



tech-info

► *Sugar drying and cooling plants*

*BMA plants are employed at
beet and cane sugar factories
and sugar refineries worldwide
for drying and/or cooling
refined sugar, white sugar,
as well as VHP
and VLC sugar.*



For the drying of sugar crystals, it is important to convert the syrup adhering to the surface into a crystalline form. This crystallization process requires time and crystal nuclei.

A countercurrent drying drum offers ideal conditions for the effective drying of centrifugal-wet sugar crystals. By moving the crystals in the drying drum, there are mechanical interactions between dried syrup and still liquid components which cause the necessary crystal nuclei to form.

The drum, which rotates about its longitudinal axis, is slightly inclined from the horizontal line, ensuring that the material fed in at the front end slowly moves to the discharge end. The air needed for drying is heated in air heaters to the required temperature and passes through the drum dryer in countercurrent direction. To achieve a good heat and mass transfer between the sugar crystals and the drying air, the drum is equipped with internals which make the product trickle down again and again through the drying air. In this way the drum dryer combines the mechanical treatment of the crystal surface with a low drying speed perfectly.

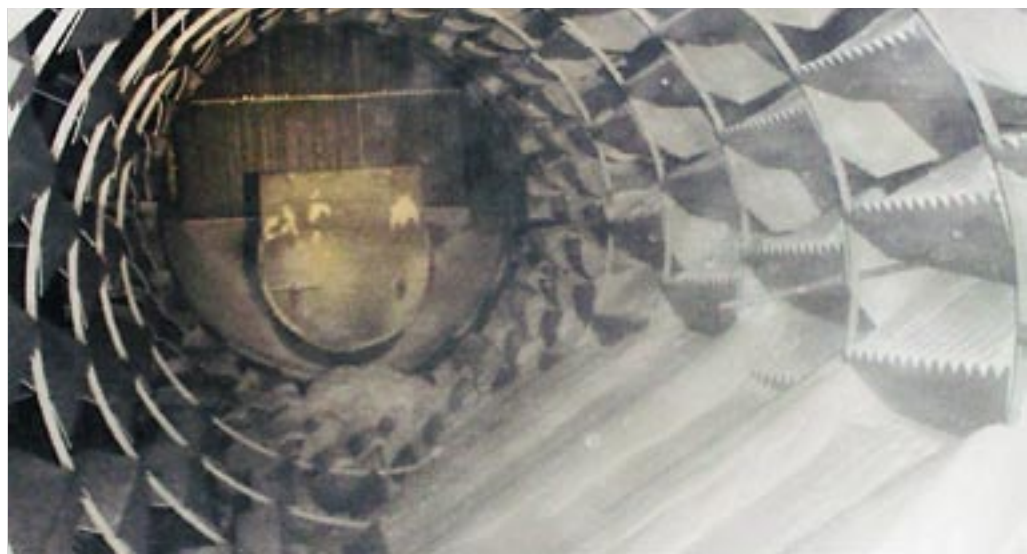
To influence the drying effect inside the drum dryer, it is possible to feed additional, heated air into the dryer via a central pipe in order to increase the air temperature, which improves the drying capacity in the first third of the dryer. The drying energy in the rear area of the drum can thus be reduced and the drying process is smoother, which has a positive influence on the product quality. The cool air entering the drum is warmed by the sugar and can be fully utilized in the drying area as drying air. So, this dryer design achieves an excellent ratio of energy input to water evaporation.

Advantages:

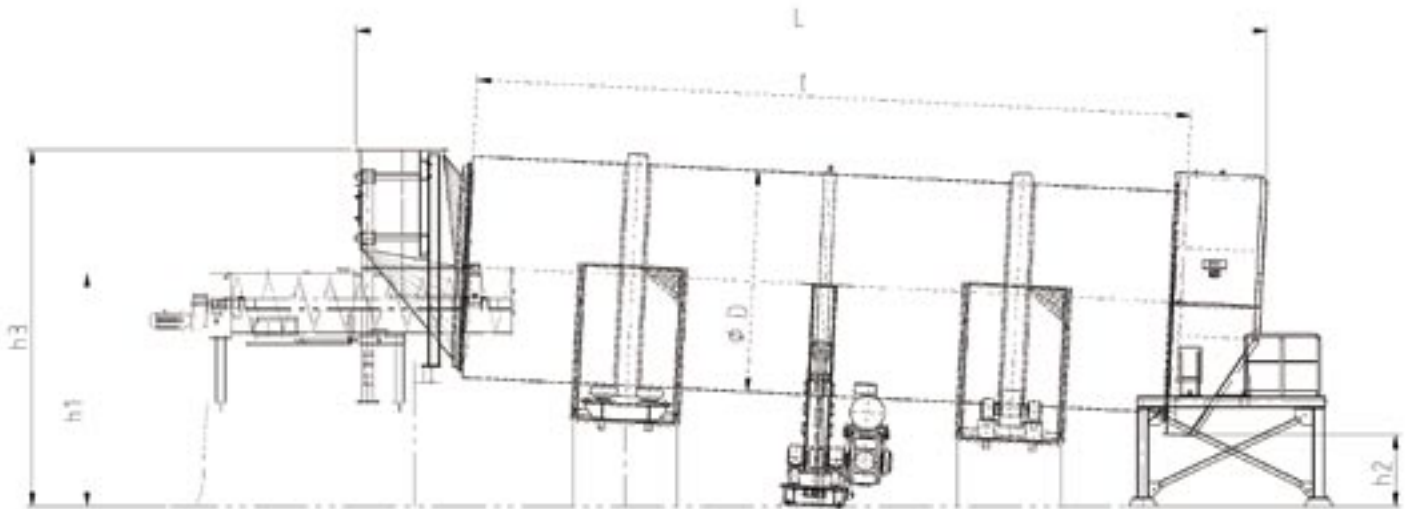
- Mechanical interaction at the sugar crystal surface through drum rotation
- Utilization of the sugar crystals' inherent heat for drying
- Large drum volume allows to homogenize the mass flux
- Lump formation or short increase in sugar humidity can be tolerated without problems
- Central pipe allows to increase the drying capacity and the drum can be operated as a dryer/cooler



*Inside view of a drum dryer
(not operating)*



Sketch



Drum dryer

dimensions

Throughput* (kg/h)	Nominal dimensions		Total length L (mm)	Total height H (mm)	Inlet height h ₁ (mm)	Discharge height h ₂ (mm)
	ø D (mm)	l (mm)				
25,000	2,000	7,000	9,000	3,200	1,900	650
35,000	2,200	8,000	10,200	3,500	2,000	700
45,000	2,400	8,000	10,200	3,600	2,200	700
60,000	2,600	9,000	11,500	4,200	2,400	800
70,000	2,800	9,000	11,500	4,200	2,400	800
90,000	3,200	10,000	12,500	5,000	3,000	950
115,000	3,600	11,000	14,500	5,500	3,500	1,200
130,000	4,000	13,000	17,000	6,500	4,200	1,300
> 130,000	upon request					

* The throughput values given are approximate and depend mainly on the local climatic conditions and on the requirements set for the final product temperature



Fluidized-bed coolers

Cooling the sugar after drying is necessary since otherwise, with high sugar temperatures, the air in the void volume among the sugar particles is highly loaded with water. Such high water loads initiate a diffusion process leading the humidity to the cooler, marginal areas of the storage tank, where it is absorbed by the sugar and may lead to lump formation. Therefore, cooling is as important for a later storage and quality assurance of the sugar as the upstream drying process.

The fluidized bed offers excellent conditions for an optimum heat and mass transfer. The characteristic feature of a fluidized bed is that granular and crystalline solids are moved through an air flow. During this process, the layer of whirling particles behaves almost like a fluid, which is why it is called fluidization.

The fluidized-bed cooler mainly consists of a stainless steel housing divided into a lower and an upper section. The lower section has air distributing chambers which a screen bottom separates from the cooling zones located above. The air from the distributing chambers passes through the screen bottom into the individual cooling zones, thereby forming the fluidized bed together with the sugar. Above the fluidized bed, the unit widens at right angles to the direction of flow and thus forms a separating chamber where the crystals carried along with the air are separated and fall back onto the fluidized bed. The exhaust air from the individual zones is led via air ducts to the dust-separating plant or to the sugar dryer, where it is utilized as drying air. The sugar crystals are transported through the fluidized bed from the product inlet to the product outlet and cooled down to the required outlet temperature.

Additional cooling energy is brought directly into the fluidized bed by water-cooled cooling tube banks that considerably increase the capacity of the fluidized-bed cooler while essentially reducing the air quantities required. This leads to a considerable reduction in the size of the unit. The sugar leaving the cooler has a defined temperature that is adequate for downstream silo storage. The cooling capacity required is ensured by using cooling water, either in an open passage or in a closed cycle.

With the fluidization in the air flow, the sugar passes through an additional after-drying. This can even be intensified with the installation of drying zones, allowing the unit to be operated as an (after-)dryer/cooler and reducing the temperature load of the sugar in the drying drum.

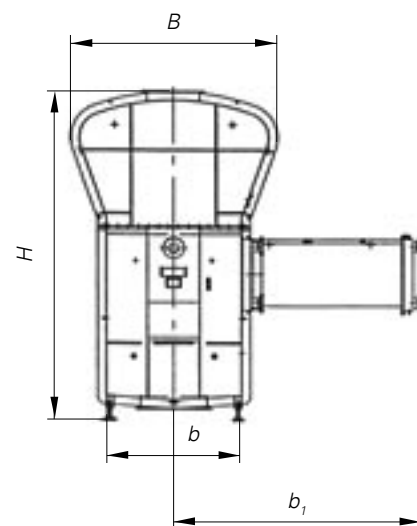
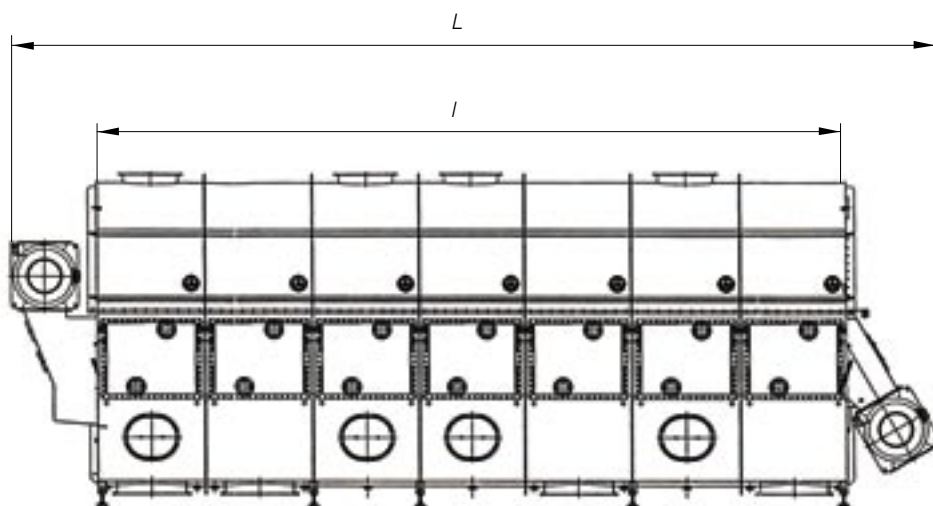
Advantages:

- Increased efficiency of cooling in the fluidized bed
- Reduced energy requirements
- Cooling down to a constant sugar temperature
- Reduced air quantities
- Compact plant size
- No movable parts
- After-drying and cooling performed by one unit
- Utilization of exhaust air in upstream drying units
- Separation of dust from the sugar stream

Fluidized-bed cooler in the

Nordstemmen works of Nordzucker AG,

Germany



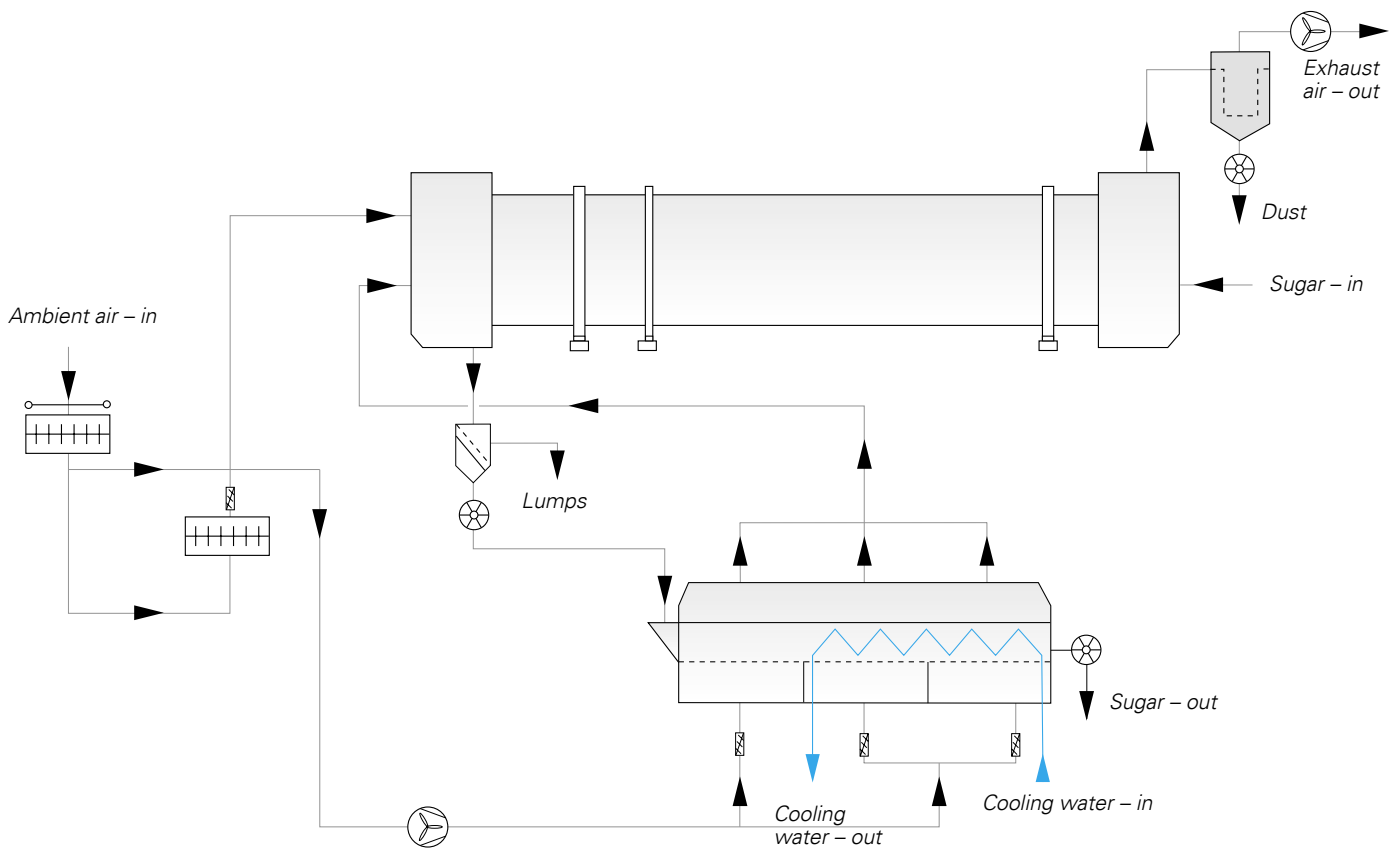
Fluidized-bed cooler
with integrated
cooling surfaces

Dimensions of
fluidized-bed coolers

Throughput* (kg/h)	Nom. dimensions active area		Total width	Total height	Space requirem.	Total length
	b (mm)	l (mm)	B (mm)	H (mm)	b ₁ (mm)	L (mm)
20,000	1,000	2,500	1,600	3,900	2,000	4,150
30,000	1,000	3,700	1,600	3,900	2,000	5,350
40,000	1,000	5,000	1,600	3,900	2,000	6,650
50,000	1,000	6,200	1,600	3,900	2,000	7,850
50,000	1,600	3,700	2,500	3,900	2,900	5,800
70,000	1,600	5,000	2,500	3,900	2,900	7,100
85,000	1,600	6,200	2,500	3,900	2,900	8,300
100,000	1,600	7,500	2,500	3,900	2,900	9,600
120,000	1,600	8,700	2,500	3,900	2,900	10,800
135,000	1,600	9,900	2,500	3,900	2,900	12,000
135,000	2,500	6,200	3,300	3,900	4,300	8,800
155,000	2,500	7,500	3,300	3,900	4,300	10,100
180,000	2,500	8,700	3,300	3,900	4,300	11,300
200,000	2,500	9,900	3,300	3,900	4,300	12,500
> 200,000				upon request		

* The throughput values given are approximate and depend mainly on the local climatic conditions, on the available cooling medium and on the requirements set for the final product temperature

Combinations of drum dryer and fluidized-bed cooler



In this combination of a drum dryer with a fluidized-bed cooler, the advantages of both systems complement each other, resulting in an energetically interesting concept that is highly suitable for new plants as well as for increasing the capacity of existing plants.

Thanks to the installation of cooling tubes in the fluidized-bed cooler, the air quantity for sugar cooling can be reduced so much that the total exhaust air from the fluidized-bed cooler can be fed into the drying drum. This exhaust air has been warmed up in the fluidized-bed cooler to temperatures suitable for drying, which allows to considerably reduce the energy required for heating the drying air in the drum.

Moreover, exhaust air from the fluidized-bed cooler is utilized as drying air in the drying drum, it need not be dedusted at all, and the overall exhaust air quantity for the drying and cooling plant can be substantially reduced. This has the positive effect that the expenditure for exhaust air dedusting is reduced, as are the size of the fans and,

in particular, their power consumption. The resulting energy saving makes the combination of drum dryer and fluidized-bed cooler a very energy-efficient option.

Retrofitting a fluidized-bed cooler with internal cooling surfaces is an excellent option for increasing the capacity of existing drum dryers/coolers that have an insufficient cooling capacity. For this purpose, only the fluidized-bed cooler with the appropriate incoming air fan is needed. All exhaust air is fed to the existing drum cooling unit, where it increases the drying capacity of the existing plant and is exhausted via the existing exhaust channel.

Advantages:

- Reduced air quantities for the process steps drying and cooling
- Utilization of exhaust air from cooling for drying without additional dedusting units
- Saving of thermal energy

- Low temperature load of the sugar during drying
- Optimum drying in the drum dryer due to thermal/mechanical interactions at the crystal surface
- Homogenization of the mass flux for all downstream plant units thanks to the large drum volume
- Lump formation or short increase in sugar humidity can be tolerated without problems
- Increase of dryer capacity, if required, by installation of a central pipe in the drum
- Effective cooling in the fluidized bed
- Adjustment of constant sugar outlet temperatures over the whole day with corresponding plant design
- Compact plant size
- Separation of dust particles from the sugar stream



*Fluidized-bed cooler
at the sugar factory
Ste. Emilie, France*



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