Freezing strategies

and how such influence your energy consumption

by FreezeTec ApS, Denmark

When blast freezing foodstuff there are generally two basic freezing-strategies;

1) Capacity utilization in which the products are aimed frozen as quickly as possible in order to fully utilize the capacity of the blast freezer

2) Operational excellence in which the company has a natural "operational cycle" - perhaps with 24 or 36 hours shifts, after which the blast freezer is emptied and reloaded. Here the freezing-strategy is to match the freezing-time to such cycles.

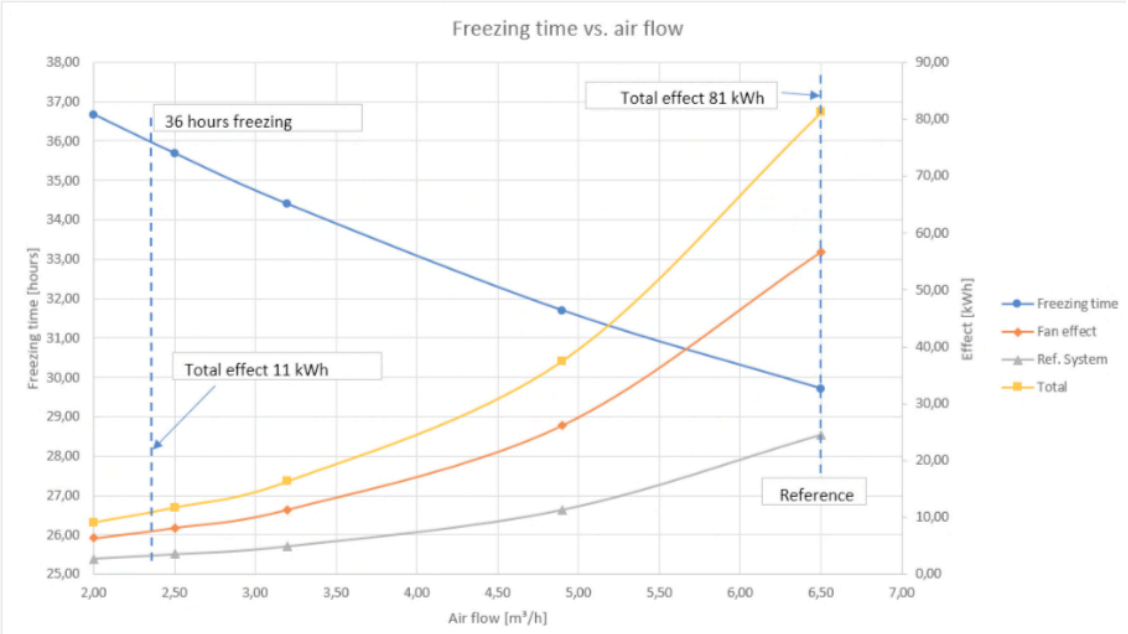
And how is this of importance?

Well – it is obvious that shorter freezing time requires more energy, as the main driver for cooling products is the combination of temperature and air-flow in your blast freezer – both factors which require energy.

But did you know that the energy-consumption develops exponentially as air-flow is adjusted?

The explanation to this is that increased air/flow requires more energy to your fans and cooling unit. As the fans generate heat during operation increased fan-speed will require even more energy just to cool is own heat.

The general relation between air-flow, energy consumption and freezing time is illustrated in the graph bellow.



Figur 1; Freezing time vs velocity and energy consumption

The above data are from a test carried out in a rather effective 20" test-blast freezer. Figures will of course vary in-between various blast freezer set-ups - but the tendency is general and more likely in an even worse relation

The graph illustrates how the energy-consumption is exponentially increasing as air-flow is increased in order to shorten freezing time.

In the example above an air-flow of 2,5 m³/s will result in a freezing-time of nearly 36 hours - entailing a total energy-consumption of approx., 13 kWh. If air-flow is increased to 6,5 m³/s freezing time is reduced to approx. 27 hours while the energy consumption is increasing to 81 kWh.

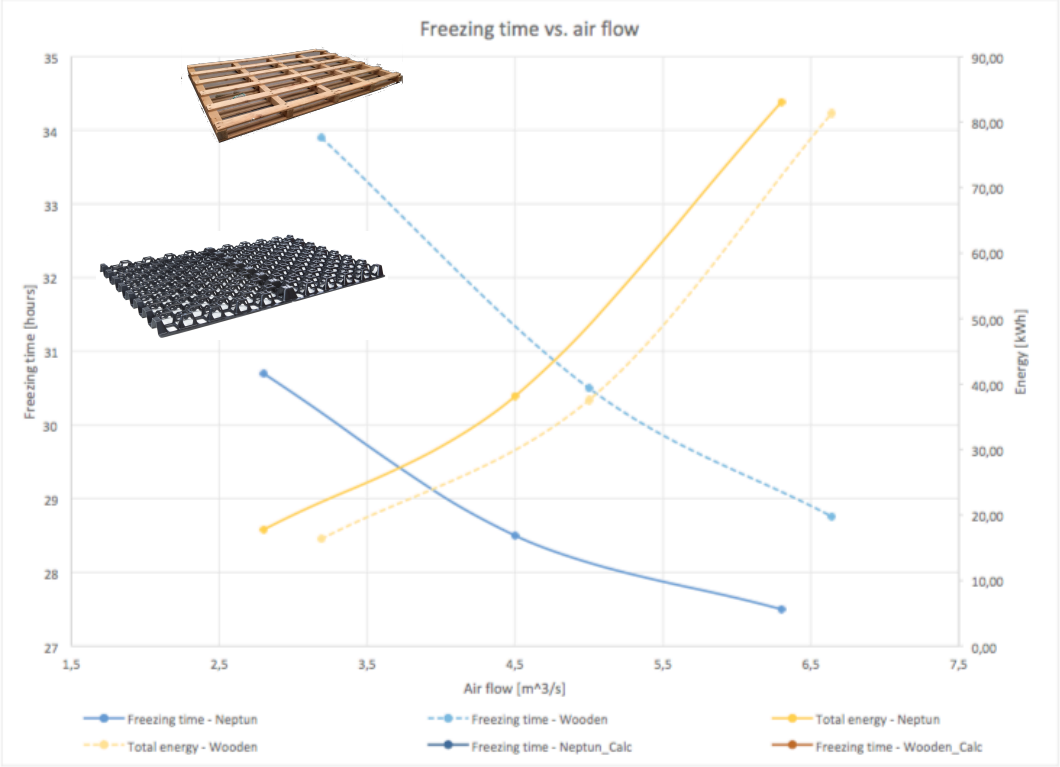
In other words; By reducing the freezing time with 9 hours or 25%, energy-consumption will increase by ***500%***

As energy consumption increases exponentially the figures can be even more alarming when looking at a reduction from lets say 31½ hours at 5 m³/s to 27 hours at 6.5 m³/s. In this case the energy consumption will double in order to save 4½ hours or 13% freezing time.

If freezing capacity is a bottleneck in the operation the above might be the only possible strategy, but generally the balance in-between freezing time and energy-consumption should always be in focus.

<u>High efficient spacers and freezing-time:</u>

Besides showing the exponentially relation between energy-costs and freezing time this knowledge also helps us understand the advantages in using high-efficient spacers.



Test recently carried at the Danish Technological Institute proved that when exchanging a rather efficient wooden spacer with the high efficient FreezeTec NFS-II spacer, the same freezing time – in this case 30,5 hours - could be achieved by reducing air-flow from 5 m³/s to 3 m³/s. This led to a drop in energy consumption from 38 to 18 kWh = **<u>+50% savings</u>**