LÖDIGE
PROCESS TECHNOLOGY

System Solutions for the Food Industry

LÖDIGE – ALWAYS THE RIGHT MIX

Food Industry – Guarantee for Healthy and Safe Nutrition

Product-specific process design ensures innovations, efficiency and quality in a rapidly growing industry

Combined processes

In addition to the classical process step of mixing, it is also technologically possible to combine all additional processing steps usually required by the food industry in a single Lödige Mixer.
This means, for example, that work intensive premixing is unnecessary.

- Alkalinization
- Fat intermixing
- Moistening / Coating
- Conching
- Emulsifying
- Heating
- Homogenization
- Iodizing
- Crystallization
- Cooling
- Lecithinizing
- Mixing / granulating
- Pasteurizing
- Fusion granulating
- Sterilization
- Drying
- Coating
- Compacting
- Fluidizing

... and many more

Foodstuffs are the „resources for sustaining life“

As the old adage goes: „you are what you eat“. People, meaning customers, are taking this saying more and more to heart. Naturally, the quality criteria for the production, processing and distribution of foodstuffs is set at a respectively high level. Production of foodstuffs means the targeted alteration or transformation of raw materials from plant or animal origins into safe, healthy and delicious foodstuffs, with substantial commercial volumes. The food industry is one of the most important and dynamic production sectors in all of Europe. With a share of more than 14 percent in employment and sales, it is the second largest industry in the manufacturing sector.
In order to remain competitive despite rising standards and changing markets as well as customer habits, the efficiency of the processing methods used will become even more important in the industry in the future. The more so since consumers expectations on product safety and quality are continually increasing. The potential for innovation lies predominantly in automation or the implementation of new types of technologies for substance conversion. The preparation and mixing of various substances plays a major role here.

Lödige provides the solution

Lödige systems provide the necessary mixing and processing precision for an optimum process design in the broad spectrum of production for the food industry. The systems operate efficiently, economically and with optimum solution concepts. Lödige possesses decades of experience in the construction of mixers and processing systems for this versatile and challenging industry. Lödige systems are successfully operated by leading brand names around the world.

Lödige is of course member of the EHEDG.

Lödige Mixing Systems for the production of international, high quality products

Processing of powders

- Ice cream powder
- Flavourings / Seasonings
- Oven-ready flour mixes with addition of fat and lecithin
- Flour
- Enzymes
- Vanilla sugar

Processing of granulated products

- Table salt
- Coffee and tea extracts
- Flavored instant drinks
- Powdered whey / powdered milk

Processing of fragile materials

- Muesli / cereals
- Instant soups
- Bouillon cubes
- Spice mixes with concentrates
- Tea mixtures
- Dried vegetables
- Frozen fruit and vegetables
- Tobacco

Processing of viscous products

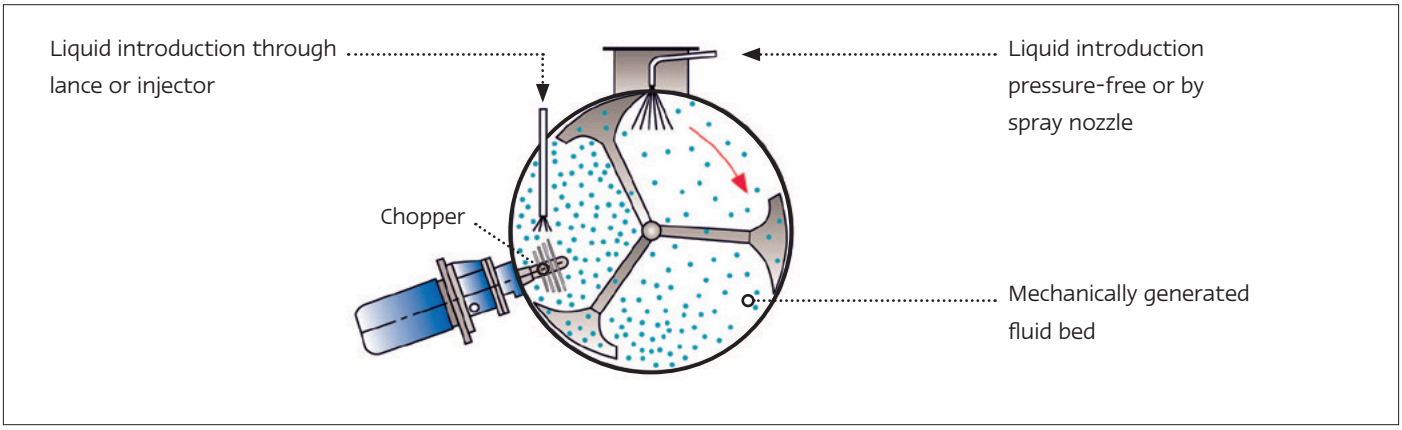
- Baby food
- Glazings
- Cheese spread ingredients
- Other emulsions and pastes

- Creams / dressing / mustard
- Basic fruit pulps
- Chocolate ingredients
- Wafer fillings etc.

Processing of nutraceuticals

- Vitamin preparation
- Dietary food
- Nutritional supplements
- Conditioning products
- Enzymes / starter culture

Batch Mixing and Granulating in a Horizontal System



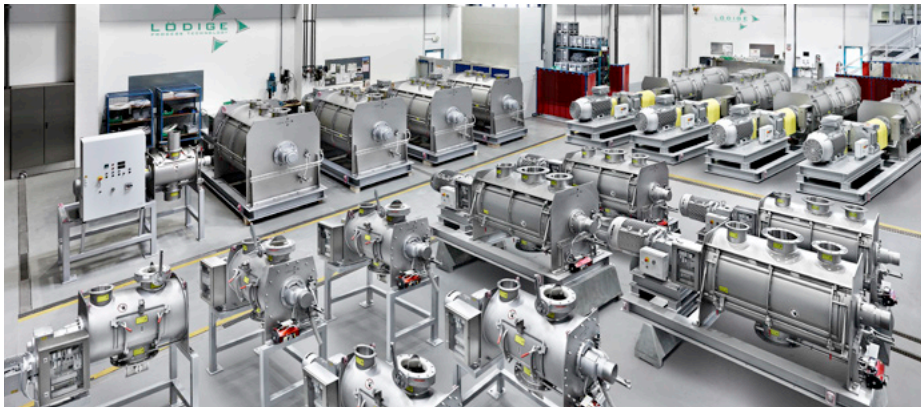
Various types of liquid dosing in a horizontal Lödige Ploughshare® Mixer

The invention of the Ploughshare® Mixer has set a high standard for mixing and processing technology. Large numbers of patented innovations are based on this system. Lödige Mixers guarantee homogeneous, precision mixing within minimum mixing times.

Ploughshare® Shovels rotate as mixing elements in special arrangement on a horizontal shaft in a horizontal, cylindrical mixing drum. The size, number and positioning, geometric shape and peripheral speed of the mixing elements are coordinated to cause three dimensional movement of the components. Turbulence in the product, with total involvement of all material, prevents the formation of dead or low-movement zones in the mixing drum and promotes high speed, precise mixing.

The specially shaped shovels lift the product radially from the wall of the drum to prevent particles from remaining between the mixing elements and the drum wall. The mechanically generated fluid bed is therefore ideal for gentle mixing if fragile and heat sensitive components are included in the mix. Modified Ploughshare® Shovels can be used for special applications or particular component characteristics to further intensify this effect. In special cases, in particular in combined processes, the effect of the mixing elements may require additional support and this is provided by separately driven, high speed choppers. A short mixing time with optimum adaptation of the drive power ensures minimized power consumption. The low-maintenance concept of Lödige Mixers guarantees maximum operational availability of production units.

The excellent accessibility to all inside parts of the mixer reduces considerably the time and expenditure for cleaning and inspection. The mixers can be adapted as an option to automatical cleaning systems (WIP/CIP) processes and therefore provide the highest standard of hygiene for even the most difficult, microbiological components.



Major contract: 18 machines are ready for the factory acceptance test

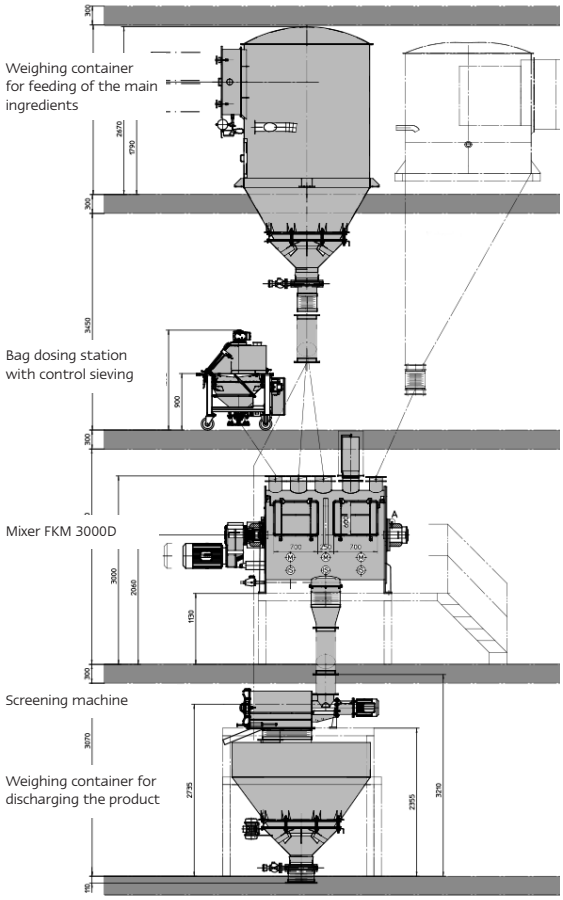
Individual production yield due to precise configuration of the system

Lödige systems produce maximum homogeneity of even the most difficult products. Quote: "Ploughshare® Mixers, running at the appropriate speed, are the most suitable. The best possible mixing quality is obtained under production conditions after only 16 seconds. In ribbon blenders products are mixed more slowly and the quality of the final mix is poorer than that obtained in Ploughshare® Mixers."

Solutions for Process Technology
With a multitude of process-technical possibilities Lödige systems can be designed and applied for various kinds of products and production steps. Besides the conventional mixing process, a combination of the additional process steps, mostly necessary in the food industry, is possible in the Lödige system. Labour-intensive premixes, for example, can thus be omitted. All systems listed below are available both in production sizes as well as in laboratory scale.

Horizontal Lödige Ploughshare® Mixer type FKM 1200 DR

Fully welded mixing elements without any gaps or dirt traps (Hygienic Design)

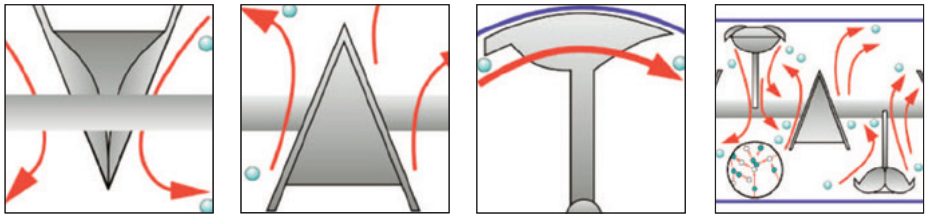


Mixing plant with weighing container

Continuous Mixing and Granulating in a Horizontal System

The continuous Ploughshare® Mixer operates according to the mechanically generated fluid bed introduced to mixing technology by Lödige. The mixing elements are specifically adapted to individual applications.
This mixing system achieves high throughputs which can be varied dependent upon residence time, filling degree and product properties.

The resultant individualisation of the particles in the mix (fluid bed) allows addition of liquids and coating of particles in a continuous process too. The continuous process is operable at filling degrees between 20 and 50 % without influencing the mix quality. The mixing elements are designed to achieve constant backmixing during the residence time prior to discharge the mixed product via the outlet. The adjustment of the size of the discharge opening by means of a slide or a weir has a direct influence on the residence time. Dosing fluctuations can be compensated by the mixer.



Mixing principle generated in the Ploughshare® Mixer

Continuous Lödige Ploughshare® Mixer type KM 150 D

Continuous Mixer type KM with adjustable slide in the discharge chute

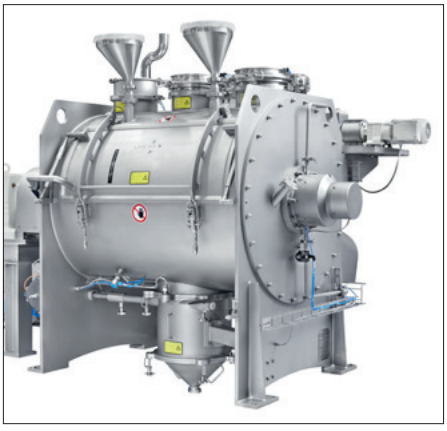
Washing in Place (WIP) as standard cleaning process for horizontal mixing systems

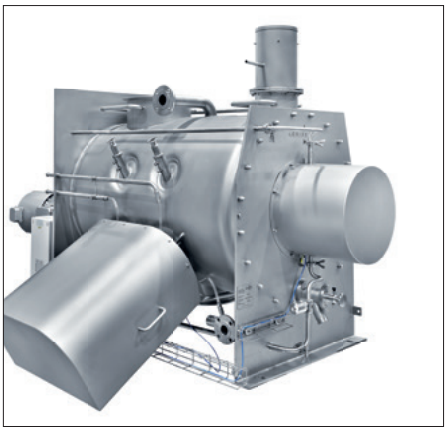
Lödige demonstrates a broad know-how not only in the field of mixing solids where hygienic designs are relevant.

Requirements made upon the Ploughshare® Mixer and design improvements:
In case of hygienic production, an optimal ease of cleaning has to be taken into account for the machine design without influencing its functionality. Some components have to be particularly considered for hygienic reasons. The mixing elements and the choppers have to be easy to clean, accessible and dismountable. A large inspection door thus enables the inspection of the complete drum inside. A specific feature of the machine design is the pull-out function of the main shaft which can be completely extracted from the mixing drum (advantageous for drying and pharmaceutical applications).
Rinseable air purged seals or mechanical face seals are usually the best technical solution for the main shaft and the chopper sealings. The product contact surfaces have a surface roughness of Ra < 0.8 µm. Generally, surface roughness has to be smaller than the particle size of the material adhering to the surfaces in order to achieve direct wetting of residue with the cleaning substances. Smoothed and polished surfaces are ideal. The surface can also be electro-polished to further reduce its roughness. In this case, the mixing elements are completely welded onto the mixing shaft and have the same surface roughness as the inside surface of the drum.

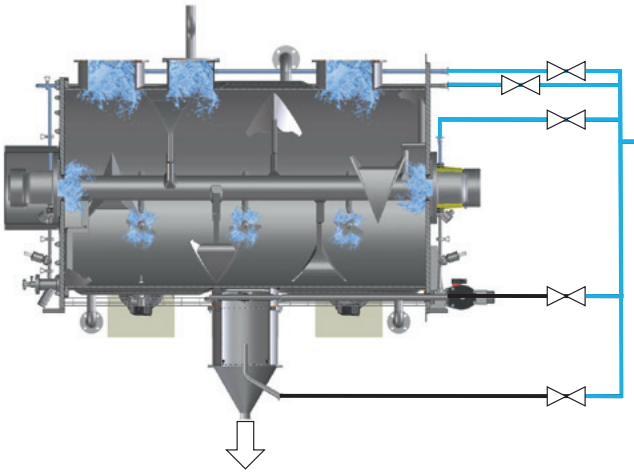
The so-called Washing in Place (WIP) is an automatic cleaning feature requiring some manual preparatory steps to perform the cleaning process. In case of the Ploughshare® Mixer, some manual preparations are required before wet cleaning (installation of washing device for example).

The shaft seals are purged with compressed air during the production process and prior to the product feeding





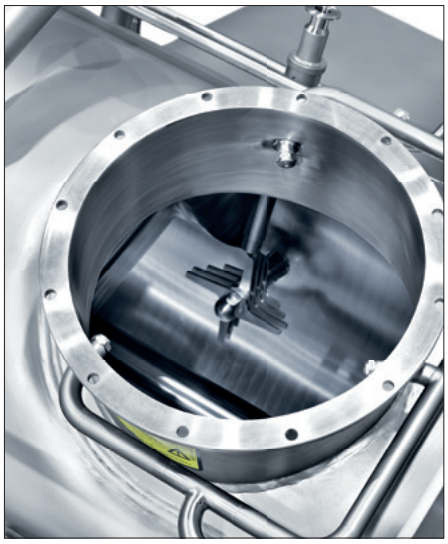
Ploughshare® Mixer with stainless steel piping for efficient wet cleaning



step. This prevents the product from penetrating into the gap between static and rotating part of the sealing. The compressed air flow is controlled by a flow meter and can be monitored. The operator can check the air quantity and pressure at the Operator Panel.

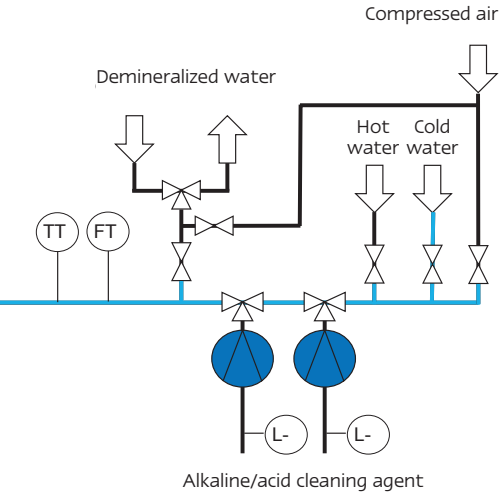
All shaft seals are purged with water, therefore they are equipped with drain valves. The feeding and discharge are cleaned by means of rotary nozzles which are installed on a removable washing adapter. During cleaning, the main shaft runs forwards and backwards at intervals. The ventilation filter has to be cleaned separately and the opening is closed with a washing adapter. A drain funnel can be docked onto the machine outlet in order to drain off the wash water. As an option there is the possibility to swivel the complete outlet to the side to clean the discharge door separately.

After the wet cleaning, all mixer parts, seals, pipes and valves which have been supplied with water will be dried by conditioned compressed air.



Cleaning nozzles for WIP cleaning process

Fully dismountable discharge door

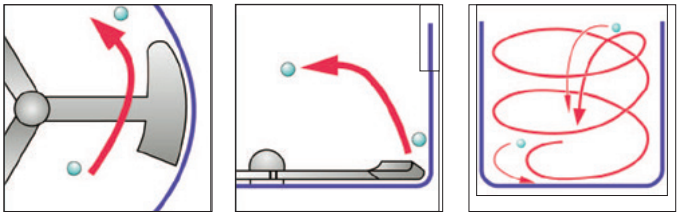


Flow diagram of the WIP cleaning for Ploughshare® Mixers

Batch Mixing and Granulating in a Vertical System

Mixing Granulators are standardized systems compliant with all GMP / WIP design requirements. They are extremely easy to clean and require a minimum of maintenance.

A three-arm mixing impeller rotates close to the base of a vertical, cylindrical mixing drum. The special design of this element and its peripheral speed are coordinated in such a way that the mixing product is circulated as vortex and thereby accelerated horizontally and vertically. This type of product movement produces a high-speed, intensive mix, even in cases where the granular structure and shape, bulk density and surface condition of components differ considerably.
High quality mixing is ensured in minimum time. If necessary, a highspeed, separately driven chopper disperses any lumps and promotes uniform liquid distribution and wet granulation. The granulation endpoint can be precisely determined.

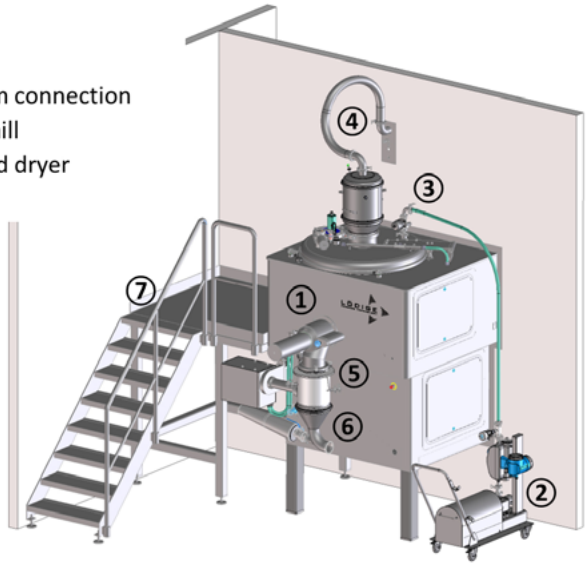


Mixing principle generated in the Mixing Granulator MGT

Mixing Granulator type MGT

Mixing tool which can be raised up

① MGT housing
② pump station
③ liquid addition
④ aspiration / vacuum connection
⑤ discharge / sieve mill
⑥ transfer to fluid bed dryer
⑦ operator platform



Example of a MGT installation with various options

Batch Mixing of viscous/paste-like products in a vertical system

Wet Mixer NOHK for food applications

The Wet Mixer NOHK is suitable for processing viscous to pasty and poor-flow products. It can be used for a wide range of applications in the food industry and also for applications in the pharmaceutical industry. The conical shape of the vessel allows for a maximum possible discharge with the least amount of residue.

Mode of operation

The Wet Mixer is a vertical mixing system designed for batch processes. The geometry of the conical mixing vessel, the arrangement and shape of the mixing tools and their peripheral speed are coordinated in all machine sizes to ensure effective mixing of the components. According to the application required, a combination of mixing tools is arranged on the shaft to generate product transport, dispersion and deagglomeration. The vertical position of the tools inside the vessel can be adjusted over a wide range to suit the application. An adjustable deflector is used to divert the product movement in a defined manner.

Range of application

Mixing and processing of products with medium or high viscosity like soup paste, baby food and special sauces.
Equipped with helical tools, the NOHK is also suitable for simple mixing process.

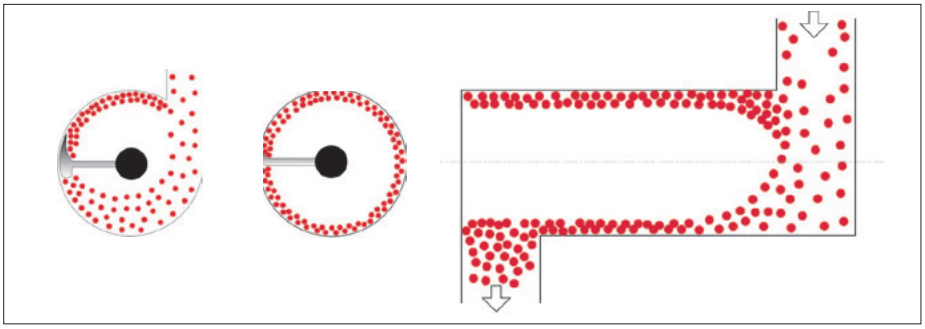
Suitable tool combination to ensure an effective process

Wet Mixer type NOHK mainly used for the production of baby food

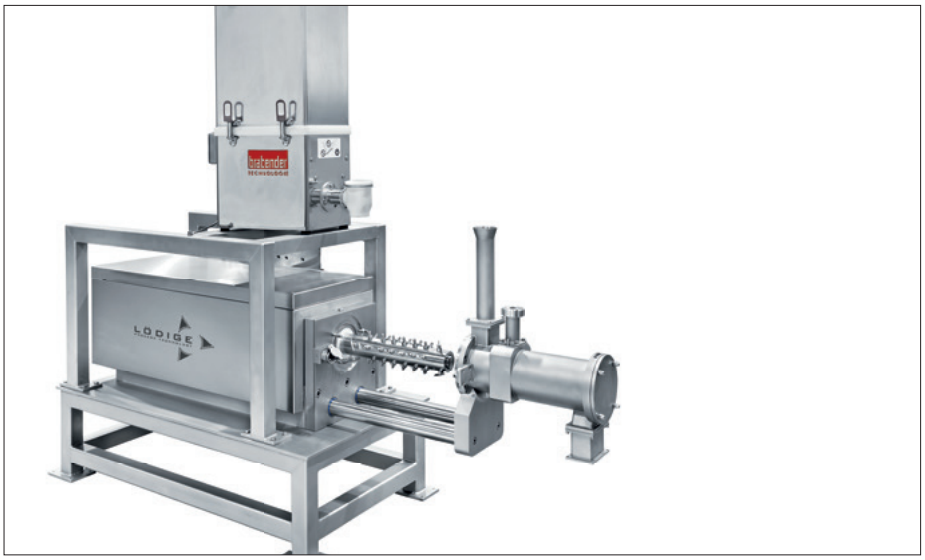
Mixing and Processing in a continuous Ringlayer System

The Lödige High Speed Continuous Mixer CoriMix® CM excels with wide range of applications for mixing, humidifying, granulating and densifying processes. The system produces constant product quality and provides controlled granulation.

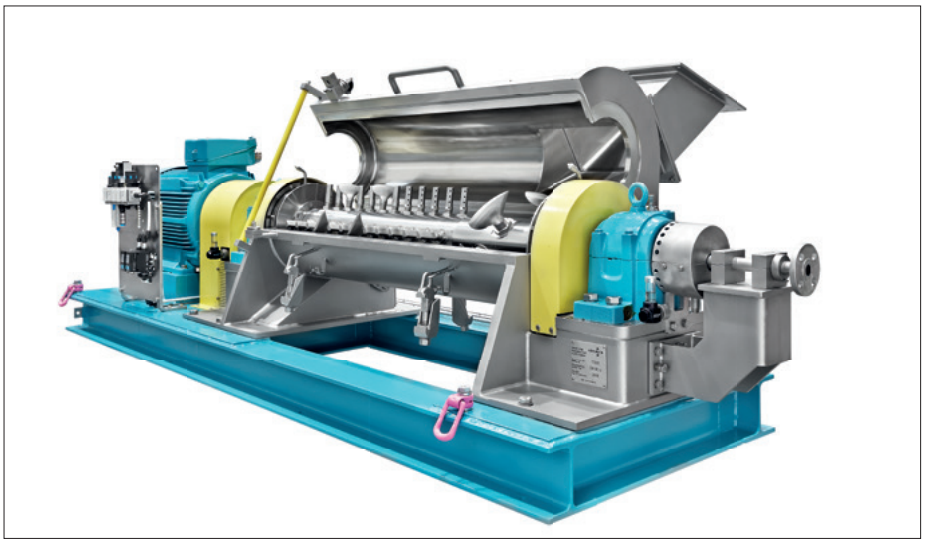
The system is based on the high peripheral speed of the mixing shaft of up to 40 m/s, the resultant centrifugal force forming an annular layer of product. The profile of the annular layer features a high shearing intensity, which is caused by the high differential speed between the rotating, specially shaped mixing tools and the mixer wall. The product is moved through the mixing chamber in a pluglike flow, with the residence time being influenced by the degree of filling, the rotation speed, the geometry and adjustment of the mixing tools as well as the mixing drum length and the volume flow rate. The system offers the possibility to divide the mixing chamber into zones of different shear intensity, thus permitting system optimisation for varying product properties. The liquid components are directly introduced into the annular layer. This ensures a homogeneous distribution within the product and avoids wetting of the mixer wall and mixing shaft. CoriMix® systems provide optimal cleaning as the mixing drum is divided axially over the entire drum. High feed rates of 20 - 200 kg/h (for example CM 20) are achieved with machines of compact design.



Principle of the continuous Ringlayer Mixing



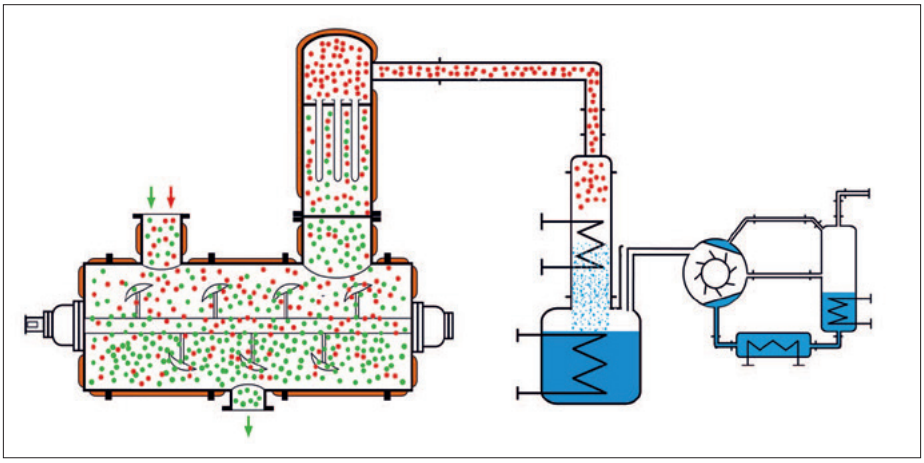
CoriMix® type CM 5 with removable shaft as hygienic solution



CoriMix® type CM 80

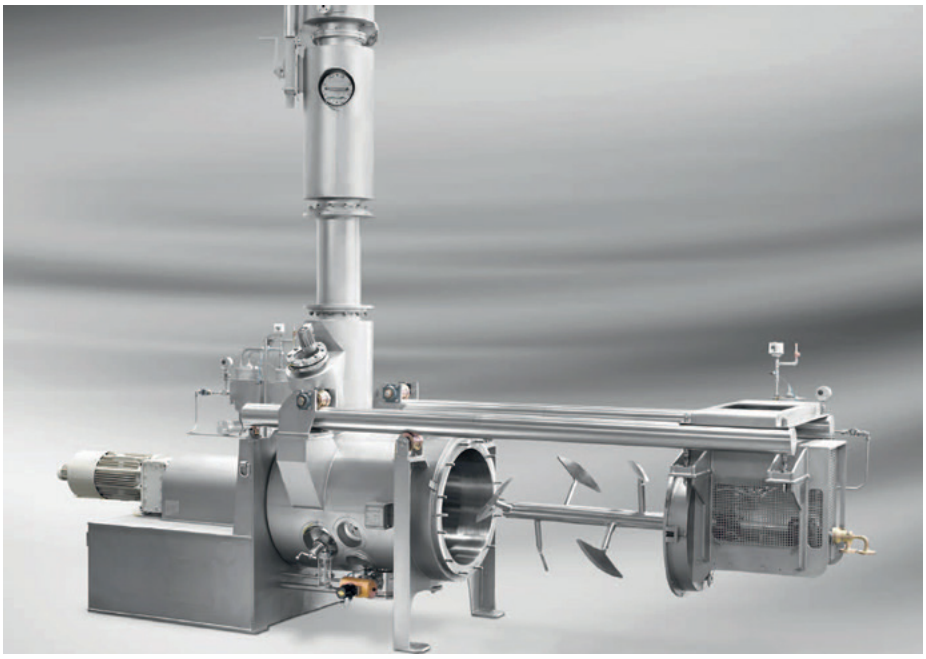
Drying in a DRUVATHERM® Vacuum Shovel Dryer

Horizontal Lödige drying systems ensure precisely reproducible, constant and reliable processes. All shovel dryers variations can be manufactured in containment design.



Principle of the DRUVATHERM® Vacuum Shovel Dryer

The large product surfaces produced in a mechanically generated fluid bed increase heat exchange whilst greatly reducing processing times. Intensive and homogeneous mixing prevents the development of temperature and moisture gradients in the product and increases at the same time the contact frequency and thereby the heat exchange between product particles and heating jacket. When drying is carried out under vacuum, the process can be run at low, product-protecting temperatures. A high temperature gradient is obtained between the product and the heating jacket resulting in the effective introduction of heat. Mixing and drying processes can be run with high precision ensuring the reproduceability of a product formulation. Shovel dryers up to 1200 l total volume can be designed with only one bearing. Even larger dryers are available with pull out mixing shafts.

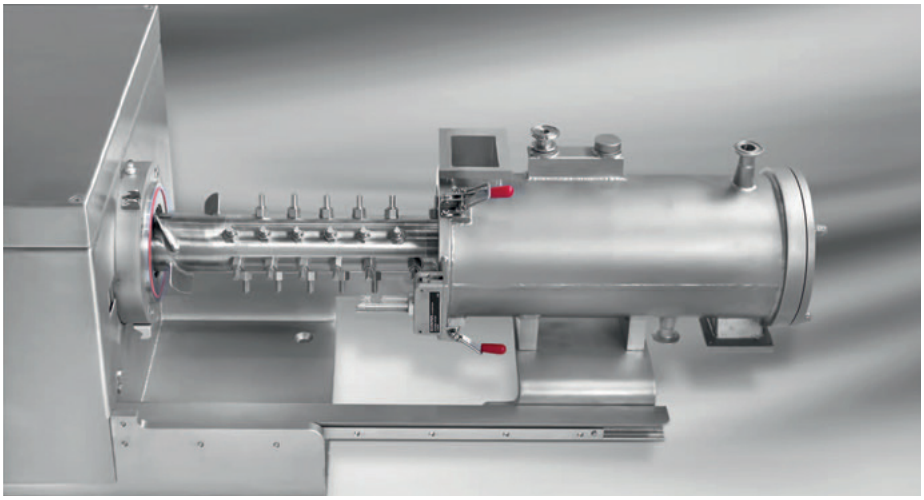


DRUVATHERM® Vacuum Shovel Dryer type VT with pull out shaft

DRUVATHERM® Vacuum Shovel Dryer type DVT 50 for research and development

Machines for research, product development and production of samples

Lödige laboratory systems work in accordance with the same principle as production machines and ensure reliable scale-up to production-machine sizes. Know-how concerning quality of the mix, product behaviour and process parameters can be scaled up without restriction.
Small scale production can be therefore carried out in accordance with the same quality criteria.



Laboratory Ringlayer Mixer type CoriMix® CM

Ploughshare® Laboratory Mixer with interchangeable drums

Laboratory Mixing Granulator with interchangeable vessels

Laboratory Vacuum Dryer

Lödige Research and Test Centre

The Lödige Research and Test Centre is equipped with the most modern machines for:
- **Mixing**
- **Kneading**
- **Dispersing**
- **Emulsifying**
- **Wet granulating**
- **Drying**
- **Heating / Cooling**
- **Coating**

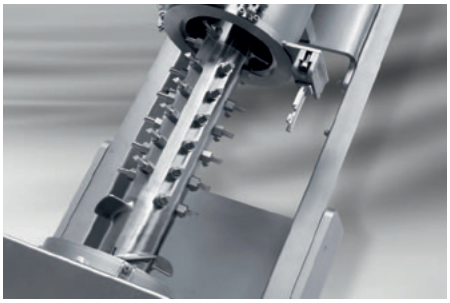
to ensure testing under production conditions and in compliance with hygienic conditions.

The Lödige Test Centre with floor space of more than 400 m^2 provides trial capacity for more than 30 machines including a laboratory for physical analysis. A separate area is dedicated to cosmetic trials. All machines are suitable for WIP/CIP and suitable for small scale production.

Plougshare® Mixer FM 130
- **Mixing**
- **Granulating**
- **Moistening**
- **Adding fat**

... and more

Total volume 130 l
Working volume 90 l
Universal applications
High mixing quality
Heating / cooling jacket



Laboratory Ringlayer Mixer CoriMix® CM 5
- **Mixing**
- **Granulating**
- **Densifying**

Throughput up to 240 l/h

Mixing Granulator MGT 125
- **Mixing**
- **Granulating**
- **Wet granulating**
- **Drying**

Total volume 125 l
Working volume 90 l
Control of the point of granulation
Dust-free feeding
Rasp / sieve downstream

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Lödige supplies high-grade components, subsystems and systems for technical processing applications in a wide range of industries. We are specialized in the field of mixing, granulating, coating, drying and reaction. Our profound knowledge of processes, development and production enables us to contribute to the success of our partners throughout the world.

Lödige, which was founded in 1938, is a family-run business in its third generation now.
With the invention of the Ploughshare® Mixer, Lödige created a mixing unit that can cover a wide range of different processing tasks. This unit forms the basis for numerous innovations in the area of mixing and processing technology.

Industrial mixing and processing technology has been significantly influenced by Lödige and will continue to be so in the future.
Over 500 patents and more than 30,000 machines and systems demonstrate our experience with customer-oriented system solutions. Lödige operates with more than 300 employees worldwide and supports its customers with a network of subsidiaries, technical offices and agencies.

LÖDIGE – ALWAYS THE RIGHT MIX

LÖDIGE
PROCESS TECHNOLOGY

SYSTEM SOLUTIONS FOR THE **PHARMACEUTICAL INDUSTRY**

ALWAYS THE RIGHT MIX

PHARMACEUTICAL INDUSTRY –
HIGH-TECH MADE BY PEOPLE FOR PEOPLE

PRODUCT-SPECIFIC PROCESS DESIGN
GUARANTEES THAT THE DETERMINED QUALITATIVE PROPERTIES OF SENSITIVE PRODUCTS ARE MET

SOLUTIONS PROVIDED BY LÖDIGE

- Mixing / Granulating
  - Basic pharmaceutical materials
  - Excipients / Active agents
- Drying
  - Active agents
  - Moist product
- Coating
  - Tablets
  - Capsules
  - Pellets
  - Granules
  - Particles / Crystals

Medicines are high-tech products
What matters is the dosage – especially when it comes to pharmaceutical products. Because modern medicines are truly high-tech products. Cutting edge technology is also necessary to research and develop them: using the latest analysis and synthesis techniques, genetic laboratories, powerful IT systems, analysis robots and much more.

Nowadays, medicines are manufactured exclusively using state-of-the-art technology. From the raw materials to the package, the products produced must meet the most rigorous standards for quality.

It goes without saying that during production all criteria which could influence the quality and effectiveness of the product must be guaranteed. The safety of the patients depends on it.

Lödige provides the solution
For this reason, medicine productions worldwide are subject to the absolute highest standards regarding safety, purity and reproducibility. Our products and services are subject to these same internationally valid quality standards.

This means: all our systems for versatile applications in the field of solid dosage forms are developed and implemented entirely in accordance with the complex body of rules and regulations governing laboratories and production lines. Our specific processing know-how for mixing, drying and coating systems forms the basis for the development of innovative system solutions in the pharmaceutical industry. Lödige adapts perfectly to the production conditions on site and helps in this way the customers to cope successfully with the current challenges in manufacturing plants. High-quality machines, service from an experienced professional and a competitive price: this makes Lödige a valuable partner in the pharmaceutic industry. A close cooperation with well-known manufacturers of pharmaceutical products for decades proves this competence: as a result more than 1,000 systems have been supplied.

You will find detailed descriptions of our systems in our brochures and flyers.

MIXING AND GRANULATING
IN A HORIZONTAL SYSTEM

By inventing the Ploughshare® mixer, Lödige revolutionised mixing and treatment technology. Numerous patented innovations based on this system are proof of the technology's incredible potential. The quality of Lödige Ploughshare® mixers has been proven repeatedly for many years in the pharmaceutical industry.

The heart of the mixer is a special arrangement of Ploughshare® shovels on a horizontal shaft. They rotate in a horizontally fitted, cylindrical mixing vessel. The size, number, positioning, geometric shape and peripheral speed of the mixing elements are coordinated for three-dimensional movement of the components inside the mixing drum. During this process, the mixture is continuously gripped by the mixing tools.

This reliably prevents dead space or low-movement zones, while guaranteeing quick, precise mixing action. This process is highly suitable for mixing processes whereby the components have widely differing bulk densities, particle sizes, rheological features and highly different mass fractions.

Some mixing tasks – for instance the addition of fluids or granulation tasks – make it necessary to support the mixing effect of the mixing elements. For this purpose, separately driven choppers rotating at high speed are installed. The mixing process can also be carried out continuously in Ploughshare® Mixers of type KM.

Ploughshare®-Mixer type FKM

Ploughshare®-Shovels with chopper

Ploughshare®-Mixer type FKM Hygienic Design

MIXING AND GRANULATING
IN A VERTICAL SYSTEM

The High Shear Mixer MGT is a system for mixing, granulating and sieving of pharmaceutical powders and granules. Lödige High Shear Mixers are particularly easy to clean and are characterized by their extremely low-maintenance.

A three-arm mixing element rotates close to the wall and with minimum clearance from the bottom of the vertical mixing container.

The special shape of this element and its peripheral speed are coordinated in such a way that the mixing product is circulated as a vortex and thereby accelerated horizontally and vertically. This product movement assures rapid, intensive mixing, bulk densities and surface condition.

High mixing precision is obtained within minimum time. If necessary, a separately driven chopper disperses lumps, distributes liquid uniformly and promotes wet granulation. In this way, the endpoint of granulation can be controlled as required. Liquid addition is carried out with a pump or by gravity.

The liquid is added into the mix right above the chopper which achieves best possible distribution. The optional wet sieve ensures the calibration of the wet granules while discharging from the mixer. Discharge can take place into a vessel or the product can be transported pneumatically to a Fluid Bed Dryer.

Vertical mixing system type MGT

Three-arm mixing element and chopper

MGT with integrated wet sieve

DRYING, GRANULATING AND COATING
IN A FLUID BED PROCESSOR

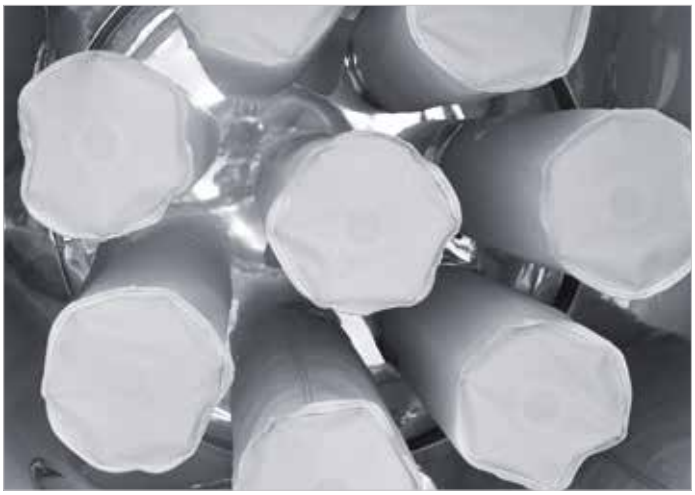
The Lödige Fluid Bed Processor LFP is available in different sizes suitable for batches from 0.1 to 500 kg. Numerous options allow the processor to be adapted to application-specific requirements.

The Fluid Bed technology of the LFP achieves a constant and reproducible product quality while ensuring a gentle process in short process times.

Processes ranging from powdery materials to free-flowing materials can be carried out as well as the drying of moist products (e.g. moist granulates).

Moreover, powders, granulates and other shapes can be coated in this system too. During the process, heated air – in defined quantity and speed – continuously flows through the special designed Conidur® bottom into the product vessel. The product starts to fluidize and can be moistened by means of a ternary spray nozzle and granulated, depending on the application. Tangential spray nozzles in the area of the Conidur® bottom (underfeed) or a Wurster system are used for coating pellets.

Integrated filters – selected according to the process and product – hold back the powder particles and return them into the process by continuous filter cleaning.



LFP filter elements

LFP Mini 1

LFP 8 for development and small production

Production unit LFP

LFP with product container in run-out position and lifting device

COATING IN A **LÖDIGE COATER LC**

Lödige Coater type LC 130

Lödige Coater type LC 150 with spray arm in run-out position

Lödige Coater type LC 70

Lödige Coaters of type LC are used for processing different shapes of tablets, capsules and pellets and operate on the co-current, under-pressure principle. 25 – 100 % of the working capacity of the Coater can be used without modification of the system. As well as the Coater itself, the LC Coating System includes the inlet air treatment, the exhaust air system, the controls, liquid dosing, feeding and discharging and the WIP system.

Optimal process control, fast coating speed, easy handling and easy cleaning were the top-priority for development of the Coater. The coating process can be divided into the following three sub-processes: spraying of lacquer, drying of the tablets and mixing of the tablets. The LC coater series optimizes all three sub-processes. The totally perforated drum with a free surface of more than 40 % enables a maximum air flow.

The mixing elements ensure the uniform and gentle mixing, even with variable filling degrees. These are the most important conditions for best uniformity of coating.

The optimised nozzle arm permits easy adjustment of the nozzle position to the tablet bed – making it possible to set the optimum spraying distance and angle at all times. The heated inlet air is guided into the Coater housing via a special distribution system and led through the perforation into the coating drum, thereby ensuring quick drying of the moist tablet surfaces. The air is then extracted through the tablet bed.

The whole product range inside the Coater is kept below atmospheric pressure. Complete discharge is done while the drum is rotating backwards, without any additional equipment. An innovative ultrasonic generator is used during the cleaning process. It reduces the cleaning time significantly – especially in case of hardly soluble substances. The Coater is designed for through-the-wall assembly, which permits optimum separation of the technical and process areas. The technical area is always available for access by the maintenance staff.

The new control system can be operated intuitively and fulfils all the latest GMP requirements.

CONTINUOUS WET GRANULATION AND DRYING IN A **LÖDIGE GRANUCON®**

The GRANUCON system is a complete, continuous production line – from powder to granules ready for compression. This range comprises dosing units, mixers, sieve/rasp and a comprehensive control system.

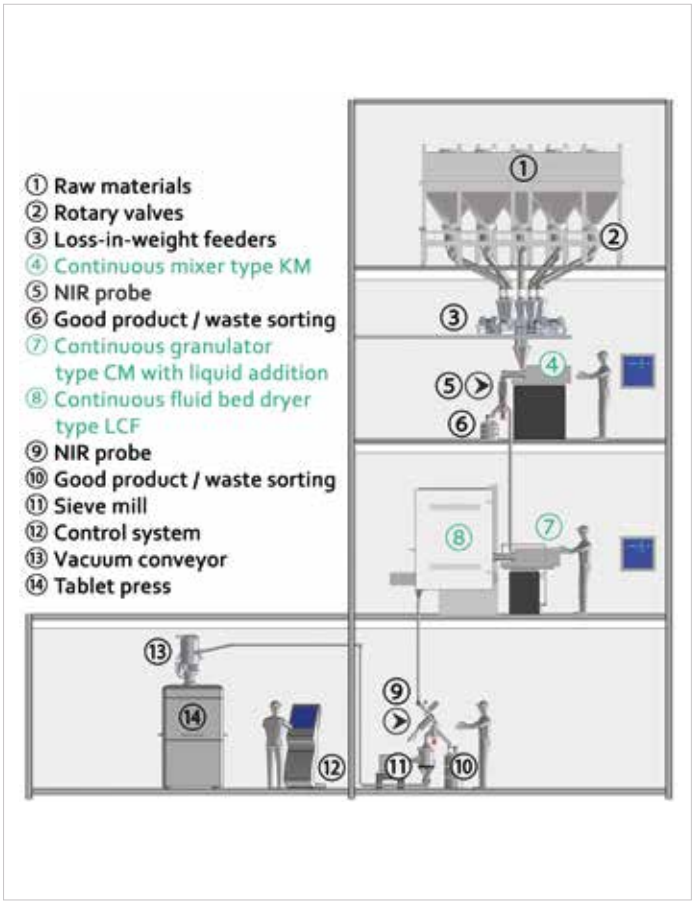
Continuous Granulator CoriMix® type CM and Continuous Mixer type KM
This high speed mixer is designed to intermix liquid or pasty components into dry powder. The high shear force introduced by the granulating tools generates a uniform granule structure.

Continuous Fluid Bed Dryer type LCF
The dryer operates in accordance with the fluid bed technology. A screw installed above the exchangeable perforation continuously conveys the product through the dryer. The speed of the screw and therefore the dwell time of the product can be adjusted in a variable manner. This design ensures a closer distribution of the dwell time than in other continuous systems available in the market. Operation and cleaning of the dryer are incredibly easy. The throughput ranges from 5 to 50 kg/h.

Continuously from Powder to Granules
Compared to a batch process, the continuous operation allows to produce the same product at much lower cost. This depends particularly on the following factors:

- Less product handling
- Plug flow, minimum product loss during starting and downtime
- Less manpower
- Smaller machines – less cleaning
- Continuous process monitoring (PAT) – less costs
- Less space required in the GMP area
- Scale-up: Increasing production is possible through mostly automated 24/7 operation

Continuous Granulator CoriMix® CM



Granucon® – Model for wet granulation and drying

DRYING IN A **VACUUM SHOVEL DRYER SYSTEM TYPE VT**

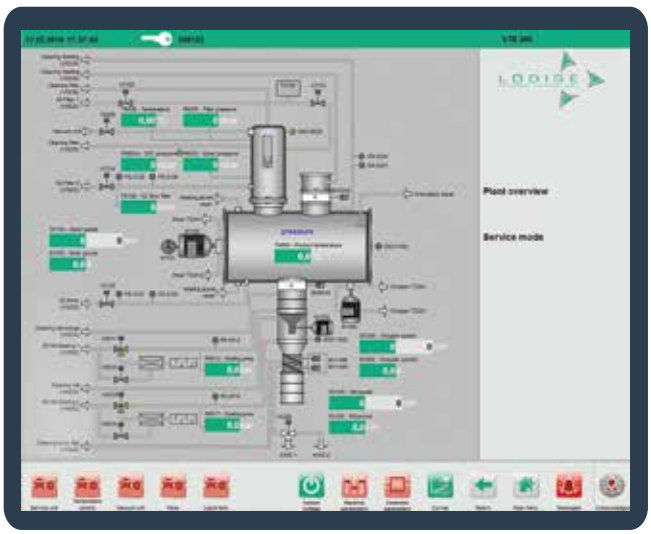
Compared to conventional drying processes, vacuum drying contains a number of process advantages: In particular, it is characterised by low drying temperatures that are gentle to the product and the possibility of high evaporation rates, reducing the resulting process times.

By carrying out a vacuum drying process in a horizontal shovel dryer the advantages of vacuum drying can be combined with the process technology options of a Ploughshare®mixer. Beyond producing mixtures with an excellent mixing accuracy, the mixing elements also provide essential support for the drying process by carrying out a steady exchange between product and heat transfer surface. This ensures a very effective heat transfer into the product.

Compared to alternative vertically arranged drying systems, the horizontal dryer has a significantly higher available heat exchange surface, which also leads to shorter drying times. Moreover, the system can be equipped with several options for liquid addition and distribution and can therefore also be used as a granulator. The possibility of installing a sieve mill directly onto the machine's feeding port for material preprocessing resp. below the outlet for final granule size calibration completes the range of possible processes in the vacuum shovel dryer.

In the pharmaceutical industry, there are multiple applications and processes which can be carried out in a vacuum shovel dryer. Typical examples are drying of APIs, the combination of several process steps in “single pot applications“ and effervescent products.

Vacuum Shovel Dryer type VT 2000



VT control panel

Vacuum Shovel Dryer type VT 200

MACHINES FOR **RESEARCH, PRODUCT DEVELOPMENT AND SAMPLE PRODUCTION**

Lödige laboratory systems provide reliable scale-up to production size. Their function principle is identical to that of production machines, making it possible to use them for production of small batches with the same quality criteria.

Vertical Laboratory Mixing Granulator type MGT-L

Laboratory Ploughshare® Mixer and Vacuum Dryer

Laboratory Coater LC with inlet air and exhaust air unit

LÖDIGE RESEARCH AND TEST CENTRE

The Lödige Pharma Test Centre is equipped with the most modern machines for:

- Mixing
- Wet Granulating
- Sieving
- Drying
- Tabletting
- Coating

in compliance with GMP and at production conditions.

Test Centres

The Lödige Test Centres of more than 700 sqm provide trial capacity for more than 30 machines including a laboratory for physical analysis. A separate test centre is dedicated to pharma trials in compliance with GMP conditions. The pilot machines are designed for a reliable scale-up to production equipment.

Lödige Pharma Research & Test Centre

Mixing Granulator type MGT 125

- Mixing
- Granulating
- Wet granulating
- Drying
- Batch size up to 40 kg
- Control of the point of granulation
- Dust-free feeding
- Rasp / sieve downstream

GRANUCON®

- Material handling
- Dosing
- Continuous mixing
- Continuous granulation
- Continuous drying
- Integrated WIP cleaning
- Variable air quantity in 3 chambers

Coating System type LC 70

- Film Coating
- Totally perforated drums
- Filling degree 25 - 100 %
- Batch size up to 40 kg

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Lödige offers high-quality partial systems and service for process engineering applications in various industries in the fields of mixing, granulation, coating, drying, reaction and related processes. Our motivated employees and their expertise in processes, development and production are the key to our success and the success of our partners all over the world. Focusing on core industries and proximity to our customers through local presence is a crucial component of the positive development of our company.

Lödige, which was founded in 1938, is a family-run business in its third generation now. With the invention of the Ploughshare® Mixer, Lödige created a mixing unit that can cover a wide range of different processing tasks. This unit forms the basis for numerous innovations in the area of mixing and processing technology. Industrial mixing and processing technology has been significantly influenced by Lödige and will continue to be so in the future.

Over 500 patents and more than 35,000 machines and systems demonstrate our experience with customer-oriented system solutions. Lödige operates with more than 500 employees world-wide and supports its customers with a network of subsidiaries, technical offices and agencies.

ALWAYS THE RIGHT MIX