Utilizing waste from the pulp and paper industry: optimizing the production of fuels from black liquor

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Abstract

Black liquor, a major waste byproduct from the pulp and paper industry, has always not been considered for producing fuels, because of the presence of complex chemicals such as lignin. In contrast to many biopolymers such as carbohydrates and proteins, lignin is resistant to bacterial degradation due to its complicated chemical structure. This resistance allows lignin to survive many traditional waste treatment methods. However, photocatalysis utilizing sunlight and a metal catalyst has been proven to be effective in degrading lignin. The chemicals produced from photocatalysis can be further converted into fuels such as methane.

In this research, black liquor will be treated by photocatalysis utilizing ultraviolet light and titanium dioxide (TiO_2). TiO_2 is a white pigment which is commonly used in air filters, to enhance the white color in paper and in white paint. Preliminary findings of this research have shown that TiO_2 photocatalysis is a viable treatment option for converting black liquor into smaller molecules which shows 36% total organic carbon removal from the experiment. In the next phase of the study, a common statistical method will be employed to optimize the photocatalysis process and maximize the amount of small biodegradable chemicals. Those small biodegrade chemicals could be digested and hydrogen would be produced.

Overall, this work contributes to improving the sustainability of the pulp and paper industry by providing an option for producing fuels from lignin.

Keywords: Black liquor; Lignin; Photocatalysis; Statistical design; Renewable energy