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The Effect of Environmental Conditions on Raw Material Quality

Several environmental conditions, such as tempetarure, UV-light, ventilation, precipitation and season, have effect on raw material quality. Rise in temperature increases extractive losses. UV-light induces loss of extractives. Increasing ventilation in a chip pile speeds up evaporation and oxidation reactions. Some extractives are water soluble (hydrophilic), which means that both rainfall and water-debarking at the mill will leach some compounds of extractives from the biomass.

TEMPERATURE

High temperatures generally facilitate chemical reactions, i.e., at higher temperatures extractives are lost more rapidly. On the other hand, if the material is frozen the rate of chemical reactions and thus, the degradation of extractives is practically seized, or at least very slow.

UV-LIGHT

Transition metal ions and light, in general, accelerate auto-oxidation reactions. UV-light is known to induce the degradation of phenolic compounds, e.g., stilbenes. Thus, exposing material to direct sun light will facilitate the loss of extractives.

VENTILATION

Increased ventilation and thereby increased access of air and oxygen, e.g. in a chip pile, further speeds up evaporation and oxidation reactions.

In a chip pile there exists a balance between high temperature and oxidation / UV-light induced degradation in extractives. The chips that make up the outermost layer of the pile are exposed to UV-light and oxidation the most while the chips inside the pile are more exposed to degradation accelerated by high temperatures.

PRECIPITATION

Some extractives are water soluble (hydrophilic), which means that rainfall, wet storage, and water-debarking at the mill will cause extraction of some compounds from the biomass. The extractives compounds that are generally found in woodyard runoff include phenolic compounds, such as tannins and organic acids, as well as resin acids and short chain fatty acids.

SEASON

All the factors mentioned above change during the year. As generalized, during the winter the material is cold / frozen, probably covered with snow. In spring the temperature raises and sunlight increaces, frozen material starts to melt and the evaporation accelerates. In summertime temperatures and precipitation are highest before both start to decline towards autumn. The average wind speed stays fairly constant inland. On coast the wind speed is higher during winter than in summer.

Example of how different season can affect the degradation of extractives in spruce bark comes from our BioHub duplicate saw log storage experiments conducted during winter and summer.

The bark was stored intact on the saw logs and was then manually removed and analyzed. The total dissolved solids show a clear difference between the winter and summer experiments, especially in the hydrophilic extractives fraction within a storage period of 24 weeks as seen in figure 1.

The lipophilic extractives fraction on the other hand remains relatively constant throughout the storage period and only minor trends in degradation of certain extractives groups can be observed by the comparison of bark stored during winter and summer (e.g. resin acids and steryl esters seem to be more abundant during summer).

Closer look at the hydrophilic extractives groups of the samples from the afore mentioned experimental setups can be seen in figure 2. The concentration of hydrophilic extractives was overall 22,3 % higher during the bark stored during winter compared to bark stored during summer.

The results for the amount of the valuable stilbenes in the same samples is highlighted in figure 3. The amount of stilbenes in the bark stored during winter is all in all 63,3 % higher compared to the bark stored during summer, which is a major difference.

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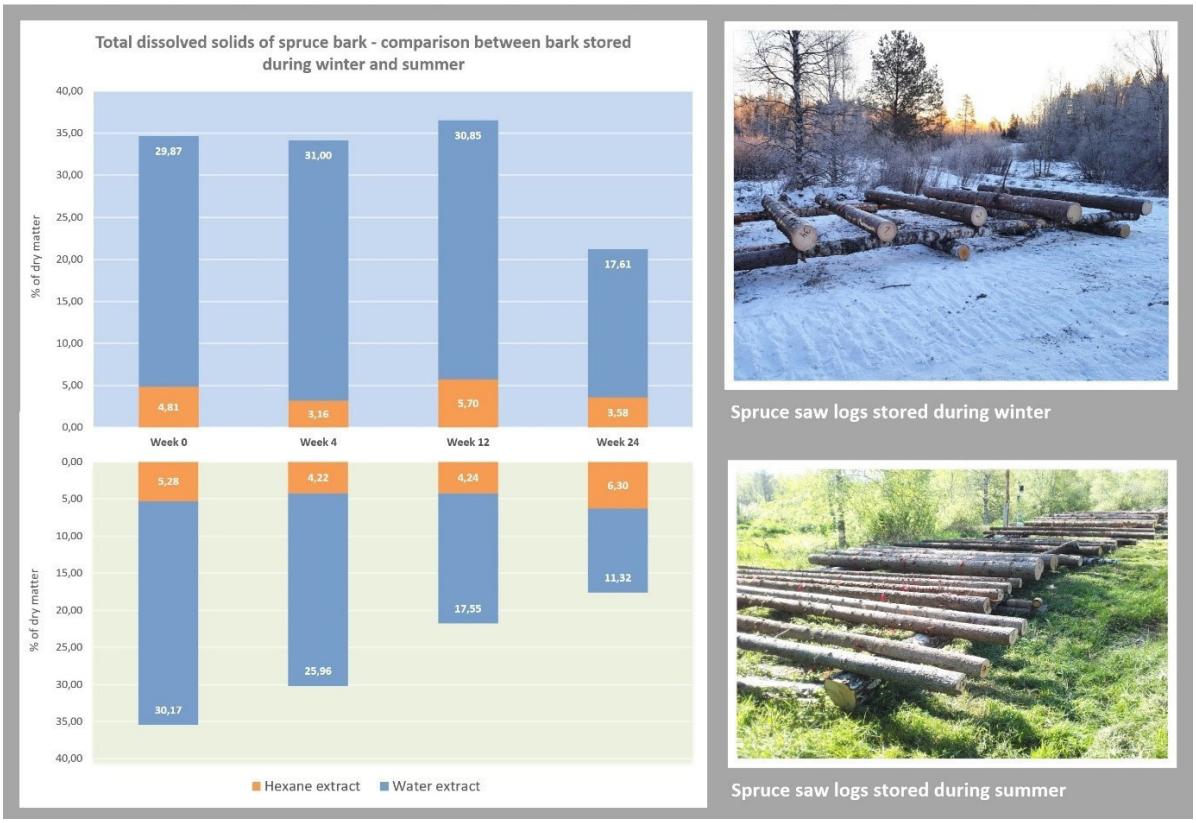

Figure 1. The comparison of the total dissolved solids from the hexane and water extracts of saw log spruce bark stored within a period of 24 weeks during winter and summer.

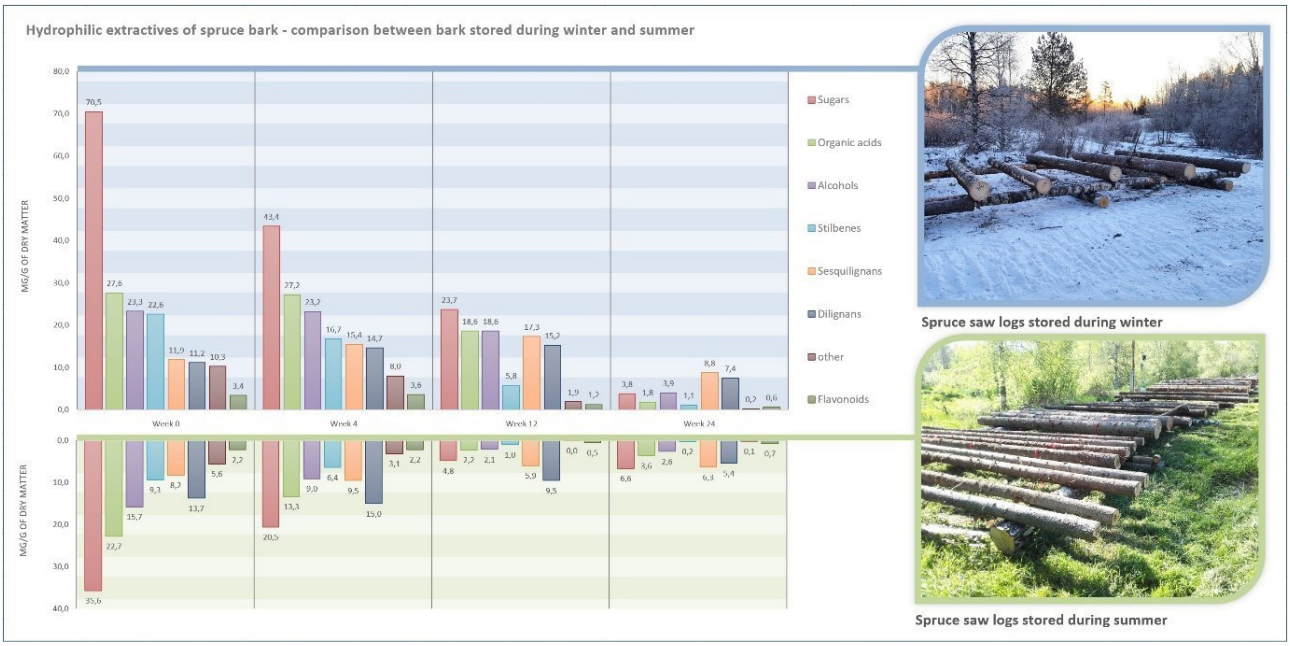

Figure 2. *The comparison of the hydrophilic extractives groups of the saw log spruce bark stored within a period of 24 weeks during winter and summer.*

Figure 3. *The comparison of the amount of stilbenes in spruce bark saw logs stored during winter and summer.*