



# SYSTEM SOLUTIONS FOR THE CHEMICAL INDUSTRY



**ALWAYS THE RIGHT MIX**

**CHEMICAL INDUSTRY: ESSENTIAL, INNOVATIVE,  
RESPONSIBLE AND ENVIRONMENTALLY AWARE**





# QUALITY AND SYSTEM RELIABILITY FROM THE VERY BEGINNING

## SOLUTIONS BY LÖDIGE

- Mixing
- Granulation
- Multi-stage processing / Single-pot processes
- Reacting
- Drying
- High-temperature processes



### **Products of the chemical industry – ubiquitous and indispensable**

Our modern lives would be unimaginable without the products created by the chemical industry. Besides the cosmetics, paints and fertilisers that we encounter more or less every day, most chemical products are actually used in other areas of industry. Amongst other things, these pre-products are required for manufacturing processes in the mechanical engineering, textiles, construction and packaging industries as well as in the automotive engineering and food sectors. It is therefore no surprise that the industry is characterised by a fast pace and innovative strength. Every year, billions of euros are invested in researching and developing new materials and applications. For instance, many climate-friendly technologies would not even be possible without the chemical industry and its innovative products and processes: solar cells, wind power plants, electric cars, thermal insulation and waste water treatment only work thanks to chemistry. The chemical industry is thus one of those with a key role to play in sustainable development.

### **Lödige Reacting and Drying Systems**

An optimum process solution requires comprehensive process expertise, scale-up data from pilot tests and, last but not least, feedback from end users, whose day-to-day experience is made an integral part of systems development. Lödige has used these criteria as the basis of its work for decades. And, on top of that, Lödige is a pioneer in the thermal treatment of bulk goods as the inventor of the Ploughshare® Mixer. The Lödige mixing process – known as a mechanically generated fluid bed – minimises temperature and concentration gradients in the reaction bed during the mixing, reaction and drying phases and increases heat exchange through the reactor walls. This allows processing times to be drastically reduced. Our DRUVATHERM® Reactors and Dryers demonstrate the performance capacity of this technology in the chemical industry day in, day out.

# LÖDIGE REACTORS AND DRYERS – ALWAYS THE BEST SOLUTION

Lödige's process solutions are tailored perfectly to individual products and their product rheology with regard to apparatus size, consumption figures and materials. This allows us to help our customers in the chemical industry to manufacture their indispensable products cost-effectively.

The high quality of Lödige's solutions is built on:

- rigorous process design
- comprehensive basic engineering
- specific design of the DRUVATHERM® Reactor or Dryer as the heart of the system

Additional units – such as choppers in various forms – support the reacting and drying processes in the different process phases.

Auxiliary units and systems are optimised and adapted to the individual system to achieve an economical complete system solution.

The specific specialist sealing systems that Lödige has developed in partnership with well-known seal manufacturers meet the most stringent requirements.



DRUVATHERM® type VT 300 Vacuum Shovel Dryer, with heated shaft

We firmly believe that the best results are achieved by working together. This is why we collaborate closely with end users in the chemical industry when developing and validating solutions.

The framework is formed by a large range of Lödige process solutions in a flexible system, which makes it possible to fulfill application-orientated, performance-related, specific customer process requirements.

Multistep reaction and drying processes using

- vacuum
  - overpressure
  - thermal and mechanical energy
- can thus be carried out in one DRUVATHERM® apparatus.

Process conditions for a wide product range can be set with high precision, so that Lödige Dryer and Reaction systems are able to guarantee exactly reproducible, constant and operationally safe process sequences.



DRUVATHERM® type DVT 130 Reactor, with bearing on one side and sampler



# SPECIAL APPLICATIONS REQUIRE SPECIAL SOLUTIONS



Henkel AG & Co. KGaA

## Production of cellulose ethers

- Methyl cellulose derivatives



## Solvent drying

- Active pharmaceutical ingredients and intermediates



## Stripping and drying polysaccharides

- Pectins, carrageenan, gellan gum in the form of food additives



## Chemical reactions / Synthesis of solids

- Metal soaps (stearates)
- Plastic stabilisers



## Contact/convection drying

- Fibres and moulding compounds
- Sludges containing oil and solvents
- Friction lining masses
- Catalyst masses
- Foodstuffs, vitamins, xanthan gum, cocoa masses
- Dyes, colourings, pigments



## Production of starch derivatives

- Acid-modified starch
- Cationic starch
- Dextrins

## Starch processing

- Gluten production
- Bioethanol production

# DRYING AND REACTION PROCESSES

**At Lödige, consultancy, machine, process and service all come from one source. The individual, project specific technical specification and the precise adaptation to the process task due to the availability of a multitude of standard options and technical solutions are our strength – and hence your advantage.**

## Drying

During the drying process, the liquid components are separated from the solid components with the introduction of energy. The aim of such an operation is to either gain the dried component as a valuable product, or to recover the solvent for re-use in the process. In the latter case, even the selective recovery of solvents is possible.

Whether low speed or high speed shovel dryers are utilised, there will always be a gentle but effective mixing of product particles, ensuring optimum heat exchange conditions. In doing so, temperature gradients and hot spots are avoided. Temperature sensitive products are preferably dried under vacuum, as a reduction in the vaporisation temperature is then achieved. Drying processes under normal atmospheric pressure can be accelerated by injecting either hot air or superheated steam directly into the product bed. Warm water, steam or thermal oil can be used as a heating medium for the heating jacket. Depending on the project, further heating energy sources can also be used according to the state of the art.

## Reacting

We can carry our chemical reactions (synthesis) of one or more components (educts, reactants) to one or more products having new chemical and/or physical characteristics. Horizontal vessels, having superb particle interaction generated by the mechanical fluid bed, are thus well suited for chemical reaction processes. For this reason, for example, organic pigment synthesis can be carried out directly without the need to create an initial suspension. Horizontal mixers/reactors are also well suited for polymerisation processes, gaining an advantage over, for example, vertical units due to their insensitivity towards product phase changes.



DRUVATHERM® type VTA 2000 Vacuum Shovel Dryer, view into the mixing chamber



# BURSTING WITH BENEFITS – LÖDIGE DRUVATHERM® DRYERS AND REACTORS

## “All-in-One Process”

The entire process chain in a single unit – no problem at all thanks to Lödige Reactors. This is all because of their versatility, which allows complex process steps such as mixing, liquid addition, heating, evaporating, reacting, drying, cooling, granulating and coating to be carried out in just one apparatus. For example: liquid reactants are initially mixed and then brought to a reaction upon introduction of additives. Subsequent evaporative crystallisation, drying, cooling and granulation yield the final solid product. These process steps are performed without intermediate storage, transportation or cleaning.

## Drying in batch operation

Most drying processes are carried out in batch operation. The product is dried at a set pressure and temperature until the desired final moisture content is achieved. The operating parameters are often varied by modifying the product's consistency.

## Continuous Drying

With continuous drying, the product is fed close to the head piece before being transported to the other end of the dryer via the shovel mechanism. A specifically designed internal weir ensures a controlled discharge of product and thus the adherence to a defined retention time. By selecting a project-specific mixing shaft, retention times of several hours are achievable.

The introduction of thermal energy is effected via the heating jacket (contact drying) or additionally using prewarmed air (convection drying).

## Steady-state drying

When products display certain characteristics, it is sometimes not recommended to carry out drying in a purely batch manner. In this case, already dried product is initially introduced into the dryer, followed by the continuous addition of moist raw product over time. The process has to be controlled such that the moisture introduction rate due to fresh product equals the evaporation rate. The drying process is then in Steady-State. When the maximum filling level of the Dryer has been reached, the Dryer is discharged. A certain amount of dried product is retained inside the Dryer for the next batch.

### Technical Features

- Process-specific speed adjustment
- Compliance to ATEX
- Flame-proofing according to international requirements
- High efficiency due to filling degree related heat exchange surface area
- High temperature ranges up to 600°C
- Operating pressures up to 50 bar
- Highest durability against load alternation
- Wide selection of materials of construction
- Compliance with welding regulations
- International certification for pressure vessels
- Shaft seals in the form of mechanical seals, gas- and liquid-lubricated



Inside view of mixer

# LÖDIGE DRUVATHERM® MODELS VT, VTE

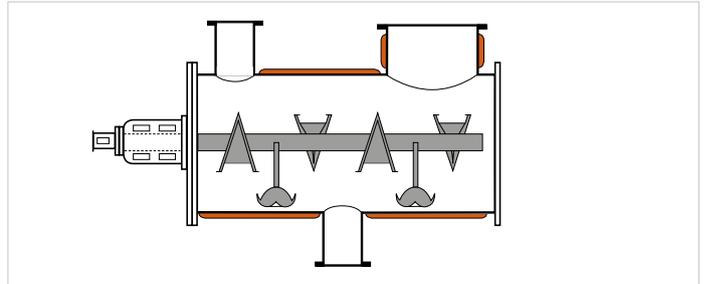
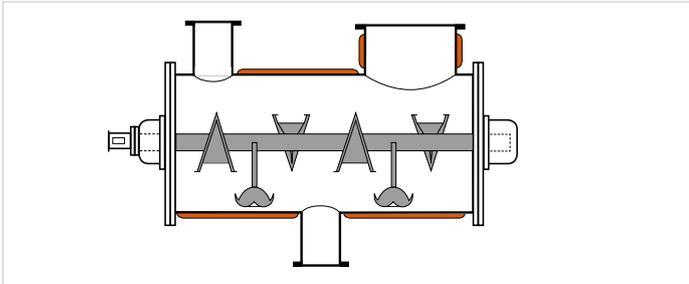
## Operation parameters of the DRUVATHERM® Vacuum Shovel Dryers

The Vacuum Shovel Dryers operate under the following parameters:

- Drum pressure -1 / 1 bar
- Jacket pressure 0 / 30 bar
- Temperature range -10 / 600°C

Construction materials like normal steels, stainless steels and special materials (for example INCONEL® or Hastelloy®) are used.

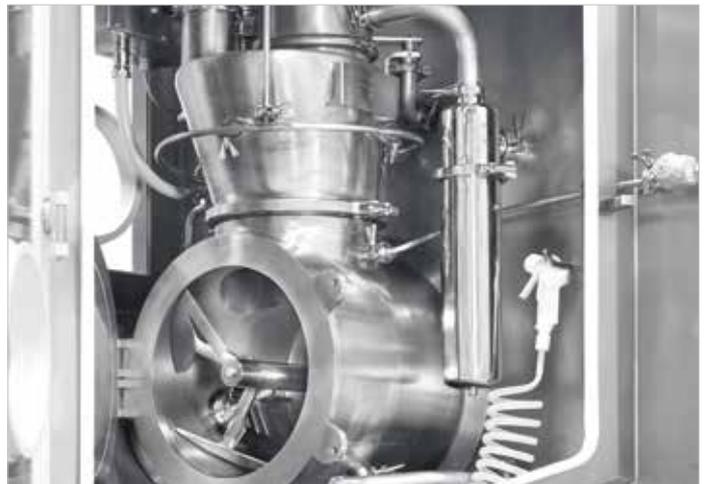
Lödige provides Vacuum Shovel Dryers for batch operation in three versions with different shaft bearing designs. Which model is used has influence on the accessibility for cleaning and inspection. A classical Ploughshare® Mixer of type FKM appropriately modified can also be used for drying processes under normal atmospheric conditions.



Vacuum Shovel Dryer DRUVATHERM® type VT 9000

### VT model VT 300 – VT 4000

The VT with bearings at each end of the dryer shaft is the classical version. An inspection door or manhole provides access to the inside of the drum. This version is particularly suitable for repetitive identical drying processes and to accommodate high drive power requirements.



Vacuum Shovel Dryer DRUVATHERM® type VT 20 in Glove Box

### VTE model VTE 5 – VTE 2000

The VTE is equipped with a bearing at one end of the dryer shaft. The endplate at the non-drive end of the machine is hinged and can be opened for access to the dryer drum, thus providing easy inspection and cleaning. As the shaft is held in a bearing at one end only, the bearing has to be suitably designed for the task.



## VTA model

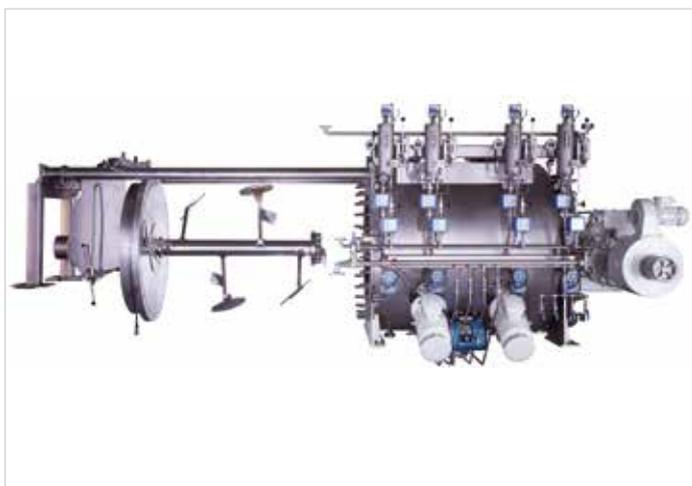
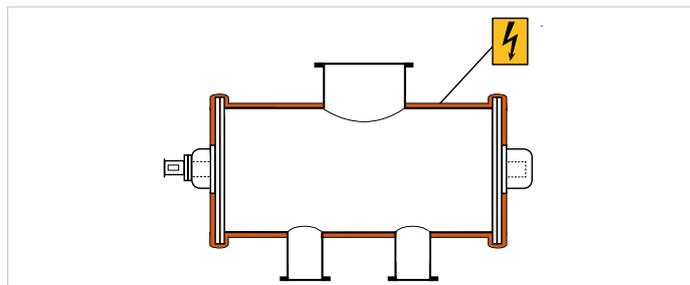
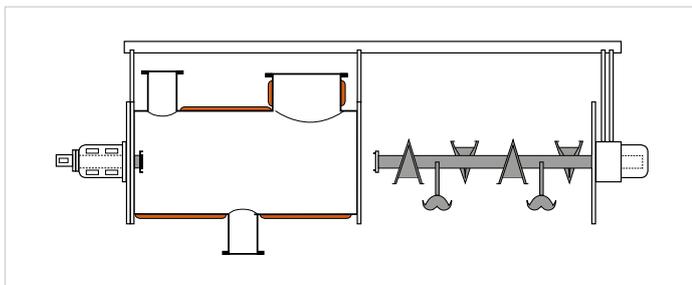
VTA 300 - VTA 6000

The VTA is equipped with a fully extractable mixing unit giving access to the complete inside of the Dryer. In this way cleaning and inspection is made even simpler. The pull-out mechanism is either motor driven or mechanically actuated.

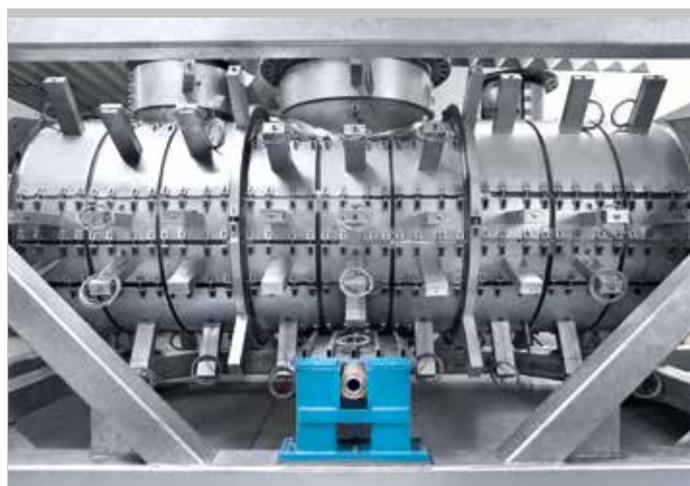
## HTR High Temperature Reactor

HTR 1200 - HTR 14000

The HTR is a special development of model in the DRUVATHERM® series which is specifically dedicated to applications at high temperatures. The detailed technical features are especially adapted to the thermal and process conditions.



DRUVATHERM® Vacuum Shovel Dryer type VTA with extractable mixing unit



DRUVATHERM® High Temperature Reactor type HTR 4200

# LÖDIGE DRUVATHERM® MODELS DVT

**The DRUVATHERM® Reactor DVT is used for drying processes and reactions with up to 50 bar gauge pressure.**

## Reactor DVT

The DRUVATHERM® Reactor type DVT provides both drying and reacting processes at overpressures up to 50 bar. In this type of machine the excellent mixing of solids by the mechanical generation of a fluid bed is put to good use. In cooperation with partners, Lödige has developed special shaft seals and shutt-off devices for use under vacuum and at overpressure. With conventional reaction processes, solid materials frequently require dispersion in liquids to ensure contact between reaction partners.

The separation and downstream treatment of the liquids after the reaction involves additional, costly process steps. The intensive, mechanical mixing in Lödige Reactors means that the liquid phase can be minimized. Downstream treatment is reduced or can be dispensed with completely. The same benefits can be implemented in liquid reactions in which solid material is produced (e.g. precipitation, polymerisation, crystallization).

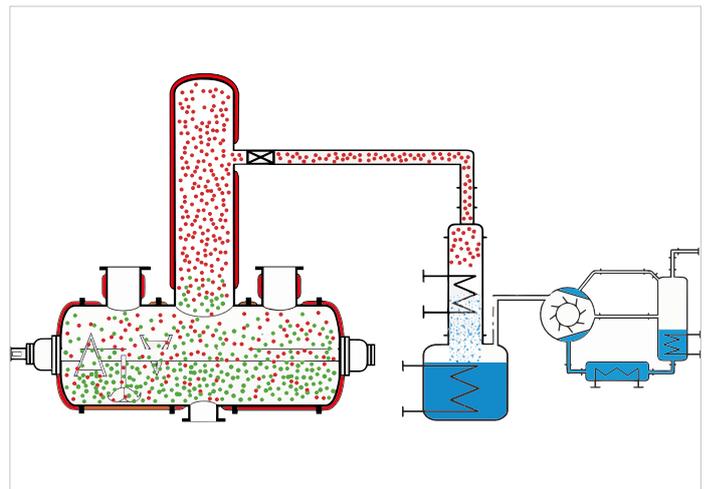
In this case solid concentration can be increased and the following steps, e.g. filtration or centrifuging, dispensed with. Drying is carried out straight away in the same machine.

Practice-proven Lödige Druvatherm® Reactors are particularly successful in the chemical industry for production of cellulose and starch ethers as well as for alkalisation processes.

## Reactor DRUVATHERM® type DVT

- Drum pressure -1 / 50 bar
- Jacket pressure 0 / 30 bar
- Temperature -10 / 600°C

Construction materials like normal steels, stainless steels and special materials (for example INCONEL® or Hastelloy®) are used.



Functional diagram of a DRUVATHERM® Reactor



DRUVATHERM® Reactor type DVT 130 with vacuum pump stand



DRUVATHERM® Reactor type DVT 20000



## Continuous process - the high skill of processing

### CGT Granulation Dryer and Stripper for continuous operation

The Dryer DRUVATHERM® type CGT is designed for continuous operation. The special feature of this Dryer is, in addition to the continuous operation, the possibility to combine convection and contact drying (aeration drying). Due to the extended residence time, products can be dried at low temperatures to protect them. At the same time excellent granulation can be obtained.

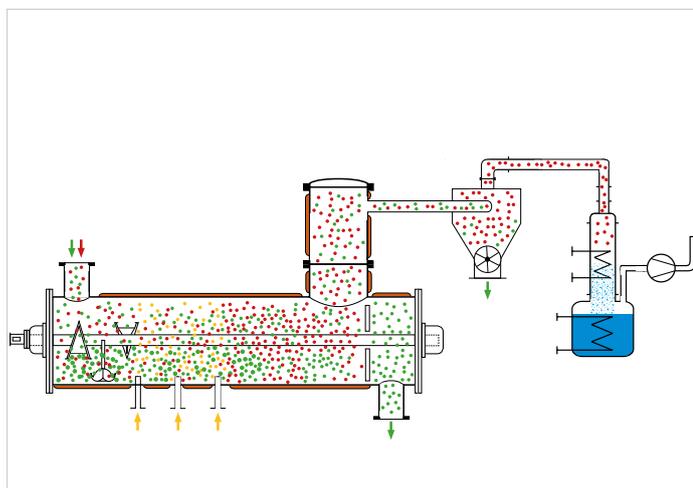
By using two CGT Dryers, a combined stripping/drying process can be run. During stripping in the first dryer, product moisture (solvent) is removed by steam. The residual water is then removed via convection drying in the second machine. This allows virtually all of the solvent to be recovered and removes the need for expensive inert gas/circulation drying. This process is often used in the field of polysaccharides.

### DRUVATHERM® Granulator Dryer and Stripper type CGT

- Volumes between 300 and 10,000 liters
- Variable retention times
- Completely heated
- Contact and convection drying
- Drum pressure -1 / +1 bar
- Jacket pressure 0 / 5 bar
- Temperature up to 160°C



DRUVATHERM® type CGT 6200



Functional diagram of a Stripper for continuous operation type CGT



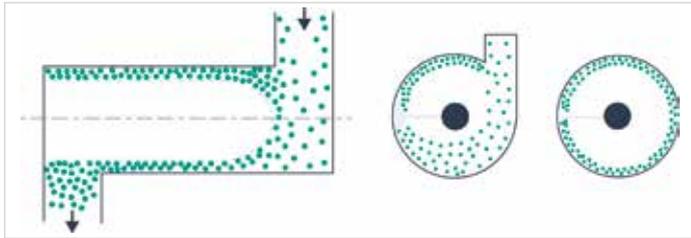
Stripper for continuous operation type CGT 2400

# LÖDIGE RINGLAYER MIXER CORIMIX® CM

## Mixing and preparation in a Ringlayer Mixer

Be it mixing, moistening, granulation or compaction – the compact Lödige Ringlayer Mixer CoriMix® type CM is perfect for a particularly wide range of applications.

The operating principle of the CoriMix® type CM is based on its high speed: The mixing tool moves the product at up to 40 m/s. The resulting centrifugal force pushes the product into a ringlayer with a high shearing intensity in its profile. This intensity is the result of the significant speed difference between the rotating, specially shaped mixing tools and the mixer wall. The filling level and speed, geometry and mixing tool settings as well as the mixing vessel length and volume throughput affect the dwell time of the components.



Principle of the Ringlayer Mixer

At the same time, the system is highly variable: The mixing compartment can be divided into zones with different shearing intensities. This permits adaptation to the individual characteristics of the products being mixed. Liquid components are guided directly into the ringlayer to ensure perfectly homogeneous distribution within the product. This also successfully prevents unwanted moistening of the mixing shaft and mixer wall. The cleaning process is also incredibly user-friendly: The drum of the CoriMix® systems can be opened along its entire length, making it easily accessible.



Ringlayer Mixer CoriMix® type CM 2500



Ringlayer Mixer CoriMix® type CM 5



# EFFICIENT SYSTEMS – ABOVE AND BEYOND THE MACHINE ITSELF

The right peripheral equipment makes a Dryer or Reactor into an efficient system. Lödige supplies complete systems with all peripheral equipment necessary for operation:

- Condenser
- Vacuum pump
- Controls
- Piping and wiring

Our experts can also take care of installing and commissioning machinery and systems. As a solution and service provider, Lödige does not just supply a Dryers or Reactors on its own. Rather, it delivers complete systems including all the necessary peripheral elements for drying and reaction processes.

The required items are defined by the drying process and the equipment already available on site. Contact drying systems allow for simple recovery of evaporated product moisture by condensation and return of this to the production process ("closed system"). There are none of the problems with exhaust air that are more or less unavoidable with convection dryers due to the large quantities of drying gas used.

This is especially important if product moistures are hazardous or environmentally dangerous, as contact dryers finally emit the vapours in the form of condensed liquid. Systems intended for multi-step reaction processes are made suitable for process requirements by consistent process design, comprehensive basic engineering and specific design of the Reactor.

## 1 Condenser

Vapours have to be condensed as they cannot be exhausted into the environment. This is carried out by a condenser which is usually operated with cooling water. In many drying processes the condensate is not disposed of, but recovered to be used again in the production process. In some cases the recovered condensate can be used as a valuable raw material.

## 2 Condensate Receiver

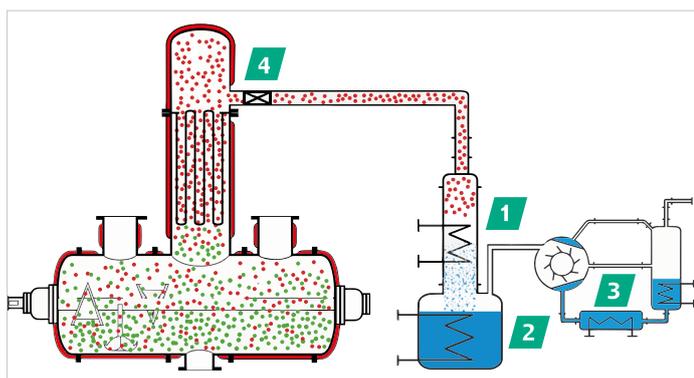
Condensate collects on surfaces of the condenser and drips into the receiver. The progress of the drying can be checked via level measurement.

## 3 Vacuum Pump

To reduce vapour pressure and thus product temperature the drying process is operated under vacuum. This reduces the boiling temperature of the product moisture and supports the removal of the vapours from the Dryer. Different types of vacuum pumps are used depending on the requirements of the process.

## 4 Piping and Wiring

After installation all peripheral equipment must be connected by piping and equipped with the necessary fittings. Extensive wiring is frequently required for automatic controls. In the case of smaller machines this can be done in the factory. The system is delivered as a package unit. Larger machines will need to be equipped with piping and wiring on site.



Functional diagram of a DRUVATHERM® with vacuum pump stand

# CERTIFIED QUALITY

**Our customer-focused quality philosophy guarantees a high level of system availability. Certified processes ensure the quality of our products and services.**

The certificates we have been awarded demonstrate our stringent quality standards. Lödige's quality management system is certified to DIN ISO 9001.

Lödige is also a certified manufacturer of pressure vessels in accordance with AD 2000 (HP0) and the ASME code (U Stamp) and holds certificates for registering pressure vessels with the National Board (USA) and in accordance with the manufacturer licence registration for the Chinese and South Korean markets.



Vacuum Shovel Dryer DRUVATHERM® type VT 30000



# EVERYTHING FROM A SINGLE SOURCE

## Lödige Test Centres

**Having more than 700 m<sup>2</sup> of floor space, the Lödige Test Centres provide trial capacity for more than 30 machines. Trials for mixing, granulating, reacting, drying and coating, representing the full range of the Lödige product line, can be carried out here.**

For the development of safe and reproducible drying and reacting processes, Lödige provides you with two state-of-the-art test centres for a wide range of testing and analyzing. During trials with your raw materials, all data relevant to the process and scale-up are measured and documented. Trials supply necessary data for correct specification of the Dryer or Reactor and peripheral equipment. A laboratory is available for initial physical analysis e.g. moisture content and particle size.



Lödige Test Centres

## Solution and Service Provider

**As a solution and service provider, we ensure the high quality of the system we supply thanks to our expert after-sales service team and provide the support required to resolve problems as quickly as possible every time – should the need ever arise.**

In addition to installation and startup, Lödige also offers professional advice regarding inspections, intervals between inspections and the number of spare parts to be held in stock. Furthermore, we provide support and advice for validation and any measures necessary for maintaining the validated condition. Lödige not only offers to you the best solution to your process task but also competent service to safeguard your investment and the long term high quality of your system.



Always on hand: that's the Lödige service



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Lödige offers high-quality partial systems and services for process engineering applications in various industries in the fields of mixing, granulating, coating, drying, reacting 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 was founded in 1938 and is a family-run company in the third generation. With the invention of the Ploughshare® Mixer, Lödige provided the industry with a mixing device that could handle a wide range of different process engineering tasks. This device forms the basis for countless innovations in the area of mixing and processing technology.

Industrial mixing and processing technology has been and still is strongly influenced by Lödige. Over 500 patents and more than 35,000 delivered machines and systems are a testimony to our expertise in customer-oriented system solutions. Lödige operates with more than 500 employees worldwide and supports its customers with a network of subsidiaries, technical offices and agencies.

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