Thermal Processing Equipment

Fluidized Bed Systems

TEMA PROCESS

About us

TEMA Process B.V. is a specialised design and manufacturing company for fluid bed systems (dryers and coolers), belt dryers and dehumidifiers. The systems are used for the drying of minerals, chemicals, food, feed, biomass, etc. The TEMA fluid bed can be applied not only for drying, but also for cooling, roasting, torrefaction, puffing, blanching, stripping, spices and herbs sterilisation and pasteurisation and calcining.

Production facility at Wapenveld, Netherlands

Assembly facility in Hattem, Netherlands

Design of fluid beds

(thermal & physical processing)

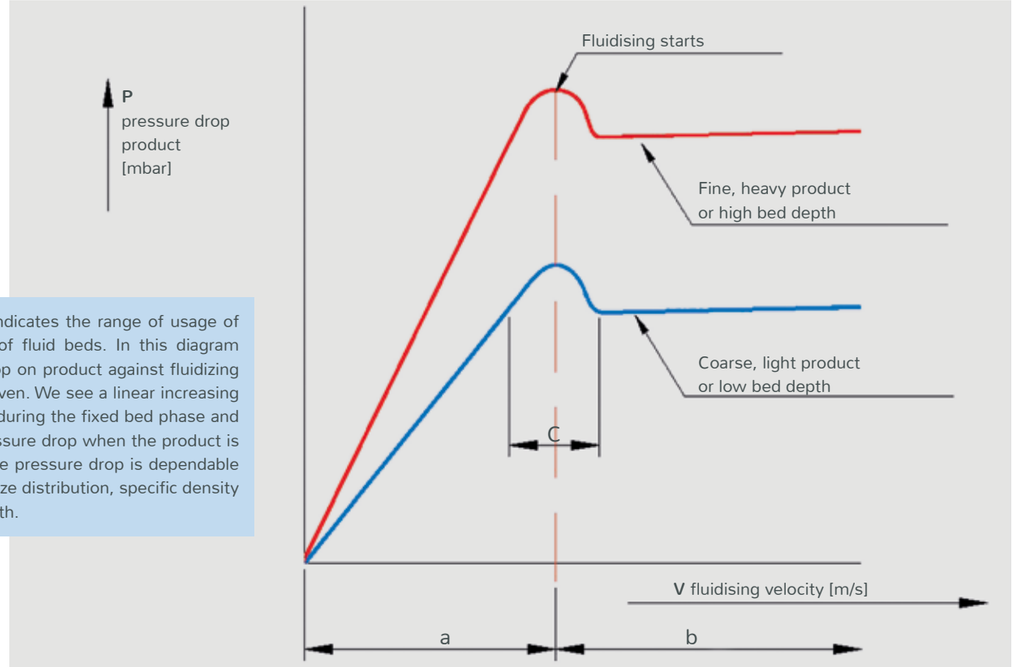
TEMA Process B.V. manufactures continuous and batch fluid beds. Batch fluid beds are used when products integrity is required for example in the pharma industry or for small quantities of product.

Continuous dryers / coolers can be delivered in static or dynamic (shaking, vibrating) fluid beds. Static fluid bed can be delivered with or without submerged heat exchangers.

Dynamic Fluid Bed Dryer

Static Fluid Bed Dryer

Figure 1.0 indicates the range of usage of both types of fluid beds. In this diagram pressure drop on product against fluidizing velocity is given. We see a linear increasing of pressure during the fixed bed phase and a stable pressure drop when the product is fluidizing. The pressure drop is dependable on particle size distribution, specific density and bed depth.



Design of fluid beds

(thermal & physical processing)

- **Fixed bed** Moving fluid bed
  (gravel, fibres, pellets)
- **Fluidised bed** **Static fluid bed**
  (non sticky powders, homogenous materials)
- **Moving fluid bed**
  (powders, inhomogenous materials)
- **Semi-fluidised bed**
  Alternative between fluidised and fixed bed (long residence time food products and granules)

Sea-salt Dryer, Italy

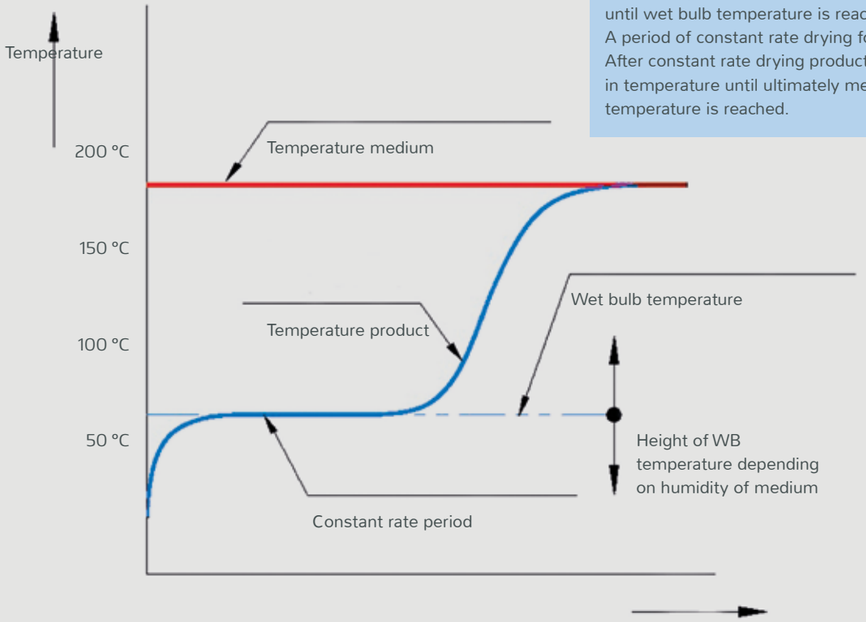


Figure 2.0 shows a typical processing curve in a fixed, semi fluid or fluidized bed. Temperature of processing medium is constant, product inclines in temperature until wet bulb temperature is reached. A period of constant rate drying follows. After constant rate drying product rises in temperature until ultimately medium temperature is reached.

Treatment of products

Thermal treatment

- **Drying**
  Removal of liquids by evaporation in a fluid bed dryer for thermally treating of powders, fibres, crystals and pelletized or extruded materials.
- **Cooling**
  After heating the product during the drying process in most of the cases cooling is required. The fluid bed cooler can be integrated with the dryer or supplied as a separate unit.
- **Calcining**
  Thermal process to remove and evaporate crystalline water.
- **Roasting / Texturization**
  Heat treatment to influence taste, flavour and texture.
- **Torrefaction**
  Torrefaction of biomass is a mild form of pyrolysis at temperatures typical ranging 200 – 320 °C. During torrefaction the biomass properties are changed to obtain a much better fuel quality for combustion and gasification applications.
- **Puffing**
  Products like rice and wheat are expanded at a high temperature resulting in a lower bulk density and to obtain better cooking properties.
- **Sterilization & Pasteurization**
  Natural ST-HT steam sterilization & pasteurization for spices, herbs & botanicals, dried vegetables, seeds & nuts.
  High and low temperature between 103 – 122 °C (Sterilization) and 85 – 98 °C (Pasteurization) within maximum of 60 seconds treatment time followed by a drying and cooling process.
- **Blanching**
  Heat treatment to deactivate enzymes and removal of peels.
- **Steam Stripping / Inertgas Drying**
  Removal of solvent either by inert gas heating or by direct exposure of steam.

Ethanol stripper, Brazil

Treatment of products

Changing physical properties

- **Agglomeration**
  Binding of particles by spraying liquids in a fluid bed.
- **Dedusting**
  Fines removal in a fluid bed by defined entrainment velocities.

Sand dryer-cooler with heat recovery, Poland

Products

(direct or indirect supplied to the fluid bed

- **Direct supply**
  Crystals, fibres or fibrous materials, granules, pellets, gravel type products up to 30 mm, powders D^{50} bigger than 80 micron, polymers
- **Indirect supply**
  Liquids, slurry, filtration cake, pastes

Medium

(temperature up to 750 °C)

Air (dry or humid), steam, inert gas

Heat source

(supply medium direct or indirect)

- Natural, bio-, propane and waste gas (direct and indirect fired), steam (direct and indirect), thermal oil (indirect) diesel and oil (direct and indirect fired), dessicant air (direct), water (cooled or chilled - indirect)

Exhaust system

Cyclones	size diameter	300	-	2000	mm
Scrubbers	size diameter	500	-	4000	mm
Bag filters	size	50	-	2000	m^2

Materials of construction

- Mild steel
- Heat resistant steel 16 Mo 3
- Heat resistant stainless steel 153 MA, AISI 321,1.4878
- Duplex steel
- Stainless steel AISI 304 (L), 316 (L), 904L, 254 SMO
- Titanium

Spice sterilizer-dryer, Indonesia

Poultry litter dryer, Netherlands

Fluid bed units

A fluid bed is an effective unit to thermally treat powders, crystalline products, pelletized or extruded materials. High heat and mass transfer are obtained as a result of the intimate contact between fluidizing air and product.

Shaking fluid bed

units for continuous operation and suitable for sticky materials with a wide particle size distribution. The shaking motion improves the fluidization and transport of any material within the fluid bed. Drying gas temperature up to 750 °C and product temperatures up to 400 °C are achieved.

Static fluid bed

units in continuous and batch type for more uniform materials that do not tend to agglomerate. It is possible to install submerged heat exchangers in a deep static bed. With submerged heat exchangers energy input is both from the fluidizing air as well as from the heat exchangers reducing the size of the equipment and limiting the exhaust air volume.

Decontamination plants

for treating food products both at high pressure and atmospheric pressure. Products are exposed to a live steam atmosphere for a short and determined period to reduce the bacterial load of the material. After steam treatment the products are dried and cooled in either a fluid bed or a flash dryer.

Belt dryers

for continuous drying of pellets or agglomerates mainly used for products that are not suitable for fluid bed drying. The materials that are sticky, of which the particle size is too large or the required residence time above 1 hour. These dryers are manufactured with single and multi-stage belts. Housing and belts in mild or stainless steel.

Flash dryers

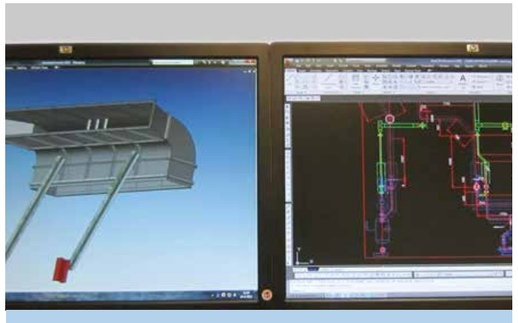
for fine sized materials and removing mainly surface moisture. Wet material is conveyed and dried in a hot air stream, drying is

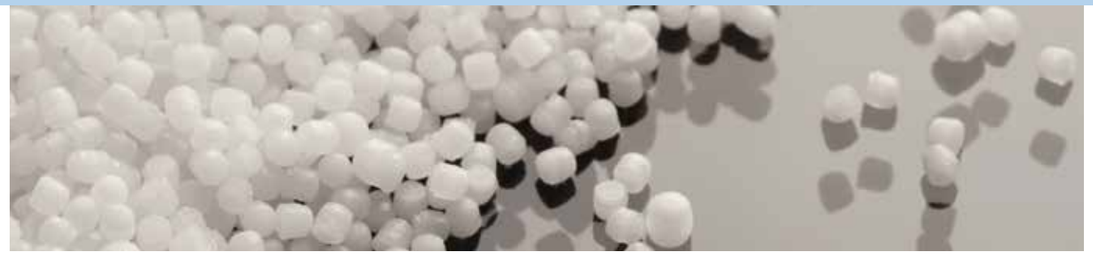
Air handling equipment

associated with the above drying systems including air heating systems, cyclone separators, bag houses, wet scrubbers, ducting etc.

Engineering and procurement

of material handling systems that are directly associated with the drying system.

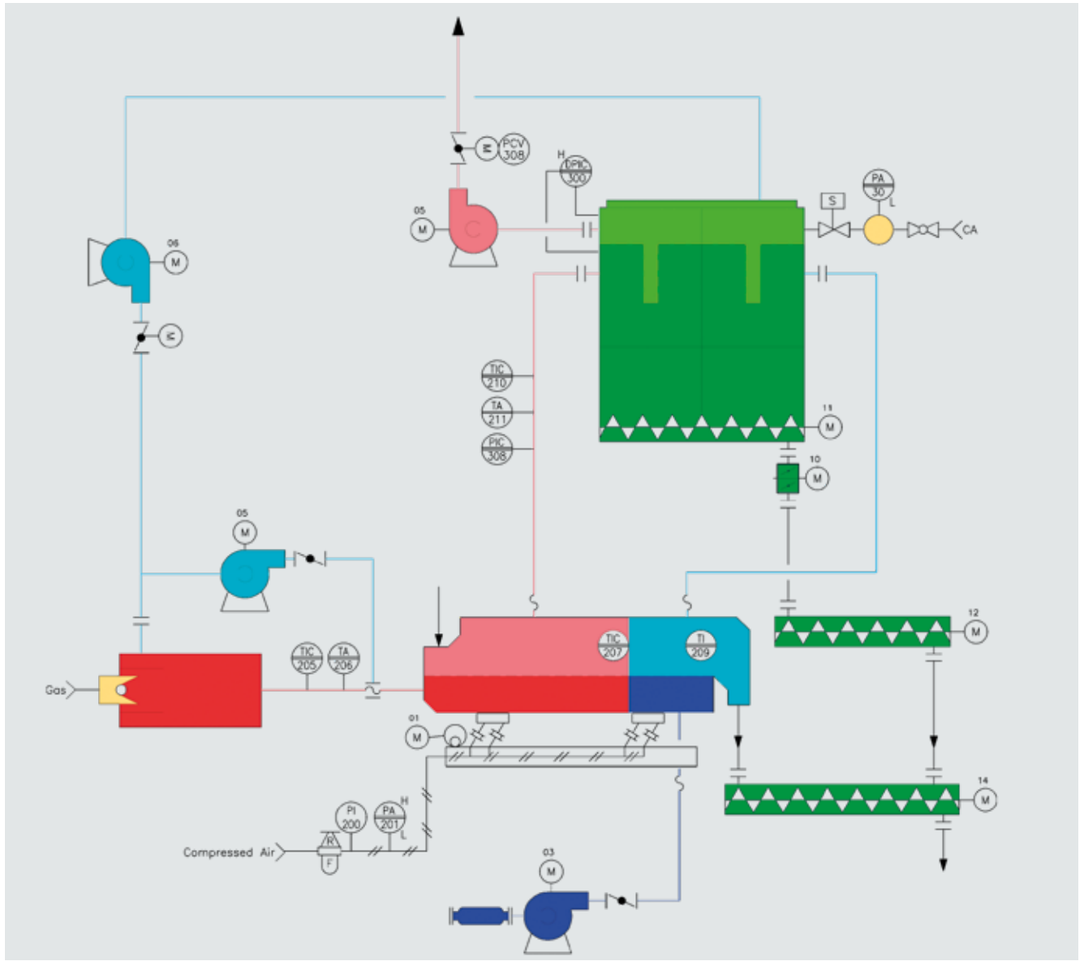




Fluid bed dryers are used for processing natural materials, our systems are designed to minimize energy usage, easy to maintain and operate, rigid construction for challenging environments.

The systems are used for drying, cooling, calcining, dedusting, etc.

Sand dryer-cooler, South-Africa



Our equipment & plants can be successfully used for several products in the Mineral Industry.
Some examples are:

- Sand
- Limestone
- Gypsum
- Betonite
- Leonardite
- Perlite
- Quarz
- Slag
- Clay
- Kaolin
- Fly-ash
- Marble
- Puzolan
- Mineral ores
- Frac sand

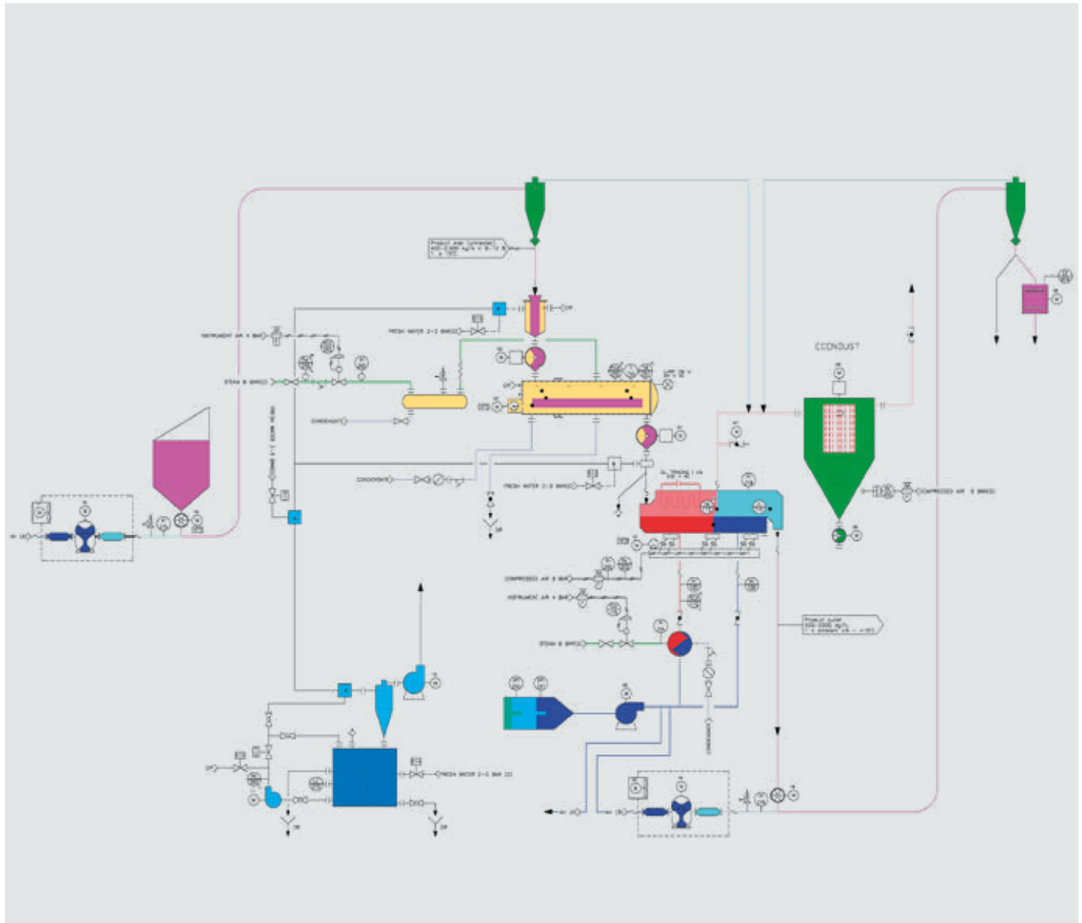
Sand dryer-cooler, Germany

Food and Feed Industry

Fluid bed systems are used for a wide variety of food and feed ingredients, hygienic design as requested in this industry with gentle and even drying to preserve the quality of the materials. Special executions with CIP, GMP design, increased residence time, operating with low oxygen levels are available.

The systems are used for drying, cooling, roasting, expanding, removal of solvents, cooking, decontamination, deactivating, etc.

Bread crumbs dryer-cooler, Netherlands



Our equipment & plants can be successfully used for several products in the food and feed industry. Some examples are:

- Rice
- Sugar
- Maiz
- Cereals
- Flour
- Gelatine
- Coffee
- Salt
- Starch
- Herbs
- Spices
- Seeds
- Pectin
- Paprika
- Potato
- Citrus waste
- Peanuts
- Tea
- Lactose
- Seaweed
- Fruits
- Vitamins
- Proteins
- Roots
- Sucrose
- Soya
- Fructose
- Bread crumbs
- Fish meal
- Fish feed
- Carob
- Cacao

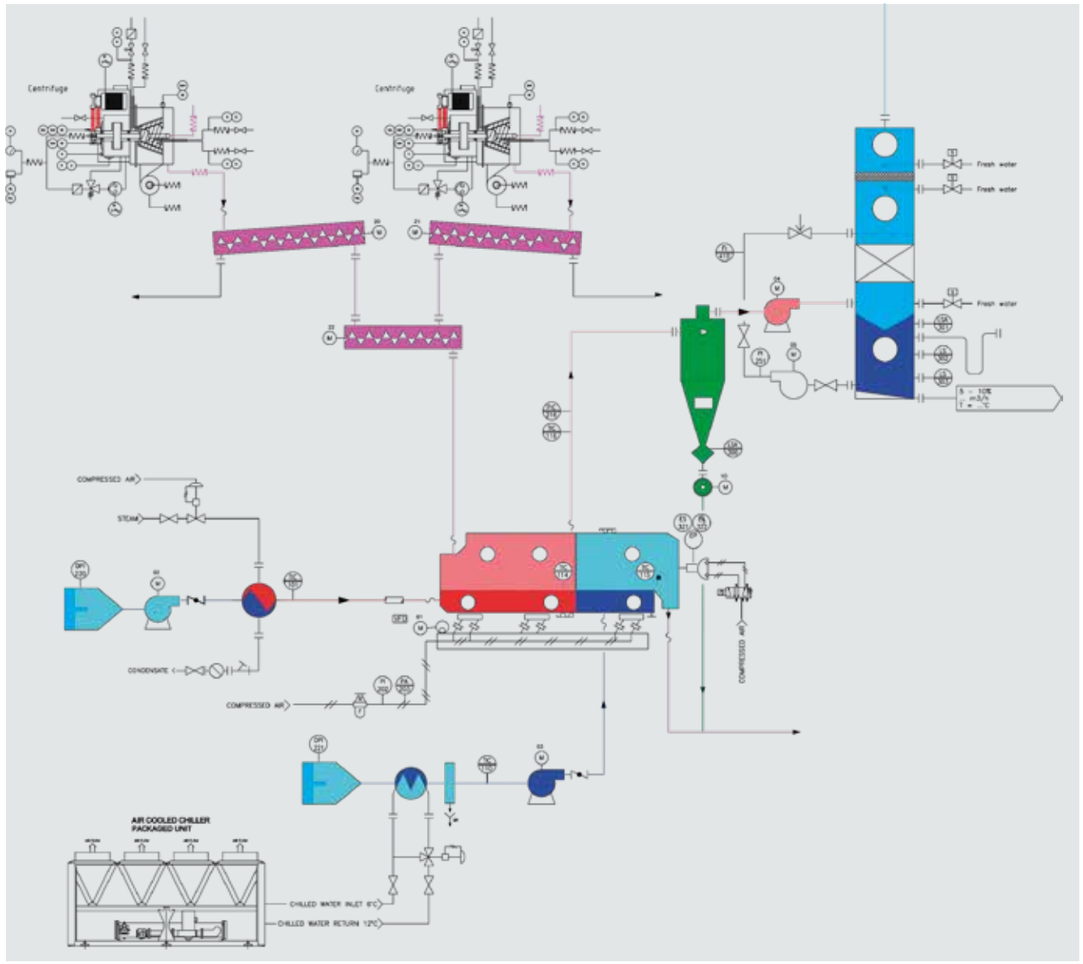
Rice dryer-cooler, Spain

Chemical Industry

In the chemical industry fluid bed dryers are used to dry all kinds of crystalline materials, powders, extrudates, etc. Special care is taken to select the correct material of construction, minimize effluent to the environment, reduce energy consumption.

Systems are used for drying, cooling, removal of solvents, chemical reactions, etc.

Chemical dryer-cooler, Spain



Our equipment & plants can be successfully used for several products in the chemical industry.
Some examples are:

- NaCl
- NH4-CIN
- Na2SO4
- CaCO3
- CuSO4.H2O
- CaCl2
- KCl
- K2SO4
- MgCl2.2H2O
- MnSO4.4H2O
- Polymers
- MgSO4.4H2O
- Ethylene Propylene
- PVC
- Polypropylene
- Hard plastics
- CMC
- Potassium
- Acrylic grains
- Cellulose
- ZnSO4
- Formaldehyd usw.

Chemical dryer-cooler, Mexico

Biomass and Waste Industry

In the biomass and waste industry fluid bed dryers are used to dry biomass materials and solid waste materials, sludges and slurries, in order to increase the heating value for biomass and alternative fuels and reduce the volume.

Drying takes normally place at lower temperatures between 100 - 200 gr. C by use of waste heat from CHP or boilers.

Poultry litter dryer-cooler, Netherlands

RDF/SRF dryer-cooler RiverRidgeRecycling facility

Our equipment & plants can be successfully used for several products in the biomass industry.
Some examples are:

- Wood chips
- Sludge
- Peat
- Empty Fruit Brunches
- Saw dust
- Manure
- Coconut fiber
- Coal
- Municipal Solid Waste
- Digester sludge
- Prunings
- Paper sludge
- Cokes
- Bamboo
- Plastics from MSW
- Organics from MSW
- Shavings
- RDF

Citrus peel dryer-cooler, Bolivia

Designing & Engineering

Manufacturing

Installation & Commissioning

Testing facilities

TEMA Process B.V. offers testing facilities to determine best possible product performance:

- On laboratory scale
- Pilot plant scale
- Industrial size

These test dryers are available in our testing facilities but can also do the test work at your production site with the professional support from our experienced engineers.

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