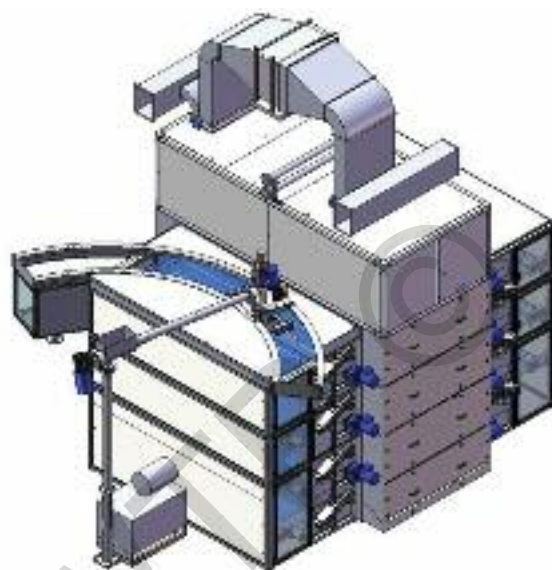
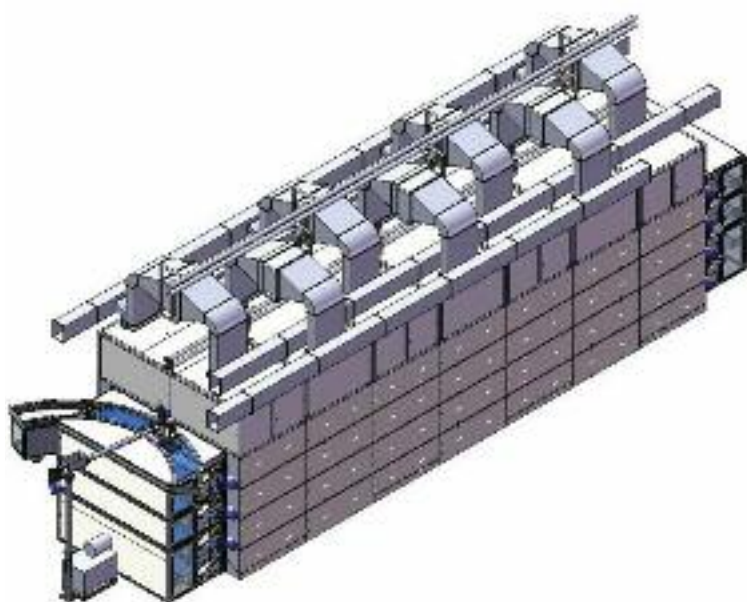




## An innovative solution for low-temperature sludge drying

Italian tanning machinery producer Cartigliano is known as an expert in drying solutions for a variety of industries, most notably leather. In this issue of *World Leather*, the company offers insight into a new drying machine called EFT, which is capable of performing the drying of a number of materials, including civil and industrial sludge, animal waste and biomass.

From the point of view of leather production, Cartigliano says the machine can reduce drastically the volume of sludge, allowing for a reduction in the cost of its disposal. It does so by bringing the incoming product to a humidity of 10-15%. The result is a weight reduction of over 70% and a decrease in volume of 50-60%.

### How it works

Drying occurs by forced convection with air appropriately conditioned inside the machine and conveyed at very high speed over the material to be dried by means of fans and special diffusers. The shape of these components enhances the transmission of heat by convection.

The material entering is dried and brought to the required final moisture content (usually 15-20%), by means of hot air (up to 70°C).

There are three classes of Cartigliano dryers, depending on the number of times the material goes through the length of the machine before exiting. There can be three, five or seven revolutions.

| Layer | Air flow rate (m <sup>3</sup> /h) | Extracted water (kg/h) |
|-------|-----------------------------------|------------------------|
| 3     | 16,000                            | 40                     |
| 5     | 20,000                            | 60                     |
| 7     | 28,000                            | 85                     |

The appropriate dryer model is determined based on the needs of the end customer.

### Description

The material to be dried is conveyed inside the machine by special belts that are permeable to air, enabling even and homogeneous drying across the whole product.

The material inside goes through the machine five times. Each of the machine's five belts is independently motor-driven in order to be able to regulate the feed speed of the material and therefore the time it remains inside the dryer.

Regarding the moisture removed from the product, three possibilities can be considered:

- Expulsion of the corresponding quantity of moist air exhausted into an external environment (after purification by means of an appropriate scrubber) and intake of the same quantity of replacement air;
- Total condensation in air-water cooling coils placed over the machine. In this case there are no emissions into the environment, but it will be necessary to make sure that the temperature of the cold water feeding the coils does not exceed 25°C;
- A combination of the previous two solutions, wherein a part of the moisture contained in the material is dispersed into the environment and the rest condensed in the coil.

The choice of the most suitable solution will be made based on where the machine is to be used and the type of material to be dried.

Another interesting possibility is that of sucking the air from the place where the machine is installed by means of one or more gas or fuel oil turbines, with the air used as fuel. The place would then be at a slightly lower pressure and all the problems related to the external emission of exhausted air would be eliminated. At the same time, this would remove the need for a cooling circuit to condense the moisture removed from the product. Moreover, in this case the turbine would provide, by cogeneration, the heat necessary to run the dryer.



The machine is equipped with a PLC system, through which the work parameters are managed. Parameter setting, control and display takes place via a touch-screen console. This can be installed remotely from the electrical panel, for example, in the control room. It is possible to set and control the parameters via a wireless internet connection, solving any problems of mobility.

### Benefits of the EFT dryer

1. The machine is innovative since, unlike other dryers available on the market, the transmission of heat mainly occurs by convection and not by radiance, enhancing the speed parameter compared to the drying air temperature parameter. In fact, low quality primary energy (water at 80-85°C) is used, which is economical and easily obtainable in cogeneration plants. This offers advantages in running costs. In addition, the method of conveying the air on the material to be dried and the possibility of appropriately treating the drying air optimises the transmission of heat by convection and speeds up the process compared to other drying plants.
2. To increase the heat exchange area and to prevent the formation of dust during drying, before entering the EFT the material is extruded into pellets of variable sizes by means of an extruder machine. They are then spread over the entire work width of the machine by means of a belt conveyor. The shape of these pellets makes them ideal for eventual use as fertiliser.
3. The machine is modular, therefore for each class there are from two to 12 modules. In case of a need to increase productivity, the machine can be easily adapted to the new needs of the customer by adding one or more modules and by modifying the transport belts. No other parts of the machine need to be changed.
4. The modularity of the machine and the regulation of conveyor belts make the EFT dryer very flexible and suitable to be used with different types of material. It is also very efficient when used for partial loadings due to the relative energetic consumption adjustment.
5. There is no dispersion or loss of the material in the environment, neither in the loading stage nor in the drying stage. The machine is perfectly isolated. The destination of the humidity extracted from the product condenses thanks to battery coils positioned over the machine. In this way, there are no emissions into the atmosphere.
6. The machine is particularly quiet - less than 70 dB(A)

All these advantages make the EFT dryer very innovative from a technological point of view and absolutely compatible with the environment. 🌱



### A practical case

The EFT dryer is advantageous when:

The cost of delivering the sludge > than the cost of delivering the dried sludge + the energy cost of drying.

Consider a practical case:

Cost for delivery of sludge - €150/tonne

Moisture content of sludge as it stands - 70%

Moisture content of dried sludge - 15%

To bring each kilogramme of sludge as it stands to the final moisture content, it is necessary to evaporate:<sup>1</sup>

$$(70-15)/(100-15) = 0.65 \text{ kg of H}_2\text{O}$$

Each of the five EFT layers evaporates approximately 60 litres of water per hour.

The average electricity consumption for each layer is approximately 11 kWh.

The consumption for each litre of water evaporated is approximately 850 kcal.

The electricity consumption for each litre of water condensed for the cooling tower is approximately 0.02 kWh.

Therefore, to dry one kilogramme of sludge as it stands, the consumption is:

$$- (11/60) \times 0.65 = 0.1192 \text{ kWh of electricity}$$

$$- (850/8250) \times 0.65 = 0.067 \text{ m}^3/\text{h of methane}$$

Therefore, the total cost of delivering the sludge once dried + the energy cost for drying is:<sup>2</sup>

$$(150/1000) \times 0.35 + (0.1192 \times 0.14) + (0.067 \times 0.33)$$

which equates to:

$$0.0525 + 0.0167 + 0.022 = 0.0912 \text{ €/kg}$$

The cost of delivering one kilogramme as it stands is:

$$150/1000 = 0.15 \text{ €/kg}$$

N.B. In the case of the thermal energy being available for free - remember that low quality primary energy is used (water at 80-85°C) and therefore economical and easily obtainable in cogeneration plants - the total cost for delivering dried mud is:

$$0.0525 + 0.0167 = 0.0692 \text{ €/kg}$$

<sup>1</sup> The moisture content of a solid material is normally expressed in parts of water per 100 parts of moist substance (moisture content as it stands). If  $G$  is the weight of the substance to be dried and  $G_i$  that of the dried substance, having a moisture content of  $u\%$  and  $u_1\%$  respectively as it stands, then  $G = G_i + X$ , where  $X$  is the quantity of water to be eliminated for carrying out drying and which is given by:

<sup>2</sup> Cost of electricity: 0.14 €/kWh  
Cost of methane: 0.33 €/m<sup>3</sup>