Biofuels in Engines: Isobutanol

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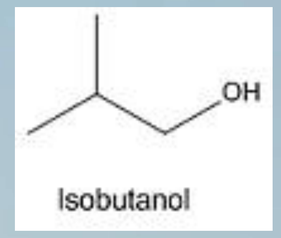


Abstract

Biofuels are fuels derived from biological resources. They can play a part in reducing the effects of global warming by minimising future greenhouse gas emissions. Isobutanol is one such biofuel with a high potential for greenhouse gas reduction. A full analysis of the potential of Isobutanol for spark ignition engines was considered, comprising a Life Cycle Analysis (LCA), Chemical Kinetics Modelling and Experimental measurements of the ignition delay within a Rapid Compression Machine.

Introduction

Isobutanol is a biofuel with promising fuel properties and an improved performance compared to other biofuels on the market, such as Biodiesel and Bioethanol [1]. Full combustion properties through experimental and modelling methods to show the viability of isobutanol as a drop-in/replacement for gasoline are yet to be fully established [2], LCA of the production routes are also in a preliminary phase as the technology transitions from demonstration to commercial stage [3].

Methodology

LCA

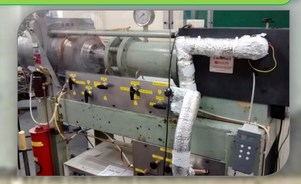
- A field-to-wheel analysis was conducted for Isobutanol under different scenarios.
- The impact of assumptions [3] and counterfactuals [4] regarding energy sources and feedstock type/production was seen through C emissions.

Modelling

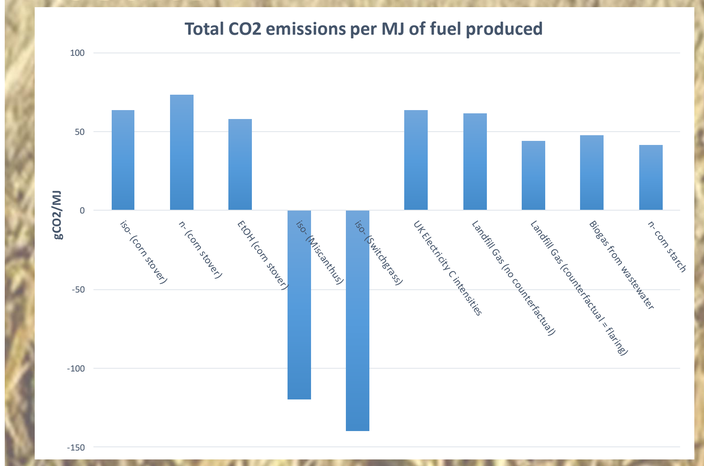
- A closed homogenous batch reactor (CHBR) was used to model the behaviour of the RCM using ChemKin Pro.
- Operation conditions with 740<T<910K and φ=0.5,0.8 & 1 [5].

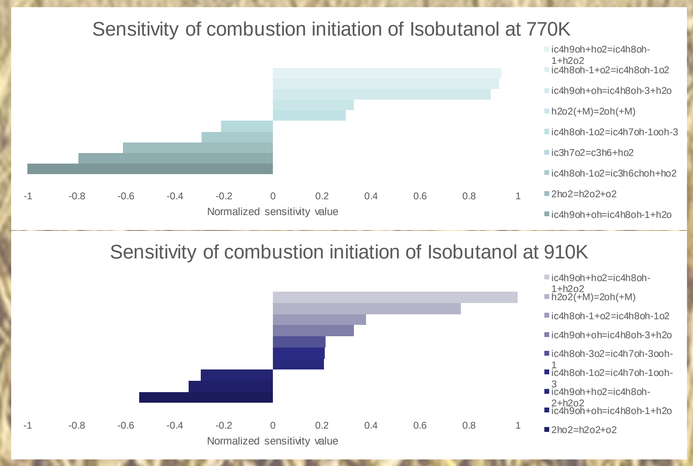
Experimental

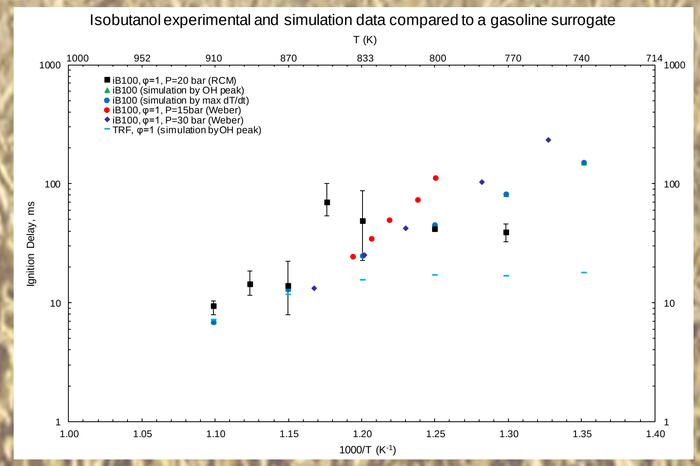
- A rapid compression machine was used at φ=1, 850<T<1050K and P=20 bar [6].



Results







Conclusion

Poor repeatability is observed at low temperature conditions experimentally possibly due to deflagration. Simulations agree with this assertion with better correlation experienced at higher temperatures of 910 K. The effect of energy source and feedstock on life cycle emissions is shown to be extremely impactful.

References

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