for an even wider range of applications. MonoPlus from Lewatit® represents the state of the art in research and development engineering. This gives Lewatit® partners the assurance that they have opted for top product performance with unmatched efficiency.

NOT SCREENED BUT SHAPED.

A large proportion of what the global ion exchange resin market declares as products of constant bead size cannot compare with MonoPlus. The decisive difference lies in the performance of the resins. A product that is manufactured by a conventional process and then turned into a supposedly "constant size" by screening is simply unable to offer a monodispersity to match that of MonoPlus, which is characterized by extremely narrow tolerances. The Lewatit® team instead developed a new process for the production of monodisperse ion exchange resins, the result being the first monodisperse generation. The chemists then worked consistently on underscoring the claim of Lewatit® to be the pacemaker in its field by raising the performance bar even further for monodisperse ion exchange resins. And the efforts have certainly been worthwhile.

The performance attained by today's MonoPlus products is quite simply outstanding. The range of products in the MonoPlus line has been consistently oriented to the varied individual needs of the customers. Equal diameter of the resin beads not only means equal size, it also means equally improved performance of the beads with regard to their chemical and physical properties.



MonoPlus beads are available for many applications in monodisperse

diameters. The bead size can be adjusted between 0.30 mm and 0.90 mm.

PROGRESS FOR ALL!

Lewatit® is available in the optimized MonoPlus grades for virtually every application. Whether industrial water, potable water or ultra-pure water is involved, whether the application is in the food industry or the product is needed for catalysis or chemical processes, the Lewatit® specialists will find the right solution: with monodisperse anion and cation exchange resins, strongly or weakly basic, or in perfectly coordinated mixtures, or with chelating resins.

Here are three from dozens of examples to illustrate the scope of the current applications:

➤ MonoPlus MP 500, for example, has proved ideal for the demineralization of water for industrial steam production by modern counter-current processes.

It is a monodisperse, strongly basic, macroporous anion exchange resin based on a styrene divinylbenzene copolymer. Its favorable kinetic properties result in better capacity utilization than with comparable ion exchange resins that have a heterodisperse bead size distribution.

➤ Lewatit® MonoPlus M 800 KR is used for the decontamination of circuits in nuclear power plants. This grade is highly regenerated and purified to meet the specifications of nuclear engineering. It is generally combined with MonoPlus S 200 KR, a highly effective cation resin.

➤ MonoPlus TP 214 is the ideal candidate for removing mercury from flue gas water or groundwater, and for separating or extracting metals (gold, silver, platinum group elements) in hydrometallurgy.

Compared with conventional types, this MonoPlus product has a number of clear advantages: greater mechanical and osmotic stability, higher kinetics, 10-20 % higher capacity and much lower leakage.





MODULE: PRODUCT QUALITY

CONVINCING PLUSSES.

MonoPlus is the Lewatit® process that enables resin beads to be produced in a defined uniform size and with a uniform internal structure, optimally geared to the particular application. This process, which has been patented for Lewatit®, represents a technology leap with considerable practical benefits. It always yields the hydraulically optimal bead size, with every single bead having a homogeneous inner structure with optimized properties. The diffusion paths are exactly the same in all the beads. Other benefits include ideal liquid dispersion, low pressure loss, economic utilization of the unit volume, no clogging of the nozzles due to fines, high mechanical and osmotic resistance, and fewer side-reactions resulting in constant yields for more efficient process control.

THE HIGHER THE QUALITY AND SAFETY SPECIFICATIONS, THE MORE COMPELLING THE ARGUMENT FOR LEWATIT®.

Faced with specifications such as these, Lewatit® will be your only alternative: High chemical resistance and mechanical stability, resistance to swelling and shrinking (osmotic stability), durability, long regeneration cycles, tailor-made selectivity, outstanding capacity, low amount of fines, genuine monodispersity.

Lewatit® is also your strong, reliable partner when you merely require supply of ion exchange resins, adsorbers or functional polymers, standard grades or MonoPlus products. Efficiency you can count on!



The monodisperse ion exchange resin grades in the Lewatit® MonoPlus range really come into their own when water is concerned. Lewatit® MonoPlus displays its



economic and ecological benefits particularly in the treatment of water for large-scale facilities with high throughput rates (e.g. power plants).

Lewatit® MonoPlus ion exchange resins in a multistep unit:
Perfect interplay of product quality, application technology and plant engineering.



GOING AGAINST THE FLOW. BUT IN THE RIGHT DIRECTION.



MODULE: APPLICATION TECHNOLOGY

APPLICATION DIVERSITY NEEDS PROCESS DIVERSITY. PROCESS DIVERSITY ENABLES APPLICATION DIVERSITY.

WHY THE LEWATIT® TEAM INVENTED THE COUNTERCURRENT TECHNOLOGY.

In the beginning was the co-current technology: The feed solution and the regenerant passed through the resin bed in the same direction. Although the basic process of ion exchange worked, it had a number of disadvantages (and indeed still does where such units are in use). To be able to achieve adequate performance despite inefficient material exchange, very high quantities of regenerant have to be used – often more than twice the amount needed for the countercurrent technology. Because of compaction of the resin bed, for example, backwashing has to be performed before every regeneration. This requires large volumes of fresh water and also produces effluent. In addition, a high internal volume is needed for backwashing, which means that only half the entire unit is left for the ion exchange resin. On top of this, because of the unfavorable concentration distribution, the use of regenerants is not very efficient, and there is an excessive consumption of acids and alkalis. This means long regeneration and rinse times. Summing up, one can say that co-current processes work in principle, but the principle is highly ineffective.

THE COUNTERCURRENT PROCESS – 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® countercurrent 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.

THREE LEWATIT® CHAMPIONS: FLUIDIZED BED, LIFTBED, MULTISTEP.



MODULE: APPLICATION TECHNOLOGY

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.

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.

MULTI-TALENTED: THE MULTISTEP PROCESS.

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.

WITH OTHER PROCESSES TOO, LEWATIT® IS THE IDEAL SOLUTION!

Lewatit® is the ideal partner not only for the fluidized bed, liftbed and multistep processes, but also for other commonly known processes. Whether the need is for consulting services, ion exchange resins or both, Lewatit® will always provide the answers!



The world's biggest multistep facility in Ning Po is an impressive example of the successful integration of the Lewatit® modules:



Expert consulting services in application technology and plant engineering plus the product quality of Lewatit®.



MODULE: PLANT ENGINEERING

THE LEWATIT® TEAM DOES NOT BUILD PLANTS ITSELF – BUT IT CAN HELP TO DESIGN THEM.

The more successfully all the parameters required for the operation of an ion exchange unit can be integrated, the better the facility will work in practice and the better the cost-to-benefit ratio will be. This applies not only to the initial investment, but also later in everyday operation. This is why it is a good idea for the Lewatit® experts to be involved in the planning and design of a new unit to contribute their wide-ranging expertise.

Many of the Lewatit® experts previously gained their experience in engineering offices, making them ideally equipped to cooperate with OEMs,

engineering offices and technical development departments. The Lewatit® specialists study all the different aspects of an individual project, analyze the tasks and functions, research application technology databases and, where necessary, carry out laboratory trials. As a result, they glean a wealth of reliable data on such aspects as selectivity, operating capacities, ion exchange techniques, regeneration procedures and resin stability.

The Lewatit® experts can also answer questions about pretreatment and aftertreatment of the product flow, disinfection, start-up, process application engineering and the recycling of used regenerant. Desorption parameters are optimized for ideal unit design.

Picture above: The world's biggest multistep facility in Ning Po in eastern China has a capacity of 500 m³/h with a daily operating time of 20 h. Lewatit® experts were involved with the partner compa-

nies from the planning phase to the start-up to give advice and active support.

This impressive multistep unit demineralizes contaminated river water for use in a power plant.



LEWATIT® ION EXCHANGE RESINS FOR WATER TREATMENT

HOW TO TURN WATER INTO A PERFECT MEDIUM.

The treatment of water is the best-known and biggest field of application for ion exchange resins. Constantly mounting specifications regarding the quality of the treated water are making ever higher demands on the suppliers. Lewatit® has the right ion exchange resins and the right processes to meet just about any set of requirements.

WORKING FLAT OUT FOR HIGH-QUALITY WATER.

One example of the application of Lewatit® ion exchange resins in industry is in power plants. There, ion exchangers have to cope with very high volume flows and withstand numerous regeneration cycles without problems. Planners and operators of power plants throughout the world put their trust in the outstanding performance of various Lewatit® ion exchange resins that have been specifically developed for such applications. They treat the water to stop it from causing any incrustation or corrosion. With the help of Lewatit®, the water treatment

process has become a reliable and unproblematic step in the overall process. It also has economic benefits: Valuable equipment, turbines, steam generators and pipelines last longer and the operating costs are significantly reduced.

ULTRA-PURE WATER FOR ULTRA-SENSITIVE APPLICATIONS.

Ultra-pure water is needed above all in the electronic and pharmaceutical industries. Demands made on the ion exchange resins used in these sectors are extremely high.

Because of the stringent specifications on water quality in terms of TOC emissions and residual ion contents, the ion exchange resins used for such applications have to be specially purified and treated.

The pharmaceutical industry needs ultra-pure water, for example for sterile applications and processes under cGMP conditions. In certain constellations, the Lewatit® specialists can compile data for pharmaceutical customers needed for certification of the water treatment – for licensing procedures or official audits, for example. The Lewatit® range also includes a line of ion exchange resins developed specifically for the production of ultra-pure water for the highly sensitive production of semi-conductors, processors and electronic components. Residual salts or organic components remaining in the water can cause enormous damage, and can well be the reason for short circuits between the conductive tracks on a chip. The greater the density of the conductive tracks, the higher the specifications regarding the quality of the water.

ENJOY!

The treatment of potable water plays a major role in food and household applications. Very often, ion exchange resins are the only possible way to comply with laws such as the potable water regulations, and numerous potable water suppliers put their trust in the reliability of Lewatit® ion exchange resins. In private households, there are two main uses: firstly, preventing “furring” in the houses’ pipe systems, domestic appliances and sanitary installations, and secondly, treating potable water by removing undesirable substances that impair the taste and odor – and in some cases, are harmful to the health. Water treated with Lewatit® is ideal for preparing beverages.



Ultra-pure water as needed, for example, in the pharmaceutical and electronic industries must comply with specifications that extend down to the ppq range (parts per quadrillion = 10^{15}). For comparison, $1:10^{15}$ is the ratio between the thickness of a hair and the distance between the Earth and the Sun.

All water is different, and hardly any of it is ideal if it is not treated. In order to remove the substances that impair processing or spoil the taste, the water must be subjected to optimal treatment. Depending on the particular application, it may need to be partly dealcalized or have its salt content reduced. Thanks to their purity and capacity, Lewatit® ion exchange resins in combination with state-of-the-art Lewatit® processes provide the ideal conditions for simple and economical treatment.



LEWATIT® – ENTIRELY TO THE TASTE OF THE FOOD EXPERTS.

INVALUABLE FOR EXTRACTING VALUABLES.

Ion exchange resins are an established and indispensable part of the food industry. Within the large Lewatit® product range, the grades developed specifically to comply with the specifications of the food industry are identified by a letter “S” in their name. Ion exchange resins and adsorbents play a key role in the technique of separation by liquid-solid partition. Often, there is no alternative for isolating, concentrating and purifying valuable materials from the liquid phase. With Lewatit®, even the most sophisticated separation processes can be performed easily. Lewatit® plays a major role in ensuring on-spec purity and durability, while giving the purified product a pleasant taste and good appearance.

LEWATIT® MAKES SUGAR SWEET AND WHITE.

One important application in the food industry is the treatment of syrup. Industrial-scale production of crystallized sugar and liquid sugar syrup would be virtually impossible without the use of macroporous Lewatit® ion exchange resins. The resins help to turn brown cane sugar into the popular white product we all know so well. It also makes sure that the sugar tastes like sugar. Special Lewatit® grades are used to demineralize the raw solution and remove the yellowish brown substance that gives the raw sugar its natural color.

A STOUT PERFORMANCE WITH STARCH.

The starch industry produces high-quality syrups and polyalcohols based on starch hydrolyzate for use as sweeteners, e.g. in soft drinks. A special range of Lewatit® ion exchange resins has been developed especially for demineralizing and decolorizing (refining) these syrups.

DEMINERALIZING, DECOLORIZING AND REMOVAL.

Lewatit® removes mineral salts from food acids and gelatine, extracts undesirable bitter substances from orange and lemon juices, takes substances like mineral salts and undesirable fruit colors from grape juice, and removes salts, acids and bases from raw glycerin. All in all, Lewatit® makes an important contribution to the taste of many products.

To extend the shelf life of beer, for example, without adding any preservatives, the water used to produce it must contain as little dissolved oxygen as possible. Lewatit® plays a key role in solving this problem: Catalysts coated with palladium are used in a process in which 99.8 % of the dissolved oxygen is removed.

WINNING WITH LEWATIT®.

Valuable proteins and milk sugar, for example, are extracted from whey and sent for further processing. For this process to be a success, the whey must be suitably treated with Lewatit® ion exchange resins.



Brita household water filters containing Lewatit® ion exchange resins are used to treat hard tap water containing lime by removing the calcium and magnesium salts (decalcifying). Substances that impair the taste and odor are



removed so that the flavor of beverages like tea and coffee can develop to the full.

Lead and copper ions are also adsorbed by the Lewatit® cation exchange resins and exchanged for hydrogen ions.



Lewatit® resins developed specifically for the needs of the mining industry make the extraction of valuable metals from the mined ores very effective.

LEWATIT® ION EXCHANGE RESINS FOR CATALYSIS AND CHEMICAL PROCESSES.

THERE'S A LOT MORE THAT LEWATIT® CAN DO.

CHEMICAL PRODUCT SYNTHESSES, HYDRO-METALLURGY, BIOTECHNOLOGY, FOR EXAMPLE.

Chemical processes generally comprise the stages of feedstock processing plus the synthesis, isolation and purification of the final products. The effluent has to be treated to protect the environment and to recycle the used materials. Ion exchange resins are used in all these steps. Their properties as catalysts or selective adsorbers under demanding, and sometimes exotic, reaction conditions are tailor-made.

There are numerous established applications for ion exchange resins in the chemical, pharmaceutical and biochemical industries, in the extraction of metals, in electroplating and electrical engineering and also in the disposal and recycling industry – and there is enormous potential for more.



PETROCHEMICALS DO BEST WITH LEWATIT®.

Organic ethers like MTBE and TAME have assumed the function in fuels that formerly fell to lead. Lewatit® makes an important contribution towards preparing these additives for large-scale, inexpensive production. Thanks to special Lewatit® resins, complex and uneconomical production processes are now a thing of the past. Today, highly selective processes with excellent conversion rates ensure that the market is supplied with sufficient quantities of organic ethers – without delivery bottlenecks and at reasonable cost. This development has been accompanied from the very beginning by Lewatit® experts working in the field of catalysis and organic synthesis. With their knowledge of acid-catalytic reactions in the homogeneous phase, solutions were found to make full use of the benefits of heterogeneous chemical reaction engineering through the use of Lewatit® ion exchange resins.

PVC PRODUCTION: WITH LEWATIT® AND WITHOUT ENVIRONMENTAL DAMAGE.

With global production standing at an estimated 26 million tons a year, PVC is one of the most important plastics of all. For PVC production, elementary chlorine is needed, produced in very large quantities by electrolysis from highly concentrated sodium chloride solutions. The controversial production process using mercury has since given way to the environmentally friendly membrane process. The only problem is that the sensitive plastic membranes become blocked by alkaline earth ions due to the precipitation of hydroxides. Lewatit® ion exchange resins are able to specifically eliminate the troublesome metals even from highly concentrated salt solutions. As a result, the expensive membranes are effectively protected and can remain in use for much longer.

SELECTIVE PRODUCTION AND RECYCLING OF VALUABLE SUBSTANCES.

Another large field of application for Lewatit® ion exchange resins is in

the hydrometallurgical steps of mining processes, both in the extraction of metals from ores (e.g. copper, nickel, cobalt) and in the removal of contaminants. The Lewatit® resins with their chelate groups developed specifically for the needs of the mining industry adsorb the dissolved valuable materials, which are very finely dispersed in the liquid (suspension or pulp). Lewatit® and the resin-in-pulp technology make the extraction of valuable metals extremely effective. Apart from this application in mining, the recovery of valuable materials from product streams is also highly interesting in the fields of electroplating, electronics and the chemical industry.

Using Lewatit® ion exchange resins, processes can also be run economically in a decentralized unit – usefully combining the two main parameters of economy and ecology.

TRACKING DOWN THE POLLUTANTS IN THE GROUNDWATER.

In the treatment of industrial effluent and in the purification of groundwater, the removal of toxic ionic and non-ionic substances plays a key role. Substances that harm the environment can be collected on exchangers and adsorbers and thus reliably removed from the water. This ensures that only water that has largely been freed of pollutants is discharged into the environment.

LEWATIT® SUPPORTS BIOTECHNOLOGY.

The processing of biotechnologically produced active ingredients and formulations of pharmaceutical active ingredients makes very high demands on the material used for separation.

The concentration of valuable substances by adsorption and desorption has proved to be an important field of application for Lewatit® just as has selective chromatographic separation and polishing. Another potential application in biotechnology and pharmacy: Enzymes can be immobilized exceptionally well with Lewatit®.



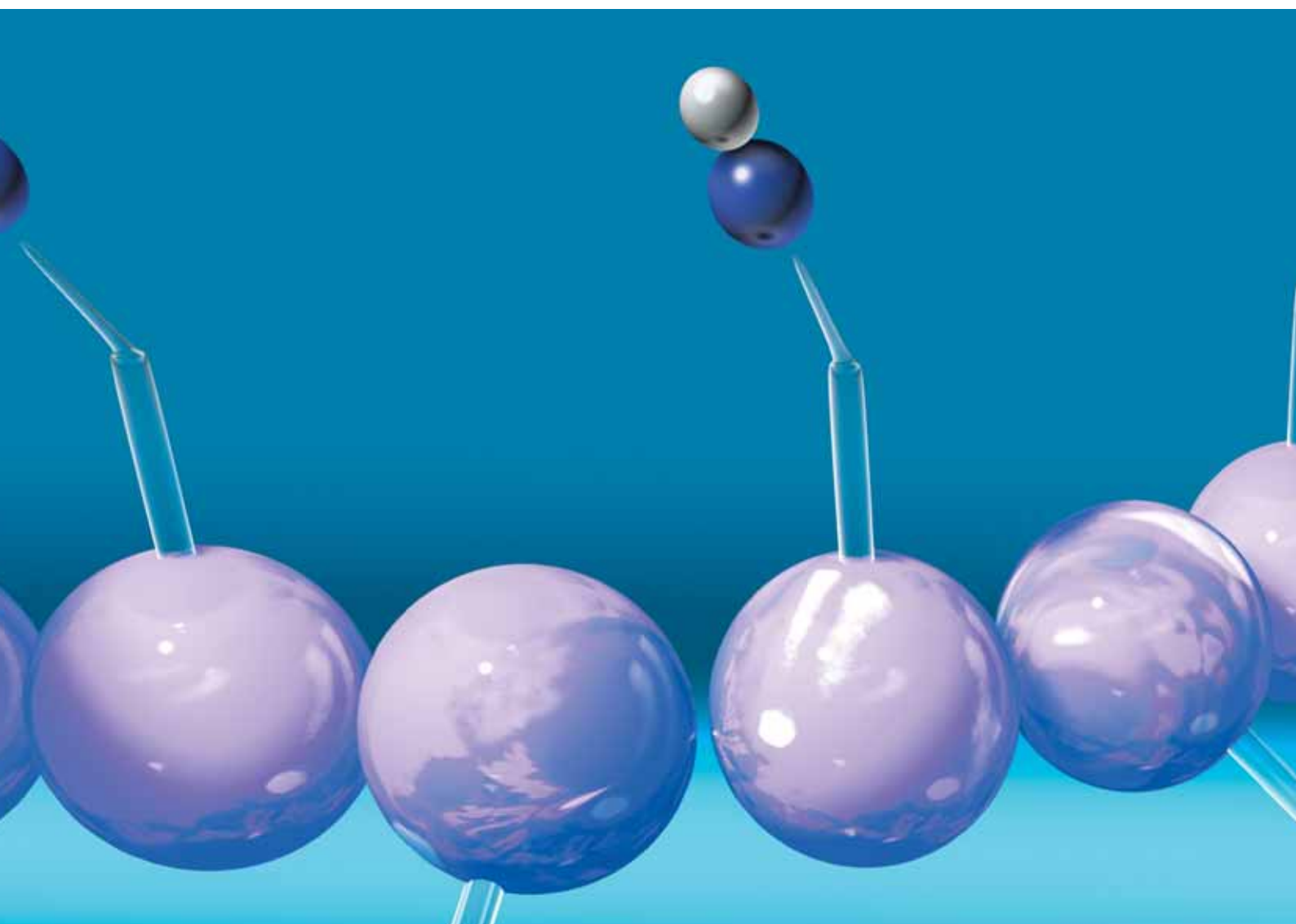
Production processes in the pharmaceutical industry and catalysis in chemical operations –



two interesting fields in which the Lewatit® team is working on new developments.

ION EXCHANGE – IN PRINCIPLE, SIMPLE.

Separation and concentration are two of the most fundamental operations in the chemical industry. Depending on the particular application, the scope and level of difficulty of the task can vary considerably: Solids can be separated relatively easily by filtration. When isolating components dissolved in liquids (ions = cations and anions), on the other hand, ion exchange resins are needed. In such applications, it is essential to have detailed chemical knowledge of possible reactions with the ion exchange resins and any other interactions.



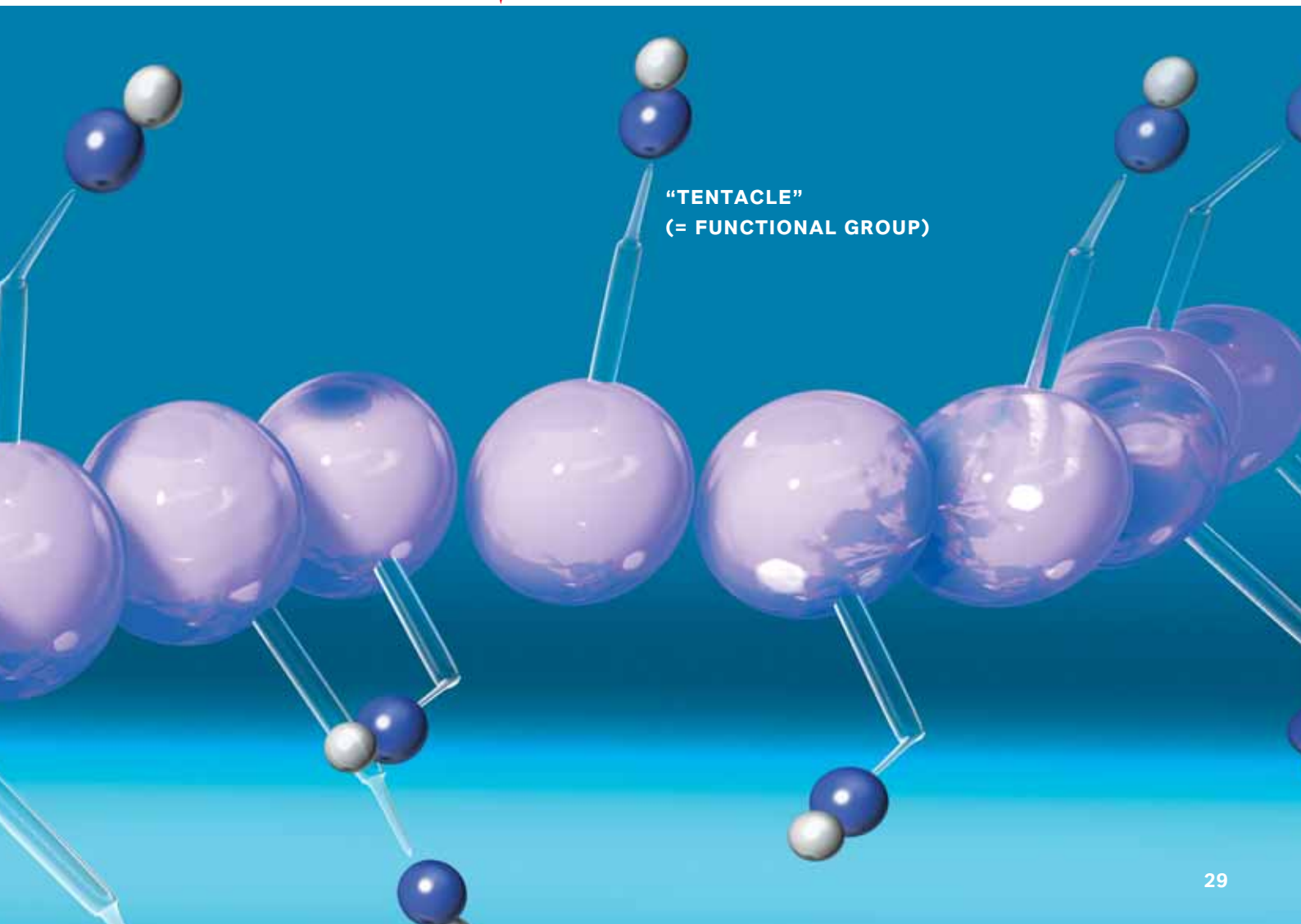
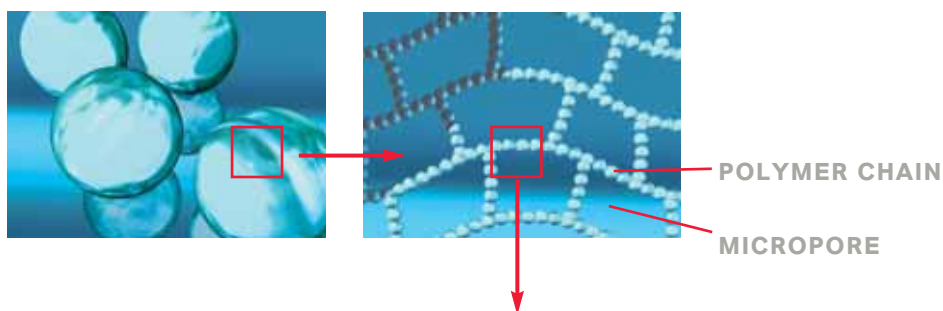


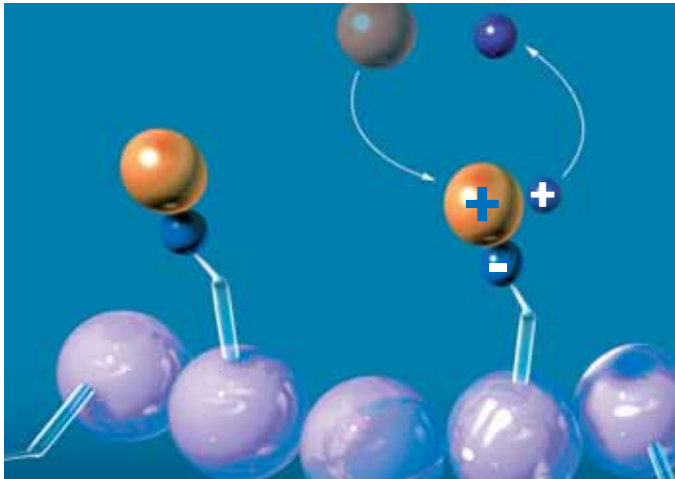
POLYMER BEADS WITH TENTACLES.

Lewatit® chemists produce ion exchange resins by combining styrene-acrylonitrile with divinylbenzene – intermediate products from the oil-processing industry. The structure of these tiny polymer beads is similar to that of a ball of wool. In this case, however, it is not a single thread but numerous individual polymer filaments. They combine to form a finely branched network with many cavities. The surfaces of all the polymer filaments are specifically manipulated by the chemists through the application of certain functional groups. These chemical

substances, which adsorb anions or cations and exchange them for other ions, function like tentacles. Depending on the nature of the functional groups – i.e. the tentacles on the surface of the filaments – a wide variety of components can be captured from the solution.

The Lewatit® product range contains a number of ion exchange resins, adsorbers and functional polymers that feature a structure such as this and operate by this kind of functional principle.

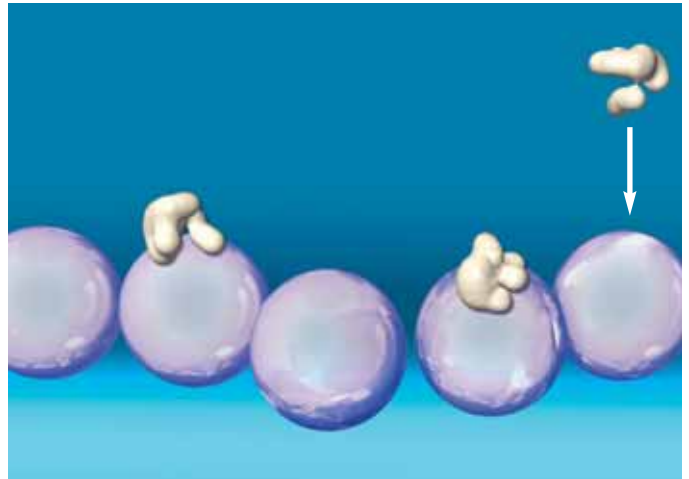




NEGATIVE CATCHES POSITIVE, POSITIVE CATCHES NEGATIVE.

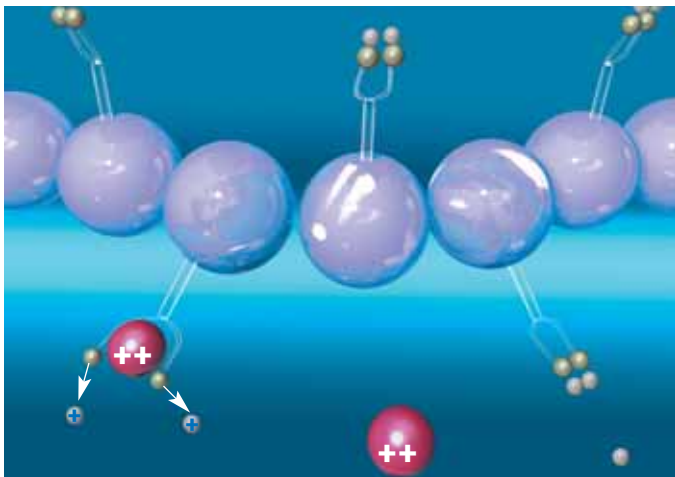
If the functional groups carry a negative charge, they exchange cations (positively charged ions). This works through the undesirable cation being replaced by the desired one. The resins involved are cation exchange resins.

The other variation is anion exchange resins, where functional groups with a positive charge replace anions (negatively charged ions) by the same principle.



ADSORBING MOLECULES, PURIFYING THE ACTIVE INGREDIENT.

If the resin beads are left “unfunctionalized”, use can be made of their surface and porosity to adsorb a variety of substances. With these Lewatit® adsorbers, for example, pharmaceutical active ingredients can be isolated and purified.



CHELATING AGENTS FOR METAL.

If chelating agents (from the Greek “chala” = crab) are applied to the surface of the polymer beads, clawed tentacles catch metal ions from the solution (like a crab that catches its victim with its claws). Depending on the particular chelating agent and the application conditions, a specific metal ion or an exactly definable group of different metal ions is surrounded and isolated.

REGENERATION.

The period of service of ion exchange resins is not infinite: The capacity of the resins is exhausted when the majority of the tentacles of the functional groups are full of “captured” ions/molecules. This means that the ion exchange resins have to be regenerated (cleaned). The beads are returned to their original state and reactivated by displacing the ions/molecules adsorbed during operation by the same functional groups that had been applied to the surface before service. Regeneration can be performed as often as necessary, although the capacity (the number of free tentacles) of the ion exchange resins decreases over the course of time.



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