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press release

Pellet Production: Belt Drier or Drum Drier ?

When it comes to the production of wood pellets, a lot of preparation of the wood material is necessary before it is capable to be delivered to the actual pellet press. The process is basically shown in Fig. 1

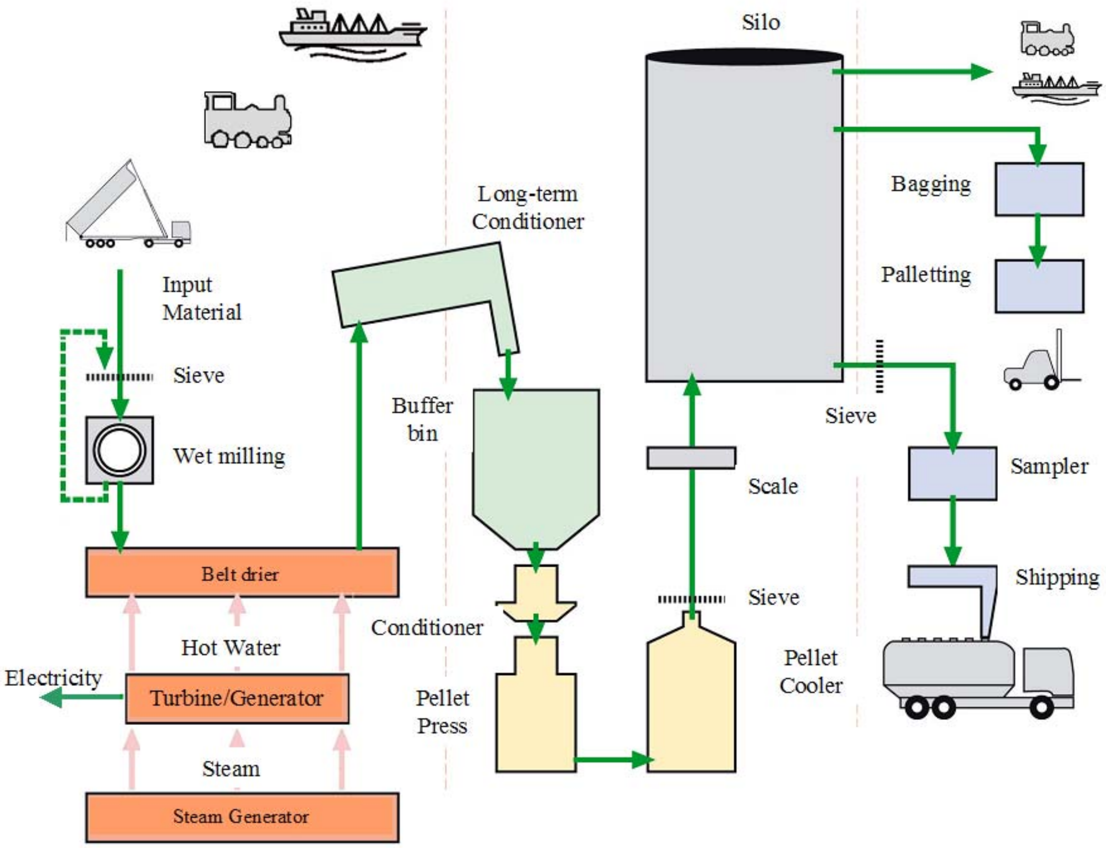

Fig. 1 Sketch of a modern Pellet Production Process

The first pellet productions started using dry sawdust as this was enough available and cheap. But when the market grew, it was more and more necessary to use fresh and thus wet sawdust for the production. For drying the sawdust, there existed already the well-known technology of the drum drier coming from the particle board industry. Thus all new pellet mills that arose in the 1990s did not think much about other technologies but installed drying drums.

The sawdust was taken care of. But still a lot of sawmills had to get rid of formerly called “waste” products from the wood processing: barks, root residues etc. Why not burning and producing electricity? And there is a lot of cooling water suddenly available at significantly low temperatures. What to do with it?

The working principle of a drum drier is based on the use of hot air for the drying process. The lower the air temperature, the less efficient is that machine. When entering the 21st century, more and more energy sensitivity came up and companies that installed pellet plants who needed driers had to think about different systems: the low-temperature belt drier was discovered for drying the sawdust.

Fig. 2 drum drier installed at a pellet mill

Fig. 3 low-temperature belt drier for sawdust

This historical story in fast motion already describes one of the big differences between the two drying systems:

The heat source

For any drying process, a mass flow of the water is necessary from the product to be dried (here sawdust) to the drying medium, usually air. Any kg of air at a certain temperature can take a certain amount of water. The higher the temperature of the air, the more water it can take. This principle anybody knows from the simple process of drying the wet hair after taking the shower.

The higher the temperature the more water the air can take, or – given a fixed amount of water: at a higher temperature, less air flow is necessary to evaporate this amount. This is the working principle of the drum drier. As visible in Fig. 4, the temperature level of a drum drier is significantly higher.

Looking at the scheme, the principle of the belt drier on the other hand is also clear. If the temperature level that is available is only low-calorific, the machine needs a higher air flow for evaporation.

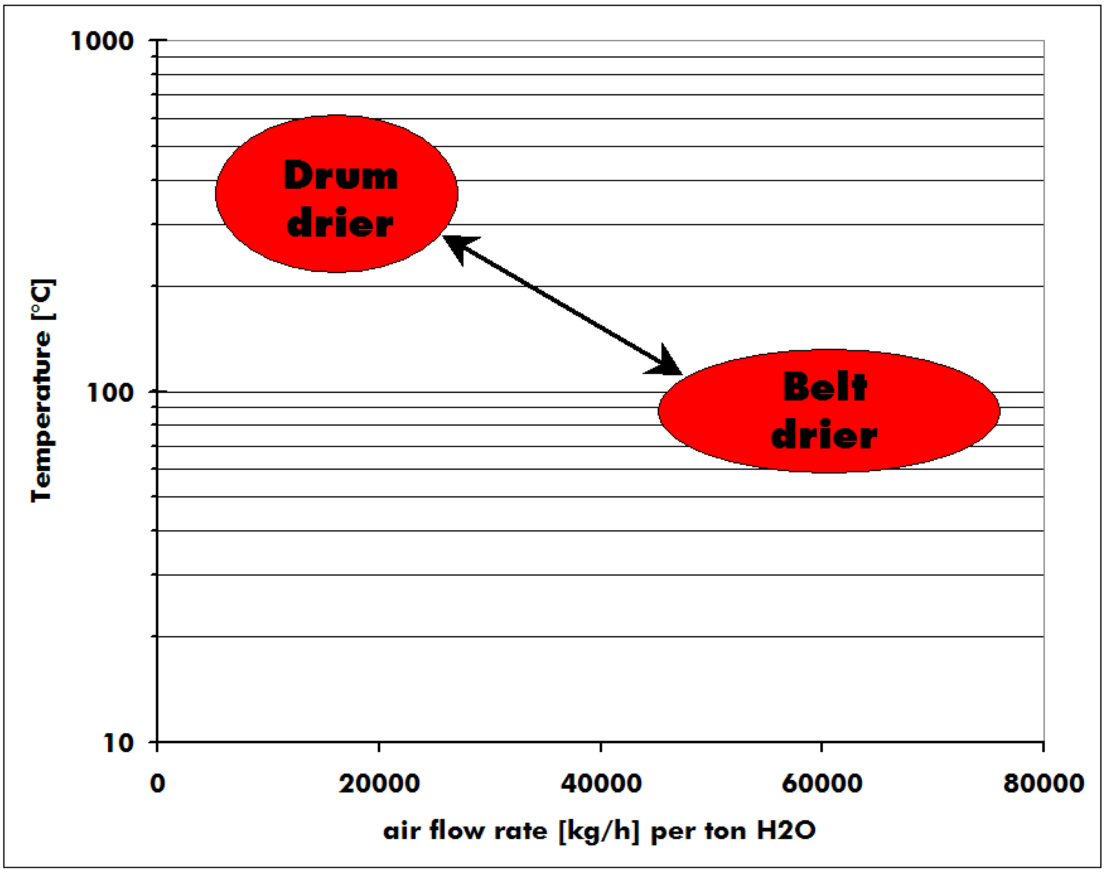

Fig. 4 temperature levels of the two drier types

In practical view, a planner has to look first: what heat is available for drying? Is the supply only low temperature “waste” heat e.g. coming from an ORC process the only chance is to use a belt drier.

If high exhaust gases from a heat plant are available and it is not planned to use them otherwise, e.g. for steam turbines, one might think of taking this energy to fire a drum drier. This high temperature exhaust gas exits then from the drum drier still on an acceptable level as this system unfortunately cannot use it fully efficient. Thus already installations have been made to use this low-temperature energy again for another belt drier for e.g. pre-drying the material.

Dust Emissions

In a drum drier the sawdust is always thrown up into the airstream. This guarantees that the drying particles all get in touch with the hot air and will be dried fast. But it also means that a lot of the particulate matter is blown with the airflow out into the exhaust. In order to cope with this dust emissions, a drum drier always needs a filter e.g. a cyclone. As the air flow rate is relatively low, some machines also recycle the exhaust air by blowing it back into the heat generation for post-combustion.

Filters or any other equipment like these are unthinkable for belt driers. Considering the high air flow rate, the necessary filters would be so incredibly expensive that the whole process is inacceptable. So the designers of modern saw-dust driers had to put a lot of effort in developing a machine that keeps the dust in the drier and to avoid blowing it to the exhaust. Nowadays very tight woven synthetic belts are used (see Fig. 5) that have to work as a filter medium for the sawdust. This plus the special knowledge how to seal the belt at the inlet, outlet and at the sides guarantee low emission rates of less than 10 mg/m³ air flow.

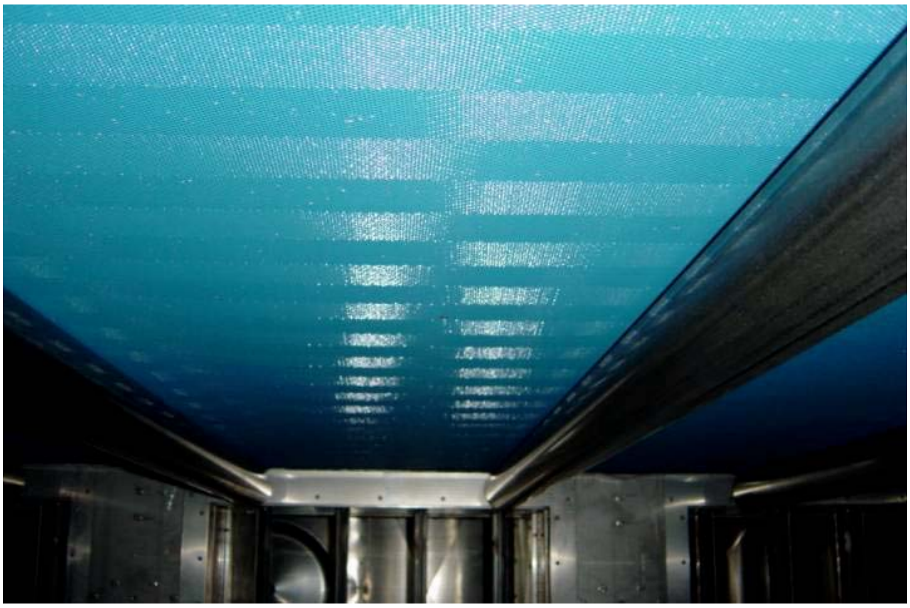

Fig. 5 synthetic belt for a belt drier

Uniformity of final product

The pelleting process needs exact moisture contents of the sawdust. Having less than 10%, it is necessary to add water before pelleting as the forces in the press get too high. Having more than 12%, the pellets simply break into more or less dust in the cellar of the final customer which increases maintenance costs and ash contents.

Due to the particles flowing in the air in the drum drier, fine particles that dry faster flow faster and big particles that dry slower flow slower. This looks like a good argument for the drum drier. The problem is that the flow speed is not manipulable. It is more statistical luck how the particles flow and the final result is not 100% guaranteed to be even, unfortunately. Putting a moisture measurement device and thus controlling the flow rate is possible but not easy at all. The retention time is very short (seconds to few minutes) and influencing the air flow by variable speed drive every few seconds finally ruins the heating process before the drier.

Fig. 6 Sawdust lying in a belt drier

Here the longer retention time in the belt drier (which is still very short for sawdust compared to other products) is much easier to be regulated. The long drying time equalizes the moisture well enough and moisture measuring plus control on the retention time is standard equipment anyway.

Fire Risk

This could be a very short chapter. High temperature means high fire risk, thus the drum drier is having a big disadvantage here, known from a lot of explosions worldwide the last years.

It surely is true, but nevertheless it needs a closer look on the reasons.
Drum driers are usually fired directly. This means the exhaust gases of the heat generation flow into the drier. The gases can never be cleaned fully and fine glowing particles are brought into the drum drier. In 99,999% of the cases they have no effect on ignition danger. But a slight risk is always left and experience shows that some operators consider “one blaze per year” as normal.

But isn’t that the same in the belt drier? No.
First of all the product is kept on the belt and not blown into the air. This in conjunction with the high air flow rate results in the dust concentration in the air being far below the lower explosion limit according to ATEX. Following this and the missing source of ignition (no sparks due to indirect heating) is a very low fire danger. The author knows only one case of fire in a sawdust belt drier. And this was caused by a carelessly thrown cigarette butt into the product flow.

Other effects on final Pellet Quality

Pellets are nothing but pressed sawdust plus around 1% of additives like e.g. corn starch. What keeps the pellets together is mostly the lignin in the wood. During the pressing process, the lignin fluidizes and after cooling down the hot pellets it glues the pellet together.

So it is important to keep the glue in the wood during the whole process.
The process of fluidizing the lignin starts due to the temperature in the pellet press. But it always starts at high temperatures, so even in the drum drier. At the high temperatures it is not only the water that is evaporated but also part of the lignin.
A French study from the Institut de Bioenergie ITEBE came to the result that pellets coming from sawdust dried on drum driers have an ash content in the final customers pellet heater of 0.3% (of overall mass) higher than from belt driers (source: pellet industry forum, Stuttgart 2008)

Considering the difference between 0.5% ash content and 0.8% ash content this is a quite amazing figure.

Fig. 7 Ligning is responsible to keep the sawdust tight

Space requirements

This is a clear positive point for the drum drier. The machine is much more compact than a comparable belt drier. The reason is again the air mass flow rate. Low mass flow needs lower space. It depends on other parameters like fan positioning also but overall the required ground space for the belt drier is about 70% to 100% more than for a drum drier.

Cost comparison

Comparing only the driers is difficult as the question is to compare the whole process including the heat generation. Comparing only the investment costs for the drier itself (assuming average temperature levels for the driers, 85°C for the belt drier, 500°C for the drum drier), the belt drier is about 20-30% more expensive than a drum drier.

Looking at the running costs, the belt drier wins as it can use low temperature heat and thus all the "waste" energy available on a production site. If e.g. a ORC Process is installed, the question of using drum drier is anyway obsolete. A drum drier has no other use of the energy contained in the exhaust gases than putting them back into the firing. A waste of money due to this low efficiency.

Summary

	Belt Drier	Drum Drier	Remarks
Low temperature heat source	++	--	Drum does not work on low temperature level. Min 250°C necessary
High temperature heat source	+	++	Drum can use high temperature directly, Belt has to mix with ambient air to cool down.
Unifirmity of Product	++	+	Automatisation possible at belt drier, drum drier works only on "statistical luck" as big particles flow slowlier than small but no fixed definition
dust emissions	++	-	belt is designed as a filter, there is NO exhaust air cleaning necessary to meet the requirements, drum drier has exhaust gas cleaning necessity
risk of fire / explosion	+	--	low temperature means low fire danger, in addition the product lies steady on the belt and is not transmitted into the surroundings
pellet quality	++	0	lignin is evaporated in the drum drier which is needed as a glue for the pellets
ash content at final customer	++	+	both meet requirements for DINplus quality but according to a French study, drum is 0.3% worse.
space requirements	-	+	belt drier is much larger than drum drier due to the necessity of higher air flow because of the low temperature
investment costs	??	??	drum is cheaper (20% ?) due to less material and less engineering costs
			looking at the WHOLE process the belt system will come cheaper as waste heat is used at low temperatures, better quality of pellets, less additives necessary etc.

The final decision what type of machine to be used has to make the investor. He has to weigh the different advantages and disadvantages and figure for him personally where to lay the focus on.

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