

Potential of existing spruce logging residues and chemical compounds

The potential of spruce logging residues (bark, branches and needles) as well as the chemical compounds that can be obtained from the logging residues have been estimated for the Swedish Botnia-Atlantica region. This region includes Västernorrland and Västerbotten in Sweden.

USED METHOD

To estimate the amount of spruce logging residues that could potentially be harvested in the Swedish part of the Botnia Atlantica area we used the National Land Cover Database that is a land cover map over the entire Botnia-Atlantica area. We identified areas (not on wetland) covered by spruce forest (Tree-covered areas outside of wetlands with a total crown cover of >10% where >70% of the crown cover consists of spruce. Trees are higher than 5 meters). Then, we identified areas that have a standing volume of more than or equal to 250 m³sk/ha (207.5 m³-fub/ha) and a tree height of more than 20 m. We then assumed, based on knowledge acquired in the forest

Table 1: The available logging residues and needles (ktons dry biomass) in Västerbotten and Västernorrland.

Municipality	Logging residues, kton dry biomass	Needles, kton dry biomass
Sollefteå	121,0	40,3
Örnsköldsvik	114,0	38,0
Sundsvall	98,0	32,5
Ånge	69,0	23,0
Kramfors	39,0	12,7
Härnösand	33,0	10,7
Timrå	20,0	6,6
Västernorrland total	492,0	163,8
Skellefteå	41,0	13,5
Umeå	29,0	9,4
Bjurholm	28,0	9,3
Nordmaling	22,0	7,2
Vännäs	22,0	7,1
Vindeln	18,0	6,0
Lycksele	18,0	6,0
Vilhelmina	16,0	5,3
Åsele	14,0	4,6
Robertsfors	14,0	4,4
Dorotea	10,0	3,2
Norsjö	9,0	3,0
Storuman	9,0	2,8
Sorsele	6,0	2,0
Malå	2,0	0,4
Västerbotten total	253,0	84,2

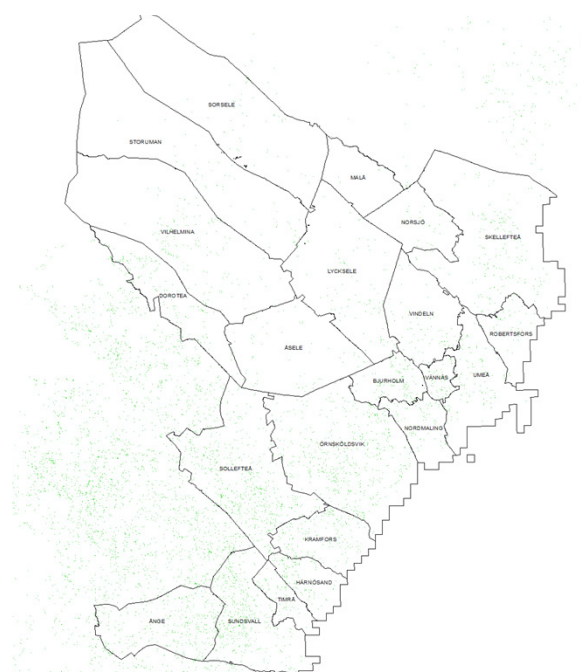


Figure 1: A map of the investigated area; the counties Västernorrland and Västerbotten including the municipalities.

practice, that if these areas were to be harvested, then an additional 10% of the harvested volume would be logging residues. We also assumed that one third of the spruce logging residues is spruce needles. For each municipality in the Botnia-Atlantica area we then calculated the amount of logging residues and the amount of spruce needles that would result if all the areas covered by spruce forest would have been harvested. Table 1 shows that there are almost double amount of needles in the county of Västernorrland as compared to the county of Västerbotten. The highest amount of spruce needles is in the municipality of Örnsköldsvik followed by the municipality of Sundsvall.

The total potential of extractives from branches and needles are around 84 000 tons in Västernorrland and Västerbotten.

Table 2. The composition of extractives from Västerbotten and Västernorrland.

Needles	Concentration,			Total tons
	%	Västerbotten	Västernorrland	
Dry biomass, tons		84 200	163 800	248 000
Fatty acids	3,22	2 711	5 274	7 985
Rosin acids	0,11	93	180	273
Lignans	0,46	387	753	1 140
Sterols	0,40	337	655	992
Steryl esters	0,09	76	147	223
Triglycerides	0,14	118	229	347
Total phenolics	5,80	4 884	9 500	14 384
Total extractives	28,30	23 829	46 355	70 184

Branches	Concentration,			Total tons
	%	Västerbotten	Västernorrland	
Dry biomass, tons		168 400	327 600	496 000
Fatty acids	0,04	67	131	198
Rosin acids	0,03	51	98	149
Lignans	0,13	219	426	645
Sterols	0,61	1 027	1 998	3 025
Steryl esters	0,02	34	66	100
Triglycerides	-	-	-	-
Total phenolics	0,75	1 263	2 457	3 720
Total extractives	2,77	4 665	9 075	13 740



POSSIBLE APPLICATIONS OF EXTRACTIVES

The extractives contain both lipophilic and hydrophilic compounds. The amount and composition of lipophilic compounds in spruce needles are shown in Figure 4. More than 70% of the lipophilic compounds constitutes of fatty acids. Lipophilic compounds are important for production of several products, e.g. fatty acids can be used as components in many products including food, cosmetics, and medicines and in production of biodiesel.

Lipophilic compound - soluble in fat
Hydrophilic compound - soluble in water

CROSS-BORDER COLLABORATION

Within the project, several sub-samples of needles and bark from spruce were extracted and the yield and the chemical composition of the extracts were determined for the optimal cases. The chemical characterization includes gravimetric analyses of extractives and the determination of valuable compounds in extracts.

POTENTIAL OF EXTRACTIVES

Based on the data from the other project partners, we have recalculated the potential for the production of extracts from the two Counties in Sweden. The data are presented in Table 2 and are divided in branches and needles. The total annual potential is around 250 000 tons of needles of where around 70 000 tons of extractives would be able to extract. For branches, the total potential is around 500 000 tons per year of where around 14 000 tons of extractives would be able to extract.

TO SUMMARIZE:

- A large number of needles from spruce are available in the two municipalities in the north of Sweden.
- Potential for production of ca 84 000 tons of extractives from needles and branches in the two municipalities in Sweden.
- By extraction techniques, it will be possible to isolate valuable compounds from needles and branches.
- The obtained compounds are bioactive and have several valuable properties, for example biologically active sterols and nonacosan-10-ol, important for hydrophobic coatings, can be obtained from spruce needles extractives.

Composition of needles extract (% dry matter)

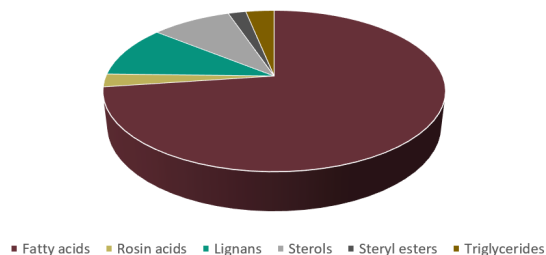


Figure 4. The composition of the lipophilic compounds in spruce needles.

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