Short ozonation of lignocellulosic wastes as effective pretreatment in bioethanol production

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Introduction

- In bio-ethanol production from lignocellulosic wastes, the removal of lignin is an essential pretreatment process for making the cellulose accessible to hydrolysis.
- Lignin is a complex poly-phenolic polymer with an irregular 3D structure which varies among different plants, plant parts and seasons.
- Pretreatment methods used today suffer from many disadvantages but although ozonation pretreatment has high potential, it is rarely used because of high energy requirements in ozone production.

- Ozone (O₃) can be produced on-demand, on-site, without need for dangerous chemicals.
- Ozonation, carried out at room temperature, avoids the formation of the inhibitory compounds known to be formed by other pretreatment methods (Furfural and HMF).
- Ozone dissolved in water has a short half life span of 20 minutes suggesting no harmful carryover.

Results

- Ozonation followed by hydrolysis is showing a 75% of ozonation time (% instead of 90 min) yielded 25% less sugar conversion (% instead of 40%). The net energy balance (green) is showing a reduction at higher ozone dose, demonstrating increased process efficiency at lower ozone doses.
- Inhibition to yeasts growth by suspended substances produced via ozonation (black), compared to growth in 2% YPD medium (green).

Conclusions

- Short ozonation (15 min), although removed only 20% of the lignin, was enough to improve saccharification efficiency 3-folds.
- Longer ozonation improve saccharification but have lower net energy balance.
- These results suggest that long ozonation is unnecessary, making ozonation pretreatment more economical and energy favored.
- The benefits of ozone (simple infrastructure, on-situ on-demand production and no toxic compounds) make it highly suitable for decentralized pretreatment facilities, reducing transport costs of biomass.

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