Measurements and numerical study of laminar burning velocities of iso-butanol and ethanol blends

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1. Motivation

Global biofuel production

![Bar chart showing global biofuel production from 2000 to 2011. The chart indicates a steady increase in production from year to year. The production is divided between biodiesel (red) and ethanol (blue).]
1. Motivation

Blending mandates and targets in key countries

* % estimated from volumetric quota set under the RFS2
** In some provinces
*** Federal: 5% ethanol, 2% biodiesel; up to 8.5% ethanol in some provinces

2. Description of Heat Flux Burner Test Rig

Flow Sheet
2. Description of Heat Flux Burner Test Rig

Solubility


Temperature: 298.15 K
2. Description of Heat Flux Burner Test Rig

Hydraulic Accumulator

**Bubble accumulator**
+ High reaction rate
- Durability of surface area

**Membrane accumulator**
+ High pressure
- Volume ratio
- Volume flow

**Piston accumulator**
+ Volume ratio
+ Sealing


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3. Description of Heat Flux Burner Test Rig

Uncertainty Estimation of Burning Velocity

\[
u_{v_g} = \sqrt{\left( \frac{\partial v_g}{\partial m_F} \right)^2 u_v^2 + \left( \frac{\partial v_g}{\partial \dot{V}_{Air}} \right)^2 u_{\dot{V}_{Air}}^2 + \left( \frac{\partial v_g}{\partial T_F} \right)^2 u_T^2 + \left( \frac{\partial v_g}{\partial p_F} \right)^2 u_p^2 + \left( \frac{\partial v_g}{\partial d} \right)^2 u_d^2}
\]

\[
u_{S_{Lr}} = \frac{s(\overline{C})}{m}
\]

\[
u_{S_L} = k \sqrt{u_{v_g}^2 + u_{S_{Lr}}^2}
\]

3. Description of Heat Flux Burner Test Rig

Uncertainty Estimation of Equivalence Ratio

\[ u_\phi = \sqrt{\left( \frac{\partial \phi}{\partial \dot{m}_F} \right)^2 u_{\dot{m}_F}^2 + \left( \frac{\partial \phi}{\partial \dot{V}_{Air}} \right)^2 u_{\dot{V}_{Air}}^2} \]

3. Validation of Test Rig

Iso-Octane

Temperature: 298 K
Pressure: 1 atm

3. Validation of Test Rig

**Ethanol**

Temperature: 298 K
Pressure: 1 atm

3. Validation of Test Rig

**Ethanol**

Temperature: 373 K
Pressure: 1 atm
4. Blends

**Ethanol\Iso-octane Blend**

Temperature: 373 K  
Pressure: 1 atm

4. Blends

Ethanol\Iso-octane Blend

Pressure: 1 atm
Equivalence ratio: 1.0

4. Blends

Butanol

Temperature: 373 K
Pressure: 1 atm
4. Blends

Butanol

Temperature: 373 K
Pressure: 1 atm
Equivalence ratio: 1.0
Thank you for your Attention.

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Literature

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