

Fractioning of wood biomass as a method to increase raw material value for fermentation

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The aims of this work is to:

- Evaluate raw material characteristics for the "sugar" platform when using different fractioning methods for chipped or crushed material
- Evaluate the improvement in characteristics:
 - Cellulose
 - Hemicelluloses
 - Extractives (process disturbing)
 - The composition of different sugars
 - Ash contents (process disturbing)

Starting up with biomass sampling in the forest

Stumps:

1. Spruce
2. Pine



Crushing of stump samples at
Biofuel Technology Center
(BTC)

Samples from thinning material was also collected

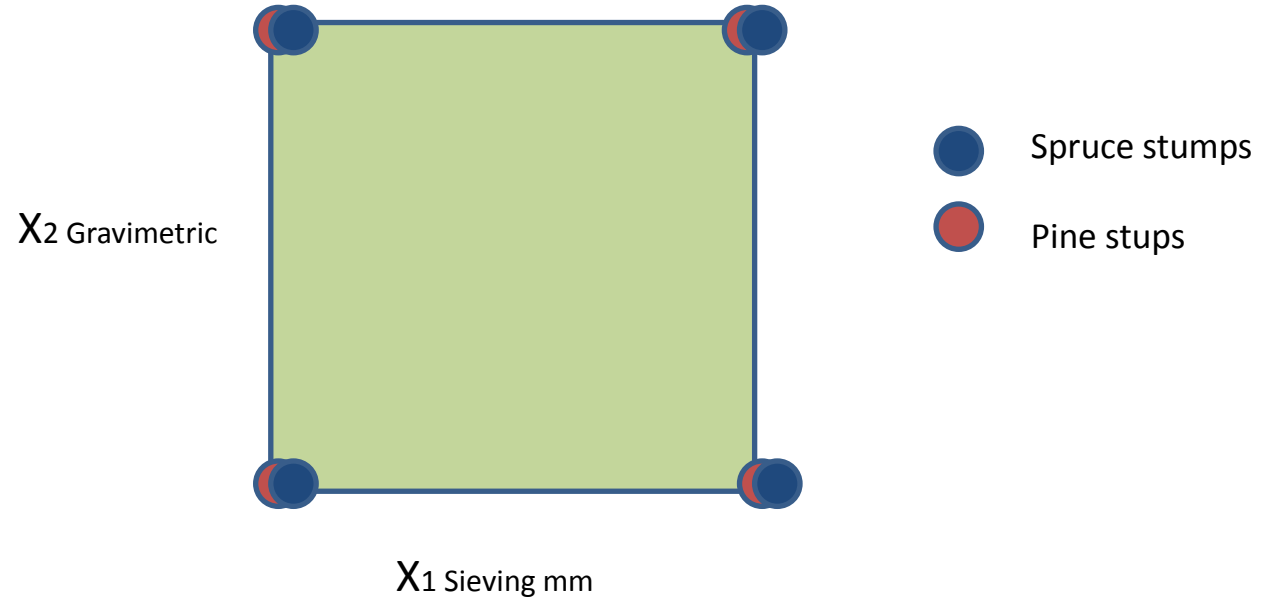
Thinning
trees:

1. Pine
2. Spruce
3. Birch

All thinning samples
were chipped and dried
and fractionated at BTC
pilot plant



Experimental design for stumps



Running operation.

All stumps (ca 2 x 1 ton, Pine and spruce) are crushed and screened at BTC pilot plant (> 25 mm is excluded)

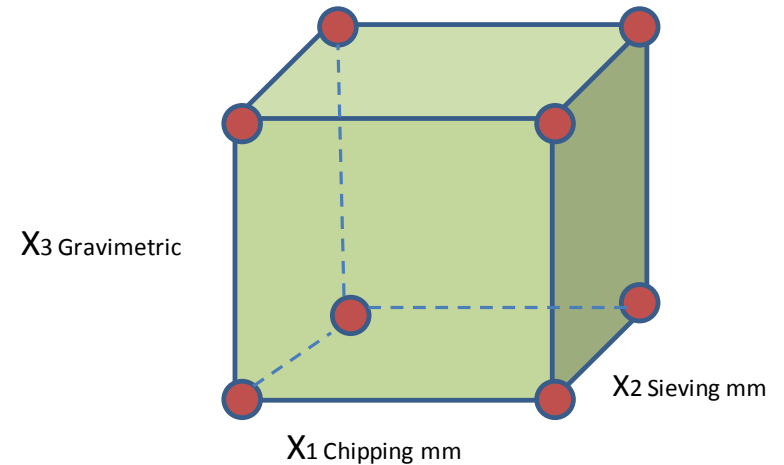
All materials are dried to 15 % w.c.

All materials are shredded (15 mm).

500 kg from each assortment is sieved (> 1 mm)

250 kg from sieved assortment is treated gravimetric

Experimental design thinnings



Running operation Logging residues /thinning trees

Starting with 2 ton of each assortments

1 ton each is chipped 8 mm alt. 12 mm.

250 kg from each chipping size is sieved and/or gravimetric treated

Cellulose, hemicelluloses and lignin analyses

- Weak acid hydrolyses and detection by GC-MS
Pentoses and hexoses will be quantified.
- Klason lignin (The insoluble lignin)
- The method is time consuming but robust and stable.

Small scale chipper used in the experiments

Edsbyhuggen Model 250 H

Inlet opening: 250 x 250 mm

Chipping length (adjustable): 5 - 12 mm

Capacity, chips / h: 10 - 40 m³

Power need: 30 - 100 hp (electric engine 63 A)

Cutting wheel diameter x thickness : 825 x 38 mm

Number of cutting steels: 4 st

Cutting wheel weight: 205 kg

Cutting wheel speed: 540 r / min

Machine weight: 940 kg

Adjustable outlet direction

Stick reducer.

Hydraulic material feeding.

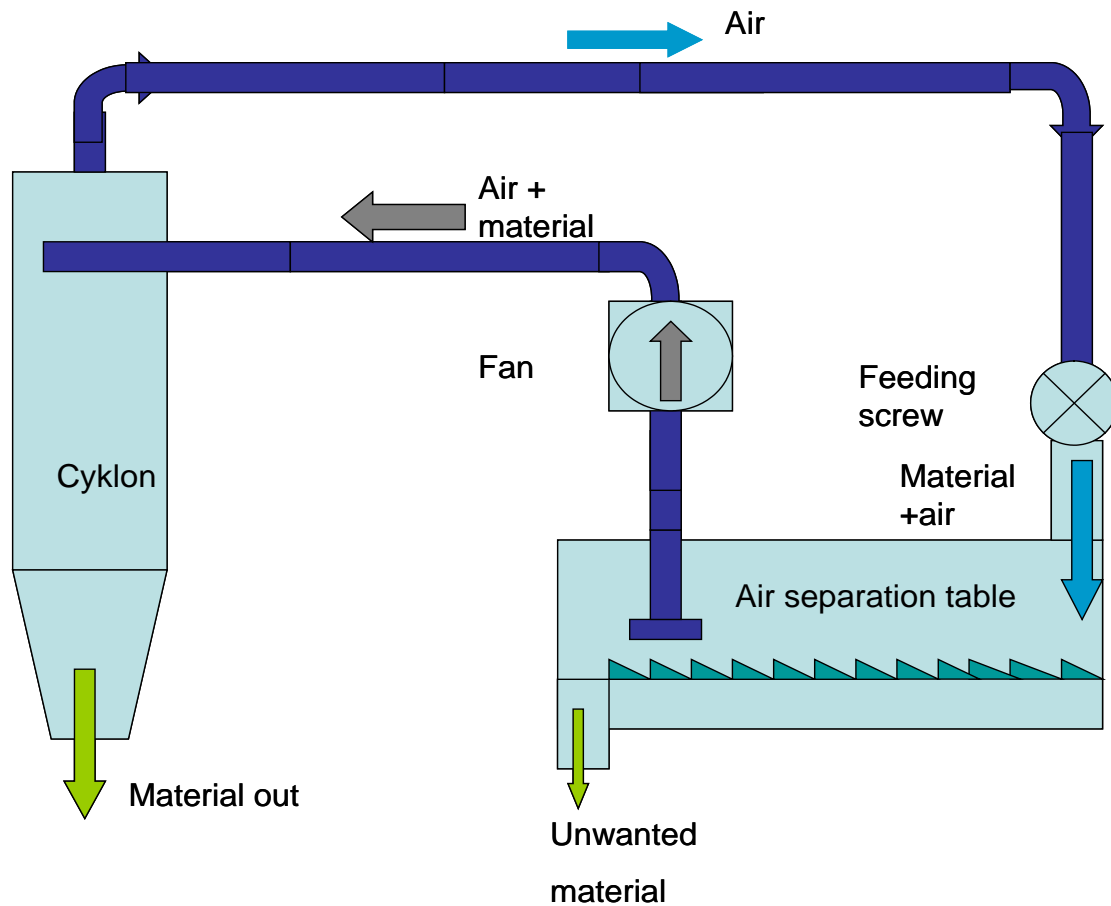


Comminuting of stumps

- Shredder (Lindner Micromat 2000, 1000 kg/h) used in the experiments



Gravity separator used in the experiments



Gravity separator



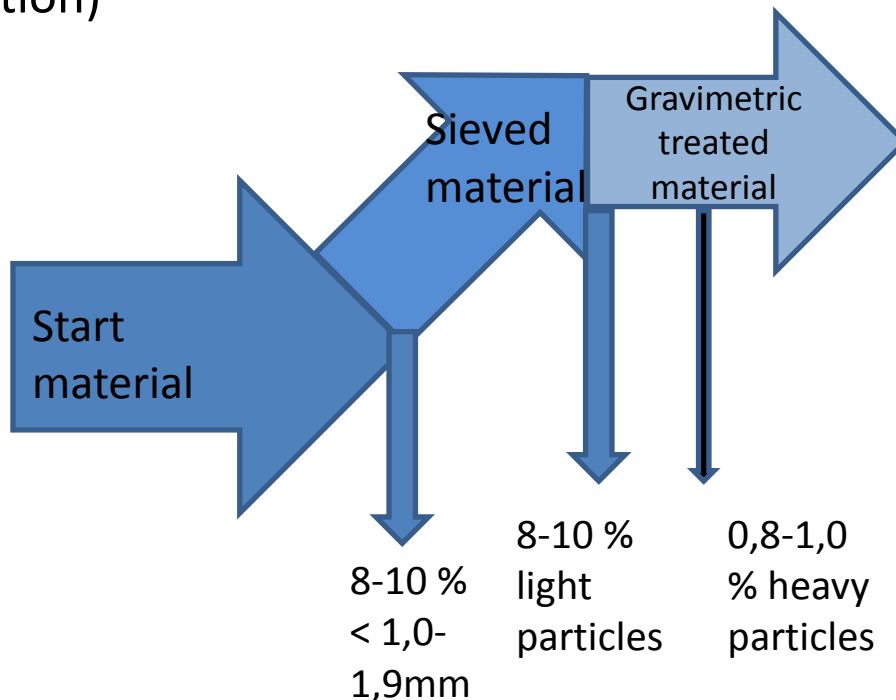
Fractioning by sieving.

Sieve sizes 1,0 mm to 14 mm

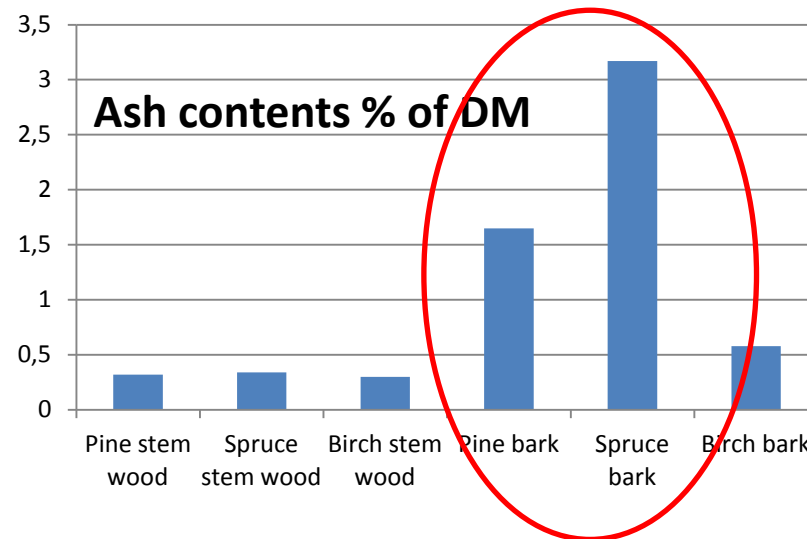


Method description

- Sieving = Fraction $> 1.0-1,9$ mm ($\approx 8-10$ % mass reduction)
- Gravimetric = two steps:
 1. Reduction of light particles (dust $\approx 8-10$ % mass reduction)
 2. Reduction of heavy particles (mostly gravel $\approx 0,8-1.0$ % mass reduction)



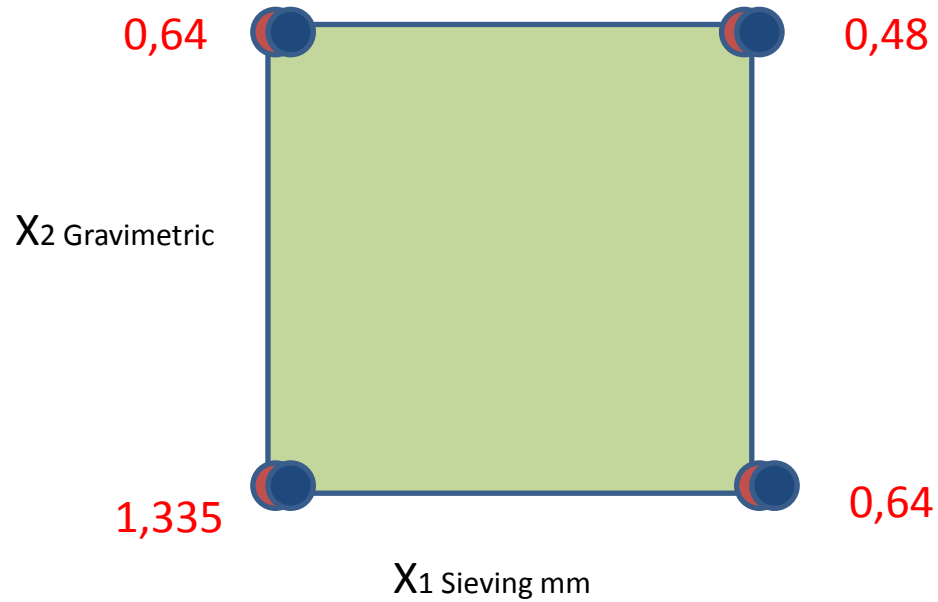
Stem wood is generally with lower ash contents compared to bark



Small trees cannot be debarked

Start material becomes a mixture when chipped

Results for multivariate prediction Pine stumps. Ash content (%) reduction

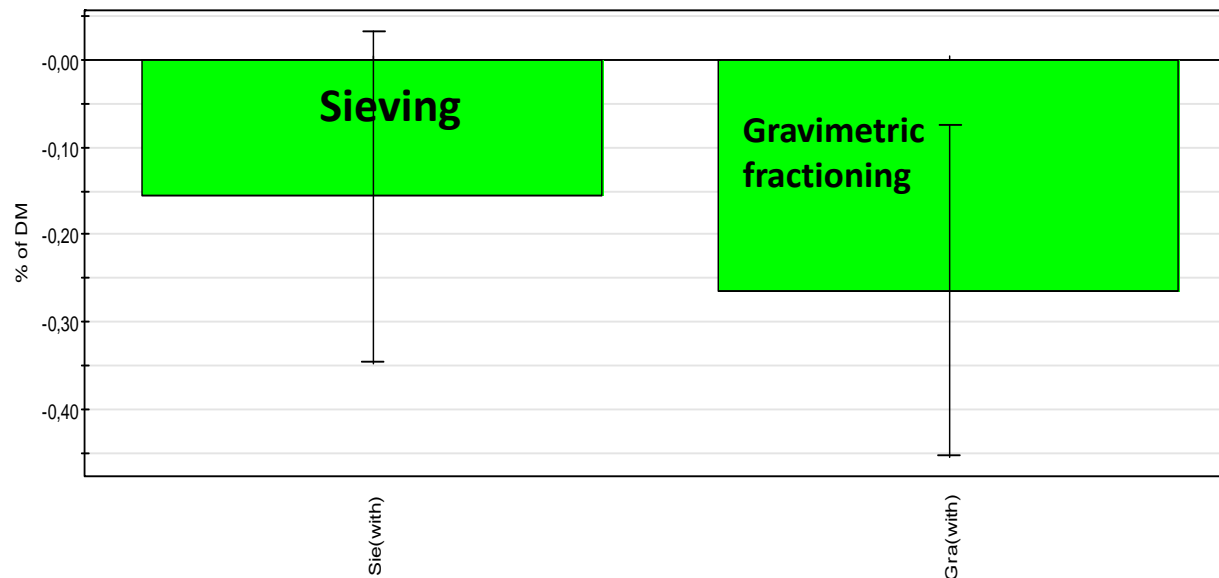


Multivariate analyses prediction of sieving and fractioning of pine stumps for particles > 1 mm

Response: Ash contents

Investigation: Pine Stumps full factor pine (MLR)

Scaled & Centered Coefficients for Ash contents (Regular)



N=8

R²=0,778

RSD=0,2072

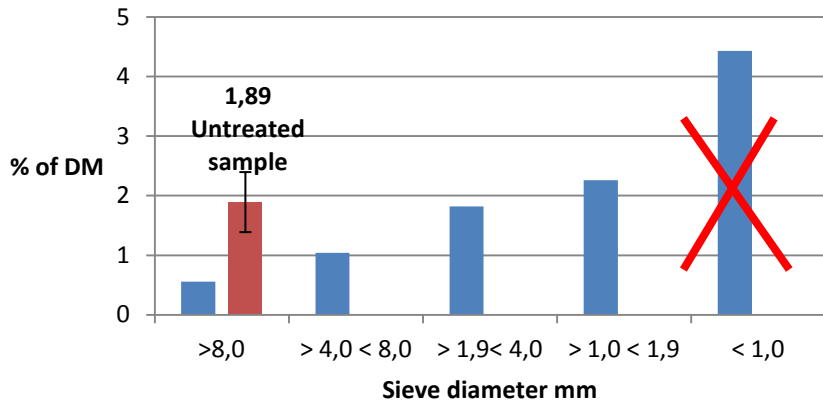
DF=5

Q₂=0,431

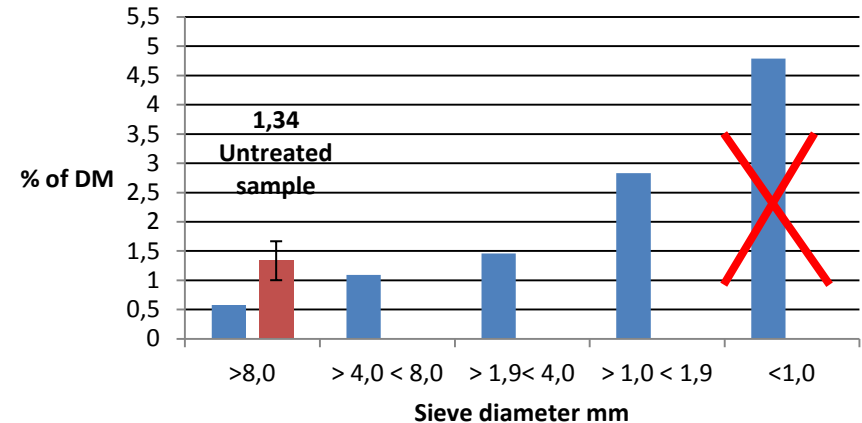
Conf. lev.=0,95

Reduction of ash contents in stumps by sieving

Ash content. Spruce stumps after sieving



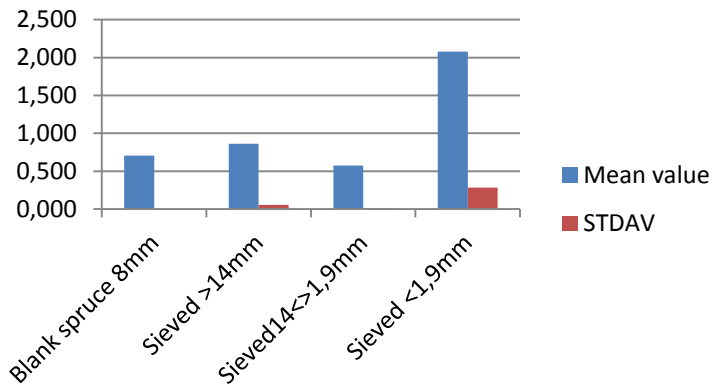
Ash content. Pine stumps after sieving



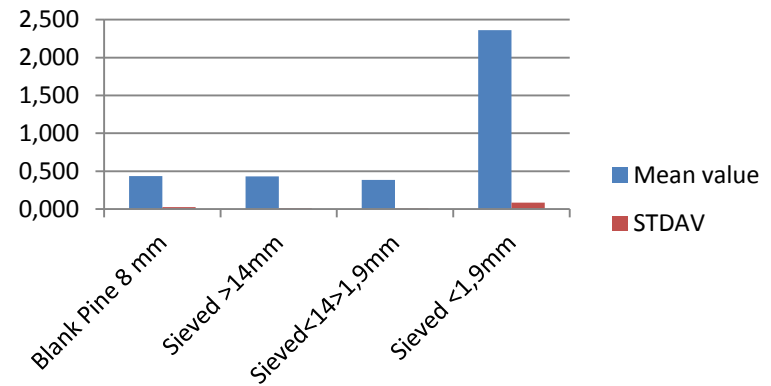
= Excluded by sieving ($\approx 10\%$)
when continued gravimetric
fractioning

Sieving of thinning wood is reducing ash contents in chipped samples

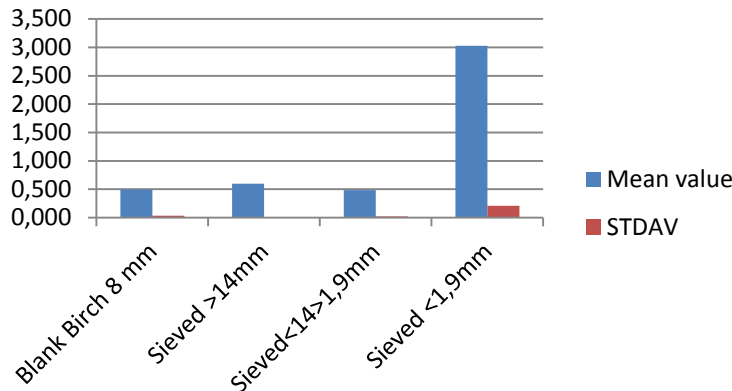
Ash contents % of dry sample Spruce 8 mm



Ash contents % of dry sample Pine 8 mm

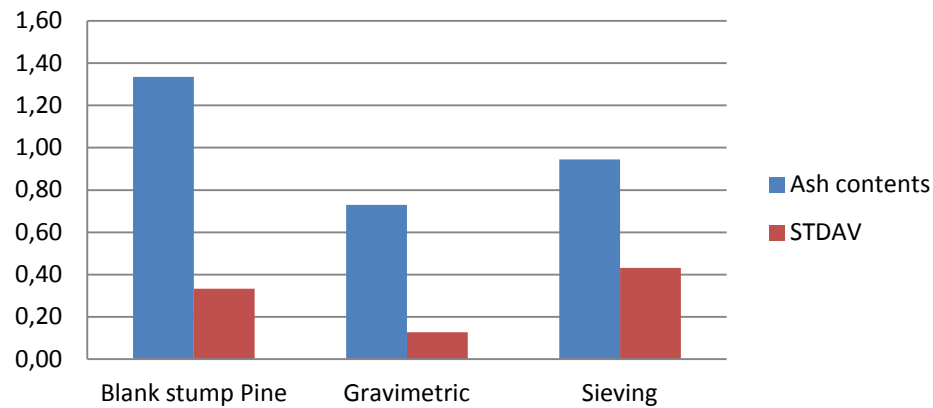


Ash contents % of dry sample Birch 8 mm



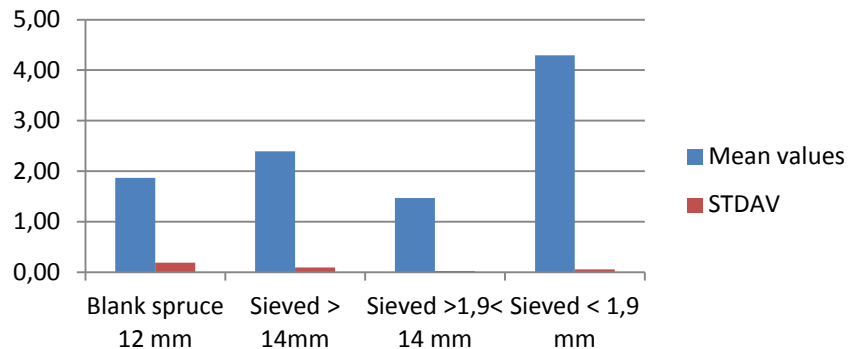
Ash reducing effect from different fractioning methods

Ash contents in Pine stumps after different treatments

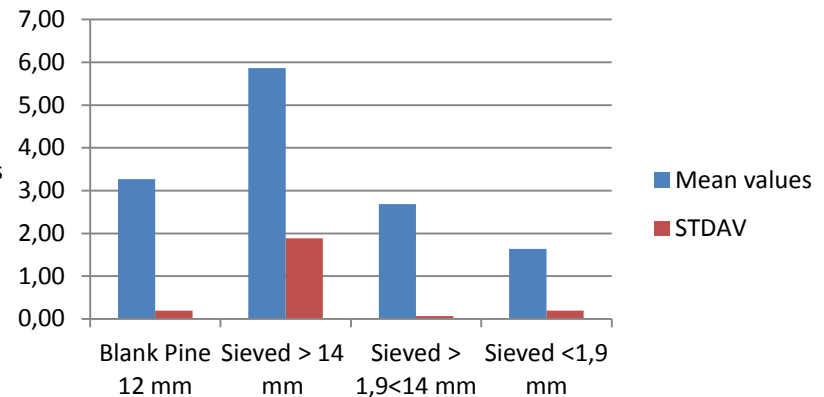


Extractives in different sieving fractions of thinning trees

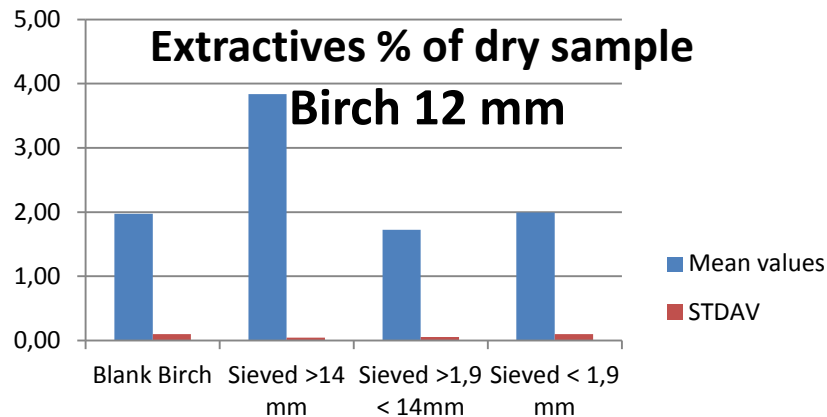
**Extractives % of dry sample
Spruce 12 mm**



**Extractives % of dry sample
Pine 12 mm**

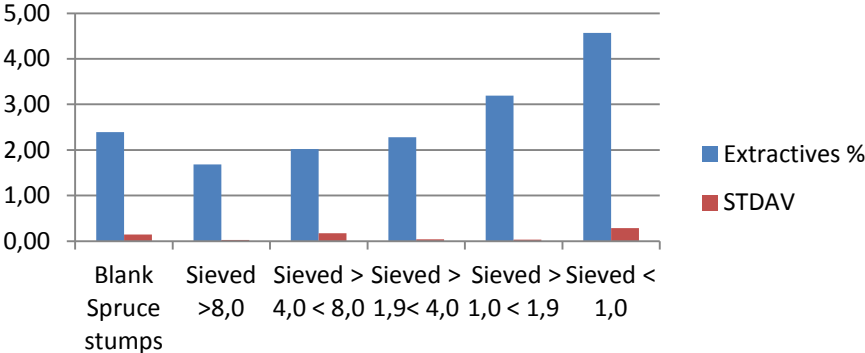


**Extractives % of dry sample
Birch 12 mm**

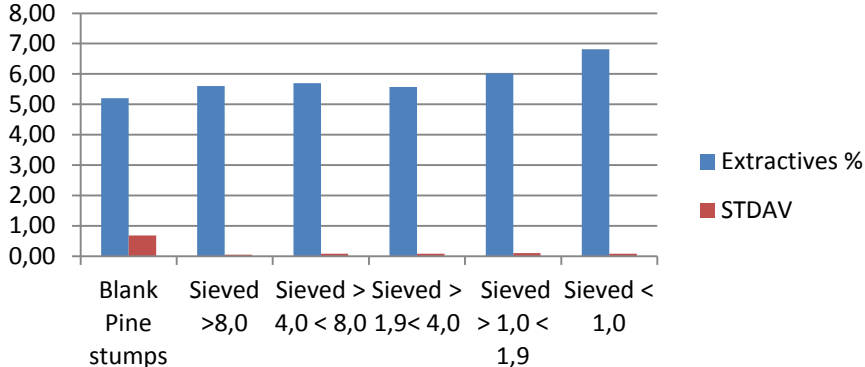


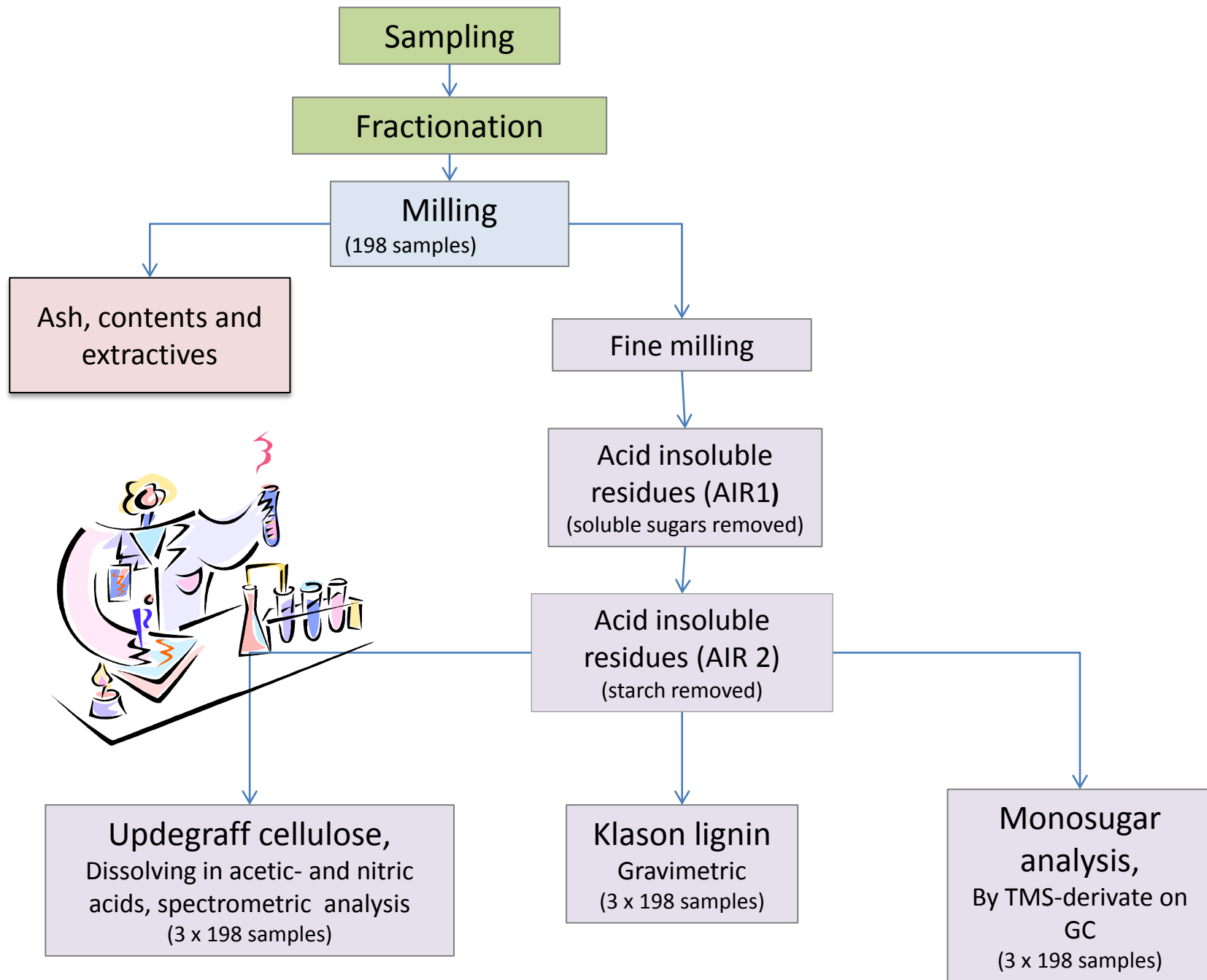
Extractives in different fractions of stumps

Extractives % of dry sample Spruce stumps



Ectratives % of dry smaple Pine stumps





Thank you for your attention



Research pilot plant BTC, Umeå