

Analysis of the Physical Properties of Carbon Blocks Derived from Pine Needle Biomass

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Pine needles contain 47.88% cellulose, 14.56% hemicellulose, and 32.91% lignin, exhibiting a relatively higher lignin content compared to other biomasses.[1] According to previous research, higher lignin content leads to an increased fixed carbon yield after carbonization and activation.[2] Biomass generally contains various impurities, making it difficult to achieve uniform properties. However, if these impurities are volatilized and removed through pyrolysis, the formation of mesopores can be facilitated. Additionally, reports indicate that after CO₂ activation in mesoporous templates, micropores can form while maintaining the size of the mesopores.[3] Therefore, we aimed to utilize impurity-removed, mesoporous biomass as a template to verify micropore formation and investigate the potential of pine needle-derived carbon blocks.

In this study, we manufactured porous blocks by mixing pine needles and resin, followed by carbonization and activation, and their pore characteristics were compared with those of resin-template carbon blocks. The pine needles collected for the study were dried in an oven to remove moisture. Excessive release of volatile substances during the carbonization process in carbon block manufacturing can cause cracking or breakage of the molded body. Therefore, impurities were initially removed from the dried pine needles through heat treatment. The heat-treated pine needles were crushed using a ball mill at 100 rpm for 24 hours. The crushed and heat-treated pine needles were sieved to a selected particle size and mixed according to resin content. The mixed powder was uniaxially pressed at 20 MPa for 1 minute to form a 5x5x25 mm green body, which was then carbonized at 1000°C. The carbon blocks manufactured were activated under a CO₂ atmosphere. The physical properties of the carbonized and activated carbon blocks were compared through analysis of bulk density, porosity, and specific surface area.

References

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