Biomass derived pyrolysis oil has the potential to displace some use of fossil fuels, and therefore may be an important step in addressing current environmental and energy concerns. Because biomass is part of the existing carbon cycle, the use of these pyrolysis oils would be more carbon neutral than the burning of fossil fuels. This is a joint project with University of Maine at Orono and Bates College. Chemical engineers at UMaine are producing the oils using pine sawdust as a raw material. They are produced through a process called pyrolysis, which involves the rapid heating of the sawdust in the absence of oxygen. This reaction yields solid, liquid, and gaseous products, and this liquid has the potential to be refined into a usable fuel source. The end goal would be to produce an oil that can be mixed in with crude oil that is sent to oil refineries that already exist to process fossil fuels.

One of the problems associated with pyrolysis oils is their instability. This instability is referred to as aging, and the focus of this study is to determine which compounds in the oil are unstable, what these compounds are forming, and how the aging reactions take place. Previous research has indicated that the unstable compounds are polymerizing over time, generally resulting in a more viscous oil. Liquid chromatography coupled with mass spectrometry (LC-MS) is being used to identify and characterize the relevant aging products.

Bio-oil is a very complicated mixture, however, containing hundreds—possibly even thousands—of compounds. In order to analyze the oil, it is necessary to sort through large and complex data sets. A lot of time, therefore, is spent figuring out ways to analyze aged bio-oils in a manner that targets only the relevant compounds. Unstable compounds that have been identified in the oil include coniferyl alcohol, trihydroxy benzene, as well as various small aldehydes, and one way we can try to figure out what these compounds are forming as the oil ages is to spike in extra of a given unstable compound. The oil is then aged, and when it is analyzed, these aged and augmented samples show an increased instrument response in the data set for the products of the aging reactions. One of the aging products that has possibly been identified could result from a reaction between two coniferyl alcohol molecules and formaldehyde (Figure 1). Continued work on this project will involve further investigation of other aging products and reaction mechanisms via LC-MS.

![Possible aged bio-oil product](image)

**Figure 1** – Possible aged bio-oil product

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