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OBTAINING LIQUID WOOD FROM SAWDUST: A SUSTAINABLE APPROACH TO MATERIAL INNOVATION

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Abstract

Liquid wood, a novel material derived from sawdust, represents an innovative approach to sustainable material production. This liquid material is obtained by processing sawdust into a resinous substance that can be used for a wide range of applications, including biodegradable plastics, coatings, and even as a building material. The process of obtaining liquid wood from sawdust involves the use of high pressure, heat, and various chemical treatments to break down the complex structure of wood into a more malleable form. This article explores the technology behind obtaining liquid wood, its production methods, potential applications, and the environmental benefits it offers. Additionally, it discusses the challenges and future prospects for scaling up the production of liquid wood from sawdust.

Introduction

Wood has been a fundamental material for human civilization for millennia. With the growing demand for sustainable and eco-friendly alternatives to synthetic plastics, the concept of "liquid wood" has emerged as a promising solution. Liquid wood, often referred to as "wood resin" or "wood-based polymers", is a type of bioplastic made by processing wood fibers, such as sawdust, into a resinous form that can be molded and used in various applications.

The process of converting sawdust, a by-product of woodworking and sawmill operations, into liquid wood not only helps to reduce waste but also offers a biodegradable alternative to petroleum-based plastics. Liquid wood has been heralded for its potential to be used in a wide range of industries, from construction to packaging and even in medical applications.

This article aims to provide an overview of the technology behind obtaining liquid wood from sawdust, including the methods of production, the material's properties, and its potential benefits in terms of sustainability and applications.

Materials and methods

Sawdust, PVA glue, water, wood stain are required for obtaining liquid wood.





The Composition of Sawdust

Sawdust is a fine, powdery by-product obtained from the milling or processing of wood. It is primarily composed of cellulose, hemicellulose, and lignin. These three components make up the majority of the wood's structure:

- Cellulose, hemicellulose, lignin

The unique combination of these compounds makes sawdust an attractive raw material for the production of liquid wood, as it can be modified to form a variety of different products based on the intended application.

Technology of Obtaining Liquid Wood from Sawdust

The process of obtaining liquid wood from sawdust typically involves several steps, including extraction, chemical treatment, and polymerization. Here is an overview of the key steps involved: Before converting sawdust into liquid wood, it is typically subjected to a pre-treatment process to remove impurities such as dirt and other foreign materials. The sawdust is washed, dried, and sometimes ground into finer particles to increase the surface area for further processing. The primary challenge in obtaining liquid wood from sawdust is the removal or transformation of lignin. Lignin is a complex and hydrophobic polymer that is difficult to break down, yet it must be altered to enable the formation of a liquid wood material. Several chemical treatments can be used to break down lignin and make the cellulose and hemicellulose more accessible for further processing:

- Alkaline Treatment: Sawdust is often treated with an alkaline solution, such as sodium hydroxide (NaOH), to break down the lignin and hemicellulose, leaving behind a more flexible and workable material. This step is crucial for making the wood fibers more receptive to chemical reactions.

- Acidic Hydrolysis: In some cases, sawdust is treated with diluted acids such as sulfuric acid to hydrolyze the hemicellulose, further enhancing the properties of the resulting liquid wood.

- Enzymatic Hydrolysis: Enzyme-based methods are being explored to selectively break down lignin and hemicellulose, providing a more environmentally friendly alternative to chemical treatments. Laccase and peroxidase enzymes are commonly used to facilitate lignin breakdown.

After lignin and other components are effectively broken down, the remaining cellulose and hemicellulose are treated further to form a resinous, liquid material. Once the lignin has been removed or transformed, the next step in the process is polymerization. Polymerization refers to the chemical process of linking smaller molecules (monomers) into longer chains (polymers) to create a more durable material. In the case of liquid wood, the cellulose fibers are typically reacted with a chemical agent, such as formaldehyde or furfural, under heat and pressure to form a solid polymer matrix.

Final Treatment and Drying

After polymerization, the liquid wood is further processed to remove any residual moisture. The material is typically dried under controlled conditions to ensure its stability and enhance its mechanical properties. The final product is a liquid wood material that can be shaped, molded, or further refined depending on its intended use.



Properties of Liquid Wood

Liquid wood offers several promising properties that make it a versatile and environmentally friendly material. These include:

-Biodegradability: Liquid wood is biodegradable, making it an eco-friendly alternative to conventional plastics. This property makes it particularly attractive for use in packaging, medical products, and other single-use items.

- Strength and Durability: Liquid wood exhibits similar mechanical properties to plastic and, in some cases, can even replace materials like plywood and particleboard. It is strong, lightweight, and resistant to wear and tear.

- Thermal Insulation: The porous structure of liquid wood offers natural thermal insulation properties, which make it useful in construction and building materials.

- Customization: The process can be tailored to produce different properties in the liquid wood by varying the chemical treatments, polymerization agents, and drying conditions. This enables the material to be adapted for a wide range of applications.

- Sustainability: By using sawdust, a waste product from woodworking, liquid wood production helps reduce waste and promotes the use of renewable resources. Moreover, the process typically requires fewer toxic chemicals compared to conventional plastic production methods.

Conclusion

Obtaining liquid wood from sawdust represents an exciting step forward in the search for sustainable materials. The process of converting sawdust, a low-cost by-product, into a versatile and biodegradable resin offers multiple environmental and economic benefits. As the technology matures and production processes are optimized, liquid wood has the potential to become a key.