

## Belt Dryer

SEVAR AG

### Functional Description

The SEVAR double-path belt dryer is horizontally traversed by two perforated stainless steel conveyor belts arranged one above the other, that move slowly in opposite directions. The belt dryer is of modular design, it consists of an inlet/outlet module, variable numbers of dryer modules according to the required water evaporation rate, and a return module. The availability of both indirect and direct heating of drying air results in designs with heat exchangers installed per each dryer module (see Figure 1), or a burner plenum with adjacent combustion chamber (see Figure 2). Both heating options are selectable per dryer module, aiding flexibility as per available heat source.

In indirect heating the supply air fan, placed outside the belt dryer transports the condensed and recycled supply air via air ducts into the individual belt dryer modules equipped with heat exchangers. More than 90% of the drying air is recycled after condensation. In a direct heated Belt Dryer system, a hot gas fan transports condensed and with combustion air blended hot gases to the dryer modules. Each dryer module is divided into process and mixing chamber (see Figure 3). In the mixing chamber, the supply air or hot gas recirculated by the respective recirculation fan, passing through the heat exchanger (indirect heating) for supply air heating and mixed with the recirculating air of the process chamber. The recirculation fan of each module transports the drying air in the process chamber across the transport direction and through the material layer of the upper and lower dryer belt.

### Condensation

Humid exhaust gas is extracted with an Off-gas fan and directed to a water-operated spray condenser. The condenser is direct operated with spray water or indirectly with heat exchangers and a cooling liquid. Condensed air is then recycled to the dryer inlet air ducts. By installation of an optional heat recovery system the hot humid exhaust air heats up the condensed and recycled supply air via water-loop operated heat exchangers (see Figure 4).

### Material feed

The material to be dried is continuously and uniformly distributed on the 3 meter wide dryer belt via the Distributor/Dosing unit and Roller press located on top the dryer inlet module. The Roller press – consisting of two counter-rotating grooved rollers - shapes the sewage sludge into strands with the effect of increasing the surface area of the material to enhance the heat transfer and water evaporation (see Figure 5 ).

### Back-Mixing

A dry solids concentration of 30% or higher of the introduced material is achieved by a back-mixing unit. Dewatered wet material (inlet) and a partial stream of dried material (recycle) are mixed in a twin screw mixer located on top of the dryer inlet module. An increase of dry solids concentration to 30% results in a material layer with a favorable ratio of surface to volume, providing a minimum resistance to circulating the drying air.

### Dried material

Dried material is extracted from the system with a discharge screw. The discharge screw is located below the inlet module. The drying process utilizes a controlled temperature gradient along the dryer modules and takes advantage of the fact that wet, cool material is introduced in the inlet module and through air circulation absorbs the heat of the dried product. Therefore, material is cooled before it is discharged from the dryer. Due to the gentle drying, the material on the belt maintains it's granular structure but with reduced size. Optionally, dried material can be sized down in a crusher to increase bulk density for storage.

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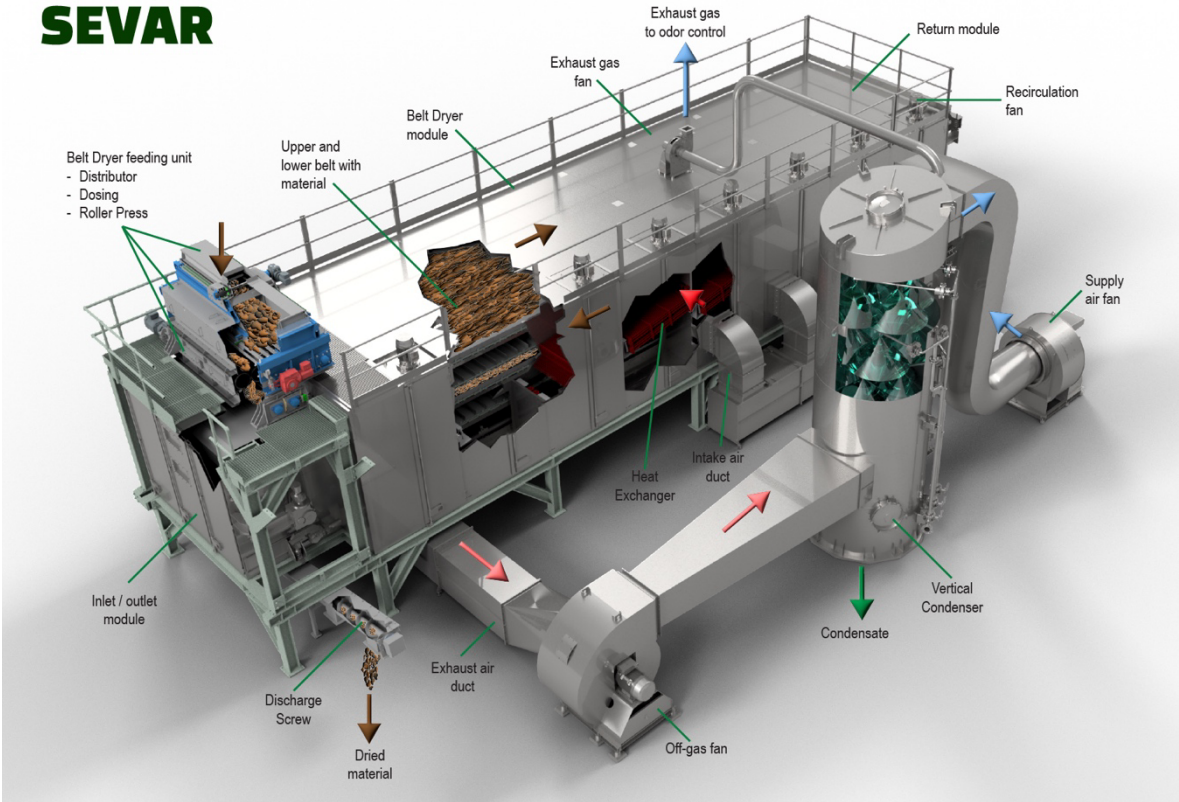


Figure 1: SEVAR Belt Dryer – indirect heated

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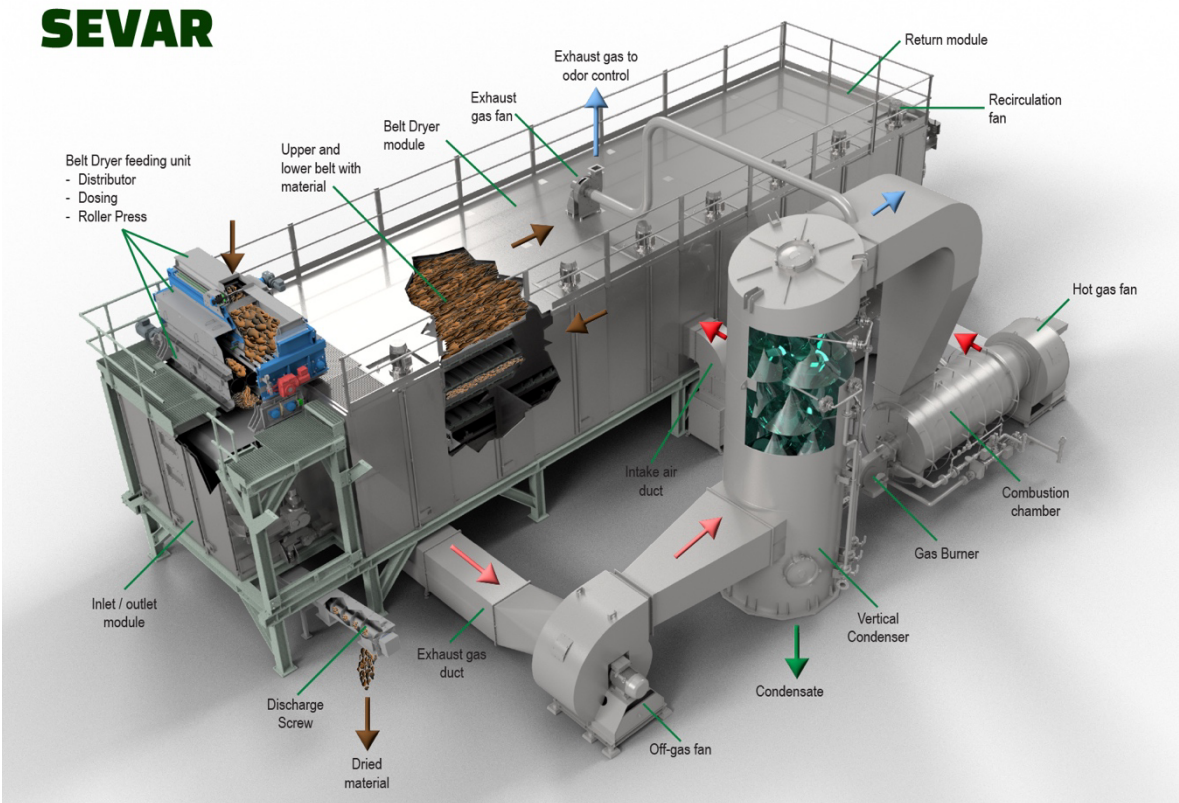


Figure 2: SEVAR Belt Dryer – direct heated

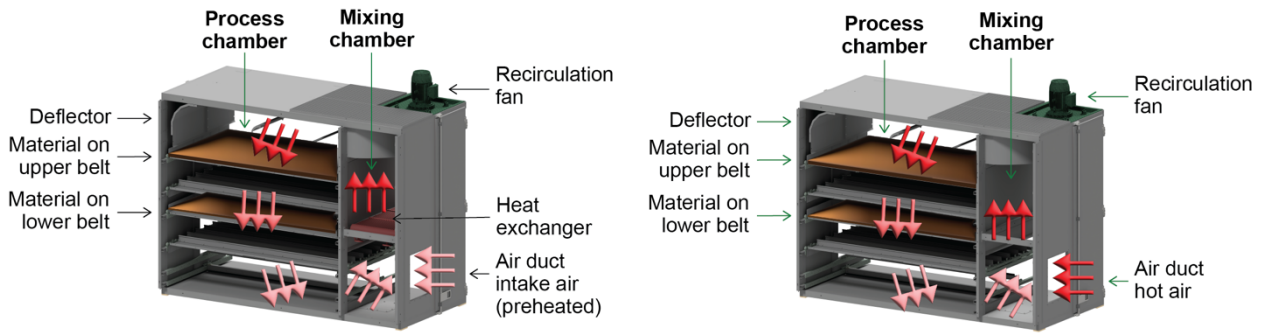


Figure 3. Cut section through Belt Dryer – left: indirect heated, right: direct heated

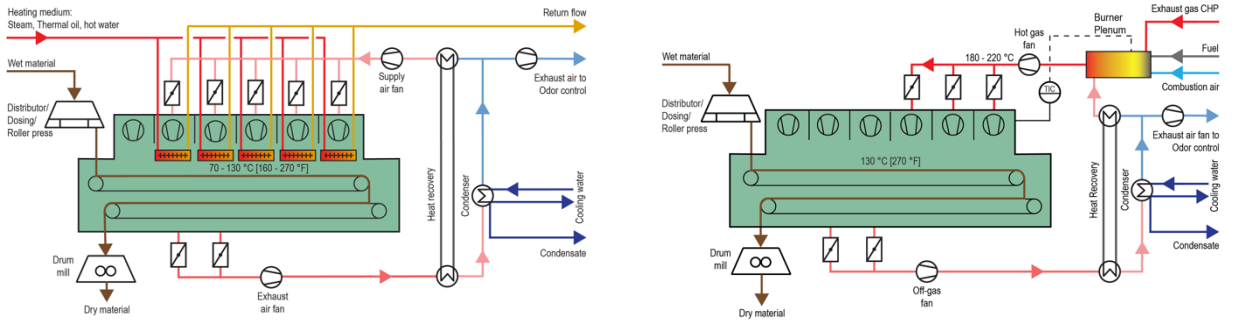


Figure 4: Functional principle Belt Dryer – left: indirect heated, right: direct heated

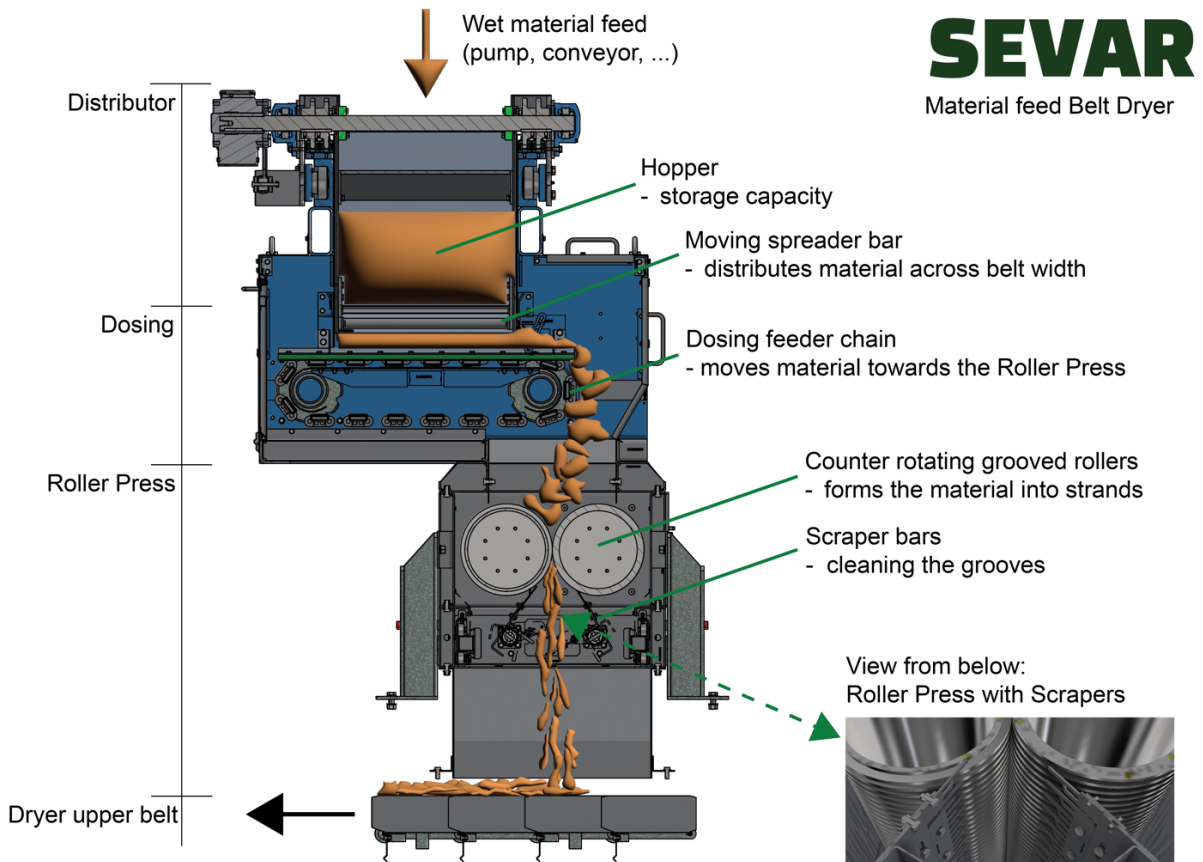


Figure 5: Belt Dryer feeding unit

Table 1: Operational and technical data of SEVAR Belt Dryer BD3000 (1 line)

SEVAR Belt Dryer		Low temperature drying	Medium temperature drying
Model BD 3000	No. modules	4 – 18	4 – 18
Temperature drying air	°C	70 – 90	120 – 140
Materials		Municipal and industrial sewage sludge: digested, undigested, Waste activated sludge, digestate, biomass	
Dry solids_in	[%]	15 – 40	
Dry solids_out	[%]	60 – 92	
Water evaporation*	[t <sub>H2O</sub> /h]	0.6 – 3.3	1.0 – 5.0
Throughput_dry (25% DS)*	[t <sub>DS</sub> /a]	1,700 – 11,300	2,800 – 17,100
Throughput_wet (25% DS)*	[t/h]	0.8 – 5.7	1.4 – 8.6
	[t/a]	6,600 – 45,300	11,000 – 68,600
Specific thermal energy consumption	[MW/t <sub>H2O</sub> ]	ca. 0.9	ca. 0.85
Heating source_indirect		<ul style="list-style-type: none"> <li>– Hot water CHP [90/70°C]</li> <li>– Jacket water of CHP</li> <li>– Heat pump</li> </ul>	<ul style="list-style-type: none"> <li>– Saturated/Process steam (min. 3 barg)</li> <li>– Thermal oil</li> </ul>
Heating source_direct			<ul style="list-style-type: none"> <li>– High temperature CHP exhaust gas</li> <li>– Burning of biogas, digester gas, natural gas, fuel oil</li> </ul>
Exhaust gas to odor control	m <sup>3</sup> <sub>N</sub> /h	2,000 – 18,000	
Exhaust air temperature condensed	[°C]	40	
Odor control		Acid scrubber, biofilter	
Retention time	[min]	60 – 180	
Space requirement LxWxH	[m]	12 – 40 x 6 x 7.5	

\*Technical note: Values for one line Belt Dryer BD3000 operating at 8000 h/a. Operation of multiple dryer lines multiples water evaporation as well as throughput capacity.