Search for alternative raw materials for pellet production – a preliminary study

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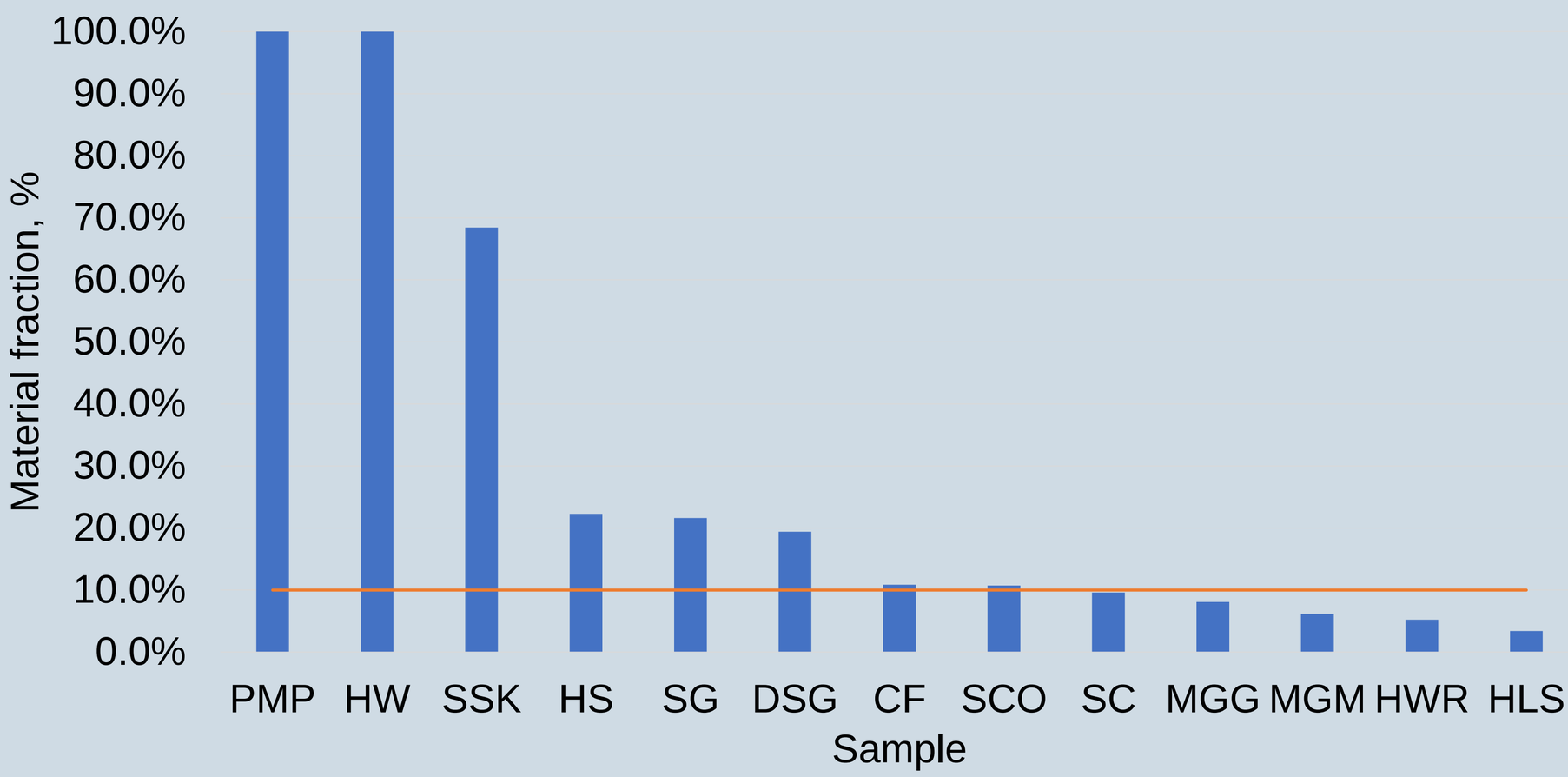

Alternative material

- Pine mix pellets (PMP)
- Pellets of wood shavings, synthetic and textile waste mix (SSK)
- Hogweed (HW)
- *Solidago canadensis L.* (SC)
- *Solidago canadensis L.* outgrown (SCO)
- Mowed grass from the municipality (MGM)
- Mowed grass from the garden (MGG)
- Chamomile full plant without stems (CF)
- Hemp without roots (*Cannabis sativa L.*, HWR)
- Hemp stems (*Cannabis sativa L.*, HS)
- Hemp leaves with seeds (*Cannabis sativa L.*, HLS)
- Spent grain (SG)
- Damaged spent grain (DSG)

Fig. 1. The maximum alternative material fraction in a mixture with wood to reach quality requirements

Introduction

A preliminary study was done for a selection of 13 alternative biomass sources and their applicability in pellet production. A comparison was made with the quality parameters defined in *ENplus* certification for *B-class* wood pellets in requirements for producers.

The main issues highlighted by the results are alternative materials' high ash content and low ash deformation temperature. Considering this, a calculation was made to determine the optimal proportion of alternative material in a raw material mix for pellets to achieve a quality corresponding to *B-class* wood pellets.

Methodology

Alternative materials were tested according to the methodology based on ISO standards for testing solid biofuels. The performed tests were:

- the determination of the total moisture content of the sample and the moisture content in the analysis sample,
- the ash content on a dry basis,
- the determination of the calorific value of the material,
- the determination of ash melting temperature using ash obtained in the laboratory environment.

Additional determination of chemical composition with:

- *XRD (X-ray diffraction)*;
- *SEM-EDX (scanning electron microscopy - energy dispersive X-ray spectroscopy)* for the ash of two selected materials - SC and HLS - was performed to determine possible issues.

ACKNOWLEDGEMENT

This research is funded by the Latvian Council of Science, project Alternative biomass knowledge for transition towards energy independence and climate targets (Bioenergy Observatory), project No. lzp-2022/1-0414.

Results

TABLE 1. THE PARAMETERS DETERMINED FOR THE ALTERNATIVE MATERIALS

Material	A_d, wt%	M, wt%	HHV, MJ/kg	LHV, MJ/kg	DT, °C	FT, °C
PMP	1.99	5.7	19.9	17.8	1191	1318
SSK	1.34	11.6	19.7	15.9	1070	1147
HW	1.92	8.2	19.5	16.5	1297	1545
SC	6.80	2.9	19.7	18.3	1133	1545
SCO	6.24	5.4	19.7	18.2	1028	1183
MGM	9.75	4.3	19.3	17.9	1119	1165
MGG	7.80	7.6	18.8	15.9	958	1074
CF	6.19	1.5	18.2	16.6	1160	>1555
HWR	11.27	8.1	18.6	17.5	1422	1543
HS	3.78	1.5	18.3	16.9	1350	1498
HLS	16.5	2.3	18.3	17.2	1300*	1800*
SG	3.85	1.1	21.2	19.7	925	>1555
DSG	4.12	7.5	21.6	20.1	944	>1555
B	≤ 2.00	≤ 10.0	-	≥ 16.5	≥ 1100	-

Conclusions

Results suggest that additional impurities, such as sand and some plant parts, like roots and seeds, should be avoided or limited in material collection and preparation. Roots might add on to impurities in the material, while seeds might have completely different chemical composition that affect ash content, formation and melting. This is supported by chemical and SEM analysis of ash from hemp leaves with seeds, as the shells of seeds can be distinguished in the SEM micrographs and seeds also show higher concentration of carbonates, that impacts ash melting.

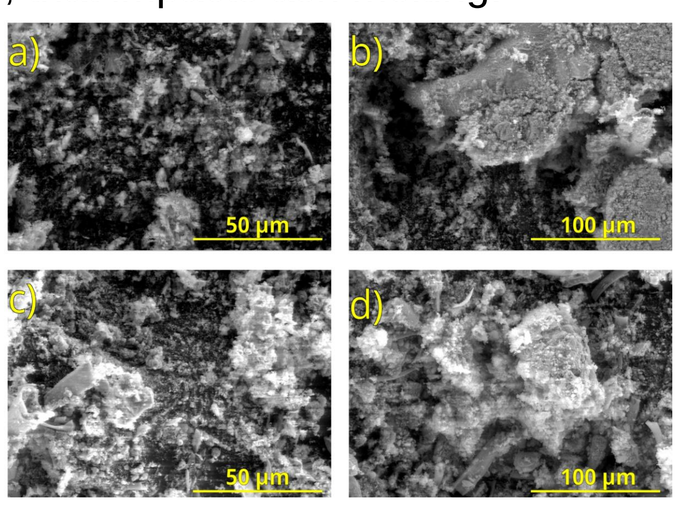

Fig. 2. SEM micrographs of studied ash samples a) SC ash 1; b) SC ash 2; c) HLS ash 1; d) HLS ash 2