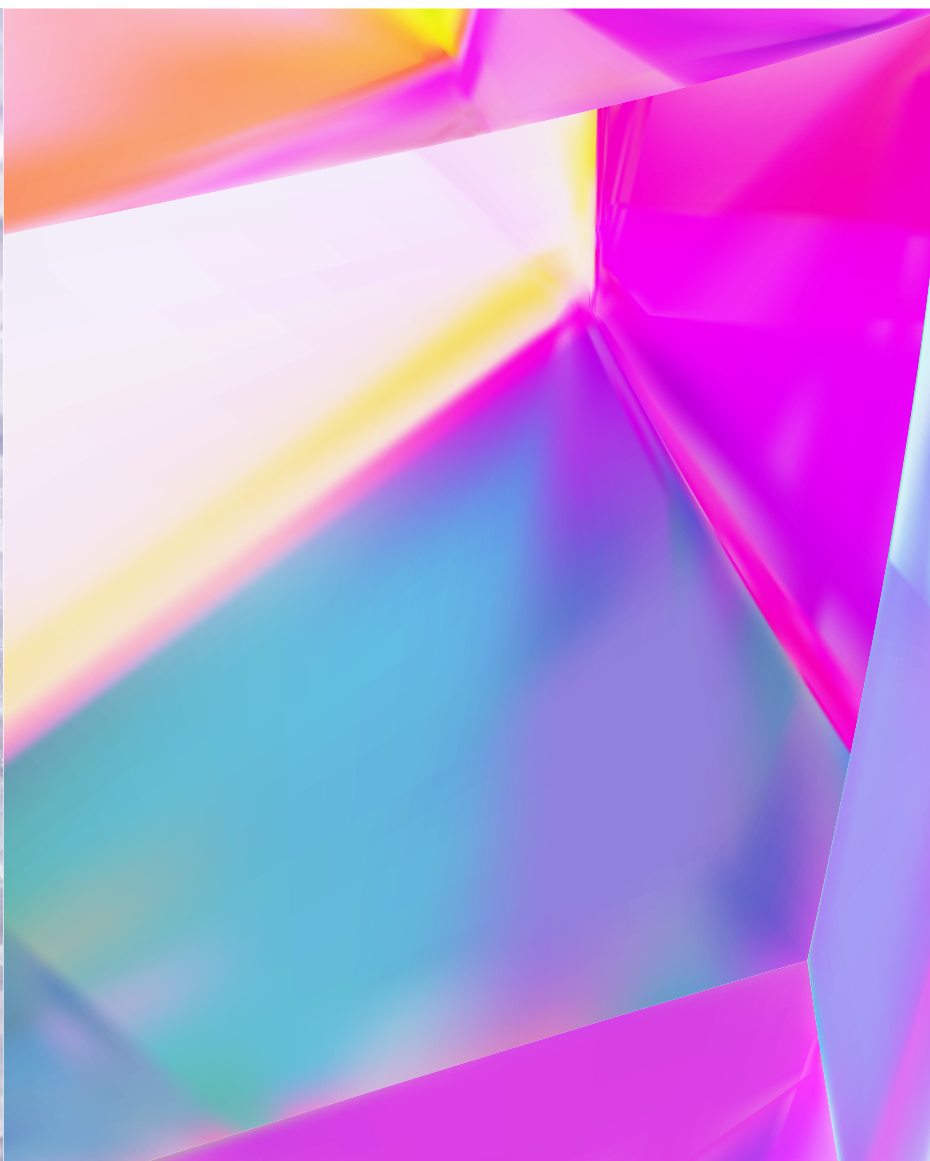


**SULZER**

Fractional crystallization

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# Crystal clear purification solutions



# Why crystallization? Why Sulzer?

Driven by the need to reduce energy consumption and to cope with new feedstocks, the chemical industry is striving to more and more improve process efficiency. Whether it's oil-based, bio-based or from recycling streams, Sulzer develops the right purification solutions to address the market requirements.

## The benefits of crystallization



It makes the purification of close boilers possible when other technologies fail – therefore allowing ultra-high purities even when impurities are challenging



It drastically reduces the thermal stress applied to the product – therefore minimizing oligomerization or degradation and/or significantly increasing operation safety



It is a solvent and emission free technology



It is operation friendly and maintenance free (layer crystallization)



It reduces energy consumption because for organics, latent heat of solidification is 3 – 6 times lower than latent heat of vaporization

## The benefits of working with us



Because we offer 3 different crystallization technologies (static crystallization, falling film crystallization and suspension crystallization) thus always ensuring the customer gets the best option for the given conditions without compromising on quality or recovery yield



Because our technologies is inherently safe and come with a proven track record of successfully implemented industrial projects



Because our product database, and lab/piloting capabilities, ensure the customer a reduced time to market



Because you have access to our unrivaled worldwide network of expertise, not only for crystallization but also for distillation and other mass transfer technologies

## We care about the market

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50+

years of expertise

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300+

products tested in our labs

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80+

melt crystallization plants commissioned worldwide in the last 20 years

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# Less than 24 months from lab to market for a new application

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For a premier Chinese producer of food additives we developed a brand-new application for the purification of benzyl benzoate. This enabled them to improve their operational excellence and help them meet the increasing market requirements.

Technical Director at Wuhan Youji comments:

“We are extremely happy with the solution delivered by Sulzer. Not only were they able to greatly simplify our existing process, improving efficiency and resource use, but they also helped us to enhance the quality of our product. Sulzer has been a very reliable partner and we look forward to collaborating again in a near future.”

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Two benzoic acid falling film crystallizers at the Wuhan Youji plant



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Product ready for the market



# What role does Sulzer crystallization play in industrial-scale bioplastics and biomaterials processing?



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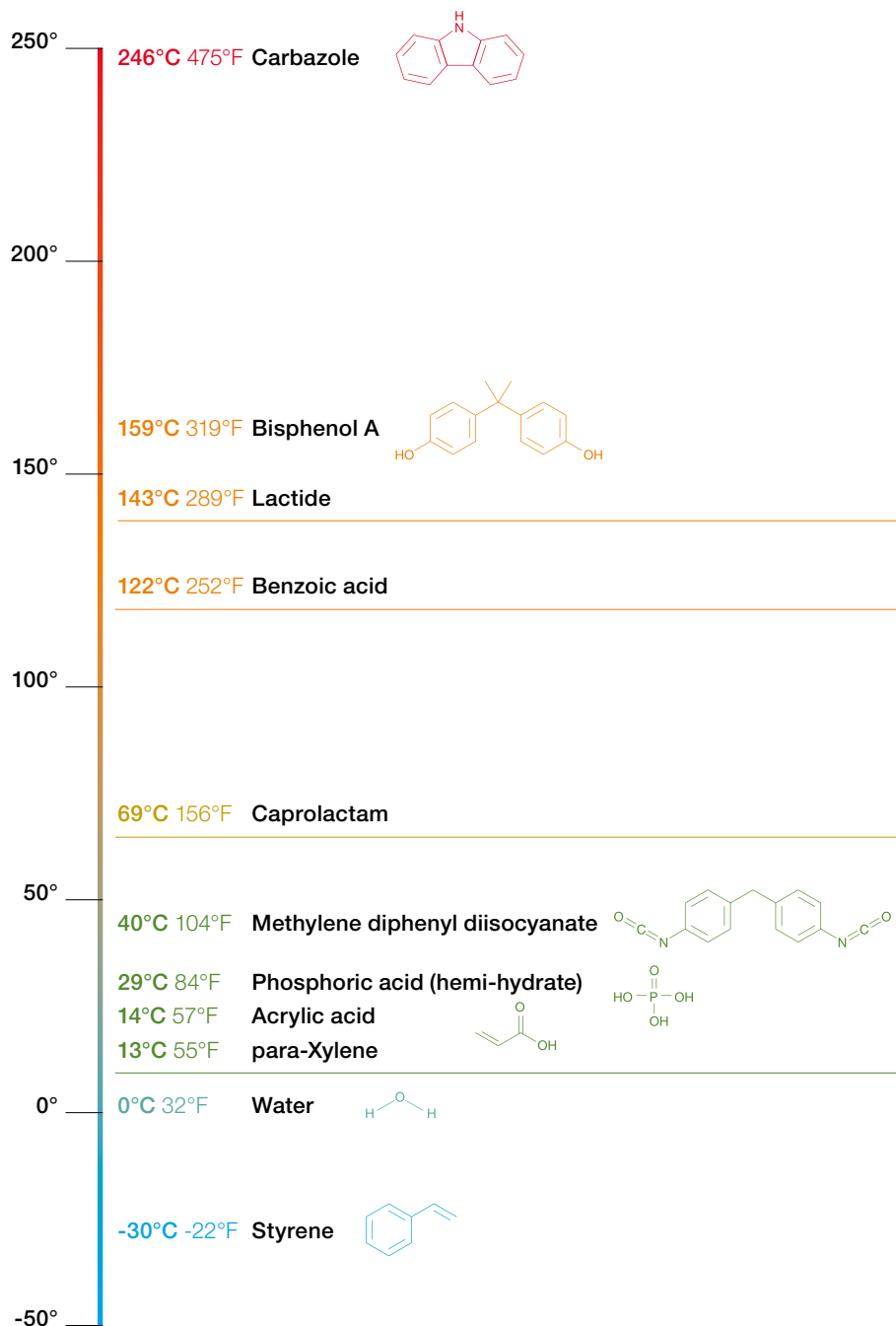
Quoted from "Chemical Engineering Magazine", 03/2021

"The nature of bio-based materials makes their separation especially challenging, which is why a hybrid solution is often necessary. The impurity profile found in fermentation mixtures are often complex. Furthermore, biomaterials mixtures tend to have components with similar boiling points, so their separation via distillation requires a great deal of energy input. These materials are also heat sensitive and can

undergo undesirable reaction, such polymerization or thermal degradation. Therefore, separation process that operates at low temperatures, such as crystallization, is preferred. Beyond offering high-purity products without the risk of thermal degradations, crystallization also decreases energy and solvent requirements, improving the overall sustainability profile for the separation process."

# We bring new applications to the market every year

Melt crystallization industrial units have also been built for the purification of: benzyl benzoate, fatty acids, hydrazine, isopulegol, monochloroacetic acid, naphthalene, orthophenyl phenol, para-cresol, paraffin, para nitrochlorobenzene, paraphenylenediamine, etc.



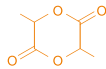


Bisphenol A plant



Acrylic acid plant

Back in the 90's Sulzer pioneered the crystallization of lactide and is now able to offer industrially proven solutions for the purification of all isomers (L-, D- and meso-lactide)



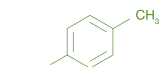
Benzoic acid is partly used as an intermediate for food applications and Sulzer's falling film crystallization purification process meets the extremely stringent 99.99wt% market requirement without compromising on the recovery yield.



Caprolactam can advantageously be reclaimed from used Nylon 6 fibers through proven recycling processes. Falling film crystallization is key to bringing the quality of recycled caprolactam back to the highest standard. Similarly, melt crystallization can be used for purification of DMT reclaimed from chemical recycling of PET (methanolysis).



Traditionally extracted from fossil-based feedstocks (coal and oil), paraxylene is now also available from bio-based feedstock. Sulzer crystallization is successful in overcoming the challenges brought by the different impurities' cocktails.



# How does crystallization work?

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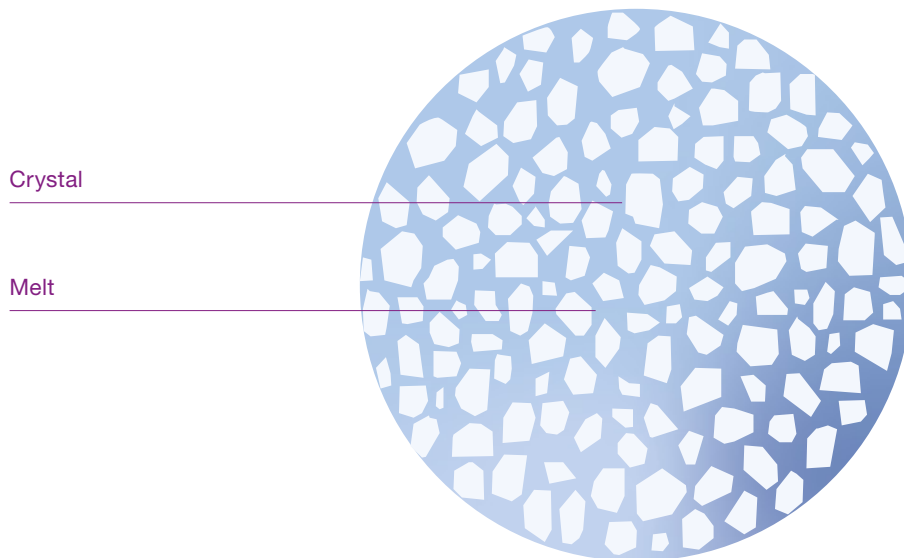
Industrial crystallization features generation of crystals by nucleation, crystal growth and the recovery of crystals from residual mother liquor. Both generation and recovery of crystals can be performed either from suspension or through a crystal layer.

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## Crystallization in suspension

With this technique, the melt is cooled below saturation temperature. Nuclei are suspended in the melt and crystal growth is maintained at a low rate by controlling the supersaturation driving force, therefore drastically improving the separation efficiency. Since the product from suspension crystallization is a

slurry, the separation of residual mother liquor from the solid phase crystals is carried out in a Sulzer proprietary wash column. This device allows not only the solid/liquid separation but also a back washing of the crystals with the purified product, therefore significantly improving the separation efficiency.





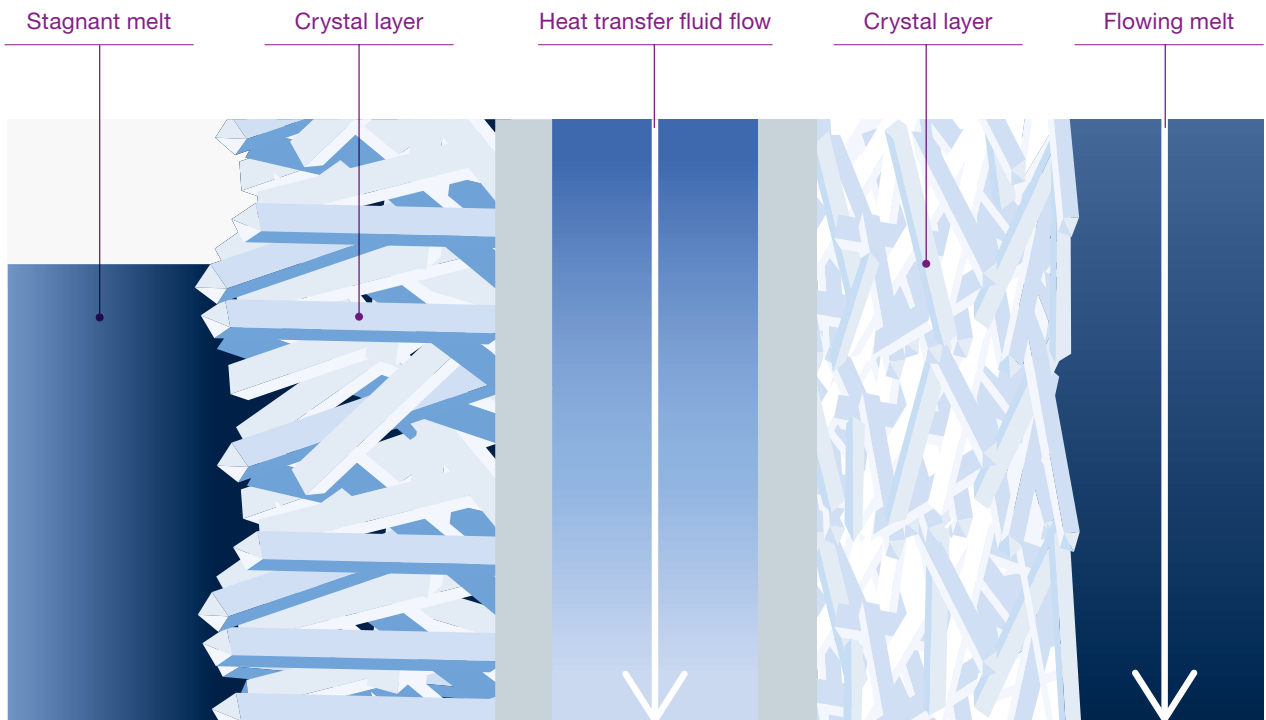
Sulzer offers the 3 mentioned crystallization technologies and will select the most appropriate one or the best combination thereof based on:

- > Thermodynamic characteristics of the product
- > Purity and recovery yield requirements
- > Capacity
- > Space available for installation

## Layer crystallization

Crystals are allowed to grow directly onto a cooled surface in such a way that cooling is supplied through the crystal layer. The driving force results from the net effect of temperature and concentration

gradients across both solid and liquid phase. Layer crystallization can be performed either in a static or falling film way.



### Static crystallization

Crystals are grown onto the cooling surface from a stagnant melt.

### Falling film crystallization

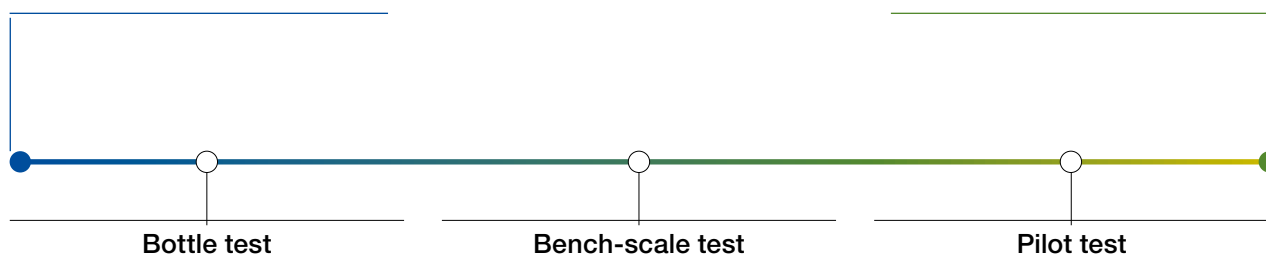
The melt is circulated downward the cooling surface where product crystallizes.

# Your project journey with Sulzer

## The first steps

From your idea

To your customized crystallization solution



Fast and easy feasibility test performed with standard laboratory glassware to give a preliminary evaluation on the ability of melt crystallization to purify your product.



Test performed with reduced product inventory (2 – 20kg) to generate preliminary process design information. The data generated will allow you to initiate and assess your business case.



Test requiring higher product inventory (100 – 800kg) performed using pilot units engineered with full-scale heat/mass transfer elements. The scaling up of the data collected during the test will allow you to get a detailed proposal which includes a preliminary process flow diagram, an equipment list and plant performance data.

In addition, test samples are provided to be analyzed in your lab: you have full control on the methods and reproducibility of the results.

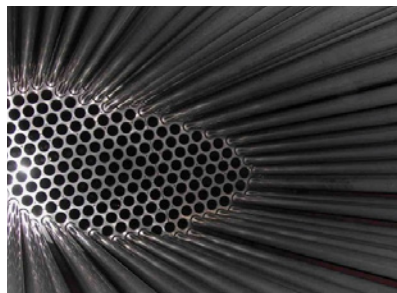
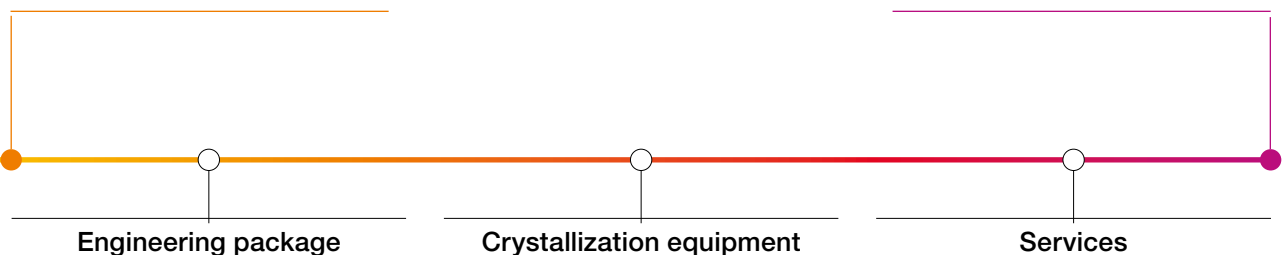
# Your project journey with Sulzer

## The idea becomes reality

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From your customized crystallization solution

To the market



Sulzer will provide you with a comprehensive set of basic engineering documentation. This engineering package will contain all the process relevant information which will allow you or your subcontractors to take the project to the next engineering step and build a state-of-the-art industrial unit.

We can also be your partner for globally integrated solutions. Thanks to our broad expertise in the field of mass transfer processes, we can deliver a package combining different Sulzer technologies (as for example distillation and crystallization).

Our proprietary crystallization equipment, whether for static, falling film or suspension crystallization, is the result of decades of accumulated experiences and continuous improvement. Our equipment is at the forefront of the crystallization technology and is specifically designed, and tailor made to withstand the most stringent operating conditions while achieving the best possible process performances. Robustness and reduced maintenance costs over an extended lifetime will allow you to maximize your profits.

In some cases, we can offer plug and play solutions by providing you with skid mounted units which will help to reduce delivery time and your site expenditures.

Our team will assist you at the key milestones throughout the execution of your project. In coordination with your project team we will organize engineering reviews, control system as well as mechanical checks and of course be at your side for the commissioning and operation optimization of the crystallization unit.

**The Chemtech division is the global market leader in innovative mass transfer, static mixing and polymer solutions for petrochemicals, refining and LNG.**

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Chemtech is also leading the way in ecological solutions such as biopolymers as well as textile and plastic recycling, contributing to a circular economy. Our product offering ranges from technology licensing to process components all the way to complete separation process plants. Customer support ranges from engineering and field services to tray and packing installation, tower maintenance, welding and plant turnaround projects – ensuring minimal downtime.

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