Enhancing Sustainability: Structural Evaluation of Biomass Cellulosic Matrix for Optimized Conversion

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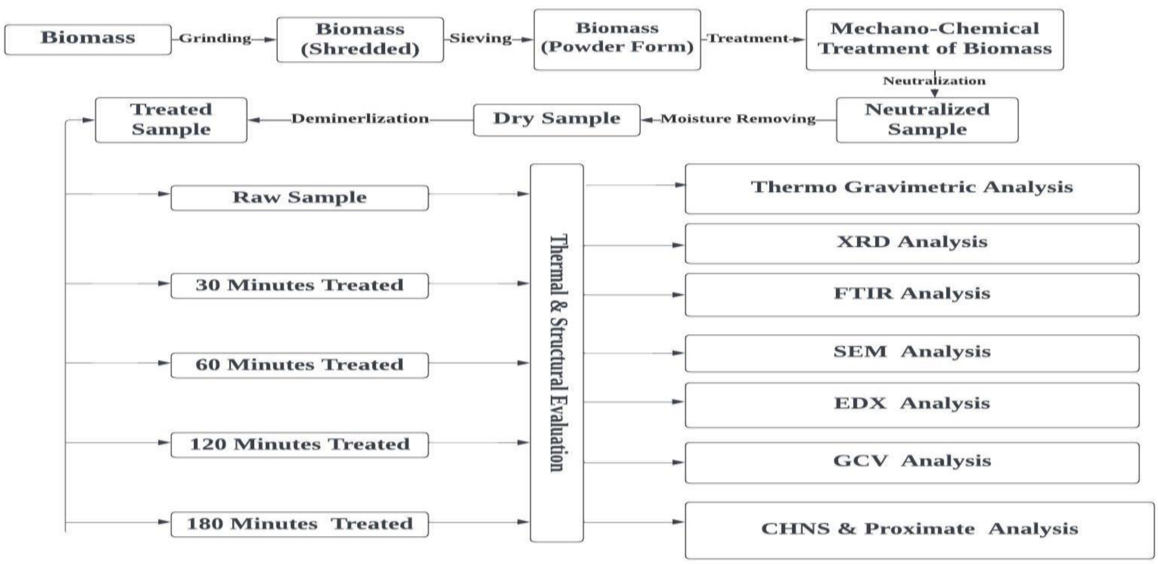
Introduction

The United Nations developed the Sustainable Development Goals (SDGs), which aim to transform society in order to solve present and future issues. However, even with their obvious importance, these objectives have not yet been put into practice in many industries. The SDGs aim to reduce climate change impacts (SDG 13), promote sustainable waste management (SDG 11), and produce sustainable energy (SDG 7). (Hameed et al., 2022). The development of technology is primarily influenced by the depletion of fossil resources and the degradation of our planet's environment. (Hameed et al., 2019). Many developing or growing economies still rely on agriculture, thus when crops are produced on a large scale, a by-product known as biomass/biowaste is produced as a source of value-added products (Miandad et al., 2019). Uncontrolled open waste disposal sites pose a threat to the environment, hence it's imperative to redirect this garbage toward the creation of alternative energy sources like waste-to-energy (WtE). (Vassilev et al., 2010). Utilizing waste resources in line with the circular economy idea is something that countries should do while adhering to the principles of sustainable development. Conventional fuels contribute to global greenhouse gas emissions and climate change, while biomass, a by-product of agricultural activities, is rapidly being utilized for energy production worldwide. (Qureshi et al., 2024) . However commercial usage of biomass will address problems like environmental deterioration, energy security, and efficient burning. Numerous countries are now researching different ways to use biomass for energy production. (Ning et al., 2019). This research aims to develop a biorefinery model for organic waste to achieve several prominent SDGs. Fourier-transform infrared spectroscopy (FTIR) technique will be used for the structural analysis.In the current work,lignocellulosic formation due to demineralization will be examined.

Materials & Mehtods

In Figure 1, the process of producing treated biomass is depicted. The first step involves shredding raw biomass, which is then sieved to form a sample. To remove impurities and dust particles, the biomass sample is washed using distilled water. The washed sample is subsequently demineralized for treatment purposes, followed by neutralization. To study the impact of changes in demineralized time on the biomass sample, the aforementioned procedure will be repeated multiple times



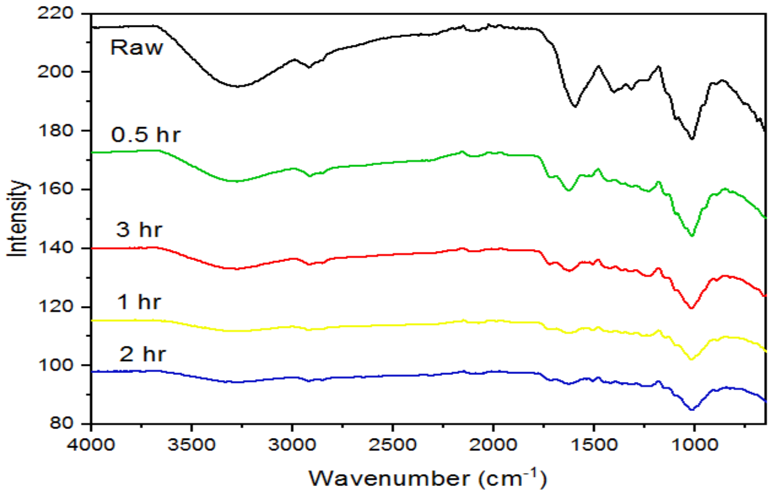


Figure 2: FTIR curves of multiple treated biomass samples

Figure 1: Experimental Methodology for Structural characterization of treated biomass samples

Results & Discussion

For every wheat straw test, a valid pattern for infrared retention has been observed in figure 2, due to precise modification in the bonds structure. The domain from 4000 to 1900 cm-1 is declared as a beneficial gatherings space, and from 1800 to 500 cm-1 is declared as a unique mark area. Stretching vibrations for functional phenolic or alcoholic derivatives of hydroxyl groups (O-H) were seen in peaks between 3500 and 3000 cm-1.It should be noted that the (O-H) group in biomass helps regulatIing the combustion process when WtE is applied.

Conclusion

This finding underscores the importance of (O-H) groups in biomass, particularly in the context of Waste-to-Energy (WtE) applications, where they play a crucial role in regulating the combustion process and disintegrating the amorphous content from lignocellulosic content. In addition,understanding these molecular features provides valuable insights for optimizing biomass utilization and enhancing energy conversion efficiency in WtE systems.

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