

VENTILEX Energy Savings

VENTILEX is a manufacturer of drying/cooling and de-dusting equipment. VENTILEX has supplied more than 140 fluid bed dryers for sand and other minerals such as clay, dolomite, limestone, etc. with capacities up to 150 tph. The VENTILEX fluid bed systems have proven over time and in heavy usage to be low maintenance, to reduce energy usage, and operate on a PLC control system that is second to none.

Design Features of the VENTILEX Fluid Bed Dryer:

- Direct product contact parts of the fluid bed are manufactured in stainless steel, no corrosion even with use of fuel oil (sulphur).
- Unlike other fluid bed dryers, the VENTILEX fluid bed can handle an abrasive product without excessive wear. This is due to the high-amplitude, low-frequency fluidized conveyance.
- Product inlet and product outlet are provided with serviceable wear plates.
- Exact control of product end moisture is possible with variations in inlet moisture content.
- No need to clean out stones or larger particles. The high amplitude motion of the dryer transports these as well.
- The burner housing and the undercase of the dryer are built in high temperature resistant steel instead of stainless steel.
- The construction of the dryer is designed to avoid problems associated with thermal expansion. Construction details include:
 - Hatches are round to avoid cracks.
 - The bedplate is mounted in such a way that the plate can move freely.
 - The undercase is mounted with a slide construction to the frame.
 - No sharp corners or edges.
 - Strengthening strapping are mounted in such way that it can expand.

Advantages of the VENTILEX Fluid Bed Dryer Over a Rotary Drum Dryer:

VENTILEX fluid bed dryers offer significant advantages over rotary drum dryers. This has led to the predominant use of fluid bed dryers in new dry mortar plants in Europe and the USA. In addition, VENTILEX is often called upon to replace rotary drum dryers in existing mortar plants. Some of the reasons for this are:

- The drying air is more evenly distributed over the product in the VENTILEX fluid bed dryer than in a rotary dryer. Therefore, the temperature of the dried product can remain constant. This allows better control of the drying air temperature and the product temperature. Fluctuations in the amount and moisture of the product do not adversely affect the VENTILEX fluid bed dryer.
- The dryer and cooler are integrated in a unitary piece of equipment. A rotary drum dryer will need a separate cooler for the product, increasing the cost by 30% to 60%.
- Due to the multi-point PLC temperature controls, the exhaust air temperature can be lowered. As a result, the energy costs are lower than for a rotary dryer and most other conventional high-frequency vibrating or static fluid bed dryers.



- Energy usage on a VENTILEX fluid bed dryer is much lower than energy consumption on a rotary drum dryer (proven value – 30%). The VENTILEX fluid bed has far better control over the final temperature of the product and the air is in cross flow with the product instead of co- or counter-current flow. The exhaust from the cooler area can be recycled to the dryer area so that all energy in the product is reclaimed in the dryer.
- Multi-stage PLC controls make sure that the product temperature is not higher than necessary, so the cooling section can be economized.
- The VENTILEX fluid bed can handle wider varieties of grain size and moisture content than rotary dryers.
- Due to low-frequency/high-amplitude plug flow design, the VENTILEX fluid bed requires less maintenance and has low consumption of wear parts.

Energy Saved in the VENTILEX Fluid Bed Dryer/Cooler

In a standard VENTILEX unitary dryer/cooler, the product must be dried down to <0.5- 0.3% and the cooler is the same size as the dryer. The sand is completely dried in the dryer and the product temperature is $\pm 175 - 185^{\circ}\text{F}$ after drying.

When cooling is required for bagging, screening or other reasons, the temperature after cooling is normally 120 to 130°F , and the cooler section is the same size as the dryer. The product is cooled with ambient air in the cooler; the heat of the sand is transferred to the cooling air. The cooler exhaust air will be 130 to 150°F depending on the ambient air temperature.

Note that the exhaust air from the cooler is dry, heated ambient air. Returning the exhaust gas from the cooler section back to the air inlet of the dryer, prior to the burner, can save energy. The amount of energy that is saved by recirculating the cooling air is ± 10 to 15% .

In most cases, recirculating the exhaust air from the cooler will give a higher return of the investment cost if the size of the unit is big enough and the amount of cooling air is about the same as the amount of drying air.

VENTILEX Evaporative Cooling – Additional Energy Savings

In most sand drying operations the required moisture content is in the range of 0.3 to 0.5% moisture content. Conventional dryers utilize heat (BTUs) to drive off all of the moisture. This results in elevated product temperatures (approx. 212°F).

VENTILEX's unitary construction allows moisture to be evaporated to $\pm 1\%$ moisture content, to the desired 0.3 to 0.5% moisture content without the addition of excessive BTUs.

Peak evaporative cooling is accomplished in the 113°F range. Dependent on the type of dryer/cooler, VENTILEX will utilize heat exchanger(s) in the cooling air exhaust stream, thus taking advantage of "free" latent energy. The pre-heated air (113°F) is reintroduced at the end of the cooling section to evaporate off the final moisture to the desired percentage.

The system with evaporative cooling has the following advantages:

- The sand is not completely dried in the dryer, so the drying capacity per ft² is increased.
- The energy per ton dried sand is lower than when completely dried.
- The temperature of the sand is not too high when entering the cooler. Also the evaporation of water takes the heat out of the sand. This means that the sand is colder after cooling than when it is completely dry before cooling, so the cooling capacity per ft² is increased.

VENTILEX Cooling Option A

The first heat exchanger is placed in the exhaust air duct. With this heat exchanger, the latent heat from the exhaust air is used to warm up water to a certain temperature. With a second heat exchanger, the warm water is used for heating the cooling air. The cooling air temperature is controlled at $\pm 113^{\circ}\text{F}$ (Figure 1).

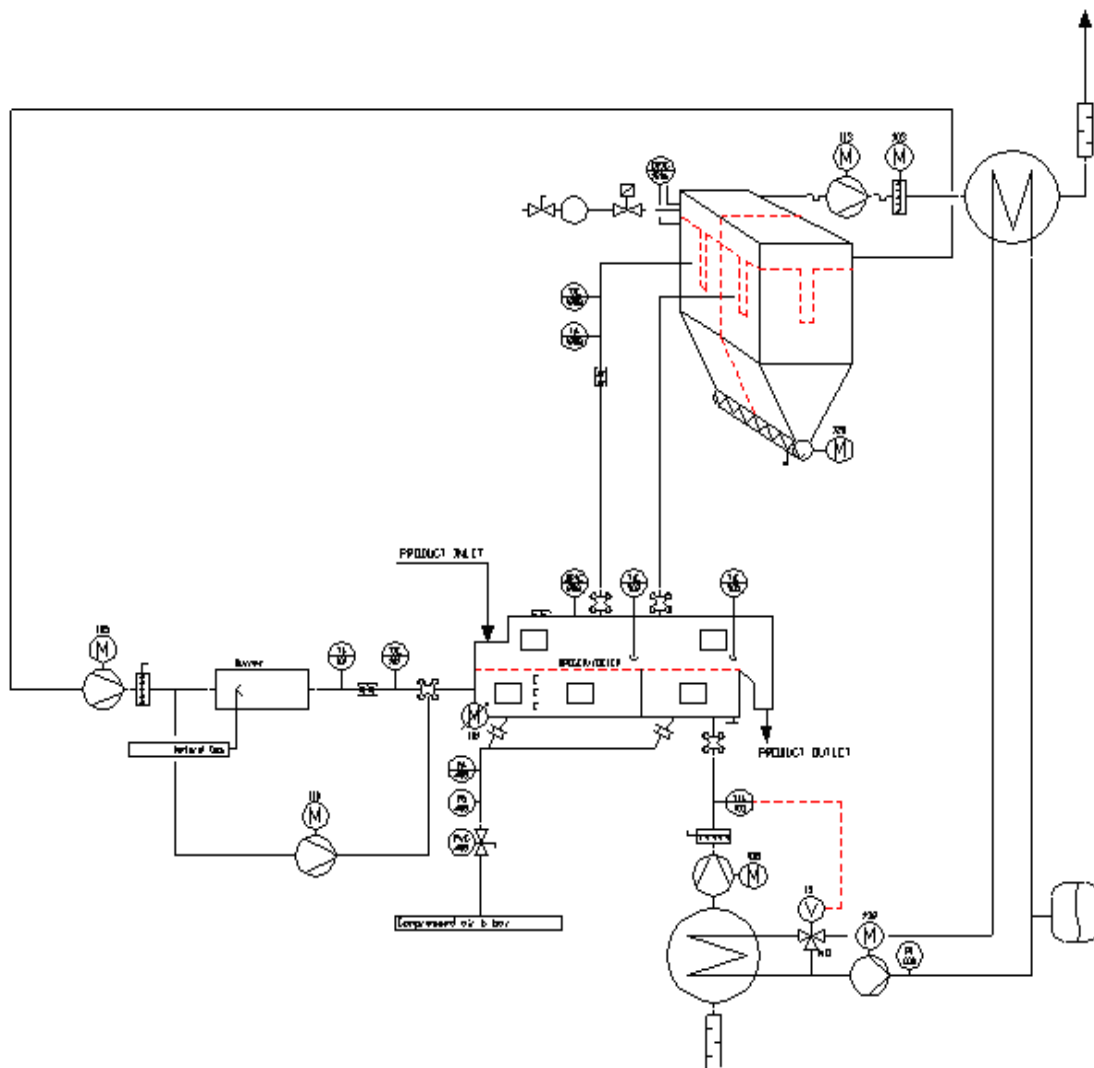


Figure 1: Flow sheet dryer/cooler with evaporative cooling, energy from exhaust air.

VENTILEX Cooling Option B

An alternative system uses a bypass from the burner duct to the cooling fan inlet (Figure 2).

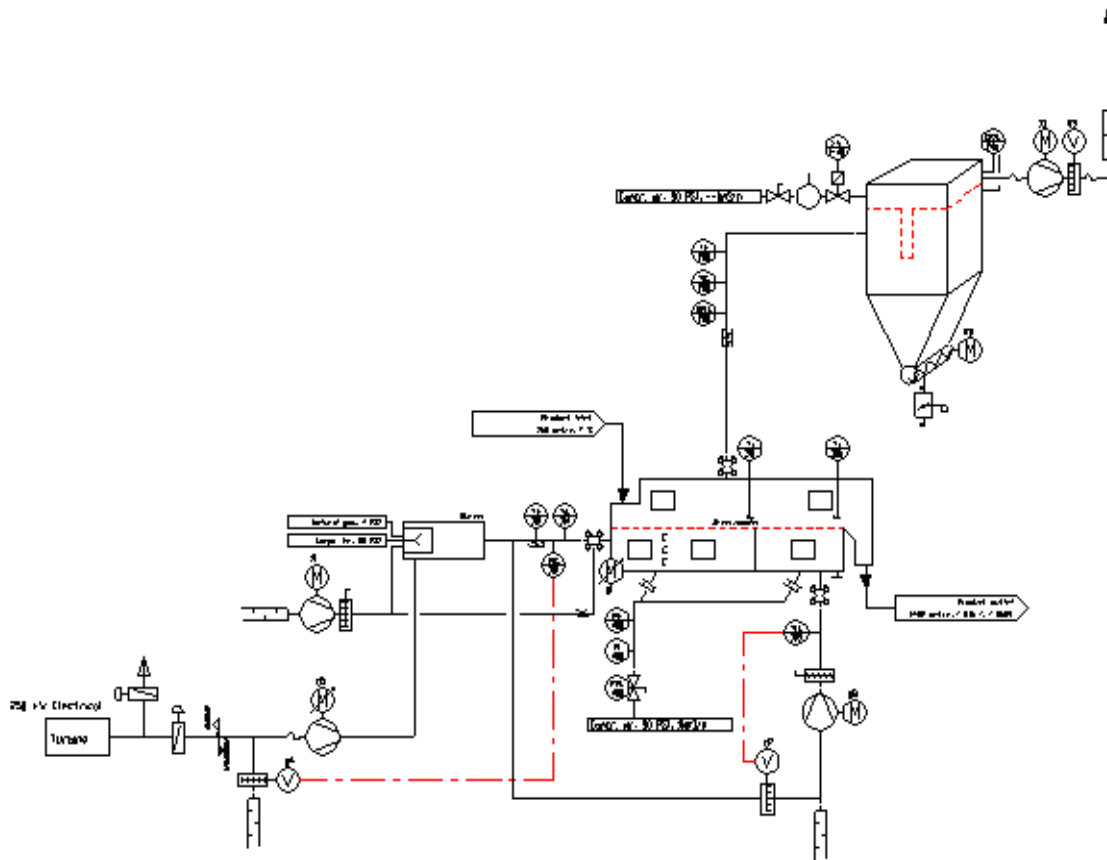


Figure 2: Flow sheet dryer/cooler with evaporative cooling, with hot air bypass from burner.

With a traditional Ventilex dryer/cooler (dryer and cooler same size) the temperature of the product will be $\pm 105^{\circ}\text{F}$ after cooling and using evaporative cooling. This is a lot lower than is really necessary for further product handling.

If a product temperature of 130 to 140 $^{\circ}\text{F}$ after cooling is sufficient, the cooler area can be smaller. In this way, we already use the benefits of the evaporative cooling.

Because of the evaporation in the cooler, the exhaust air is relatively wet (higher relative humidity) and the air temperature is a bit lower than with a traditional cooler. It is economically not feasible to have recirculation of the cooler exhaust air with evaporative cooling. Note that the amount of latent heat in the exhaust air is a surplus of the energy that is required for heating the cooling air to 113 $^{\circ}\text{F}$ (also with ambient conditions of 0 $^{\circ}\text{F}$).

With the evaporative cooling, the total investment costs will be lower because we have a smaller cooler and we do not have the recirculation ducting.

Examples of tests are shown in the next figure.

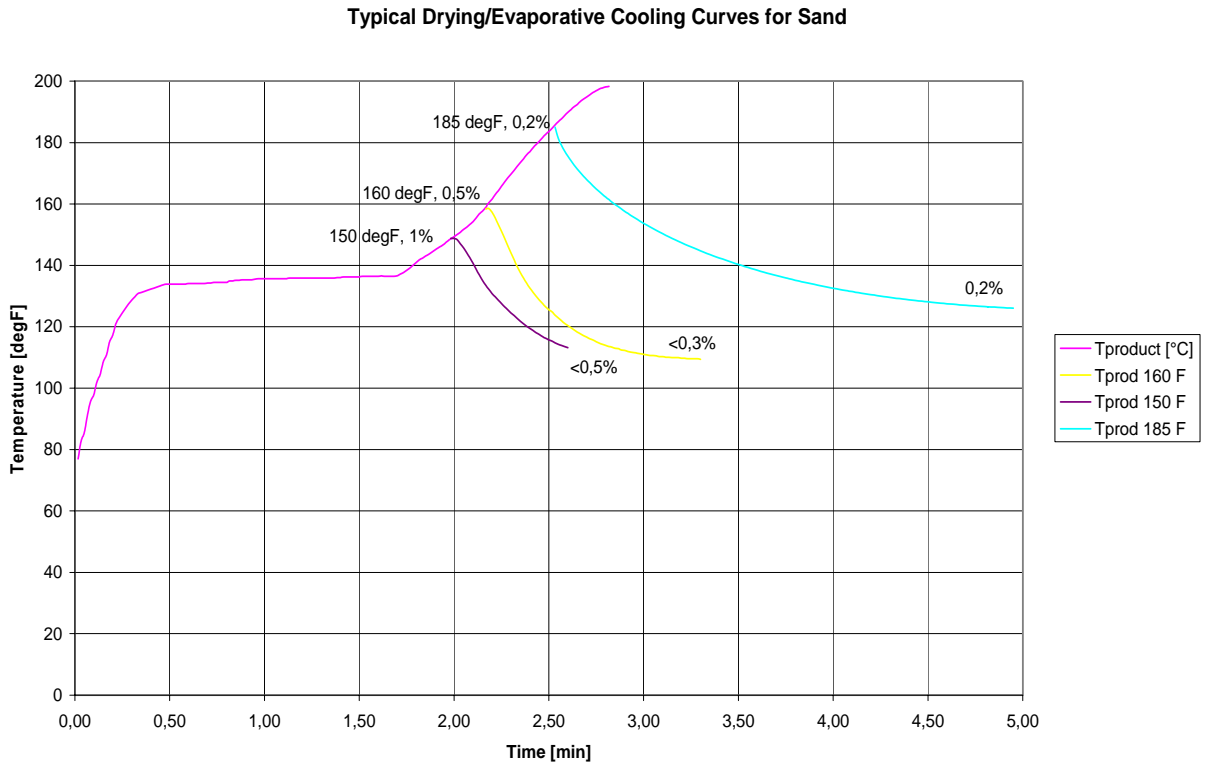


Figure 3: Typical evaporative cooling curves of sand after leaving the dryer at different temperature/moisture content

Product Feed Systems

System A:

This is the simple "Low Cost" solution.

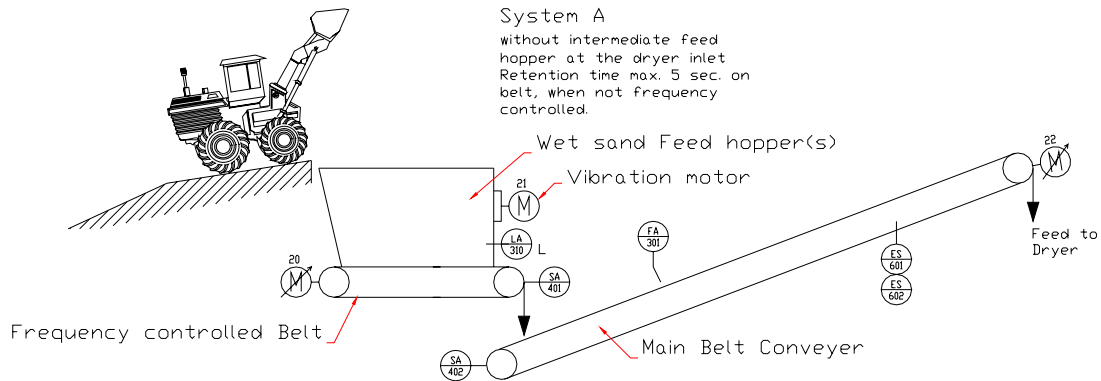


Figure 4: Feed System A

- M20 Belt Conveyor (Frequency controlled)
- M21 Vibrator Motor
- M22 Main Belt Conveyor (Frequency controlled)
- LA310 Low Level Alarm Wet sand hopper
- ES601 Switch Safety Pull Cord
- ES602 Switch Safety Pull Cord
- FA301 Switch for Product detection
- SA401 Rotation detection Belt Conveyor
- SA402 Rotation detection Main Belt

The system consists of a belt conveyor (M20) underneath the wet sand hopper and a feed belt conveyor (M22). During the start-up of the drying installation, the speed of the belt conveyor (M20) is gradually increased from $\pm 30\%$ to the maximum capacity. The temperature control system increases the air temperature while increasing the capacity.

The belt conveyor under the hopper controls the amount of product fed to the dryer. The main belt conveyor must also be frequency controlled, so the amount of product lying on the belt is always the same. If the main belt conveyor would be On/Off instead of frequency controlled and the dryer would be stopped at once during full production, at a new start-up the feed to the dryer would be maximal until the belt is empty. This cannot be controlled by a temperature controller.

System B:

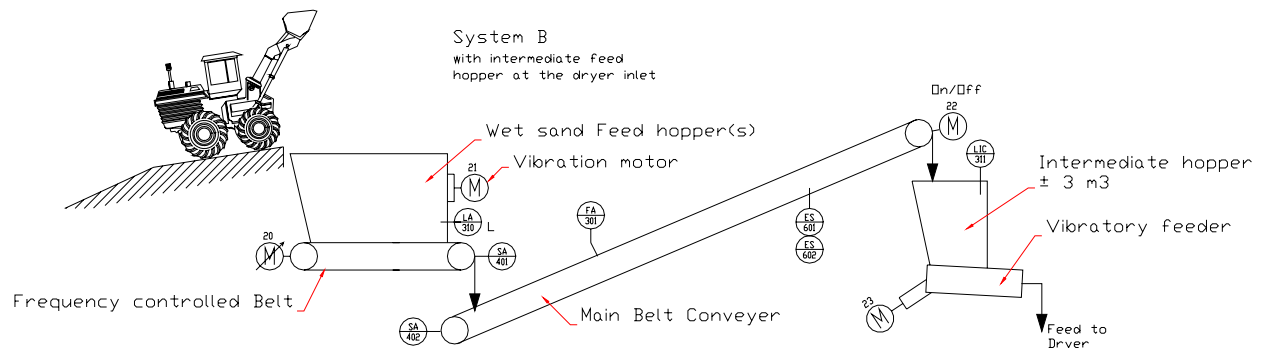


Figure 5: Feed System B

- M20 Belt Conveyor (Frequency controlled)
- M21 Vibrator Motor
- M22 Main Belt Conveyor (On/Off or Frequency controlled)
- M23 Vibratory Feeder
- LA310 Low Level Alarm Wet sand hopper
- ES601 Switch Safety Pull Cord
- ES602 Switch Safety Pull Cord
- FA301 Switch for Product detection
- SA401 Rotation detection Belt Conveyor
- SA402 Rotation detection Main Belt
- LIC311 Level indicator/controller Feed hopper

This system is similar to system A, completed with an intermediate hopper. The advantage of this hopper is that, in the case the wet feed sand hopper is empty (Alarm LA310), the shovel driver has about 10 -15 minutes to react.

The main belt conveyor can be either On/Off or frequency controlled. The main belt conveyor is controlled in such way that the wet sand level in the intermediate hopper stays within limits, so the capacity of the vibratory feeder remains constant.

During the start-up of the drying installation, the speed of the vibratory conveyor (M23) is gradually increased from $\pm 30\%$ to the maximum capacity. The temperature control system increases the air temperature while increasing the capacity.



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Fluid Bed Dryers and Coolers

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