

## The Effect of Particle Size on Raw Material Quality

*In materials with smaller particle size like wood chips, losses of extractives occur faster as compared to materials with large particle size, like round-wood. This is mainly caused by the increased total reactive surface area in finer particles.*

### HOW IS PARTICLE SIZE RELATED TO EXTRACTIVES LOSSES?

When wood is chipped and stored in a pile, by various different reactions oxygen is consumed and heat is released. This heat generation provides good growth conditions for bacteria which feed on the extractives in the wood.

The self-heating of the stored material occurs in a series of processes; usually one process raises the temperature to the level required for the next, usually more intensive process to begin.

At higher temperatures, various chemical processes take over from the biological processes. The rate at which this occurs and the types of fungi and bacteria that thrive in the material at any given moment depend on the type of material, its freshness, particle size, moisture, temperature, size and shape of the wood pile, the amount of nutrients, and oxygen content of the pile, as well as the storage duration.

Here the effect of particle size on the losses of valuable extractives is discussed more closely.

### ROUND-WOOD VS CHIP PILE STORAGE

Every change in wood storage and handling technology (e.g. flotted and irrigated wood vs. dry wood, or storing stem wood vs. storing chips) will result in new substrate and environmental conditions for the development of wood-attacking microorganisms.

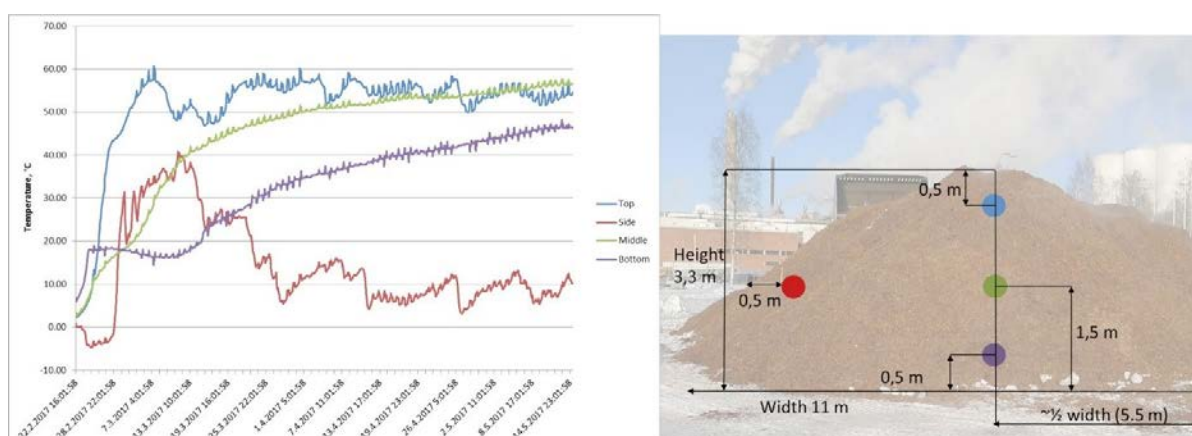
The predominant microorganisms in chip piles are thermotolerant fungi and bacteria. One advantage with storage in chip piles as compared to round-wood is that brown-rot fungi are very uncommon.

### SMALLER PARTICLE SIZE MEANS EXTRACTIVES ARE LOST FASTER

In addition to the heat generation in chip piles, small particle size increases the extractives losses due to larger reactive surface area.

Woodchips with a small particle size offer a higher surface to be colonized by fungi, thus increased particle surface area will enhance fungal growth.

Chemical decomposition reactions are also increased as a consequence of small particle size. Small particle size



**Figure 1.** Thermocouple locations in saw mill spruce bark pile and the measured temperatures during the first 12 weeks after the construction of the pile.

leads to faster deterioration of compounds due to the larger surface area that makes substances more easily accessible.

#### TEMPERATURE CHANGE IN BARK PILE

The temperature change over time in a 450 m<sup>3</sup> storage pile of fresh saw mill spruce bark is presented in Figure 1. The pile consisted of bark that was debarked no more than 48 h before the construction of the pile at 20.2.2017. The temperature increased from below 10 °C to 40-50 °C during the first week of storage at the top of the pile and was then stabilized during the rest of the storage time. The temperature at the side of the pile stays around 10 °C.

#### EXTRACTIVES CHANGE IN BARK DURING STORAGE

An example demonstrating a difference in extractives influenced by the physical form of the raw material is seen in our case study. The extractives content of spruce bark from saw mill, stored in large pile, was evaluated and compared with the extractives content from spruce bark stored intact on saw logs.

It could be observed that, extractives are much better preserved in intact saw log bark compared to chipped bark stored in piles. In piles the hydrophilic extractives

(extracted with hot water) are best preserved in the middle of the pile. The loss is most substantial where the exposure to external influences (weather, UV-radiation, etc.) is the greatest (figure 2).

Stilbenes are an important group of extractives in the bark, which can be used e.g. in medical, cosmetic and health food industries, and as antimicrobial agents. The loss of stilbenes during storage in the same samples mentioned in previous example is highlighted and can be seen in Figure 3.

The amount of stilbenes in the spruce samples from the spruce bark pile decreases and reaches an undetectable level after four weeks of storage. On the other hand, for the spruce bark samples from the saw logs, the stilbenes were still observed after 24 weeks of storage.

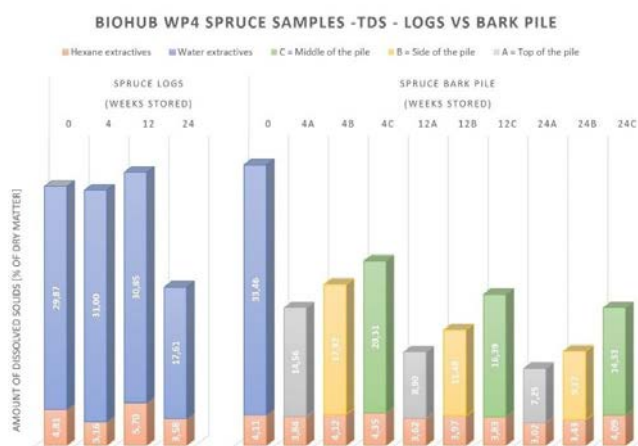
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*Figure 2. The degradation of extractives in spruce bark from saw log and bark pile samples over the period of 24 weeks indicated by the amount of total dissolved solids [% of dry matter].*



*Figure 3. The loss of valuable stilbenes during storage. Conclusion: Stilbenes are much better preserved in saw log bark compared to chipped bark stored in piles.*

#### Changes in the amount of stilbenes during storage

