**Valorization of Pine Needles as Biochar for Development of Proton Exchange Membrane for Microbial Fuel Cell**

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**Abstract**:

Pine needles are forest waste biomass and found abundantly in the forests of Uttarakhand. This forest waste causes various economic and ecological losses to the Himalayan region as it is responsible for forest fires. The pine needles waste was valorized as biochar (PNBC), which was sulfonated (SPB) and then used to develop proton exchange membranes (PEM) by mixing it, in different ratios with montmorillonite clay (MMT) as inorganic support. The developed PEM (SPB30-MMT membrane) had excellent properties (conductivity, ion exchange capacity, water uptake capacity, and proton mass transfer coefficient) to be used in MFC. The SPB30-MMT membrane was examined by deploying it in MFC, which removed 86% of COD and 297 mV voltage output from a simulated wastewater. The SPB30-MMT membrane based MFC was also tested successfully to treat simulated textile industrial wastewater containing Congo Red dye. The preparation of PEM, its characterization, and application in MFC for the treatment of wastewater will be discussed in this talk.

**Keywords:** Biochar;Forest Waste; Renewable energy; Azo dye; Wastewater treatment