Decrease in Extractives of Stumps

Stumps are readily available, underutilized source of renewable forest biomass which is rich in chemical composition in comparison with stemwood. Forest Refine studied the effects of logistical choice and storage time on the chemical changes in two stump feed stocks. These were freshly extracted and comminuted stumps and stumps which had remained in the ground for a year after clear cutting the mature timber. The crushed feed stocks were stored and observed for 24 weeks after comminution for changes in chemical composition.

Introduction

The forest industries use annually substantial volumes of wood resources in Finland and Sweden. As a result the formation of harvesting and manufacturing by-products such as stumps, branches, and bark is significant.

The amount of extractives in woody materials is 2-5 % of the feedstock dry solids in stemwood (Alén, 2000). Stump wood is richer in extractives than stemwood, especially pine stump wood. The extractives content varies in different parts of the stump. According to Hakkila (1975), the concentration of acetone-extractives is highest in stump and in the roots near the stump having high amount of heartwood (see Table 1). According to Hakkila, the concentration of extractives decreases towards the end of the roots.

Table 1. The proportion of acetone-extractives (Hakkila, 1975) and extracts originating from Soxhlet extraction with four different solvents (n-hexane, acetone, ethanol and distilled water) in a row (each extraction 4 h) (Nurmi, 1997). Amount of pine (Pinus sylvestris) stump extractives given as % of dry weight.

Root wood, mm							
5-50	**50-100**	**100-200**	**> 200**	**Average**	**Stump wood**	**Grand mean**	
	5,1	4,5	8,1	5,6	9,1	7,5	(Hakkila, 1975)
6,4	6,8	6,0			18,7		(Nurmi, 1997)

Many initial extracts suitable for potential applications are either rather volatile or chemically unstable. The content of extractives starts to decrease immediately after tree felling and this degradation continues during storage [1, 2]. This also means that the chemical composition of the extractives-based fraction changes gradually. The present study focuses on changes in the chemical composition of stump wood from pine (Pinus sylvestris) dominated stands during storage of 24 weeks.

Experimental set-up

The stump material consisted of two types of pine (*Pinus sylvestris*) stumps; fresh stumps and stumps that had been kept one year in the ground for one year after clear cutting the mature stand. The stumps were lifted, crushed and the storage pile built at UPM Pietarsaari Mills. One 150 m^3 storage pile of crushed stumps was designed for both stump materials. The sampling frequency was at the time of experiment initiation, 1, 2, 4, and 24 weeks of storage. Four different samples were taken at every sampling time, representing all areas of the pile. The samples were analyzed with respect to their extractives content. Subsequent Soxtec extractions with two solvents (first with hexane and then with a mixture of acetone: water, 95:5 V:V) were conducted. The extractives in various groups were chromatographically (GC/FID) determined according to the method presented by Örså and Holmbom [3].

Results and discussion

The total amount of stumps-derived extractives decreased slightly during storage, from 4.1 % of dry solids to 3.6 % of dry solids in case of fresh stumps, and from 4.3 % to 3.7 % in the case of one year old stumps. When comparing these results to the values presented in Table 1, it should be considered that the extraction method and solvents used aeffect the yield remarkably. In this study, only two solvents were used consecutively for extraction.

The changes in the chemical composition of extractives fraction were more remarkable than the changes in the gravimetric extractives amount. The extractives composition of stumps differs from that of for example stemwood. This also explains partly the differences inon their behavior during storage.

In the case of stumps, the most notable decrease during storage occurred in the free fatty acid content, although the triglycerides and steryl esters decreased as well. From the figures 1 and 2, we can observe that the decrease in the extractives groups during storage starts and proceeds faster in the case of the fresh stumps. It is likely that some changes occurred in the one year old material already during the storage underground but, to a lesser degree than in the freshly comminuted material. From the yield point of view this means that it may be preferable to store the stumps underground instead of being comminuted and stored fresh.

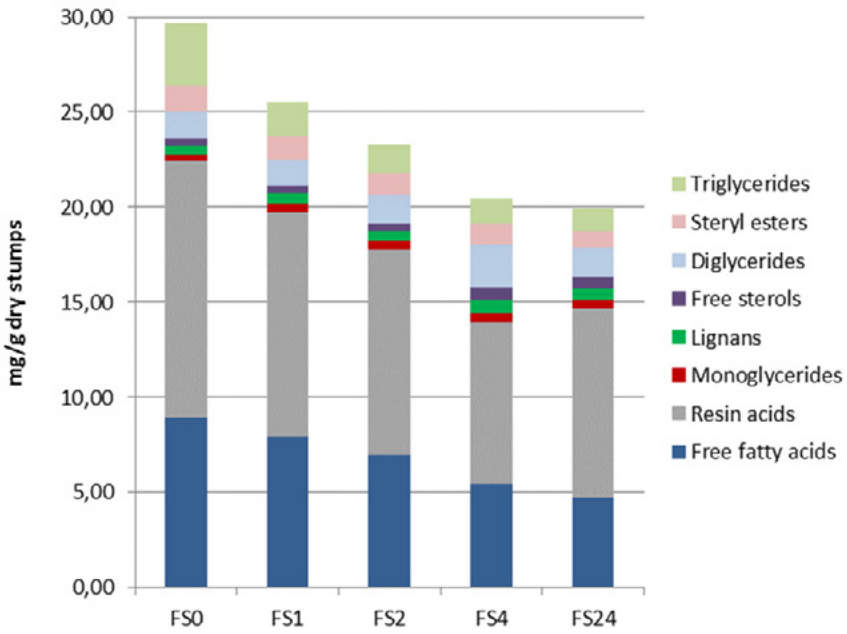

Figure 1. Extractives group analysis for fresh stumps. Key: FS0 = fresh stump sample taken before storage, FS1 = after 1 week, FS2 = after 2 weeks, FS4 = after 4 weeks, and FS24 = after 24 weeks.

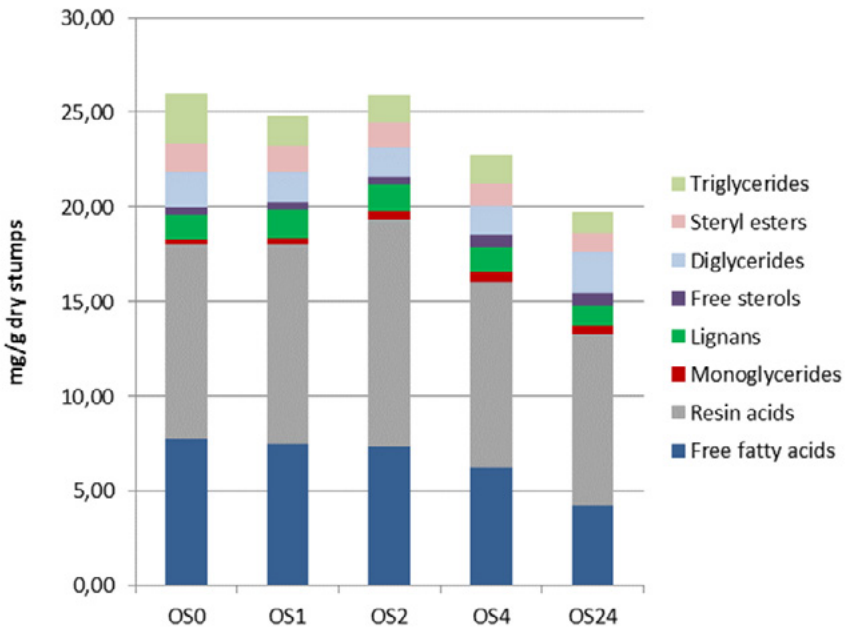

Figure 2. Extractives group analysis for one year old stumps. Key: OS0 = old stump sample taken before storage, OS1 = after 1 week, OS2 = after 2 weeks, OS4 = after 4 weeks, and OS24 = after 24 weeks.

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