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Authors: Das, Atanu Kumar; Agar, David; Thyrel, Mikael; Larsson, Sylvia;

Rudolfsson, Magnus

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Mailing address: Mailing address
Street address: Street address
VAT no: SE202100281701
www.slu.se

Phone: +46 18 67 10 00 (switchboard)
Mobile: XXX-XXX
firstname.surname@slu.se

www.slu.se

Wet one-step size reduction for better powders and feedstock conversion

Atanu Kumar Das*, David A. Agar, Mikael Thyrel, Sylvia H. Larsson, Magnus Rudolfsson
Swedish University of Agricultural Sciences, Department of Forest Biomaterials and Technology, SE 901 83 Umeå, Sweden.

INTRODUCTION

Saccharification and enzymatic hydrolysis yields are influenced by feedstock size reduction technology and resulting particle characteristics [1]. Milling green feedstock can provide better chemical conversion since original chemical composition of biomass is better preserved [2]. This study characterised biomass powders from a multi-blade shaft mill (MBSM) with those from conventional hammer milling.

Fig. 1. Overview of biofuel production from biomass.

MATERIALS and METHODS

Green and dried pine logs (*Pinus sylvestris L.*) were milled (Fig. 2) in 27 designed experimental trials with moisture content, log feeding speed and blade speed as parameters [3]. Produced powders were characterised using sieve analysis, a camsizer and SEM.

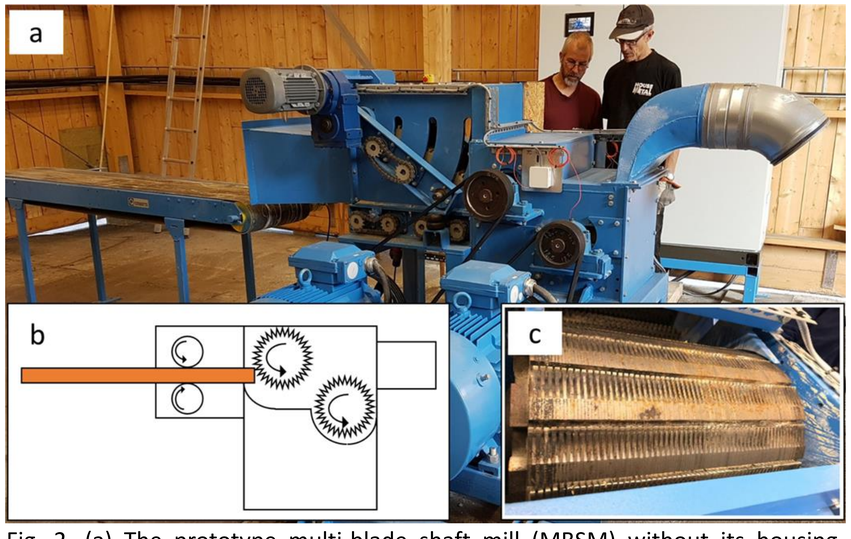

Fig. 2. (a) The prototype multi-blade shaft mill (MBSM) without its housing enclosure, (b) the principle of operation and (c) the multi-blade shaft [3].

RESULTS

Particle size and image analysis of MBSM powders showed enhanced sphericity and a particle size distribution significantly shifted to finer powders compared to hammer milling (Fig. 3), especially at particle diameters less than 500 µm. Sphericity of MBSM powders was 13 % higher. The specific surface area ranged from 33 to 56 mm^{-1} compared to values of 29 to 38 mm^{-1} from hammer milling. Visible differences between powder particle morphology were evident from SEM imaging (Fig. 4). As large surface areas promote reaction chemistry and digestibility during chemical conversion, MBSM powders appear attractive for biorefining applications.

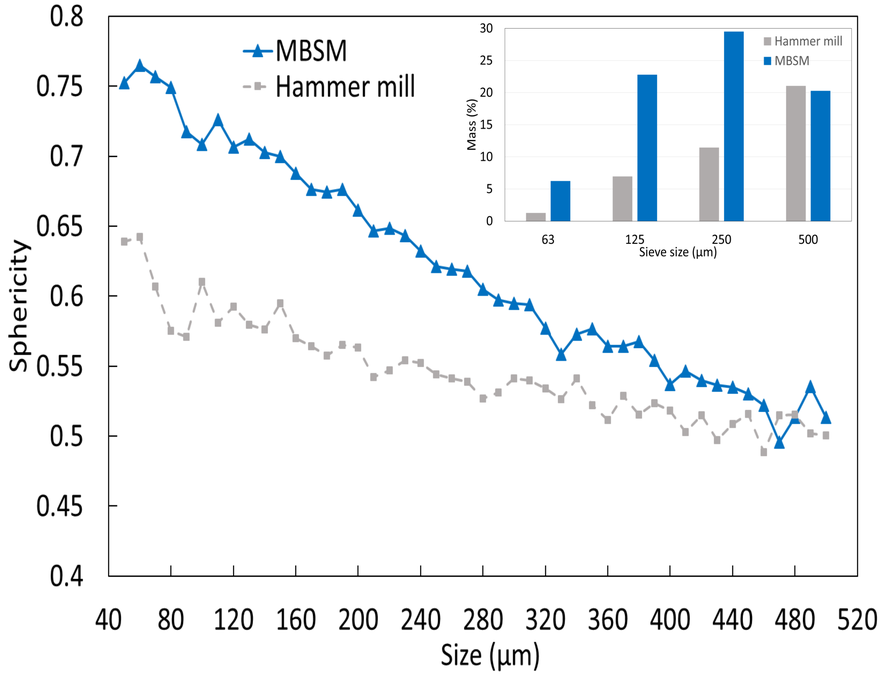

Fig. 3. Comparative analysis of sphericity between MBSM and hammer mill powders. The insert graph compares particle size distribution below 500 µm.

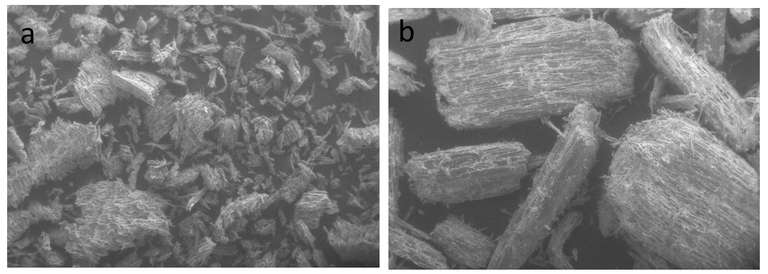

Fig. 4. SEM images of a) MBSM powder and b) hammer mill powder.

CONCLUSIONS

- MBSM produces more spherical particles/powders with higher specific surface area compared to conventional hammer milled powders
- MBSM provides greater potential for efficient conversion for biorefining processes through milling green feedstock and better controlling over powder shape properties and particle size

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Contact: Atanu Kumar Das
atanu.kumar.das@slu.se
+46 (0) 76-133 9953