

# COMSPAIN

COMPANÍA DE MANUTENCIONES ESPECIALES ESPAÑA, S.A.



**Industrial Equipments**

# Fluidization Engineering

# FLUIDIZATION ENGINEERING

## The phenomenon of fluidization

Place a quantity of fine solid particles in a glass column, the bottom of which is made of a porous or perforated plate.

Pass a gas through the porous or perforated plate, and let it rise slowly upward through the bed of solid particles. You will see that the gas percolates through the particles, separating them from each other. As the gas flow increases, the separation gets larger, and the bed expands, then bubbles appear. This is the state called fluidization: solid particles dispersed in a gas to form a fluid mass which behaves like a liquid.

Note: if the gas flow is increased beyond fluidization, the solids then reach a condition in which they are pneumatically transported in a lean phase.

## Therefore: fluidization is a state of dynamic balance of a solid in a fluid

A fluid bed is an intermediate between two limiting states: the state in which solid particles are at rest... and agitated state of lean phase pneumatic transport.

The fluidized bed occurs in two phases: one, a smoothly fluidized bed in which the gas is uniformly distributed between the solid particles with little or no bubbling, two, an agitated bubbling fluid bed. In the agitated bubbling bed, the solid particles are in vigorous agitation and have a very high capacity for heat transfer.

Ideal fluidization is obtained when agitation of the solids and size of the bubbles are balanced. Therefore, it is very important to give careful consideration to the design of the gas flow, the size of the processor for the job to be done, the gas diffusion plate, the bed height and the method of heating and cooling.

In most cases, it is important to experimentally check the fluidization characteristics of a material before designing the system. A well-equipped laboratory for this determination is essential.

## COMSPAIN'S capability in fluidization

All processes and equipment proposed by COMSPAIN are described in this document.

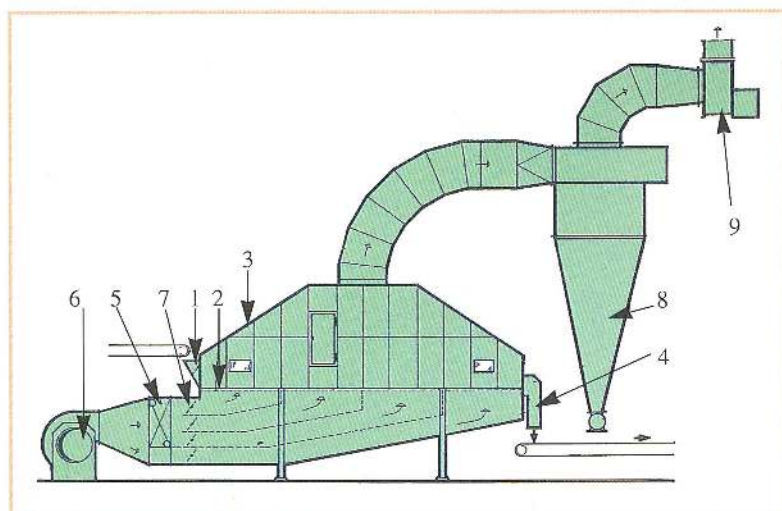
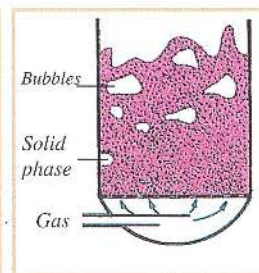
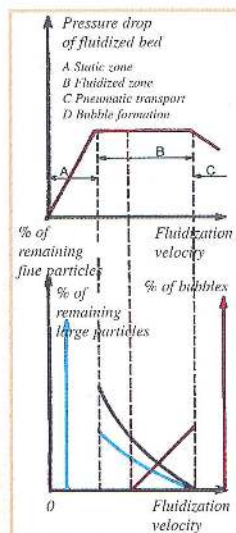
The process applications are very numerous, for example: drying, cooling, calcining, desolventizing, reactions sterilization, granulating, pyrolysis, incinerating, heat treatment, mixing, and others.

The fluid bed processor is a closed container in which a distributor plate is secured some distance from the bottom. The volume beneath the distributor plate is the fluidizing gas plenum chamber, and above the distributor plate is the fluid bed processing region. Distributor plates may be perforated sheet, porous metal, our proprietary tuyere type or others, depending upon the requirements of a given application.

The plenum chamber is generally subdivided into several sections to provide the optimum fluidisation velocity at each stage of processing. The temperature of the fluidising gas can be changed for each plenum section and the final sections can be cooling zones to discharge low temperature product.

The behaviour of the fluidised product is remarkably similar to a liquid. The processed product is discharged by overflowing an adjustable weir. Adjustment of this weir controls the level of product in the unit and facilitates emptying the unit when necessary.

Products fines are collected by cyclones or other suitable systems and are usually remixed with product before or after the overflow discharge weir.



These fluid bed units are utilised primarily for drying. Fluidising air is heated by means of steam or oil in an air heater. Hot gases can be used from a direct fired heater for products which can withstand high temperatures and air quenched gases. These units are also used for cooling applications.

- 1.- INLET CHUTE
- 2.- DISTRIBUTOR PLATE
- 3.- HOOD
- 4.- DISCHARGE
- 5.- AIR HEATER
- 6.- BLOWER
- 7.- HOT AIR DAMPERS
- 8.- CYCLONE
- 9.- EXHAUSTER



*Static Fluid bed for Chemicals Products.*

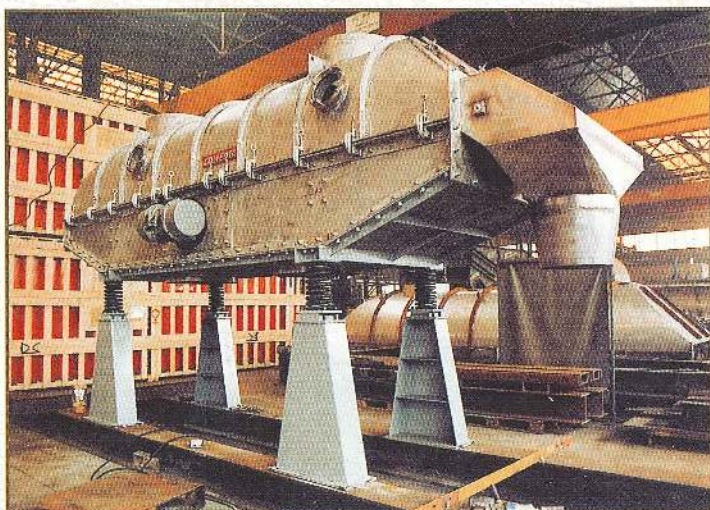


*Vibrating Fluid bed supported by blades.*



*Static Fluid Bed Cooler-Fertilizers.*

*Special Fluid bed for foods or pharmacology.*



*Vibrating Fluid bed supported by springs.*

## **DRYERS, CALCINERS, REACTORS, GRANULATORS...**

Calculations and simulations by means of computer: drying, cooling, iteration for cooling in double step, cost, speed of fluidisation, flight of fines, time of stay, adiabatic heating in fans, perforation percentage of the heart, pressure drop, point of dew, etc...

## **SPECIAL TECHNOLOGIES**

Product double way over all the length  
Expanded shell (also in the vibrating Fluid beds)  
Gas double step  
Gas triple step  
Double/simple step with independent recirculations  
Indirect heating Fluid bed  
Fluid bed over vibrating platform (high temperature)  
Fluid bed with heat exchangers  
Mixers or shakers in the first stage ( over the fluidised product)  
Electrical heating fluid bed  
Double step fluid bed with heat exchanger, working with fluidized alumina  
Fluid bed with diving radian tubes  
Circular static Fluid bed of high capacity  
Fluid bed reactors  
Fluid bed calciners  
Fluid bed granulators  
Drying-Cooling Fluid beds  
Reactor-Dryers Fluid beds  
Inertia Fluid beds  
Desolvanting Fluid beds

## **WORKING WITH DIFFERENT DISTRIBUTOR PLATES**

"Conidur" type (for sizes less than 500 microns of the product).  
"Screws or bolts" type  
Stainless steel plus nylon (size of product less than 70 microns)  
Ceramic plates  
Porous metal plates

## **VIBRATING HEADS**

Excitors of our own technology,  
manufactured by COMSPAIN.

## **LABORATORY TESTING**

Allowing several test to semi-industrial production.



*Laboratory mobile plant-COMSPAIN.*

# EXPERIENCES AND CAPACITIES

|                                                  |                                       |
|--------------------------------------------------|---------------------------------------|
| Maximum surface (static fluid bed):              | 32 m <sup>2</sup> / 64 m <sup>2</sup> |
| Maximum surface (vibrating fluid bed on springs) | 12 m <sup>2</sup>                     |
| Maximum surface (vibrating fluid bed on blades)  | 32 m <sup>2</sup>                     |
| Maximum surface serially                         | 54 m <sup>2</sup>                     |
| Maximum temperature (vibrating fluid bed)        | 1100°C / 860°C                        |
| Maximum temperature (vibrating fluid bed):       | 400°C                                 |
| Maximum production (by cooling)                  | 100.000 Kg/h                          |
|                                                  | 200.000 Kg/h (2 lines)                |
| Maximum production (by drying)                   | 45.000 Kg/h                           |



3 cooling Fluid beds-surface 54 m<sup>2</sup>.



*Cold air conditioning-open circuit by ammoniac evaporation.*

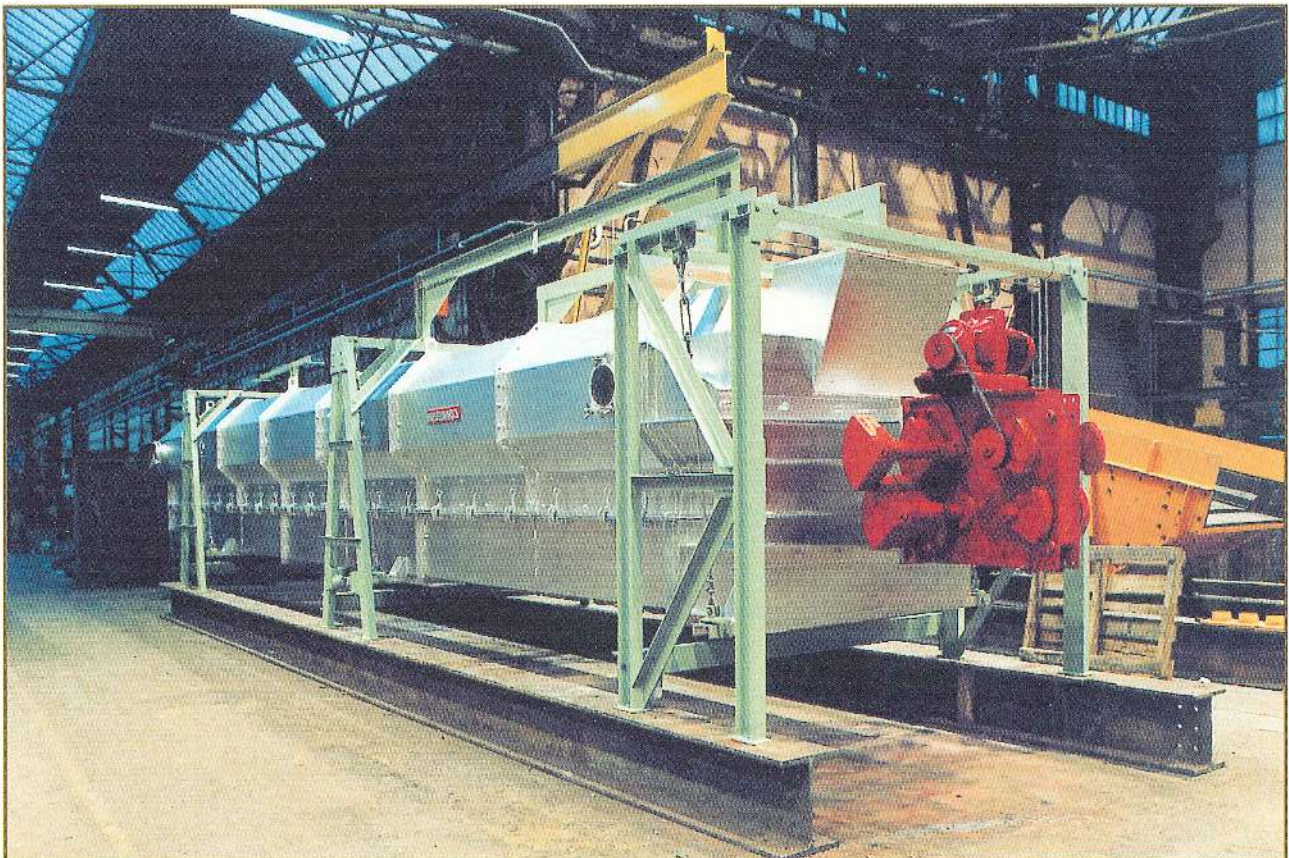
## DRYING AND COOLING

The static or vibrating fluid bed is an equipment coming strength in the drying and cooling industrial processes.

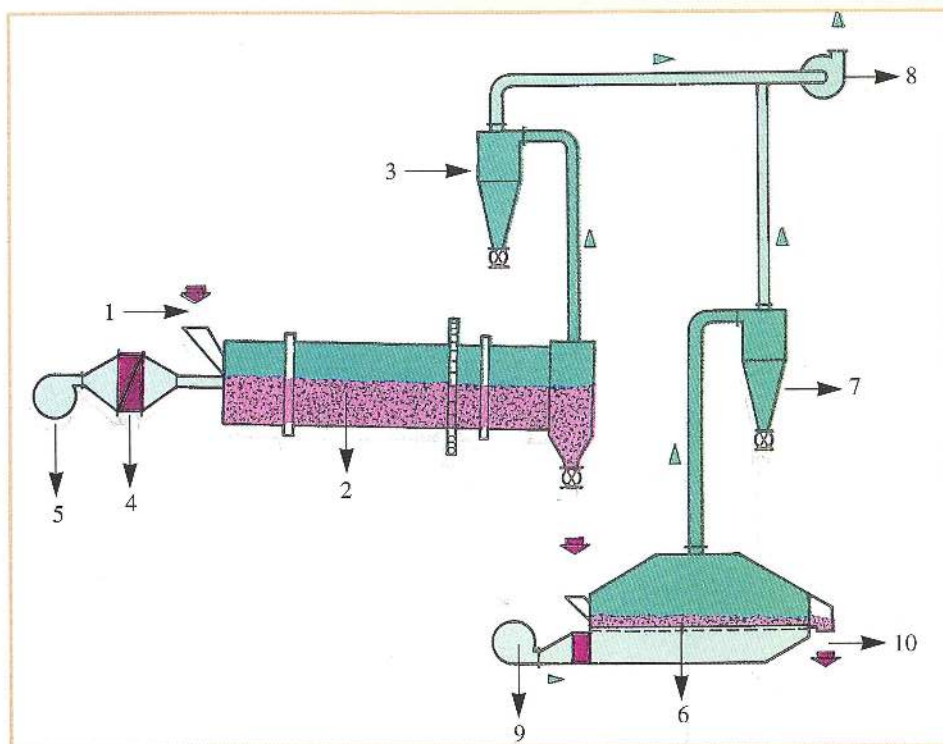
Its characteristics and advantages are:

- drying temperature to 400 °C.
- drying and cooling possibility in the same equipment
- moistures to 30 / 50 % depending on the product
- flows to 45 tph
- fluidification surface to 32 m<sup>2</sup> in only one vibrant machine
- less energetic cost
- better installation.

*Cooling Vibrating Fluid Bed.*



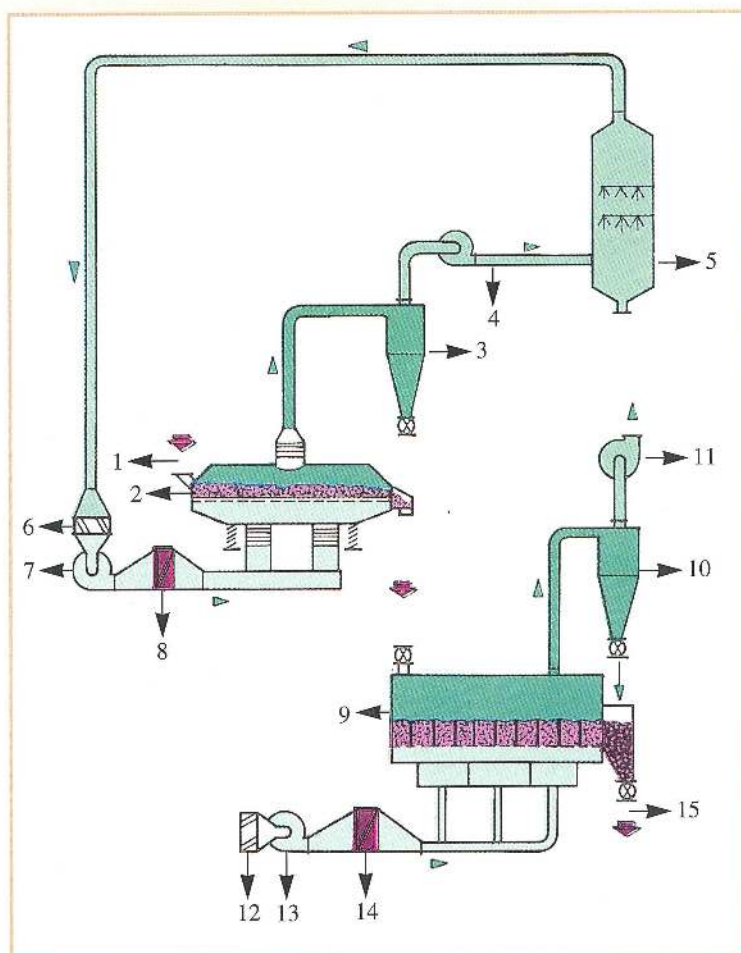
*Drying Inertia Fluid bed-Sand (High temperature).*



1. Inlet chute
2. Rotating dryer
3. Cyclone
4. Air heater
5. Blower
6. Fluid Bed
7. Cyclone
8. Exhauster
9. Blower
10. Discharge

The COMSPAIN fluid bed dryer may be used alone or it may be placed downstream of the rotary dryer to permit final drying or cooling of the processed material.

In some cases when fluidisation of the product is doubtful, predrying is feasible in a COMSPAIN vibrating fluid bed. Final drying or cooling is carried out in a standard fluid bed or in a vibrating fluid bed dryer.

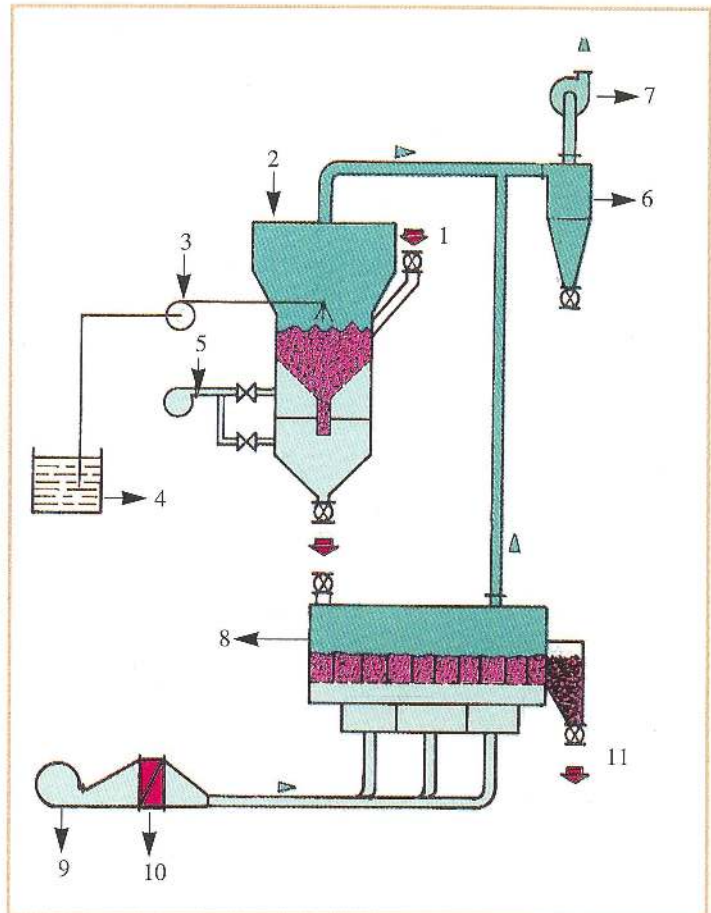


1. Inlet chute
2. Vibrating fluid bed dryer
3. Cyclone
4. Exhauster
5. Scrubber
6. Filter
7. Blower
8. Gas heater
9. Exchanger fluid bed dryer
10. Cyclone
11. Exhauster
12. Filter
13. Blower
14. Heater
15. Discharge

## GRANULATING

Special COMSPAIN fluid beds permit granulation of fine powders. The operation consist of spraying solvent over the fluidised material. The constituted granules being gravimetrically selected are discharged towards a COMSPAIN exchanger fluid bed or a vibrating fluid bed.

1. Inlet chule
2. Fluidizing granulator
3. Pump
4. Tank
5. Blower
6. Cyclone
7. Exhauster
8. Exchanger fluid bed
9. Blower
10. Heater
11. Discharge

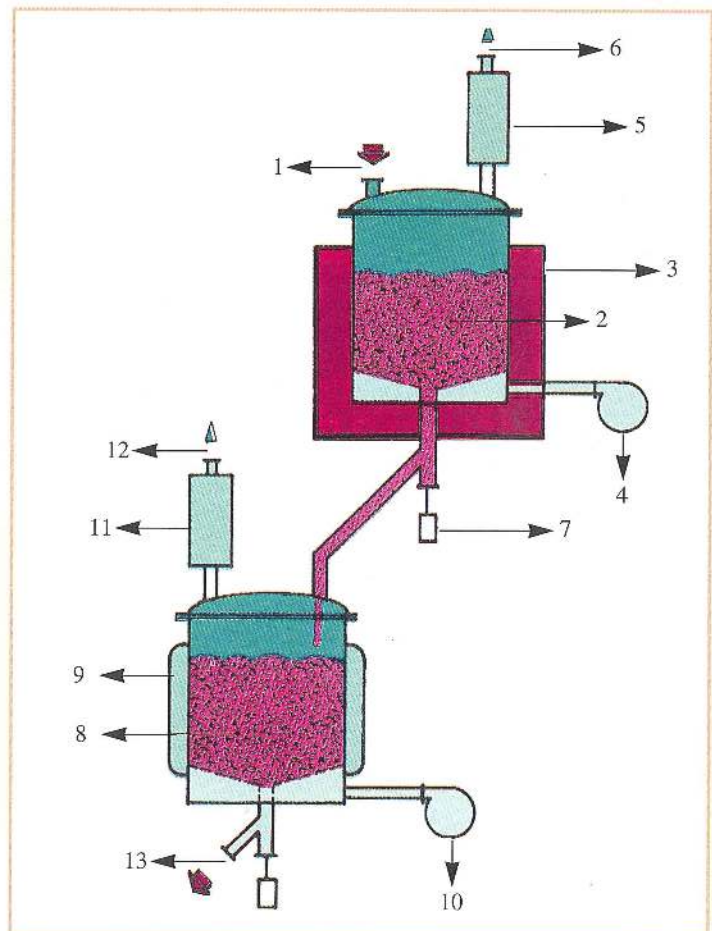


## CALCINING

Due to the excellent heat transfer characteristic and the good mixing of particles the COMSPAIN fluid beds permit very uniform treatment, this factor being essential for good calcining. Small particle systems (30 microns) can be processed in the calciner for a controlled cycle operation of up to 24 hours in some cases. Power is controlled to meet the temperature-time profile requirements of this process.

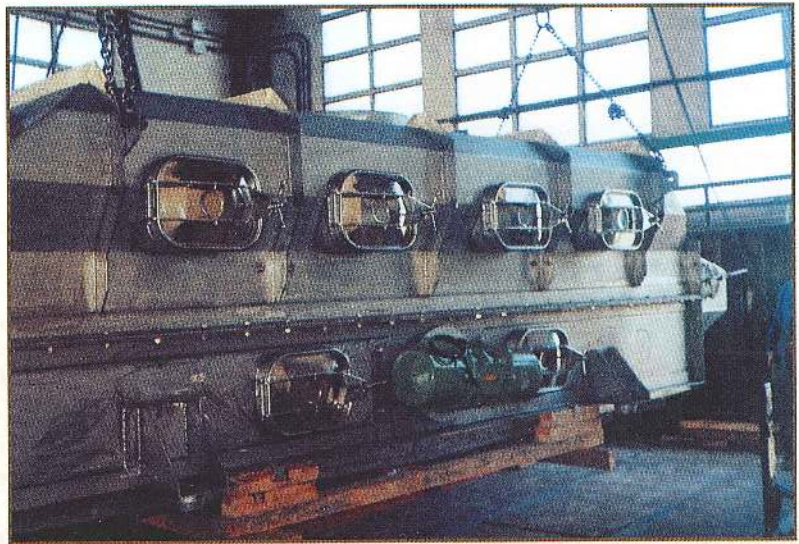
Then product is discharged into the fluidised bed cooler which is similar to the fluid bed calciner, except that it is equipped with a cooling jacket. A rapid cool-down of the product may be advantageous or necessary.

1. Product feed
2. Calciner
3. Heating jacket
4. Inert gas blower
5. Filter
6. Clean atmospheric discharge
7. Calciner product discharge
8. Cooler
9. Cooling jacket
10. Inert gas blower
11. High temperature filter system
12. Clean atmospheric discharge
13. Cool product discharge

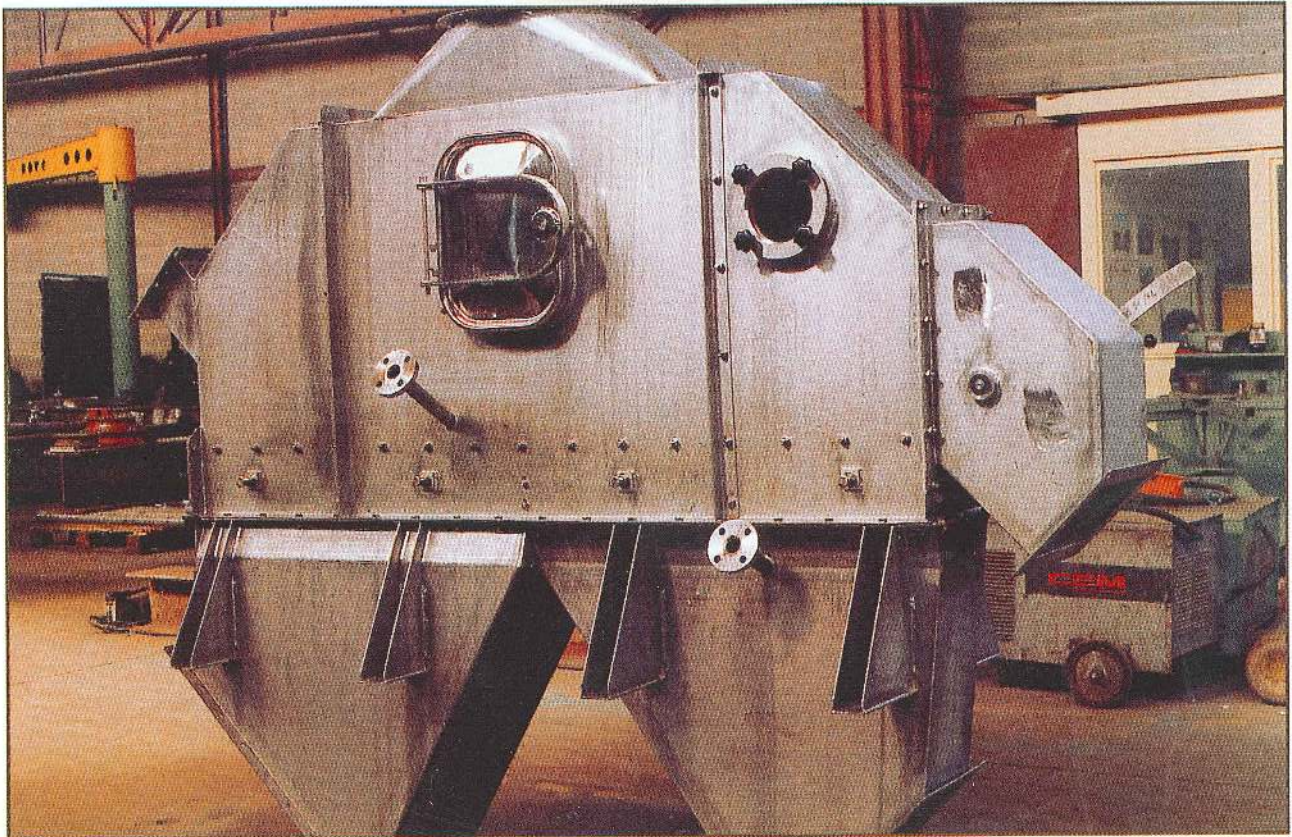




*Catalytics-calcination.*



*Urea Granulator.*



*Granulation Food Products.*

# THE VIBRATING FLUID BED

## Advantages of the vibration in a fluid bed

The principle involved is to vibrate the particles to form a mechanically fluidized bed and then pass a gas phase across the bed.

The gas flow requirements are determined by processing considerations independently of the creation of the fluidized state. The direction and force of vibration are readily changed to adapt to the needs of an extremely diversified sampling of products.

## The casing of this kind of processor is vibrating

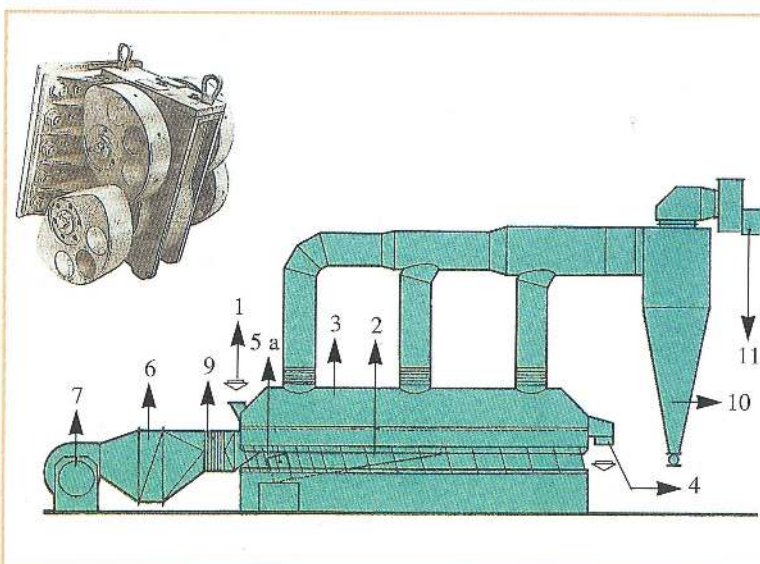
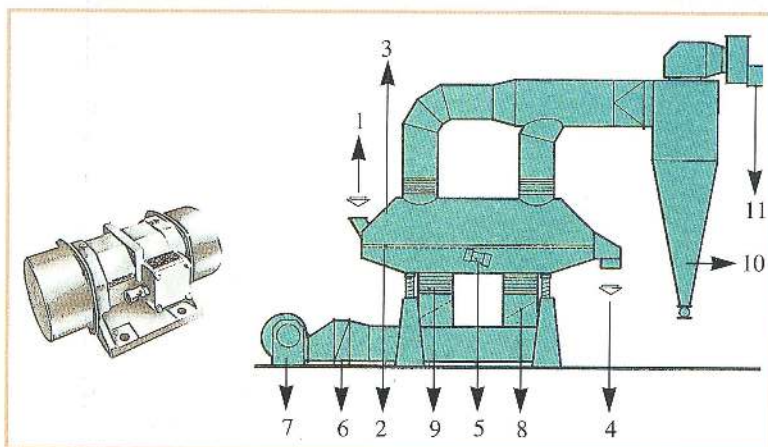
Two basic types are proposed:

- D type for small and medium units ( distributor plate surface from 0,3 to 12 m<sup>2</sup> ). The casing is vibrated under the action of two adjustable vibrating motors and variable static torque.
- DL type for heavy duty units (surfaces from 10 to 32 m<sup>2</sup>). The casing is supported by plate springs and is actuated by means of an exciter.

Adjustment of the vibration is performed by variation of the static torque or by adjustment of the exciter's speed.

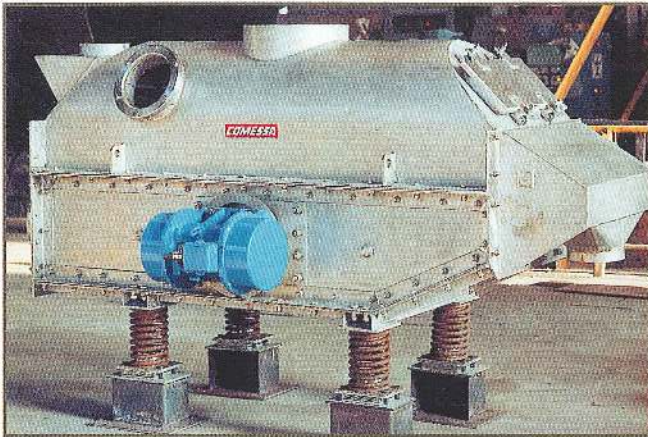
## Advantages of this system

- Handling of products having high water contents at feeding or inconstant wetness.
- Breaking of conglomerate product and lumps formed during process.
- Acceptation of a wide product and lumps formed during process.
- Uniform product temperature.
- Will not break fragile crystals.
- High evaporation rate.
- Energy-saving.
- Recycling of gases ( closed loop).
- Small floor space.
- Easy adjustment.
- Low maintenance.
- Multiple processing in on machine.

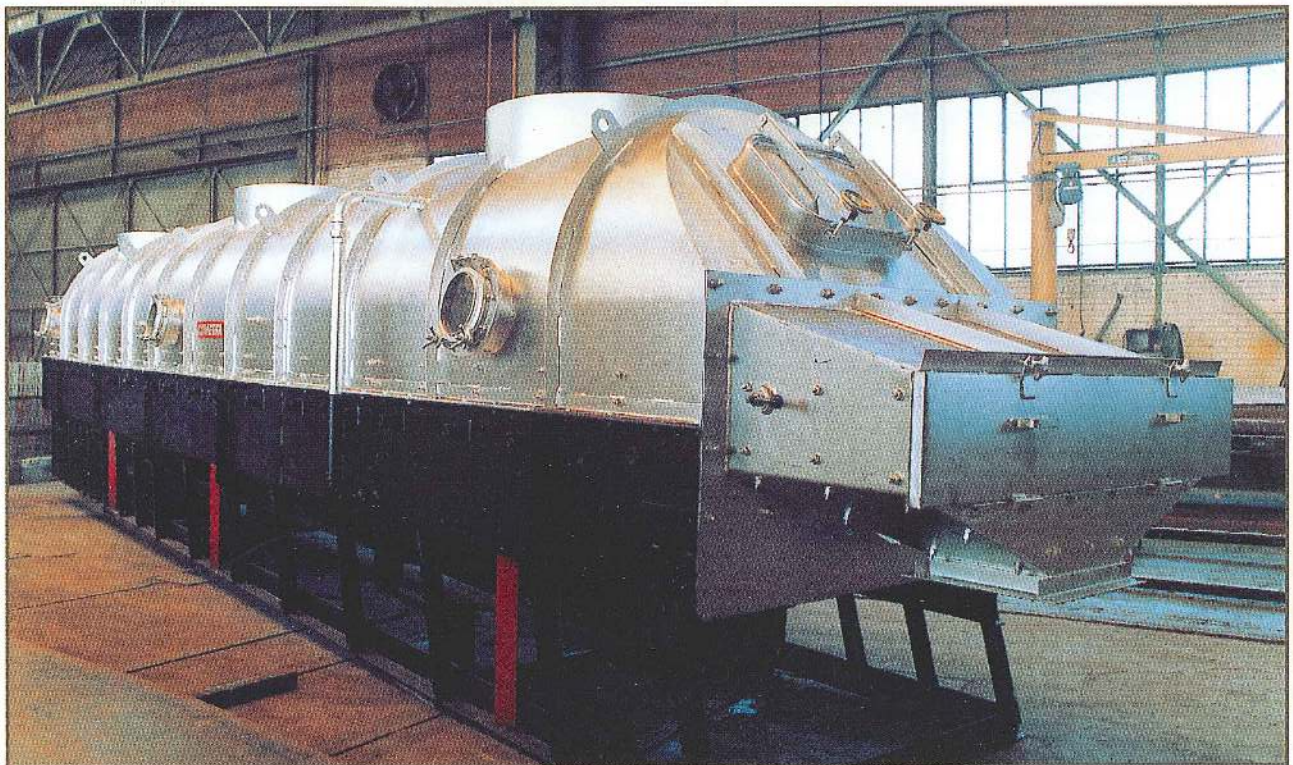
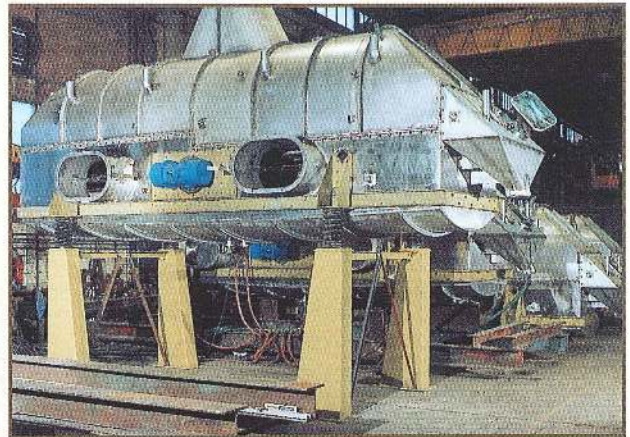


1. Inlet chute
2. Distributor plate
3. Dome
4. Discharge
5. Vibrating motor (D type VFB)
- 5a. Exciter (DL type VFB)
6. Air heater
7. Blower
8. Air dampers
9. Bellows
10. Cyclone
11. Exhauster

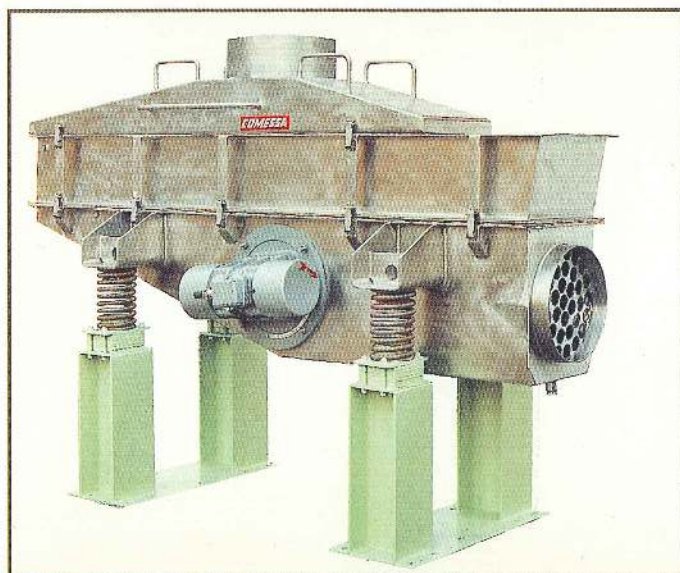
*Vibrating Fluid Bed supported by springs*



*Vibrating Fluid Bed-Lisine*



*Vibrating Fluid Bed supported by plate springs-Organo-Minerals.*



*Vibrating Fluid Bed-boric acid*

*Vibrating Fluid Bed cogeneration-clays*



## THE STATIC FLUID BED

### Description

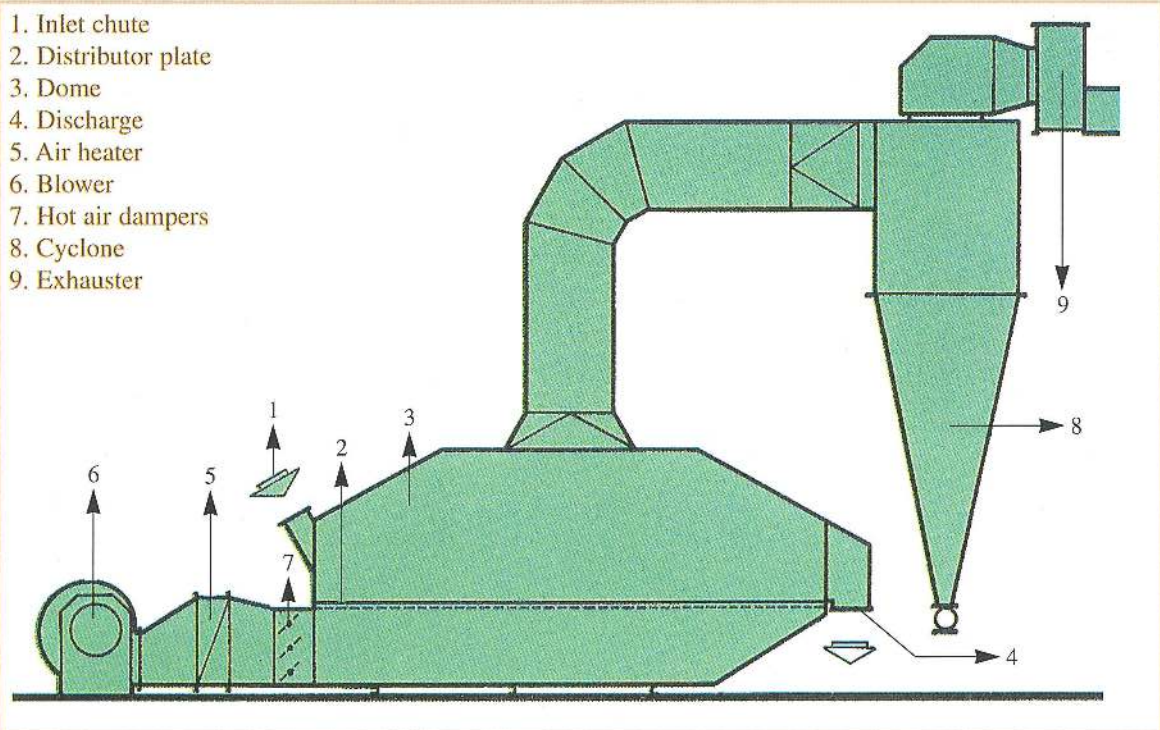
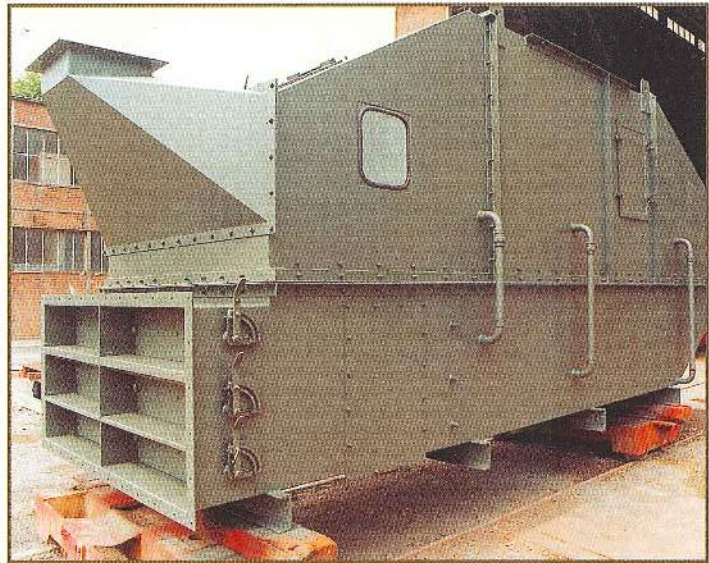
The static bed processor is a closed container in which a distributor plate is secured some distance from the bottom. The volume beneath the distributor plate is the fluidizing gas plenum chamber, and above the distributor plate is the fluid bed processing region. Distributor plates may be perforated sheet, porous metal, or proprietary tuyere type or others, depending upon the requirements of a given application.

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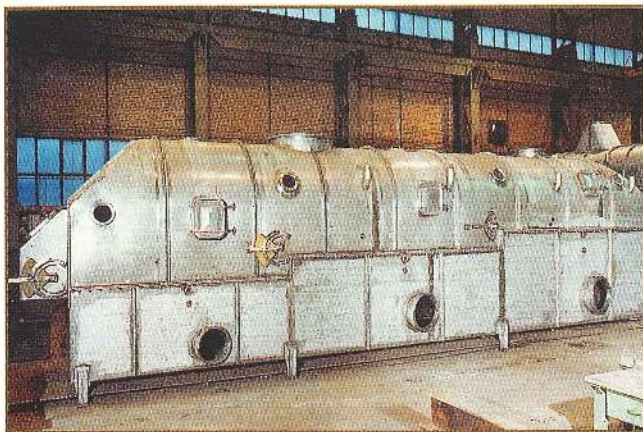
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*Static Fluid Bed «cascade» for reactions-drying-cooling.*



*Static Fluid Bed for Ammonium Sulphate.*



*Static Fluid Bed for Fertilizers-Air double stage.*



*Static Fluid Bed for pellets.*



*Static Fluid Bed for salt.*

## HIGH TEMPERATURE STATIC FLUID BED

The technology of radiant tubes allows to obtain until 1000 Celsius degrees in the fluid bed. The radiant tubes are burners (included the system of recovery of heat) that, introduced in the mass of product, they arrive to temperatures of 1300 Celsius degrees, contributing a great amount of heat for radiation.

The gases of fluidisation are clean and do not contaminate the product, could use, many times, in close circuit.

The energetic saving is big. Not only are retrofitted the hot gases, but rather it could recover the energy by means of heat exchangers.

For example, COMSPAIN has supplied the Research Department of Auxini-National Institute of Industry - a pyrite turn-key distillation plant with a high temperature, inert atmosphere, closed circuit fluid bed. Pyrrhotite and sulphur are profitably obtained for the first time ever. The plant performs mineral treatment (milling, classification, transport, stockage...), drying (vibration fluid bed, hot gas generator, cyclones), dosing (SAS, continuous scales), furnace (static fluid beds crossed by 23 radiating tubes at 1.300 °C), exchangers, high pressure blower, etc.

The plant is operated by computer with programmable automata, including gas analysers, etc.

## HIGH TEMPERATURE VIBRATING FLUID BED

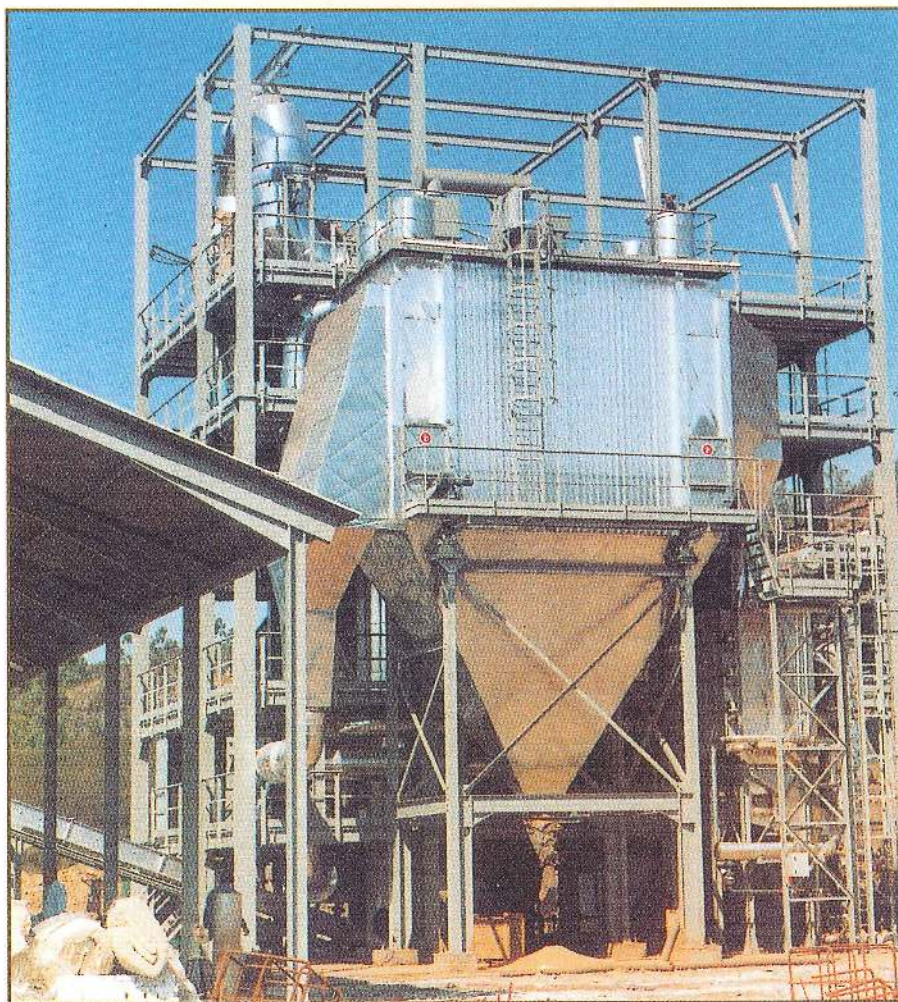
COMPAIN is the only company of the world that has developed the technology with success of compensate the vibration in the fluid bed, with a temperature of drying from more than 400 Celsius degrees.

It is fluid bed that goes located on a vibrant platform of flexible blades. The effort is absorbed for the cold platform and the fluid bed works only like a heat exchanger of crossed flow.

Another of necessities that it has been solved with success is the idea of carrying out an effective interior heat isolation of the fluid bed, that could work, so, in extreme conditions:

- more than 400 Celsius degrees and its corresponding dilatations
- speeds of air in the plenum of up to 24 metres per second
- vibrations of  $\pm 3$  millimeter of amplitude and 750, 1000 or 15000 Hertz.

This type of fluid beds is especially appropriate in order to work with gases of cogeneration.



*A pyrite distillation plant with a high temperature, inert atmosphere, closed circuit fluid bed*



*Drying Vibrating Fluid Bed (High temperature) for sepiolite-clays (400° C).*

# FLUID BED WITH EXCHANGER

## Description

Typically, the depth of fluidized bed in the dryer is 600 to 1800 mm. Interior baffle plates maze segment dryer into separate drying compartments. The fluidized product advances through the unit from feed to discharge, by overflow and underflow.

## Advantages of an Internal Heated Baffle Maze in Continuous Fluid Bed Drying Systems

### 1. Heat transfer

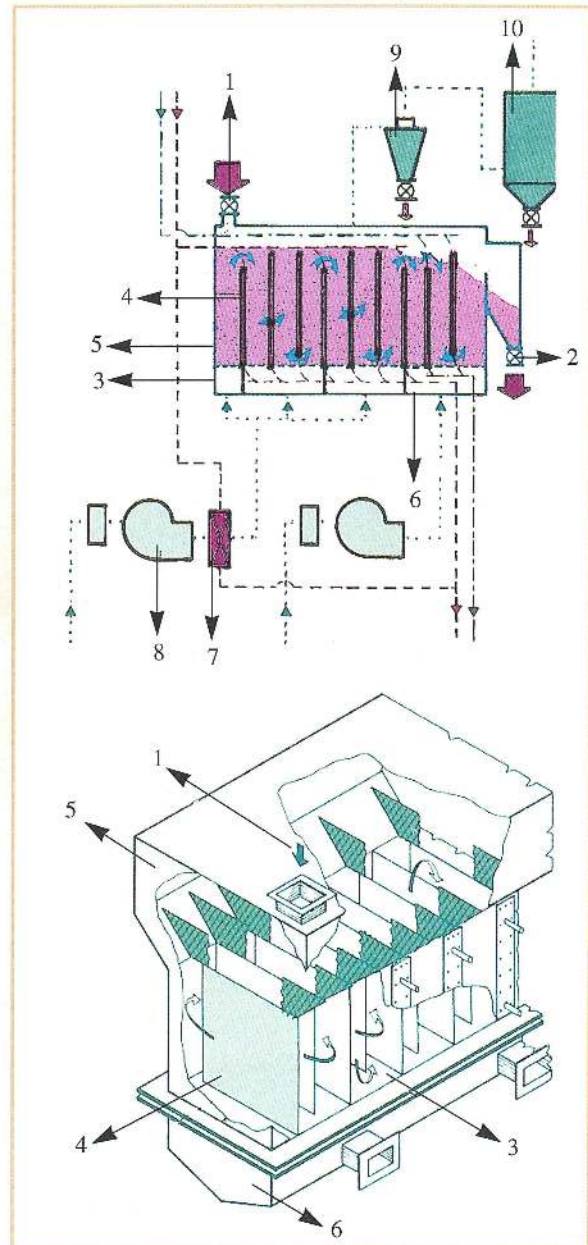
When fine particles, rather than large particles are processed, it is necessary to use a low volume of air passing up through the bed, in order to minimize the amount of product that is carried out with the air.

In our Internal Heated Baffle system, only a very small amount of air is passed up through the product bed (only enough to fluidize the bed). In many cases, up to 95% of the heat transfer required for drying and cooling is accomplished through the heated baffle walls.

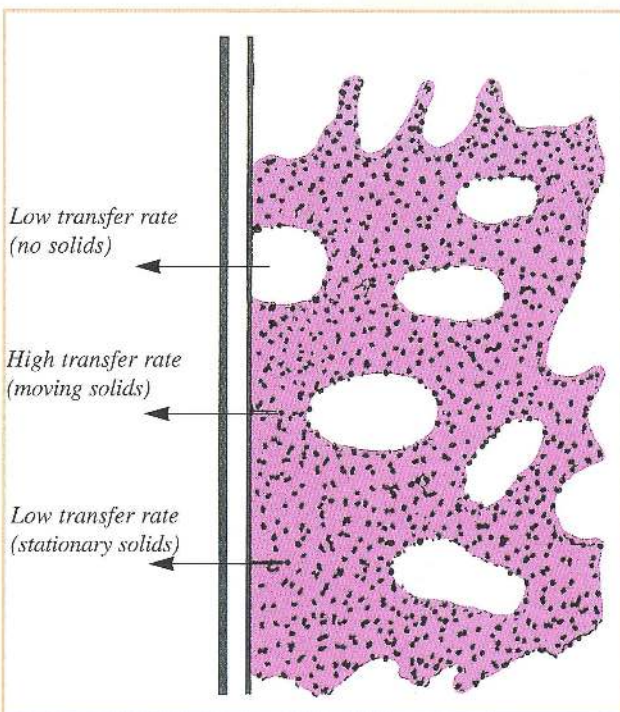
Because a fluidized bed has a very high rate of heat transmission, the transfer from the internal baffles can be made with reduced heat transfer area and smaller temperature difference.

Thus, a small Procedyme fluid bed processor can provide a very considerable capacity for drying or cooling... minimize air pollution or dust collection equipment because only a very small amount of air is used... and in general, will be more energy efficient than other types of drying or cooling equipment.

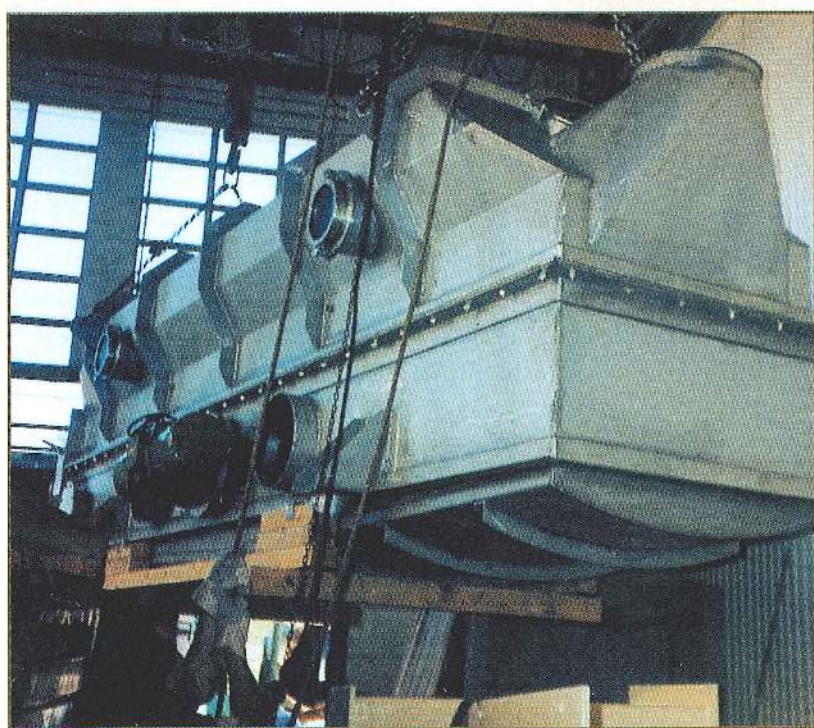
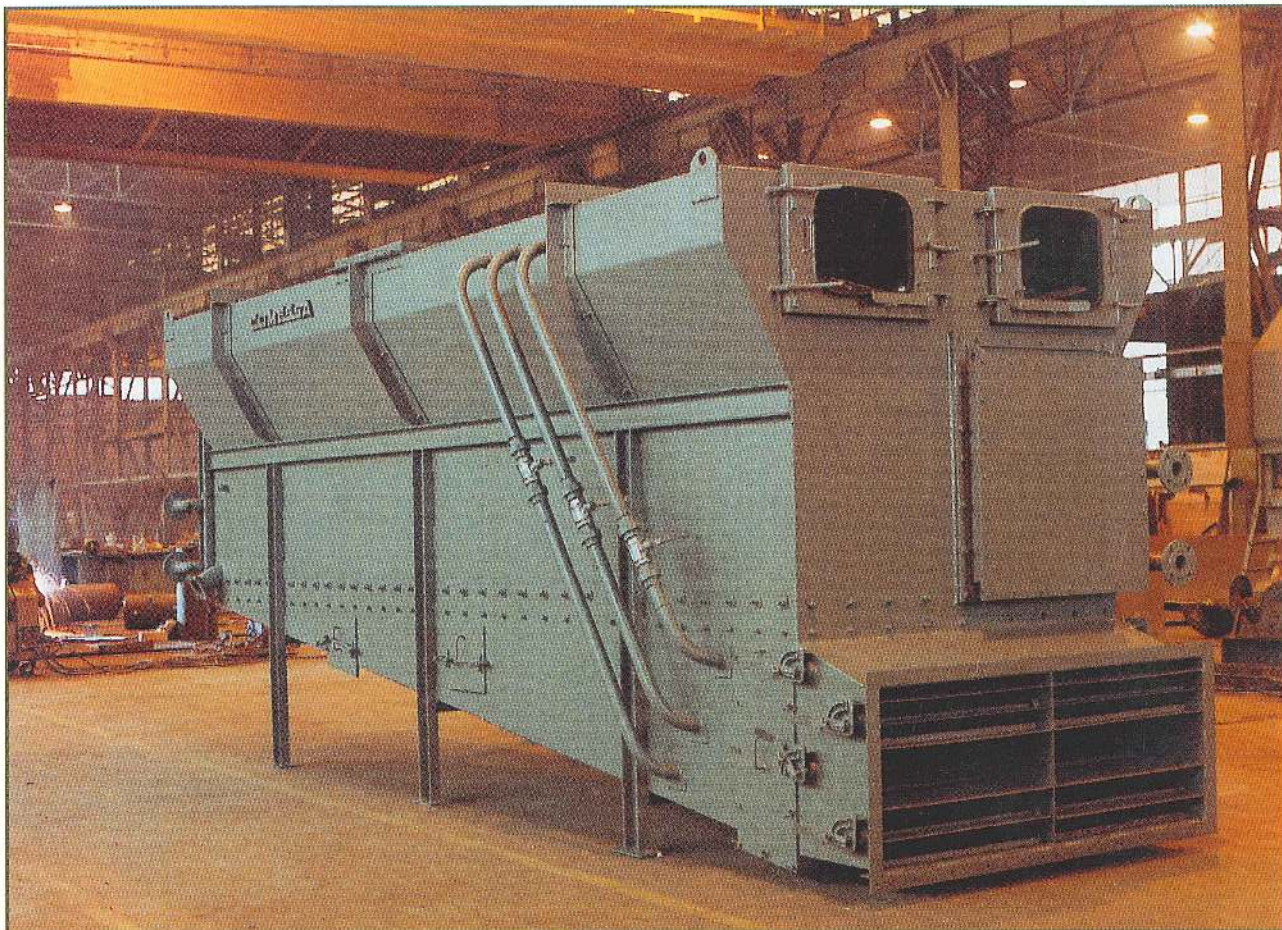
The coefficient between solid particles and the heat source can be as high as 150 to 300 Kcal/m<sup>2</sup>/H° C, depending upon properties of the solids and temperature level.



1. Wet feed
2. Discharge rotary lock
3. Distributor plate
4. Hot water or steam heated baffle maze
5. Fluidization sections
6. Plenum Chamber
7. Gas heat exchanger
8. Blower
9. Cyclone
10. Scrubber



*Fluid Bed «High Fluidized Bed» (1.200 mm).*



*Fluid Bed with exchanger for sodium sulphate.*

*Fluid Bed with exchanger-Thermic oil.*

## PRODUCTS

### MINERALS

Atapulghite  
Bauxite  
Clays  
Coal  
Coke  
Dolomite  
Feldspat  
Fluor spath  
Iron Oxides  
Limestone  
Magnesite  
Pyrite  
Pyrroutine  
Sand  
Sepiolite  
Talc  
etc.

### CHEMICAL INDUSTRY FOOD

Alumina  
Aminoacid  
Ammonium sulphate  
Boric acid  
Catalytics  
Explosives  
Fertilizers (Na, Nac, Dap, Npk, Urea, Tsp, Nitrosuphate, Compost, Organominerals, Map)  
Magnesium sulphate  
Manganese dioxide  
Oxalic acid  
Porous nitrate  
Potassium bromure  
Potassium chlorat  
Potassium nitrate  
Resin  
Sodium chlorat  
Sodium metasilicate  
Sodium methabisulphite  
Sodium monopersulphate  
Sodium nitrate  
Sodium perborate  
Sodium sulphate  
Sodium tripoliphosphate  
Triioic acid  
Trisoium phosphate  
etc.

Chocolate powder  
Coffee beans  
Coffee powder  
Dried fruit  
Flour  
Lactose  
Leaven  
Lemon acid  
Lisine  
Milk Powder  
Nutmeg  
Pollen  
Protein  
Salt  
Snacks  
Soja  
Starch  
Sugar  
Sunflower  
Tomatos powder  
etc.

### DIVERSES

Bark  
Bath salt  
Fibre  
Matches  
Rubber  
Toothpick  
etc.

## STANDARD-EQUIPMENTS VIBRANTING FLUID BED

### WITH VIBRATING MOTOR

| Type/m <sup>2</sup> | Wide mm | Length mm |
|---------------------|---------|-----------|
| LFV 0,3             | 250     | 1250      |
| LFV 1,2             | 600     | 2000      |
| LFV 1,8             | 600     | 3000      |
| LFV 2,4             | 800     | 3000      |
| LFV 3,2             | 800     | 4000      |
| LFV 4               | 1000    | 4000      |
| LFV 5               | 1000    | 5000      |
| LFV 7               | 1400    | 5000      |
| LFV 8,4             | 1400    | 6000      |
| LFV 10              | 1750    | 6000      |
| LFV 12              | 1750    | 7000      |

### WITH EXCITER

| Type/m <sup>2</sup> | Wide mm | Length mm |
|---------------------|---------|-----------|
| LFV 10              | 1400    | 7000      |
| LFV 12              | 1400    | 9000      |
| LFV 15              | 1400    | 11000     |
| LFV 18              | 1400    | 13000     |
| LFV 22              | 1750    | 13000     |
| LFV 26              | 1750    | 15000     |
| LFV 29              | 2.000   | 14.500    |
| LFV 32              | 2.000   | 16.000    |

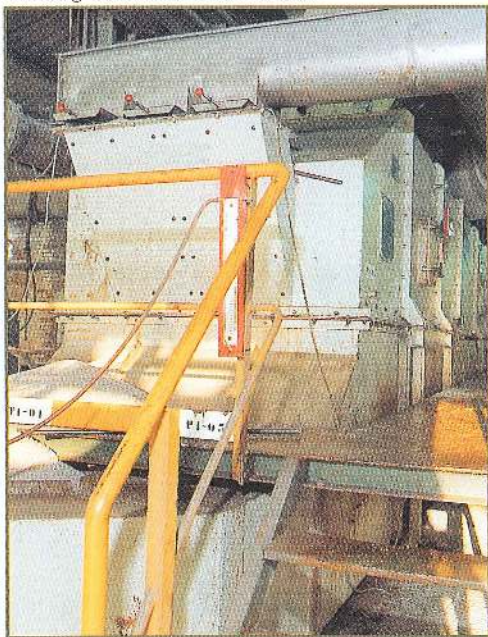
## STATIC FLUID BED

According to the needs of the client, until ..... 32/64 m<sup>2</sup>

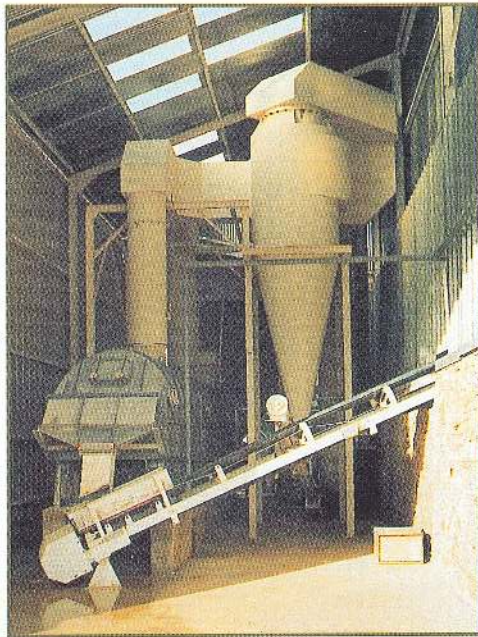
## INERTIA FLUID BED

According to the needs of the customer, until ..... 24 m<sup>2</sup>

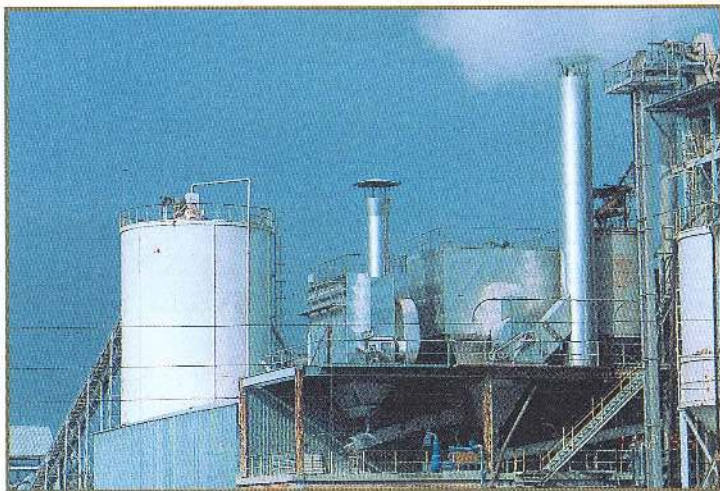
*Granulation Plant-NPK-DAP.  
Cooling Fluid Bed-Guixi-China.*



*Dryer Plant-coffee beans-Nestle-Switzerland.*



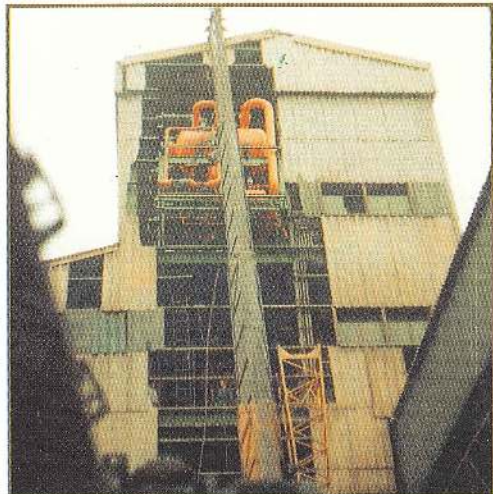
*Dedusting Plant-Cogeneration Fluid Bed-Sepiolsa SPAIN.*



*Cooling TSP-SABIC-SAUDI ARABIA.*



*Erection cooling production-Fertiberia Spain.*



*Cooling static fluid bed products from prill tower.*



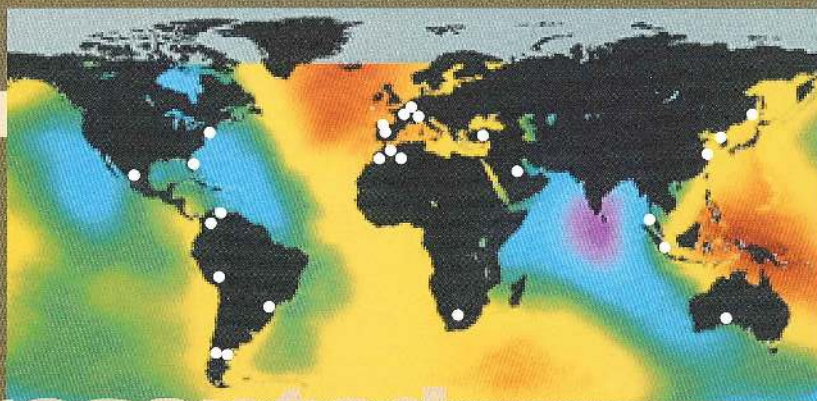
# COMSPAIN

Compañía de Manutenciones Especiales ESPAÑA, S.A.

## SUMMARIZED LIST

| COUNTRY  | CLIENT                                  | EQUIPMENT                       | PRODUCT                | COUNTRY       | CLIENT                                       | EQUIPMENT                   | PRODUCT                     | COUNTRY        | CLIENT                      | EQUIPMENT                  | PRODUCT                     |
|----------|-----------------------------------------|---------------------------------|------------------------|---------------|----------------------------------------------|-----------------------------|-----------------------------|----------------|-----------------------------|----------------------------|-----------------------------|
| ALGERIA  | KREBS                                   | 1 LFE 18 m²                     | NPK                    | GERMANY       | KRUPP-UNDE                                   | 1 LFE 30 m²                 | NA, NAC                     | SPAIN          | ISENAGA (JAEN)              | 1 LFE 0,6                  | POLLER                      |
| ALGERIA  | SOMATRACH                               | 1 LFE 12,00 m²                  | UREA                   | GERMANY       | OKRABME TX OKRABME                           | CALCINATION CATAL 1.050° C  | CATALYTICS                  | SPAIN          | JUSTE, S.I.F. MADRID        | 1 LFE 0,6                  | TRICHOIC ACID               |
| BELGIUM  | SOPAD (SAINT MEMET-FRANCOIS)            | 1 LFE 14 DL                     | COFFEE                 | GERMANY       | PRIZER, IN                                   | OXIDES REDUCTION 900° C     | METALLICAL OXIDES           | SPAIN          | KOPE, S.A. (JAEN)           | 1 LFE 14                   | GRAPES                      |
| BELGIUM  | APPAREILS & EVAPORATEURS                | 1 LFE 4,6                       | AMMONIUM SULPHATE      | GHANA         | SOTROPALPARIS                                | 1 LFE 1,8                   | MATCHES                     | SPAIN          | LUZENAC                     | 1 LFE 4                    | TALC                        |
| BELGIUM  | LAGUILHARRE PARE LATERIE BELGE          | 1 LFE 40                        | POWDER-MILK            | GREECE        | PEC                                          | 1 LFE 11,00                 | NPK                         | SPAIN          | MAGNESITAS DE RUBIÁN (LUGO) | 1 LFE 5 D                  | PELLETS MAGNESIUM           |
| CHINA    | CHUMILLAS Y TANGONGI (ESPAÑA)           | 1 LFE 2,4                       | CLAYS                  | GREECE        | UNDE                                         | 1 LFE 10,00                 | NA                          | SPAIN          | MYTA (MADERUELO)            | 1 LFE 2,4                  | SEPIOLITE                   |
| CHINA    | KPEC-TAINMAN                            | 1 LFE 4,9 m²                    | NPK                    | GREECE        | UNDE                                         | 1 LFE 24                    | NA                          | SPAIN          | MYTA (SEGORIA)              | 1 LFE 10,5 DL              | ATAPULGITE                  |
| CHINA    | TOYO ENGINEERING                        | 1 LFE 34,00 m²                  | No                     | HOLLAND       | FABELTA                                      | 1 LFE 6                     | CELLULOSE                   | SPAIN          | NESTLE                      | 1 LFE 22 DL                | COFFEE                      |
| CHINA    | JIANGXI (GUOXI)                         | 1 LFE 30                        | NPK, DAP               | IRELAND       | IRISH FERTILIZER INDUSTRIES (IFI)            | 1 LFE 30 m²                 | NA, NAC                     | SPAIN          | NESTLE                      | 1 LFE 3,2                  | COFFEE                      |
| CHINA    | WANG KAHAI                              | 1 LFE 2,4                       | SUGAR                  | ITALY         | AMC                                          | 1 LFE 4R                    | THERMOPLASTIC               | SPAIN          | MITRATOS DE CASTILLA        | 1 LFE 11,00                | NA-NAC-NMG                  |
| COLOMBIA | INDRO                                   | 1 LFE 8 m²                      | NPK                    | ITALY         | S.E.P.R.                                     | 1 LFE 5                     | SAND                        | SPAIN          | ORSAN                       | 1 LFE 8,4                  | FERTILIZER                  |
| DENMARK  | BENDIX                                  | THERMIC TREATMENT 760° C-925° C | STEEL                  | ITALY         | STRUTHERS WELLS                              | 1 LFE 3,2                   | AMMONIUM SULPHATE           | SPAIN          | PENIBÉRICA-ANTIBIÓTICOS     | 1 LFE 5                    | LISINE                      |
| FRANCE   | C.D.F. CHIMIE                           | 1 LFE 5                         | TAR                    | JAPAN         | CATALYST IND., JPN                           | CALCINATION 1.000° C        | CATALYTICS                  | SPAIN          | PRODUCTOS LABIN             | 1 LFE 20                   | FERTILIZER ORGANUM MINERALS |
| FRANCE   | L'AIR LIQUIDE                           | 1 LFE 1,2                       | MONOSULPHATE POTASSIUM | JAPAN         | LUZHA                                        | 1 LFE 5                     | NPK                         | SPAIN          | PYCASA «LA COCINERA»        | 1 LFE 2,4                  | FOOD POTATOES               |
| FRANCE   | L'AIR LIQUIDE                           | 1 LFE 5                         | TAR                    | KOREA         | DELATRE LEVIVIER                             | 1 LFE 15                    | AMMONIUM SULPHATE           | SPAIN          | RISI                        | 1 LFE 2,4                  | SNACKS                      |
| FRANCE   | L'AIR LIQUIDE                           | 1 LFE 5                         | PERSULPHATE            | KOREA         | DOWSBU                                       | 1 LFE 6                     | AMMONIUM SULPHATE           | SPAIN          | SANCA                       | 1 LFE 6                    | CLAYS                       |
| FRANCE   | L'AIR LIQUIDE                           | 1 LFE 3,2                       | AMMONIUM PERSULPHATE   | KOREA         | INDRO                                        | 1 LFE 11,4 m²               | NP-NPK                      | SPAIN          | SEFAMITRO                   | 1 LFE 18,00                | NA-NAC-NMG                  |
| FRANCE   | L'AIR LIQUIDE                           | 1 LFE 3,2                       | SODIUM PERBORATE       | KOREA         | NMA HAE                                      | 2 LFE 10,3                  | NPK                         | SPAIN          | SEPIOLSA                    | 1 LFE 4                    | SEPIOLITE                   |
| FRANCE   | NAPHTACHIMIE                            | 2 LFE 1,8                       | POLYOLEPHINE           | MEXICO        | KREBS-FERTIMEX                               | 1 LFE 28,01                 | SODIUM                      | SPAIN          | SEPIOLSA (GUADALAJARA)      | 1 LFE 20,4 DL              | SEPIOLITE                   |
| FRANCE   | NESTLE-SOPAD                            | 1 LFE 20                        | COFFEE                 | NIGERIA       | NEW NIGERIA SALT COMPANY                     | 1 LFE 15 DL                 | SEA SALT                    | SPAIN          | SEPIOLSA (GUADALAJARA)      | 1 LFE 3,2                  | SEPIOLITE                   |
| FRANCE   | NESTLE-SOPAD                            | 2 LFE 3,2                       | COFFEE                 | RUSSIA        | SPHICHIM                                     | 1 LFE 2,4                   | SODIUM SALT                 | SPAIN          | STEIN NESTLE                | 2 LFE 7                    | COFFEE                      |
| FRANCE   | PECHINEY                                | 1 LFE 4,6                       | SODIUM CHLORATE        | SAUDI ARABIA  | NATIONAL FERTILIZER CO. (NPL)                | 2 LFE 32,01                 | NP-DAP-GTSP                 | SPAIN          | STEIN BALTOGAR              | 1 LFE 3,2                  | COFFEE                      |
| FRANCE   | POTASSES ET PRODUITS                    | 1 LFE 4                         | BROMIDE                | SAUDI ARABIA  | TECHNIPETROL (ROMA) PARA AL-BATAR, AL-JUBAIL | 2 LFE 35,01                 | DAP-NPK-NP-GTSP             | SPAIN          | TOLSA                       | 1 LFE 10                   | CLAYS                       |
| FRANCE   | POTASSES ET PRODUITS CHIMIQUES DE THANN | 1 LFE 1,8                       | BROMIDE                | SOUTH AFRICA  | OMNIA FERTILIZERS LTD                        | 1 LFE 19,24                 | NPK                         | SPAIN          | TOLSA (MADRID)              | 1 LFE 12                   | BENTONITE                   |
| FRANCE   | PROCESS ENGINEERING C.O.                | 1 LFE 5                         | ACIDO CITRICO          | SOUTH VIETNAM | P.E.C.                                       | 1 LFE 5                     | SEA SALT                    | SPAIN          | TOLSA-MADRID                | 1 LFE 15                   | CLAYS                       |
| FRANCE   | RHONE-POULENC                           | 2 LFE 12,6                      | CHEMICAL PRODUCTS      | SPAIN         | 3M, MN                                       | REDUCTION 900° C            | CATALYTICS                  | SPAIN          | TORREGIO (ALICANTE)         | 1 LFE 4                    | CERAMICS                    |
| FRANCE   | RHONE-POULENC                           | 2 LFE 5,0 D                     | ALUMINA                | SPAIN         | AGRAZ-BADAJOS                                | 1 LFE 8,4 D                 | POWDER-TOMATO               | SPAIN          | TORREGIO S. A. (CASTELLÓN)  | 1 LFE 4                    | CERAMICS                    |
| FRANCE   | RHONE-PROGIL                            | 1 LFE 2,4                       | ALUMINA                | SPAIN         | ALDOA FORGINGS                               | TRET 400° C                 | STEEL                       | SPAIN          | TRATAMIENTOS RIZA           | THERMIC TREATMENT 1.000° C | TOOLS                       |
| FRANCE   | S.E.I.T.A.                              | 1 LFE 5                         | MATCHES                | SPAIN         | AUXINI-INVESTIGACIÓN                         | TRET 850° C / 180° C-525° C | PIRITTE                     | SPAIN          | TRAVESA                     | 2 LFE 4                    | SNACKS                      |
| FRANCE   | S.E.I.T.A.                              | 2 LFE 4                         | MATCHES                | SPAIN         | AUXINI-MINI-STERIO INDUSTRIA                 | DESTILLATION 1.300° C       | PIRITTE                     | SPAIN          | UNION CARRIBE NAVARRA       | 1 LFE 12                   | COKE                        |
| FRANCE   | SERETE                                  | 1 LFE 12 D                      | COKE                   | SPAIN         | CHIMISA (CUENCA)                             | 1 LFE 7                     | TARTARIC ACID               | SWITZERLAND    | WELDING ENGINEERS           | 1 LFE 1,8                  | RUBBER                      |
| FRANCE   | SERETE ENGINEERING                      | 1 LFE 3,2 D                     | SAND                   | SPAIN         | COMERCIAL DE NITRATOS                        | 1 LFE 5                     | FERTILIZER                  | THAILAND       | ADRA SUGAR                  | 1 LFE 4                    | SUGAR                       |
| FRANCE   | SOCIETE FRANÇAISE D'ELECTROMETALLURGIE  | 1 LFE 1,8                       | BAUXITE                | SPAIN         | E. I. ARAGONÉSAS                             | 1 LFE 12                    | AMMONIUM SULPHATE           | THAILAND       | MID SIAM SUGAR              | 1 LFE 4                    | SUGAR                       |
| FRANCE   | SOCIETE UCLAMA                          | 1 LFE 7                         | LACTOSE                | SPAIN         | ENFERSA                                      | 1 LFE 12,00                 | UREA                        | THAILAND       | MITE PHOI SUGAR             | 1 LFE 4                    | SUGAR                       |
| FRANCE   | SPEICHIM                                | CALCINATION 1.050° C            | CHEMICAL PRODUCTS      | SPAIN         | ENFERSA                                      | 1 LFE 28,8                  | NA-NAC                      | THAILAND       | PRACHUAP                    | 1 LFE 4                    | SUGAR                       |
| FRANCE   | TECHIMP                                 | 1 LFE 0,6                       | POLYETHYLENE           | SPAIN         | ENFERSA                                      | 1 LFE 8,40                  | NA                          | THAILAND       | THAI IDENTITY               | 1 LFE 4                    | SUGAR                       |
| FRANCE   | USINE KUHLMANN                          | 1 LFE 5                         | SODIUM METHANESULPHATE | SPAIN         | EURECAT                                      | 2 LFE (L=11 m) INERTIA      | CATALYTICS                  | TUNISIA        | HEURTEY SAIPA               | 1 LFE 10,00                | DAP                         |
| FRANCE   | USINE KUHLMANN                          | 2 LFE 7                         | NITRATE SODIUM         | SPAIN         | FERTIBERIA SEVILLA                           | 1 LFE 1,2 DL                | NITRATE                     | TUNISIA        | SALINES DE TUNISIE          | 1 LFE 4                    | SEA SALT                    |
| FRANCE   | USINE KUHLMANN                          | 1 LFE 4                         | PHOSPHATES TRISODIUM   | SPAIN         | FERTILIZANTES DEL OESTE                      | 1 LFE 20                    | FERTILIZER ORGANUM MINERALS | TUNISIA        | GCT                         | 1 LFE 30                   | NP-NAC                      |
| FRANCE   | UNICHEMA, BRD                           | REDUCTION 900° C                | BAUXITE                | SPAIN         | FORET                                        | 1 LFE 10                    | SODIUM PERBORATE            | TURKEY         | ALARKO                      | 1 LFE 4                    | SEA SALT                    |
| FRANCE   | WELDING ENGINEERS                       | 1 LFE 0,3                       | PELLETS RUBBERS        | SPAIN         | FORET, S. A.                                 | 2 LFE 16,8                  | SODIUM PERBORATE            | TURKEY         | INTECSA                     | 1 LFE 15,5                 | NPK                         |
| GERMANY  | BABCOCK WILCOX                          | TEMPER 1.100° C-1.315° C        | STEEL                  | SPAIN         | FORET, S. A.                                 | 2 LFE 8,4                   | SODIUM PERBORATE            | TURKEY         | L'AIR LIQUIDE               | 1 LFE 12 L                 | PERSULPHATE                 |
| GERMANY  | EXTRACTIONS-TECHNIK                     | 1 LFE 8                         | SUNFLOWER              | SPAIN         | FORET-LAZADA (ZARAGOZA)                      | 1 LFE 30                    | SODIUM PERBORATE            | TURKEY         | SAMSUM                      | 1 LFE 12,00                | DAP                         |
| GERMANY  | EXTRACTIONS-TECHNIK                     | 1 LFE 8                         | GRANULATED             | SPAIN         | GENOSA                                       | 4 LFE 7                     | COKE                        | TURKEY         | STRUTHERS WELLS             | 1 LFE 22                   | BORIC ACID                  |
| GERMANY  | EXTRACTIONS-TECHNIK                     | 3 LFE 12                        | COLLING                | SPAIN         | HEFRAN                                       | 1 LFE 8,4 D                 | CLAYS                       | UNITED KINGDOM | ALDOA FASTERMERS            | THERMIC TREATMENT 480° C   | STEEL                       |
| GERMANY  | HOECHST                                 | 1 LFE 1,2                       | CORK                   | SPAIN         | HERCULES                                     | REDUCTION 900° C            | CATALYTICS                  | UNITED KINGDOM | MOBIL OIL                   | CALCINATION CATAL 1.000° C | CATALYTICS                  |
| GERMANY  | KREBS                                   | 1 LFE 18 m²                     | NPK                    | SPAIN         | HOECHST IBERICA                              | 1 LFE 5                     | POLYPROPYLENE               |                |                             |                            |                             |

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