

Atmospheric Chemistry of Butanols as potential biofuels

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In most cases, the combustion of biofuels, such as ethanol and methanol, in vehicle engines results in a reduction of regulated pollutants emitted into the atmosphere (1). However, it is known that biofuels can lead to an increase in unregulated emissions, such as carbonyls. Methanol and ethanol are the most widely used alcohol based fuels, with much interest recently into the use of higher alcohols such as the isomers of butanol and propanol (2). Butanols provide greater energy density than ethanol, giving them an advantage as potential fuels.

The atmospheric fate of shorter chain alcohols such as ethanol and methanol has been well studied; however, fewer studies have reported on the atmospheric fate of higher chain alcohols, such as the isomers of butanol. Aldehydes are the major combustion and oxidation products of alcohols. The hydroxyl radical (OH) is the most important oxidizing agent in the troposphere, responsible for the removal of trace gases and pollutants. Chlorine atoms are also of importance in the removal of trace gases and pollutants in the troposphere, with reactions typically occurring at much faster rates than those with OH.

Here, work will be presented on the atmospheric chemistry of a series of butanols and their oxidation products in relation to both the hydroxyl radical and the chlorine atom. Studies under varying levels of NO_x will also be presented with a focus on ozone formation and OH reactivity. The oxidation of butanols in the atmosphere leads to formation of a number of further OVOCs, which typically have greater atmospheric reactivity, with respect to OH, than the butanols themselves. The ability to follow the change in OH reactivity during the oxidation of any VOCs within an atmospheric chamber provides extremely useful information on the total VOCs. The degradation of these compounds contributes to tropospheric ozone formation, and as such is of great importance for consideration in the potential use of alcohols as future biofuels. The stainless steel structure of the Highly Instrumented Reactor for Atmospheric Chemistry (HIRAC) (3, 4) allows for both pressure and temperature dependent studies to be carried out, with the recent coupling of an OH reactivity instrument to HIRAC providing a valuable measurement of the overall chemistry occurring in the chamber.

References

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