CHANGES IN PORE SIZE DISTRIBUTION WITH PYROLYSIS TEMPERATURE, PARTICLE ASPECT RATIO AND PRETREATMENT BY LEACHING OF LARGE BEECH WOOD PARTICLES

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Key Words: pore size distribution, specific surface area, pyrolysis, beech wood, porous carbonaceous materials

When assessing the usefulness of pyrolysis chars as porous materials for the application as adsorbents, catalysts or catalyst supports, one of the most important parameters of the assessment, besides the specific surface area, is their pore size distribution [1, 2]. The aforementioned processes are highly pore size selective, hence inappropriate pores sizes of the applied material can lead to the material's uselessness for a given application. In terms of the application of pyrolysis char as a soil amendment (i.e., biochar), pore size also plays a major role. For example, in case of a too large share of micropores, even though the water capacity is relatively high, water is only partially available for plants due to strong capillary forces in the micropores pores [3]. Besides their beneficial environmental applications, porous materials of biomass origin, like pyrolysis chars, are characterized by the possibility to change their porous structure with production parameters. Therefore, the possibility exists to set production process parameters in a way that allows obtaining a material with a desired pore size distribution. It makes pyro-chars more advantageous materials in comparison to its current, strongest market rival - silica-alumina materials. Even if the desired structure of the carbonaceous porous material is not obtained in the primary production process (pyrolysis), it is possible that specifically pre-processed materials will behave better in upgrading/activation processes (e.g., steam activation) and in the end, a tailor-made material, with tailor-made pore size distribution will be obtained.

The strongest inhibitor of the implementation of the mentioned approach is the large inhomogeneity within biomass feedstocks, in terms of both biological and inorganic composition as well as in the initial structure. Due to the significant amount of parameters playing a role in the process of surface and pore development of biomass-derived carbonaceous materials, detailed knowledge about their individual and shared influence is relatively low. Hence, at the present day, biobased materials obtained through thermal conversion are burdened with strong randomization of results in terms of pore size distribution.

The presented study had been performed to fill the existing gap and meet the increasing need for tailor-made, functional carbonaceous materials, for instance for environmental applications (absorbents). The study aimed at investigating the changes in the internal structure of large beech wood particles in relation to the production (pyrolysis) and initial biomass parameters. Large particles instead of fine powders were selected in order to bring the study closer to the conditions that are more likely to occur in large scale processing. As investigated parameters were chosen five different temperatures (300, 400, 500, 700 and 900 ^{o}C) and as the initial biomass parameters: two particle size (ø8x10mm and ø8x16mm) and initial inorganic concentration (samples with and without acidic leaching pre-treatment to demineralize the biomass beforehand). Each particle's pore size distribution was analyzed through three analysis methods, most suitable for specific pore size: helium pycnometry (total porosity) and N_2 adsorption (meso-porosity) and CO_2 adsorption (micro-porosity) [3]. Such approach allowed for proper and detailed assessment of changes in overall porosity, specific surface area, and pore size distribution.
The results obtained in this study allowed for the identification of the influence of investigated parameters on pore size distribution. Moreover, the applied data matrix will allow to form correlations between the investigated parameters and pore size distribution, resulting in basic formulations of the phenomena and therefore giving the foundations for initial modeling and possibility of process optimization.

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