



## Thermal Processing Equipment Fluidized Bed Systems

# Introduction

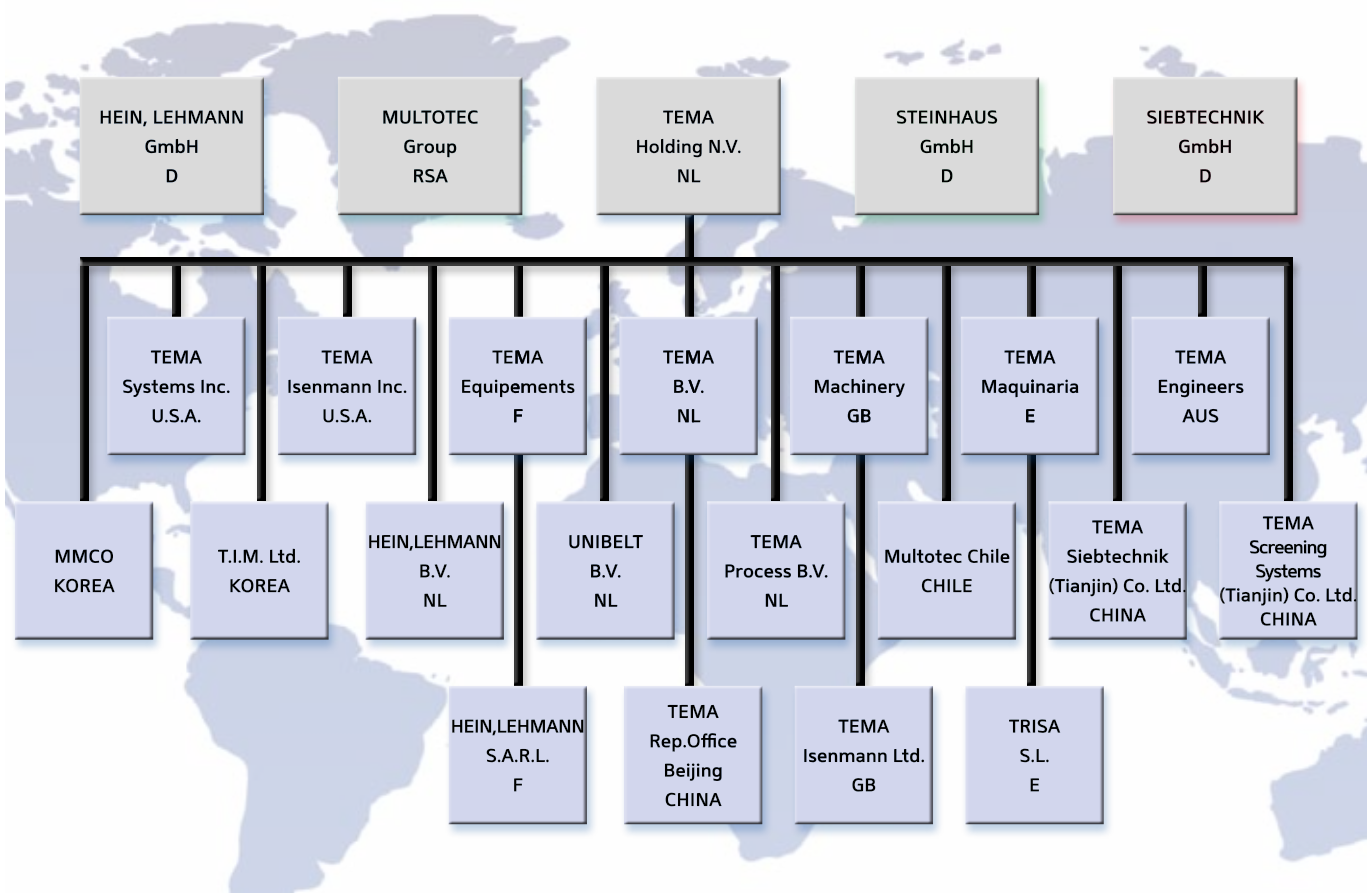
TEMA Process B.V is a young Company but its management and employees have many years of experience in the design and manufacturing of

thermal and physical process equipment, mainly fluid bed dryers / coolers with associated equipment & plants.



TEMA Process B.V. belongs to the Group of Companies below that has grown over the last, almost 90 years, to more than 45 Companies worldwide with a total

number of employees of approximately 2.700 and has approximately 360 Mio € of annual turnover.



# 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.

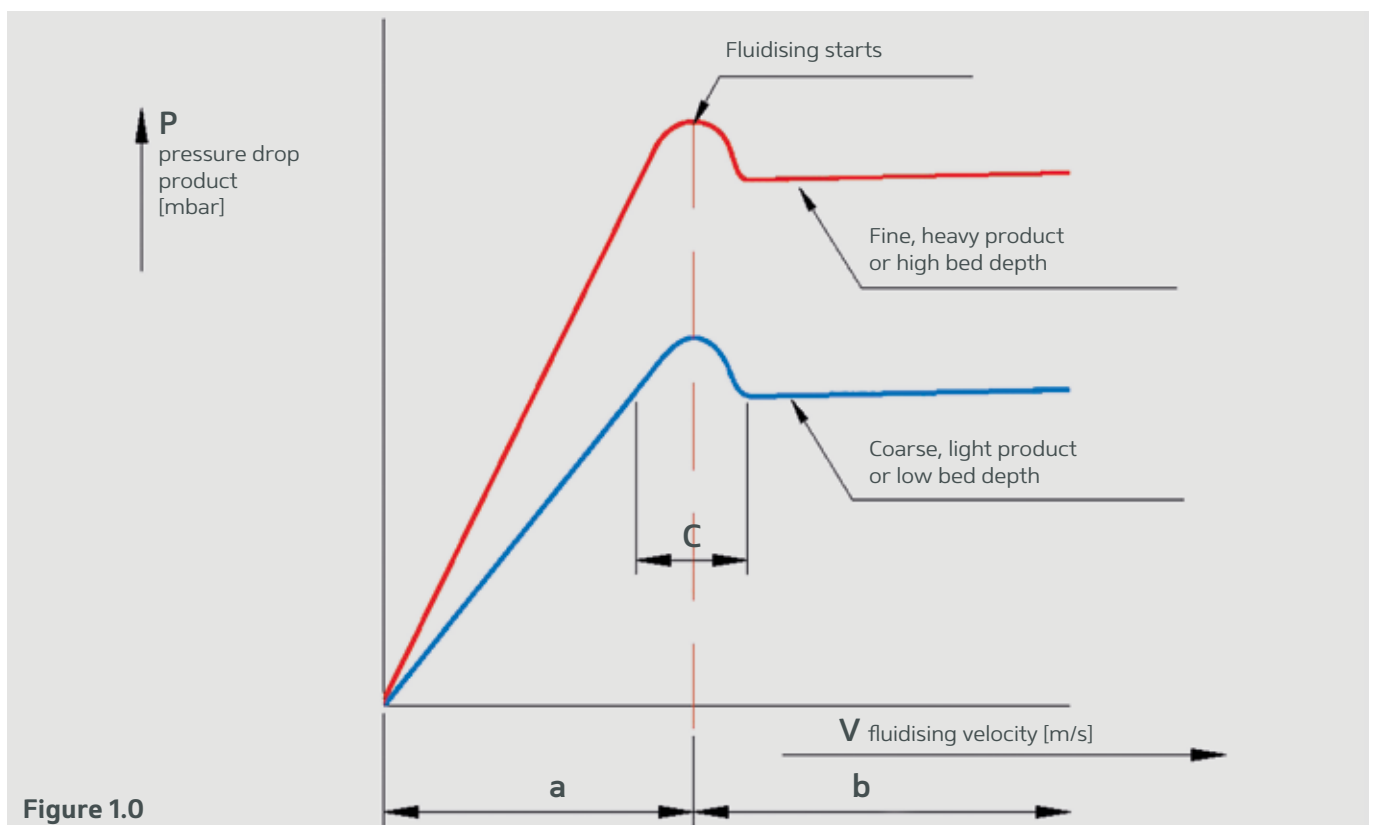


Figure 1.0



# Design of fluid beds (thermal & physical processing)

**Fixed bed** Moving fluidbed (gravel, fibres, pellets)

**Fluidised bed** *Static fluidbed* (non sticky powders, homogenous materials) *Moving fluidbed* (sticky powders, inhomogenous materials)

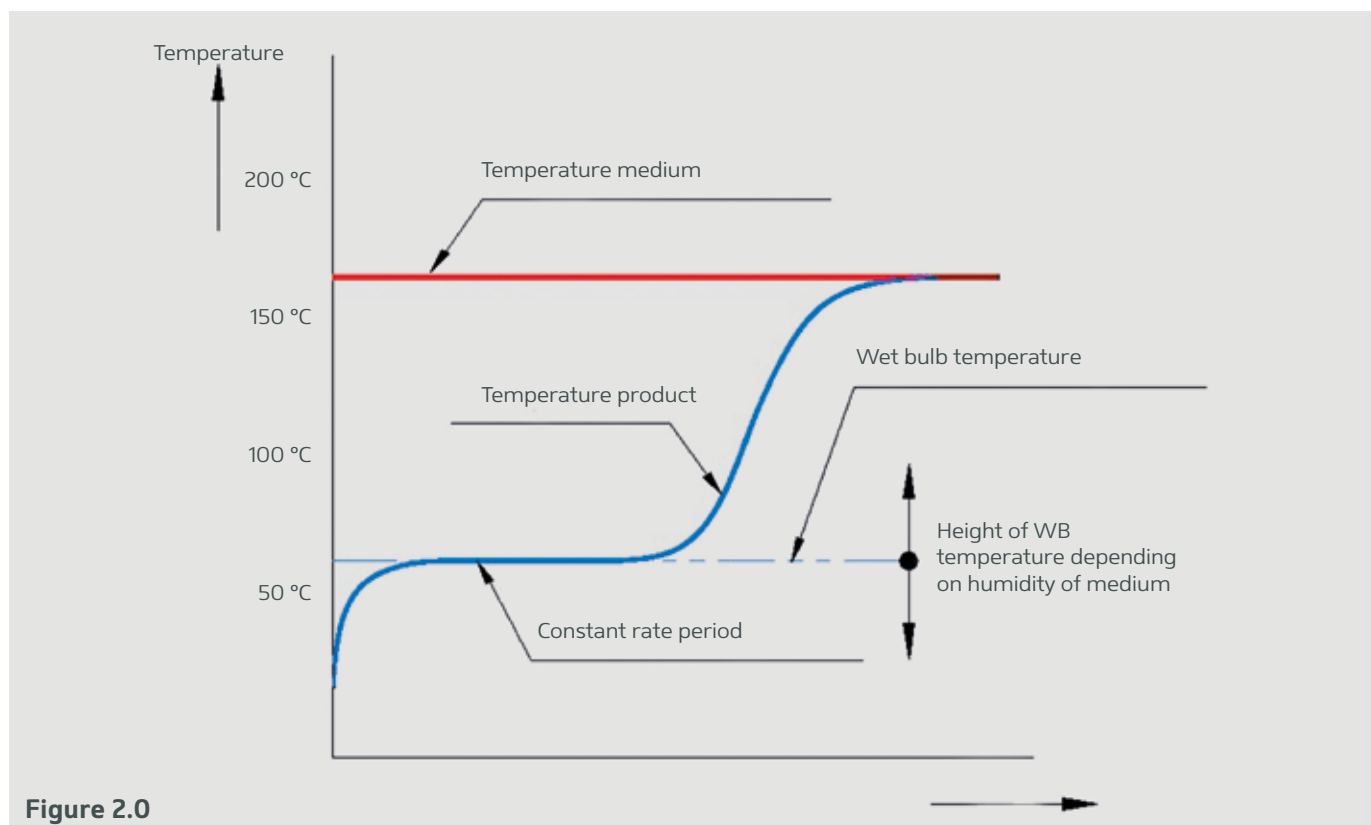
**Semi-fluidised bed** Alternative between fluidised and fixed bed (long residence time food products and granules)



**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.



**Figure 2.0**

# 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.



# 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.





# Products

(direct or indirect supplied to the fluidbed)

## 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 <sup>2</sup>

# Materials of construction

Mild steel

Heat resistant steel 16Mo 3

Heat resistant stainless steel 153 MA, AISI 321, 1.4878

Duplex steel

Stainless steel AISI 304 (L), 316 (L), 904L, 254 SMO

Titanium



# Delivery program

**Fluidbed units:** A fluidbed 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 fluidbed** 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.





# Delivery program

**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.



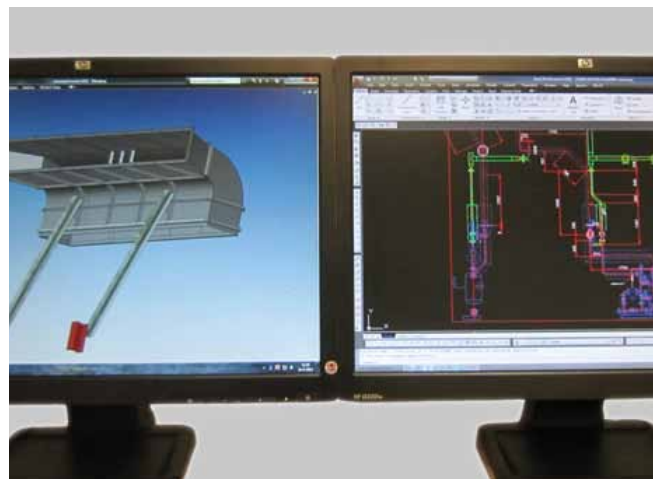
**Belt dryers** for continuous drying of pellets or agglomerates mainly used for products that are not suitable for fluid bed drying. The materials that are sticky, of which the particle size is too large or the required residence time above 1 hour. These dryers are manufactured with single and multi-stage 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 typically achieved within seconds.



**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.

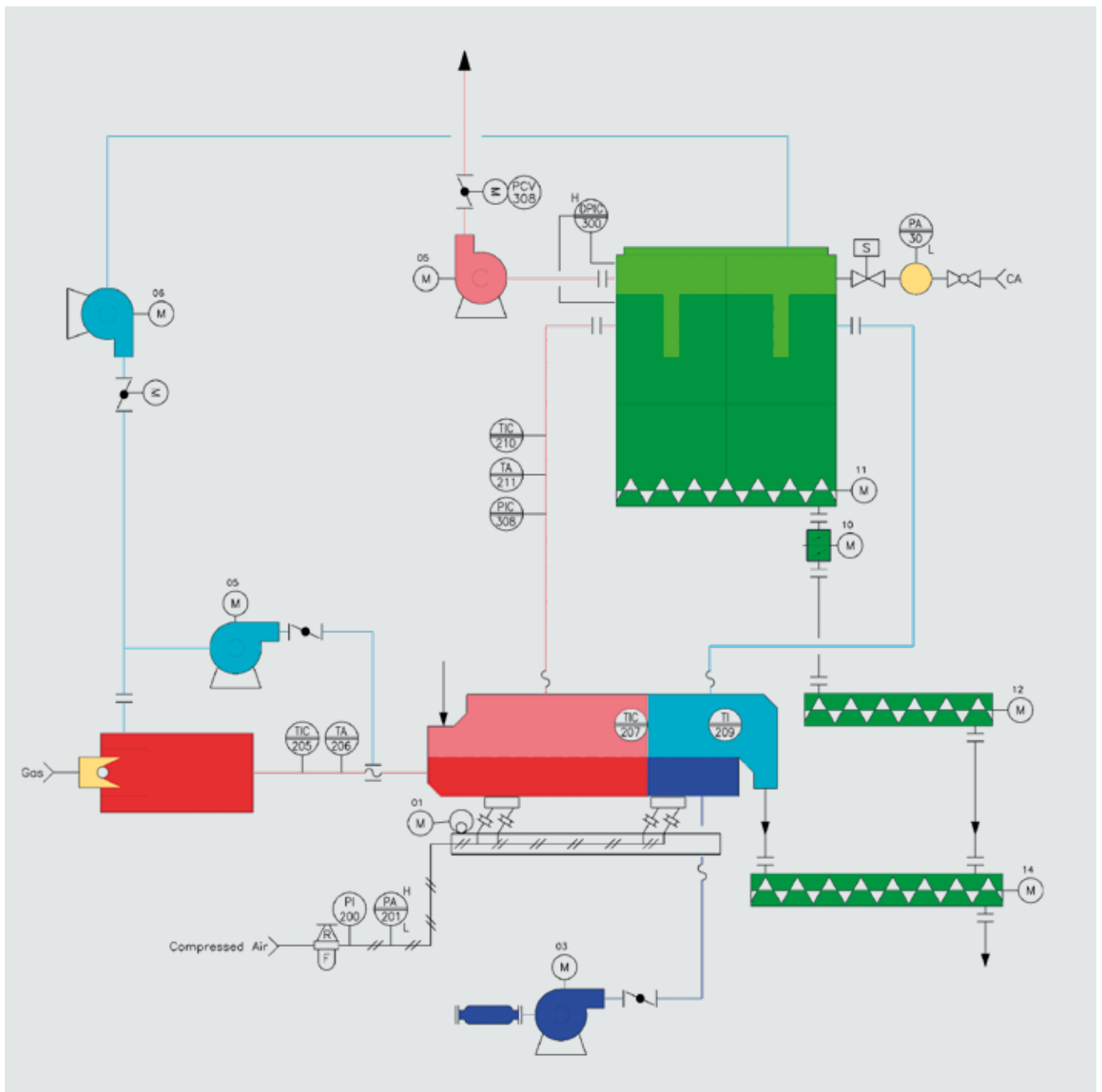


## Mineral Industry

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.





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

Sand, quartz sand, gypsum, slag sand, limestone, kaolin, potash, phosphates, coal, mineral ores etc.







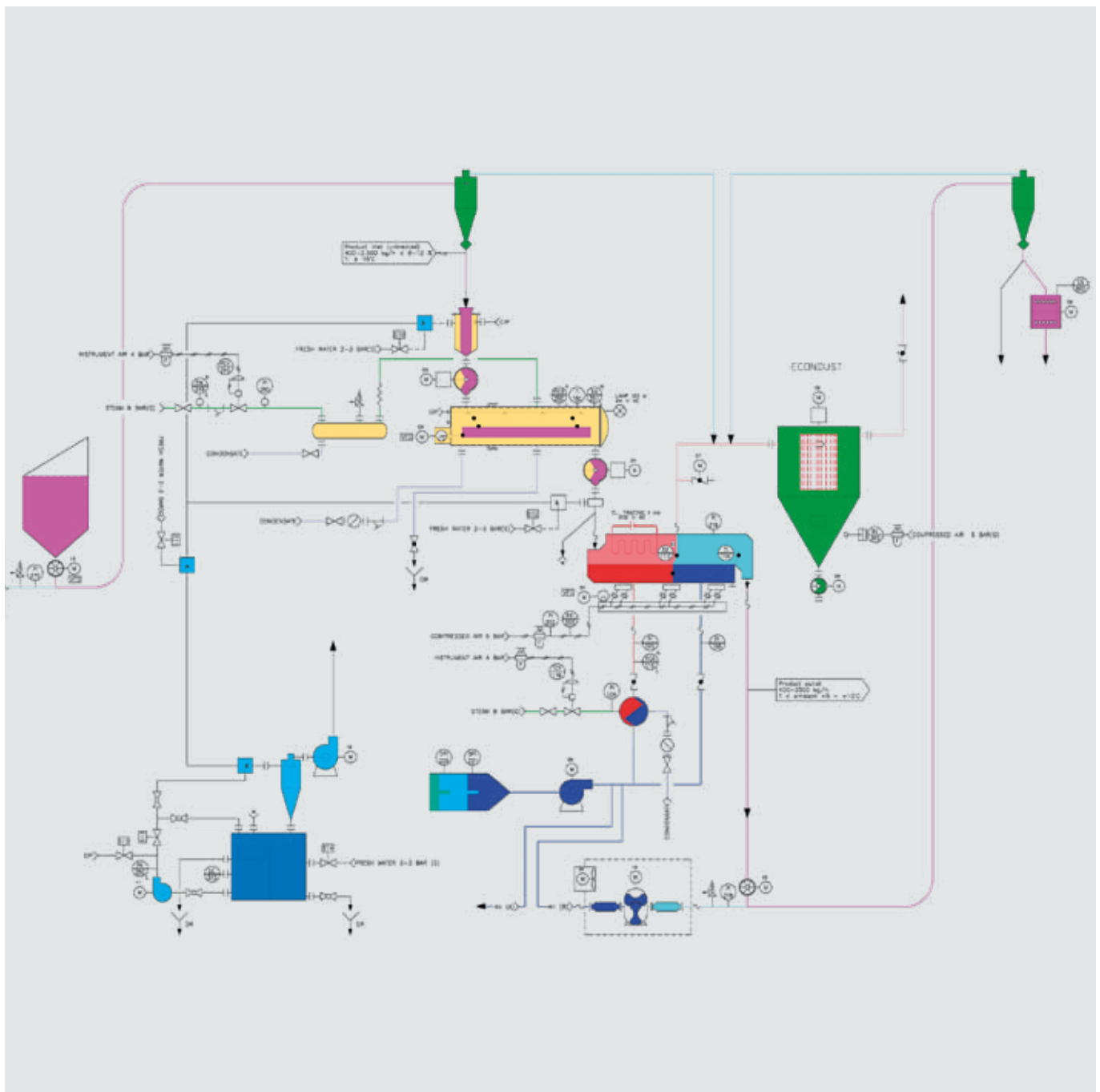
## Food and Feed Industry

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.





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

Breadcrumb, rice, sugar, dextrose, herbs and spices, flaked or extruded cereals, milk powder, lactose, tomato and citrus pulp, fish meal, fish feed, animal feed, return bread, etc.





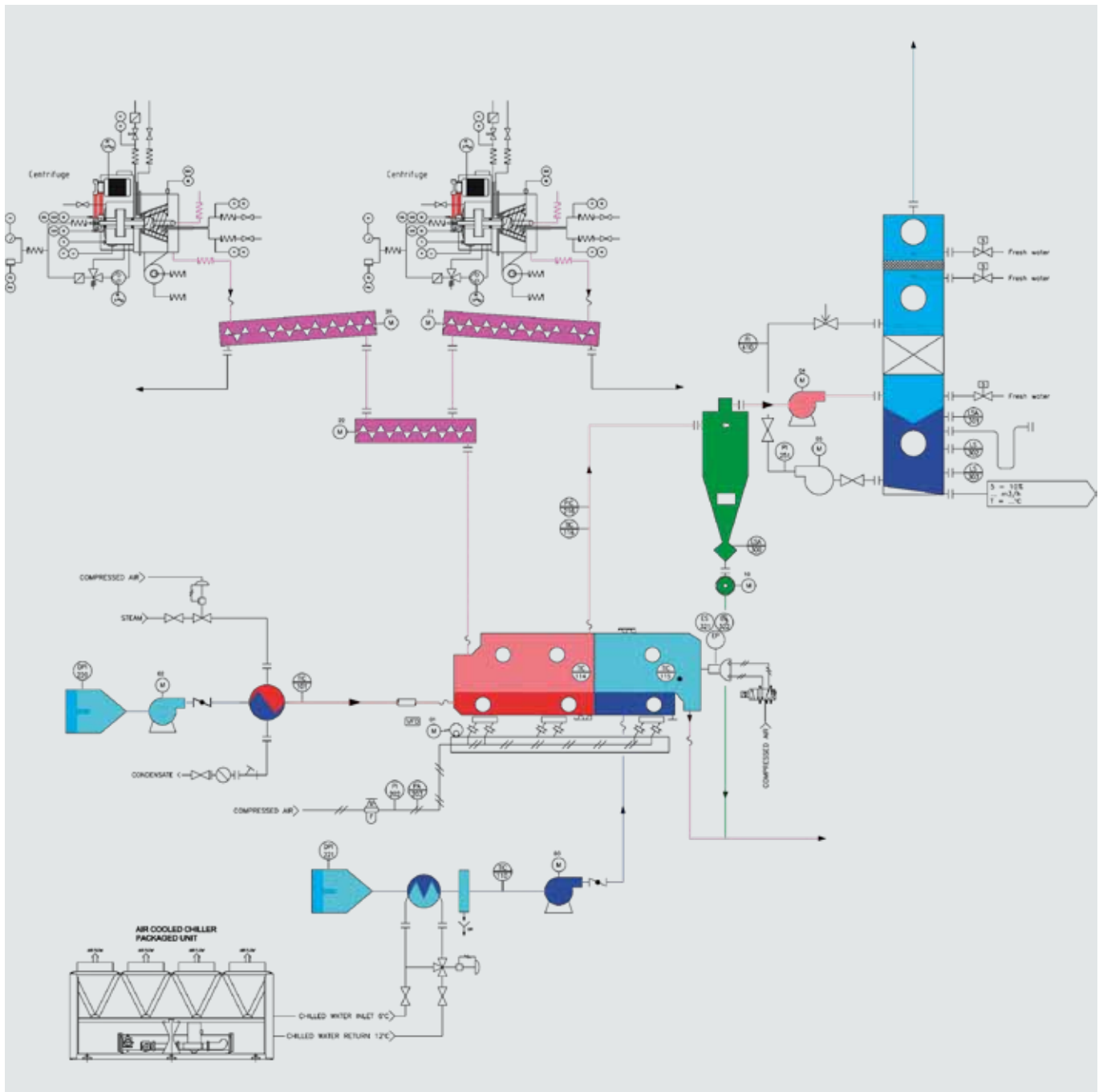
In the chemical industry fluid bed dryers are used to dry all kinds of crystalline materials, powders, extrudates, etc. Special care is taken to select the correct material of construction, minimize effluent

to the environment, reduce energy consumption.

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







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

Salts, sodium chloride, herbicides, CMC, detergents, ammonium sulphate, sodium sulphate, kalium sulphate, polymers, PVC, PVDC, fertilizers, plastics, EPS, fibres, metal salts.



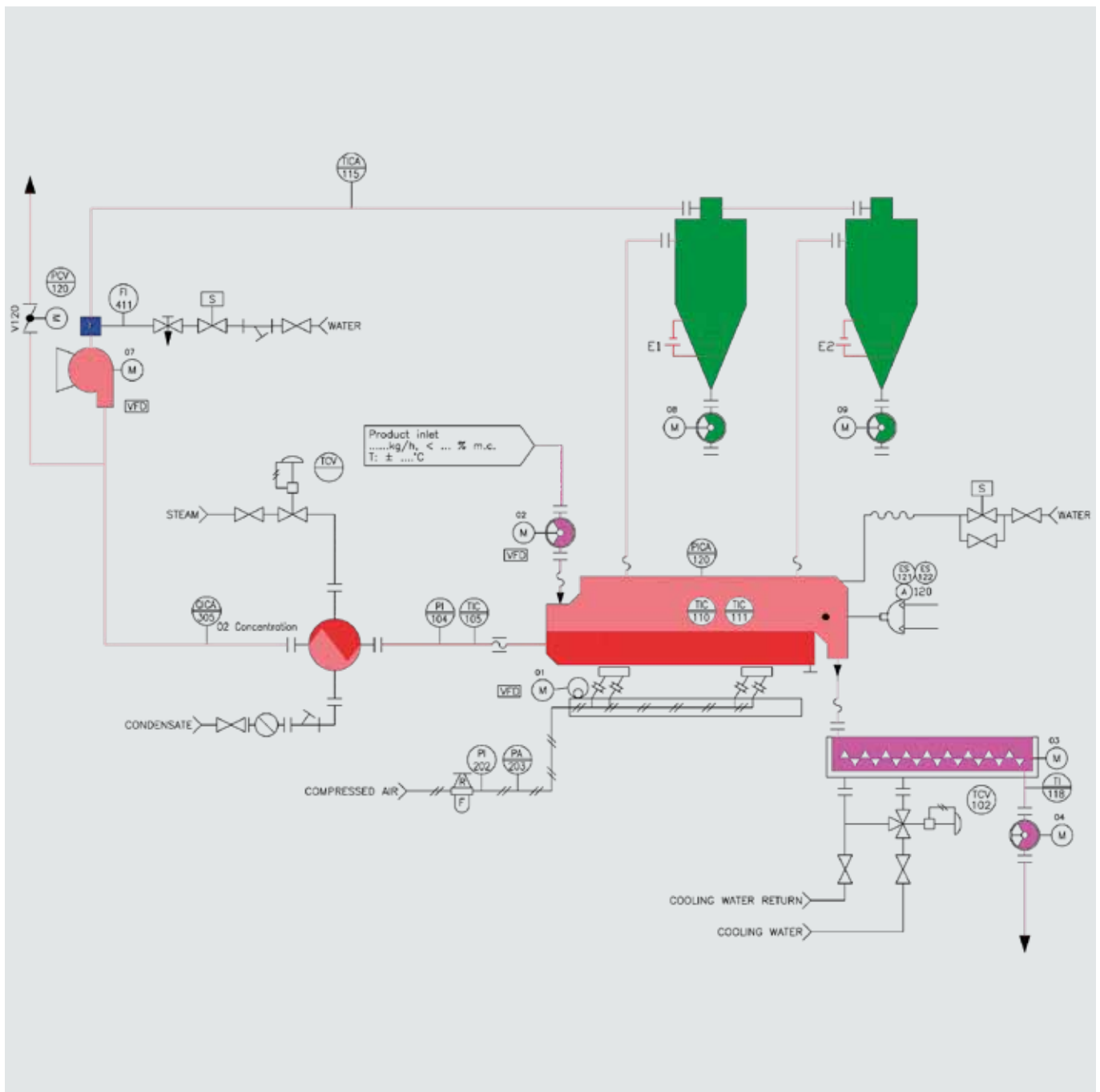


## Biomass Industry

In the biomass industry fluid bed dryers are used to dry residues, sludges and slurries. Most of the systems are in closed loop to reduce emissions,

odour level. Slurries and sludges are back mixed to a free flowing granule before drying. Reduced oxygen level to prevent fires and dust explosions.





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

Orange and lemon peel, sludge, manure, paper sludge, wood, biomass, etc.





## 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.



# TEMA Process B.V.

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