# Abstract

**[Project Information]**


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| Project Title : | Establishment of Biomass Powder Extrusion Molding and Insolubilization System Using Cellulose Derivative as an Auxiliary Agent |
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**[Abstract]**


Wood and paper lack thermoplastic properties like plastics and are instead prone to thermal decomposition, limiting their processing to adhesion and cutting. This study aims to develop an innovative technology for producing fully biomass-based molded products by utilizing the thickening properties of cellulose derivatives, without relying on plastics or easy-decaying starch. By transforming biomass powder into a clay-like material, it can be extrusion-molded at room temperature and dried.

However, since cellulose derivatives function as adhesives between biomass powder particles and are water-soluble, the molded product dissolves upon contact with water, causing slipperiness and ultimately disintegration in water. To address this issue, two approaches were explored: (1) adding citric acid along with hydroxypropyl methylcellulose (HPMC) and using heat-induced crosslinking to make the adhesive water-insoluble, and (2) replacing HPMC with ammonium carboxymethyl cellulose (NH4-CMC) and achieving water resistance solely through heating.

First, to tackle cost-related challenges, the use of cellulose derivatives was minimized to 1/4–1/5 of the biomass powder weight. It was confirmed that water resistance could be achieved at approximately 170°C for approach (1) and 150°C for approach (2). The resulting water-resistant biomass-molded products retained sufficient strength even under humid conditions, without surface stickiness, making them viable for non-submerged applications. The effects of cellulose derivative

viscosity, usage ratio, biomass powder particle size, and glycerin on strength and elongation properties were also clarified.

Furthermore, two drying methods were optimized: dielectric heating-assisted vacuum freeze-drying and infrared-ventilation drying. These methods allowed the molded products to transition from high moisture content immediately after molding to an almost completely dry state, preventing deformation and surface defects while ensuring water resistance through subsequent heating. Additionally, for products deformed after conventional drying in a thermostatic chamber, a heat pressing technique was developed for shape correction, successfully achieving water resistance.

This sequence of material formulation, molding, drying, and heating (water resistance enhancement) has led to the establishment of a complete biomass powder molding and water resistance system. The technology is applicable not only to wood powder but also to paper powder, bamboo powder, coffee grounds, and other biomass waste materials, making it highly suitable for sustainable biomass utilization. Moving forward, collaboration with companies interested in materializing these biomass resources will facilitate the transition towards social implementation and industrial application.

## [References]

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