# Bio-oil Stabilization with Methanol over Amberlyst Catalysts

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Pyrolysis bio-oil is not as stable as conventional petroleum fuels. Bio-oil is very complex mixtures of highly oxygenated compounds derived from decomposition of cellulose, hemicellulose and lignin fractions of biomass. High oxygen content of bio-oil leads to some negative properties such as high acidity, poor stability caused by reactive components, and high viscosity. Among the methods for bio-oil upgrading, methanol addition can simply reduce acidity and viscosity of bio-oil. Besides, various catalysts can be used to catalyze esterification reaction through which acids and aldehydes present in bio-oil are converted into esters and acetals, respectively, by the following reactions.

$$R_1COOH + R\text{-}OH \leftrightarrow R_1COOR + H_2O$$

$$R_1CHO + 2R\text{-}OH \leftrightarrow R_1CH(OR)_2 + H_2O \quad [1]$$

In this study, bio-oil (containing two separate phases) extraction using ether was performed to prevent phase separation and solid formation. Water content is also reduced during extraction. Then, upgrading and stabilization of bio-oil was carried out by mixing bio-oil, methanol and various types of Amberlyst in a three-neck flask at 80 ℃ for 24 h. After the reaction was over, the viscosity and total acid number were measured to evaluate the degree of stabilization. The gas chromatography/mass spectrometry was used to determine the composition of stabilized bio-oil.

Fig. 1 shows the viscosity and total acid number of stabilized bio-oil. Showing the highest stabilization efficiency, the viscosity and TAN of bio-oil was reduced to 70% and 49% using Amberlyst 36, respectively. Compositional analysis for volatiles fraction of upgraded bio-oil revealed that acids and aldehydes were efficiently converted during the upgrading process.

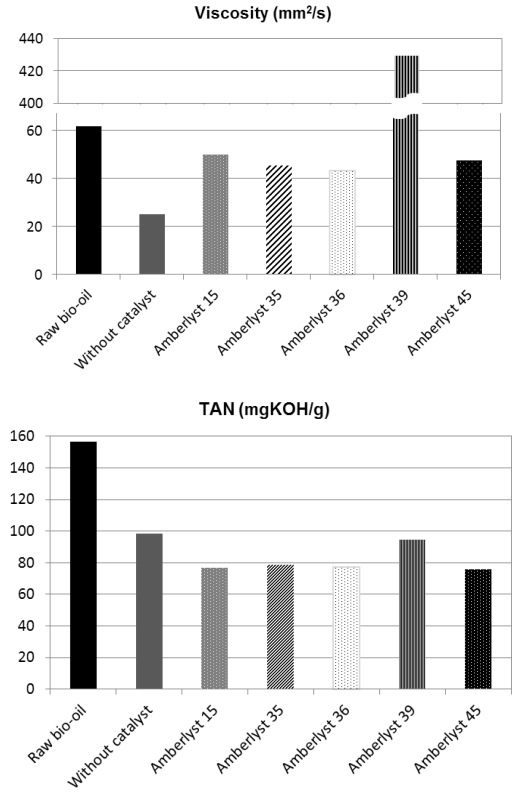


Fig. 1 Viscosity and TAN of bio-oils stabilized via Amberlyst-catalyzed upgrading.

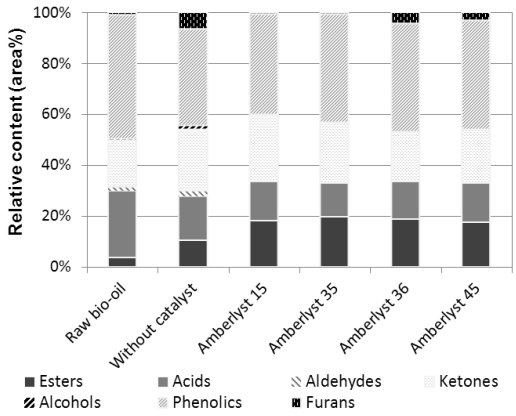


Fig. 2 Chemical composition of bio-oils stabilized via Amberlyst-catalyzed upgrading.

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## REFERENCES

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