

"Study of the reactions of methanol and other alcohols with hydroxyacetaldehyde in bio-oil"

Priyanka Bhattacharya, Leonard Ingram, El Barbary Hassan, and Phil Steele

Department of Forest Products, Mississippi State University, PO Box 9820, Mississippi State MS 39762

Abstract:

Bio-oil is produced by the rapid pyrolysis of biomass and is a source of renewable fuel. The increase in viscosity during storage is a major problem that can be controlled by the addition of methanol or other alcohols. The objective of this research was to determine how alcohols stabilize bio-oil by investigating the reactions of alcohols with low molecular weight aldehydes and acids. The reaction of methanol with hydroxyacetaldehyde (HA) and acetic acid to form the respective acetal or ester was catalyzed by the 7×10^{-4} M strong acids such as sulfuric, hydrochloric, p-toluene sulfonic acid, and methylsulfonic acid. HA formed 2,2-dimethoxyethanol (DME) and with 60°C reaction conditions, equilibrium was reached in less than one hour. Smaller amounts of DME were formed in the absence of strong acid. HA, acetaldehyde, and propanal formed their corresponding acetals when reacted with methanol, ethanol, 1-propanol or 1-butanol. Esters of acetic acid and hydroxyacetic acid were observed from reactions with these same four alcohols. Other acetals and esters were observed by GC/MS analysis of the reaction products. The results from accelerated aging experiments at 90°C suggest that the presence of methanol slows polymerization by formation of acetals and esters from low molecular weight aldehydes and organic acids.