

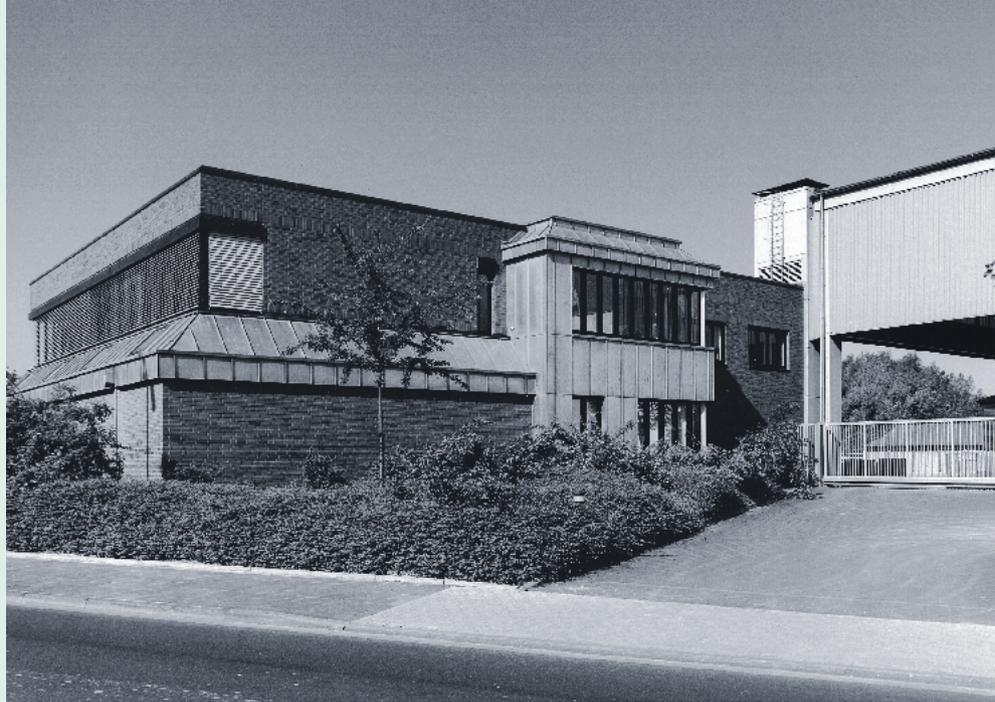
Research and
Test Centre -
Customized solutions
to process technology

Lödige Test Centre

We may know all kinds of things about the future, but we cannot anticipate today what we shall know only tomorrow.

Sir Karl Popper

You have good reason to use our Test Centre. It provides full potential to look ahead in your future products and processes. And to set new or better ways if this is worth it.



Product and Process Development

You develop new products not only based on new recipes and new components, but probably requiring new processes. Prior to investment in production units you need of course certainty about your new products to ensure economic production with regard to production scale and required quality. For this purpose you need to produce samples made of original raw materials using the same systems and according to the same process in a batch size which ensures scale-up to production machine sizes.

Stepwise scale-up from the smallest scale using laboratory machines up to pilot machines is performed to test

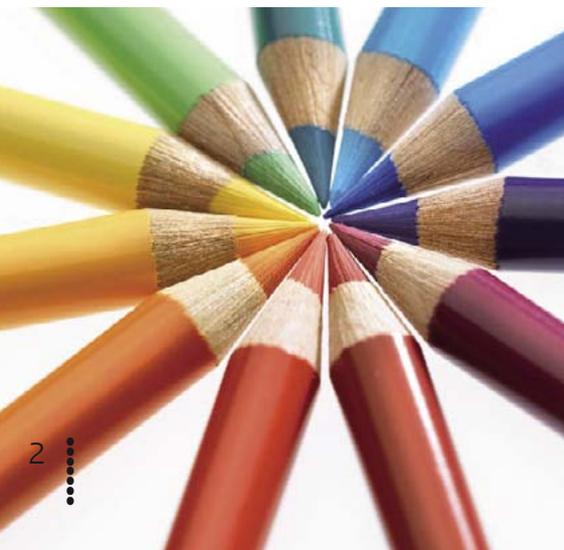
the operation of the process and to enable further analysis of the required end product.

In doing so the Lödige Test Centre provides optimal service: it is equipped with small scale machines and with pilot machines to ensure reliable scale-up to batch production machine sizes up to 55000 l.

All processes are built up upon a combination of the various basic physical and chemical operations and their effects can be examined either individually or in combination with each other. It is therefore decisive for us to be informed about all characteristics of the raw materials

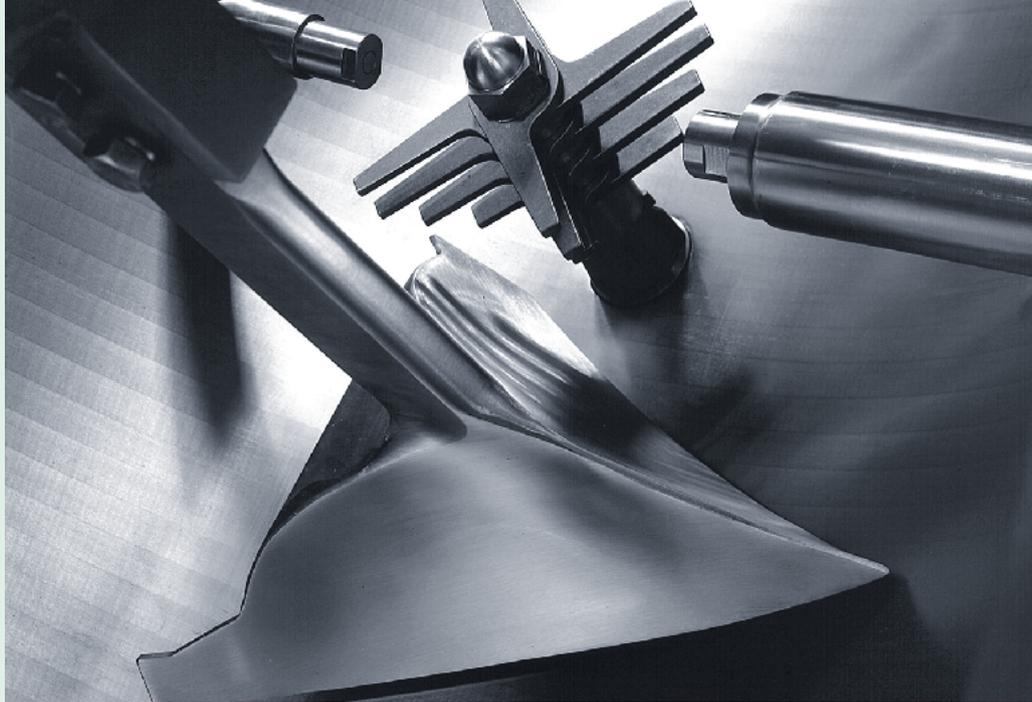
to allow for planning production units and tests. While planning the process a description of the required quality of the end product is as important as the description of unwanted characteristics.

You will find the basic process operations described below as guidance. Main focus is made on the processes achievable by the machines available in our Test Centre.



Basic operations of process technology

To better understand the production processes with regard to technology, they must be divided into their individual basic operations in order to get a feeling for the influence of each individual basic operation on the overall process.



Mixing

The term of "mixing" is understood to be the specific combination of at least two products under the introduction of energy to form a mix with best possible homogeneous distribution.

If the products are made up of individual particles, then a certain free space must exist around these particles to allow for their spacial interaction. This free space either is present above the product or is generated in the mixing system by loosening up of the product. The mixing steps are characterised by the presence of individual physical states whereby we basically summarize two main states. In simple terms this results in the following combinations:

- solid - solid;**
- solid - liquid;**
- solid - gaseous;**
- liquid - liquid;**
- liquid - gaseous.**

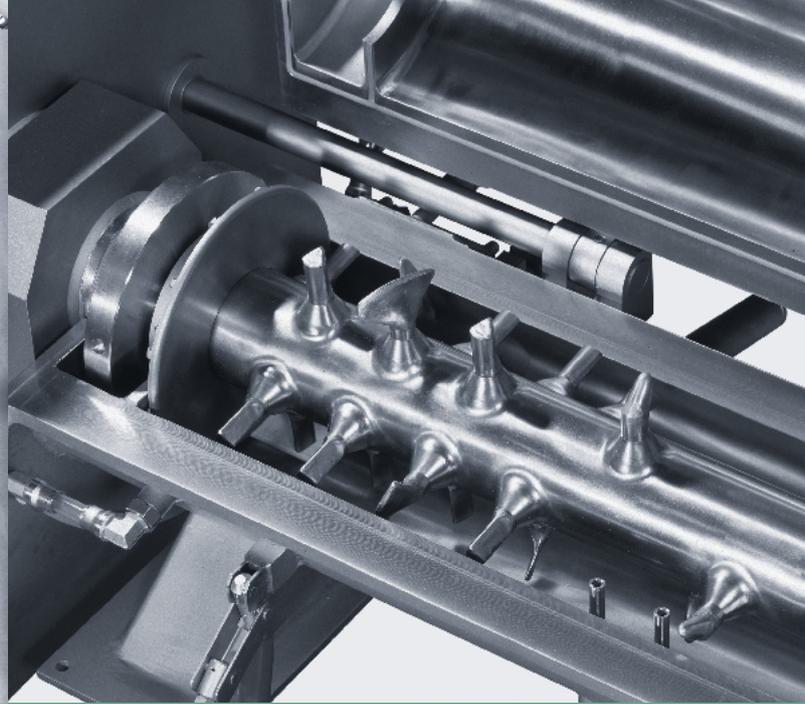
Mixers which actively set the product into motion are classified in two types: tumbling mixers and forced mixers. The forced mixers are available in two types of construction: horizontal and vertical mixers.

Horizontal mixers have a horizontal shaft fitted with tools producing a loosened product bed up to a mechanically generated fluid bed depending on the product movement.

Vertical mixers have a vertical shaft; the product movement produces a so-called product vortex.

Horizontal mixers can be used for batch and continuous processes due to the generated product flow.





Granulation

The term of "agglomeration" or "granulation" is understood to be the bonding of fine particles to form coarse particles in a gaseous or liquid environment whereby the formed granulate displays the presence of smaller or larger voids.

In most cases the surface of the particles are moistened with liquids or binding agents whilst the granulate is being formed. The particles then stick together during subsequent drying forming bridges between the particles. The granulating liquid may consist of a melt which - after moistening the particle surfaces - displays binding properties by forming bridges during cooling down. This process may be performed in a forced mixer while benefiting from the

homogenizing effect. Afterwards, drying is usually necessary in a further process step downstream to be performed in a separate system. Using the knowledge of the recipes and the required granulation times, the same process can also be run in a continuous system for the corresponding product capacity.

Agglomeration steps are also possible in a fluid bed process where the liquid is sprayed onto an intensively mixed up product bed and dried at the same time.

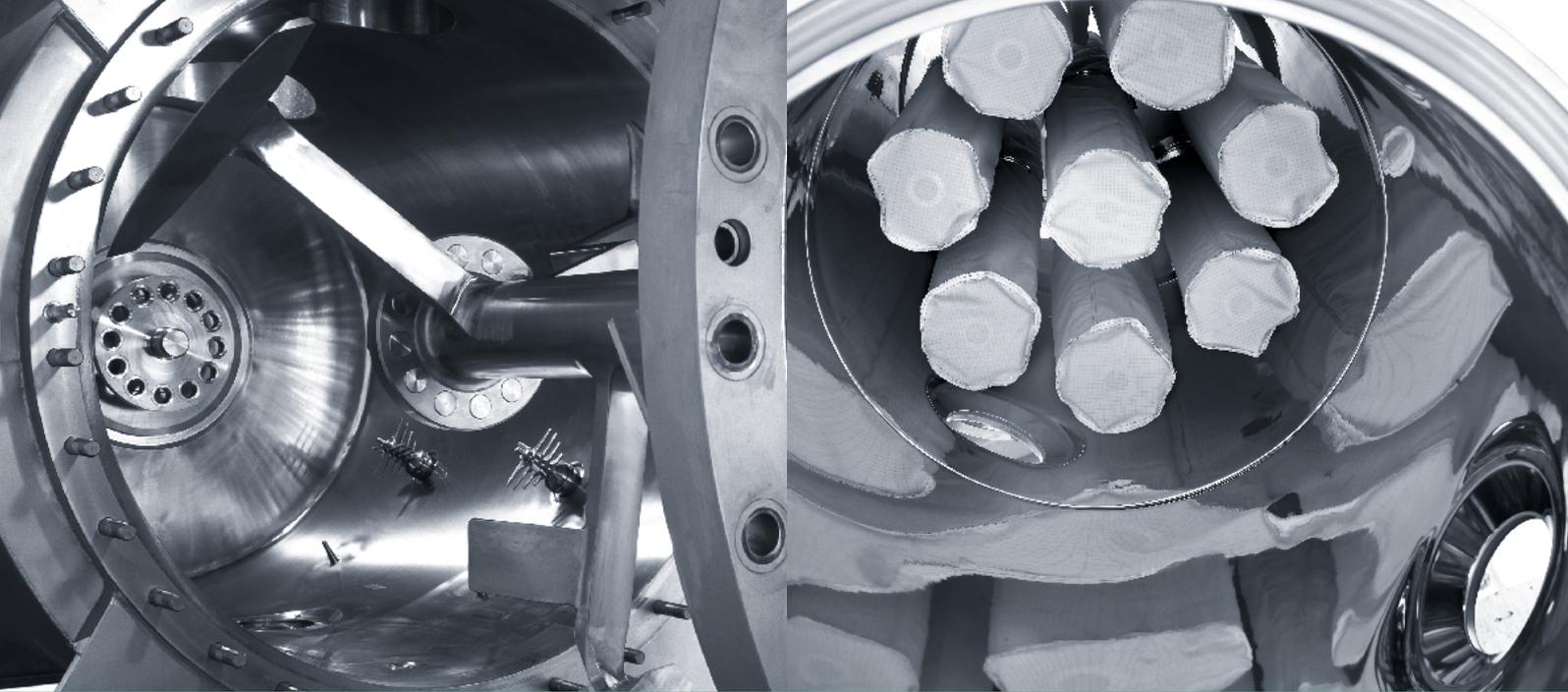
This type of process usually generates low-density and light agglomerates compared to those achieved in mixing granulators.

Reaction

Because of the excellent mass transfer characteristics created by the mixing movement, horizontal mixers are particularly suitable for reactions and syntheses. When the input materials are dry, it is obvious that the conversion should be done in a dry and semi-humid atmosphere. The degree of conversion is dependent upon the operating conditions of the machine, namely that of the temperature and pressure. Organic pigments can thus be directly produced avoiding a round-about way via suspensions.

Cellulose derivatives are also produced in this way. Polymerisation, too, can be performed. One advantage of the horizontal mixer is that it is less sensitive to changes of state than a vertical mixer.





Drying

Drying is the process of separating liquid components from dry materials by addition of energy in order to either recover the dried product as a valuable material or to regain the solvent for re-use in a new process. In doing so the solvent can be directly fractionated. A maximum product temperature must be often observed during the process to ensure product quality.

This is the reason why sensitive products are dried under vacuum and at reduced evaporation temperatures.

An extreme example for such a process at low temperature is the freeze drying.

Under normal pressure, the drying speed can be increased by injecting heated air onto the product bed.

Drying can be efficiently performed in forced mixers: not only the mixing of particles is achieved rapidly but also the development of temperature and moisture gradients in the product is prevented thanks to the intensive product movement and the efficient heat exchange between product and wall. So-called hot spots cannot develop in the product or on the wall.

Fluid bed technology generally achieves efficient drying processes under normal pressure. In this case, the air introduced keeps the product in motion and ensures heat transfer.

Usual energy carriers to operate the heating jacket with are hot water, steam or thermo oil. As described

before, heated air can also be used to introduce heating energy directly into the product. Saturated steam or overheated steam can also be applied. A further possibility is to use microwave energy generated in the machine.

In many cases the drying process can also be carried out in a continuous machine provided that all process parameters are available for effective planning.





Emulsifying

The combination of hydrophilic and hydrophobic phases to form a stable homogeneous mix e.g. pastes, creams or lotions is mainly performed by subjecting the individual components to high shear in rotor stator systems.

The recipe components are roughly pre-mixed in a storage tank and pumped through a suitable emulsifying system.

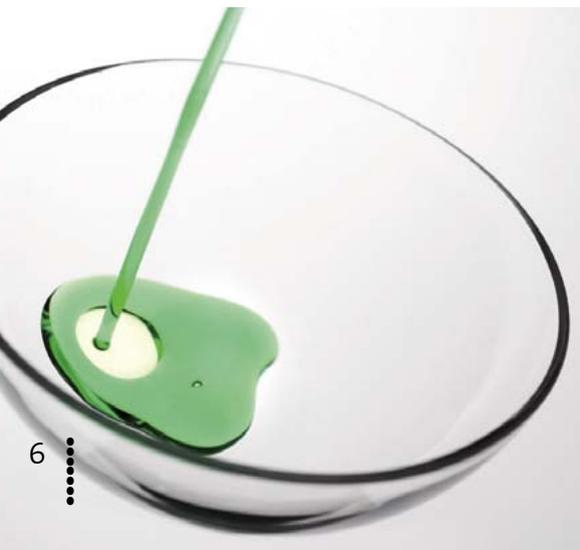
Coating

In many applications the surfaces of particles of the most different sizes and shapes must be coated for various reasons.

The bigger the particles are, the more sensitive they generally are against breakage and abrasion. The process control and the right machine must therefore be selected with great care.

Powders can be easily coated in forced mixers, but a drum coating system is better suited to coating bigger particles like pellets or tablets.

For example solutions or melts can be used as coating agents. The solvent must be evaporated subsequently or the product must be cooled to solidifying the coating agent. This can be performed in two steps with separate melts and subsequent drying or by simultaneous coating and drying.





Empirical

All basic operations previously described require tests to be carried out on scale-up compliant machines to ensure safe planning of the whole process. Based on the data gained during the tests and our practice-proven know-know, we are then able to design and fabricate production units.

Recording test data with suitable programmes assists in performing a thorough analysis of the process.

Statements can be made with regard to the achievable product quality and production performance.

In this way we have the possibility to accommodate contractual warranties.

Process Optimisation

We not only provide product development for new products but also optimisation of current production processes.

Routine over several years – not to mention having a tunnel vision – sometimes mask the route to easy and rapid solutions. Fresh ideas from other sources may help to overcome a mental block.

Contact us for advice. We will be pleased to visit you on site, too.

Small scale production for evaluation purpose

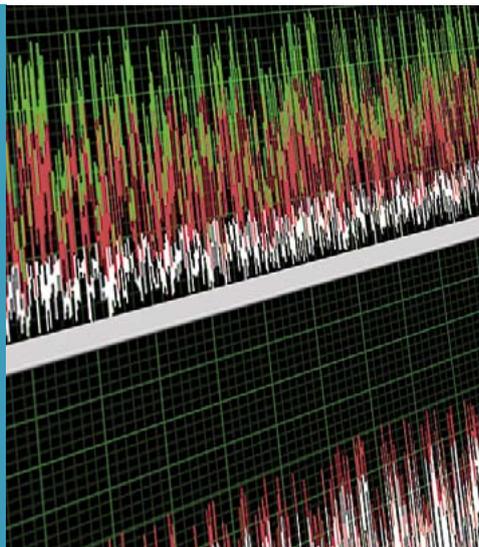
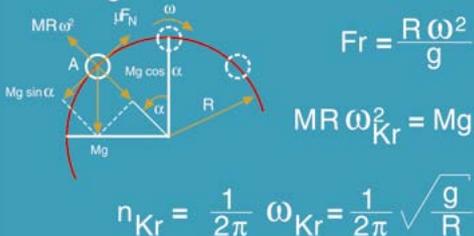
We shall be pleased to perform the sampling of new products on your behalf as far as possible.

Please contact us should you require several batches, for example for your sales preparation or for clinical samples.

We would be pleased to submit a quotation for this purpose.

Lödige Test Centre – The key to success

Order principle in rotating systems according to the Froude number



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PROCESS TECHNOLOGY



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