

# Moving Closer to Customers

In different industries, liquid-liquid extraction is an important process step. Quite often, tests and product demonstrations are necessary to assure the process solution. Such demonstrations are performed in Sulzer's test center in Allschwil, Switzerland, or with rental equipment at customer's sites. In Asia, Sulzer now provides rental equipment locally for liquid-liquid extraction. This offering triggered immediate customer interest.



1 Rental equipment in use at a customer's site.

## Industries that use liquid-liquid extraction

Liquid-liquid extraction is used in many applications in different industries. Typical examples are the separation of aromatics from hydrocarbon streams in the petrochemical industry, or the removal of phenol from wastewater in the general industry. Further applications are the wet purification of phosphoric acid for the food industry, the separation of metals in hydrometallurgy, or the washing and purification of monomers. Also in the pharmaceutical industry, many active pharmaceutical ingredients (API) are recovered by this process, which can be operated at ambient temperature for those often heat-sensitive substances. The basis of liquid-liquid extraction is the different solubility of the individual components of a mixture in an additional solvent.



Petrochemical industry



Plastics industry



Pharmaceutical industry



Food industry



Metal industry

Liquid-liquid extraction is a unit operation: Two immiscible liquids are brought into contact and the dissolved components of the mixture distribute themselves between the two liquid phases. The key to an efficient process is to choose the right equipment to first thoroughly contact the two liquids. The second step is then to separate them from each other. Liquid-liquid extraction is found in hydrometallurgy, refinery, petrochemical, and chemical operations. Typical applications are purification of process streams and wastewater treatment. Sulzer provides proprietary equipment for liquid-liquid extraction, the agitated Kühni™ ECR extraction column, the ECP packed extraction column, and EMS as well as ECMS mixer-settlers. As opposed to the design of distillation equipment, the reliable design of such extraction equipment cannot be based on a process simulation alone. Pilot trials are always necessary.

### How Sulzer conducts pilot trials

The pilot trials are divided into two steps:

1. Laboratory scale test to measure the distribution of the chemicals in the two liquid phases at equilibrium (so-called “shaking test”).
2. Pilot scale column trials to collect the scale-up data for the industrial scale column.

Often, clients can conduct the laboratory scale shaking tests independently in their own laboratory. The most important part is the analysis of the composition of the mixture. If the client has the analytical equipment and methods in place, the mixing and settling can be documented by photos or videos.

For the scale-up of the column, the separation performance of a pilot scale column with 60 mm and sometimes 150 mm diameter must be measured. Such trials require much more effort, planning, and installation than a simple bench scale shaking test. The extraction column needs to be installed. Additional auxiliary equipment has to be connected. Accurate process control is important for successful trials. Fig. 2 shows the installation of the pilot column at a client's site in Asia. The control system of the installation on the computer is presented in Fig. 3. Operating such a complex installation requires experience and in-depth understanding of the process itself, the hardware, and the control system. Therefore, it is preferable to conduct the pilot trials at the Sulzer test center in Allschwil. The feed material for the tests is shipped from the client's site to the Sulzer test center, where all equipment is set up and an experienced team conducts the tests. Unfortunately, this approach is not always feasible. Sometimes the

“The pilot tests on site demonstrated to us the superiority of the extraction technology. The operation parameters provided valuable information to have a smooth commissioning. The capability and strong commitment of the engineers onsite convinced us of the reliability of Sulzer. We definitely benefit from the two columns we have purchased.” **Jeong Dae Seong, General Manager for project TFT from Kumho Mitsui Chemical Inc., South Korea**

transportation of the feed material is not possible because the material is unstable and could degrade during transportation. The toxicity might be too high or there may be regulations in force that prohibit the export of the material from the country of origin.

### On-site trials in Asia

If the feed material cannot be brought to the pilot plant, the pilot plant has to be brought to the feed material. Even if a liquid-liquid extraction column does not involve evaporation, condensation, or vacuum, a full installation requires a substantial amount of equipment. The transportation and customs clearance to a client's side in, e.g., China or Southeast Asia is time-consuming and expensive.

To facilitate on-site pilot trials in those locations, Sulzer decided to establish a strong local setup. In Singapore and Shanghai, both equipment and personnel are now available for on-site pilot trials. A senior process engineer from Singapore relocated to Allschwil, Switzerland, and an extensive on-the-job training took place to transfer the expertise about and around pilot testing.

### Mobile liquid-liquid extraction column

The team developed a concept of a mobile liquid-liquid extraction pilot unit. This mobile unit consists of a liquid-liquid extraction column, a pump rack (with mass flow meter and control valve), a process control system, and a computer (see Fig. 3). These systems enable Sulzer to carry out pilot tests at customer plant sites with trained personnel from Sulzer. Two pilot plants were assembled and tested in house in Allschwil and sent to Singapore and Shanghai. From these bases in Asia, the pilot plants are rented to clients in the region along with on-site assistance and engineering service by local Sulzer engineers.

### Pilot trials at customer's site

Setting up a pilot trial on site involves some challenges that are not involved with an in-house pilot trial. Because of a lack of space at the customer site, pilot trials are quite often carried out outdoors. The engineers have to cope with sudden rain or intense sunlight. Every trial needs an inspection beforehand. Safety is the top priority; therefore, the suitability of the test site for a pilot plant needs to be discussed with the customer before setting it up. Proper installation of the equipment is required to ensure good results for proper scale-up. Having trained specialists in Singapore eases communication with our customers and enables faster service to the regional market. In addition to the direct use of the test rigs for customer trials, the transfer of know-how and experience takes place with training courses at Sulzer sites in Singapore or Shanghai.

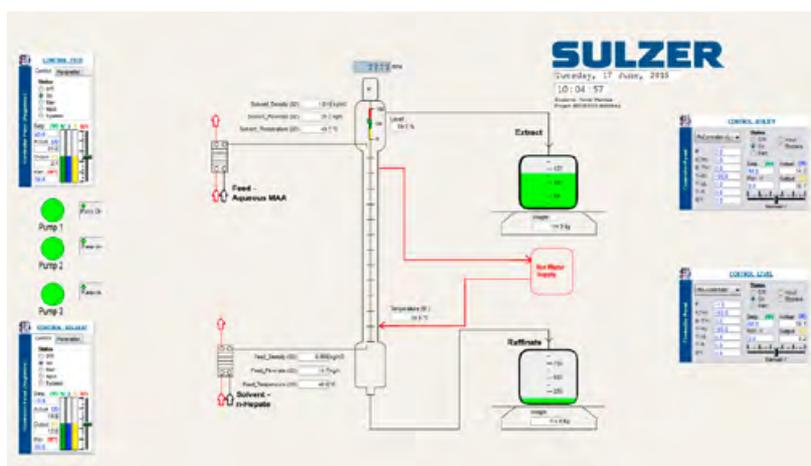
### Success in a challenging market

So far, Sulzer has carried out five pilot trials in Southeast Asia and China with good results. In consequence, the customers ordered a total of six liquid-liquid extraction columns with a diameter ranging from 1 500 mm to 2 500 mm. These projects often include distillation units for solvent recovery. Sulzer offers packages with complete, engineered solutions for the integrated process. Currently several new liquid-liquid extraction pilot trials are ongoing in Asia. Sulzer was able to provide qualified expertise on site, to prove the performance with pilot trials at the customer's facility, and to manufacture the equipment locally. All of these have contributed to the successful sales effort.

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2 Pilot plant installation at the client's site in South Korea.



3 Setup screen of the control system.