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Bioethanol: role and production technologies

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1. Introduction

Bioethanol ($\text{CH}_3\text{CH}_2\text{OH}$) is a liquid biofuel which can be produced from several different biomass feedstocks and conversion technologies. Its main physical and chemical characteristics, compared to diesel and gasoline fuels, are given in the Table 8.1.

Table 8.1. Main physical and chemical properties of bioethanol (Source: DG XII 1994; Blondy 2005; Mc Cormick et al. 2001).

| | Diesel | Ethanol | Gasoline |
|------------------------------------|-----------|----------|-------------|
| Low Heating Value - LHV (MJ/kg) | 42.7 | 26.9 | 43.7 |
| Low Heating Value - LHV (MJ/l) | 36.4 | 21.0 | 32.0 |
| Viscosity (cSt) | 2.5 | - | - |
| Density (kg/m^3) @ 15°C | 830 - 880 | 790 | 700 - 780 |
| Cetane number | > 45 | below 8 | - |
| Octane number (MON) | - | 96 - 106 | 79 - 98 |
| Stoichiometric ratio | 14.5 | 9 | 15.1 |
| Vapour pressure @ 38°C (psi) | 0.04 | 2.5 | 7-9 |
| Flash point (°C) | 55-65 | 13 | -40 |
| Boiling temperature (°C) | 170-340 | 78 | 33-213 |
| Vaporization heat (kJ/kg) | - | 842 | 300 |
| Auto-ignition temperature (°C) | 230-315 | 366 | 300-371 |
| Flammability limits (°C) | 64-150 | 13-42 | (-40)-(-18) |
| Flammability limits (% vol) | 0.6-5.6 | 3.3-19.0 | 1.4-7.6 |

Bioethanol can be used as chemical in industrial applications, as fuel for energy generation, or as food. It can be produced by synthesis or by fermentation processes, and be or not denatured. Ethanol can be used neat or blended with gasoline or diesel fuels. It is also used for the production of ETBE (Ethyl Tertiary Butyl Ether), an oxygenated fuel obtained by mixing ethanol and isobutylene and reacting them with heat over a catalyst. ETBE promotes clean gasoline combustion, thus improving air quality.

2. Bioethanol market

Biomass currently supply 4 % of EU energy needs from biomass (Biomass Action Plan, 2005). The increased use of biomass is expected to generate a wide range of benefits and advantages, such as a greater diversification of energy supply and reduction of energy imports, reduction of greenhouse gas emissions, and creation of new permanent jobs, especially in the rural areas.

Bioethanol is playing a very important role in the liquid fuel market: bioethanol worldwide production was greater than 18 Mt/y in 2003, sig-

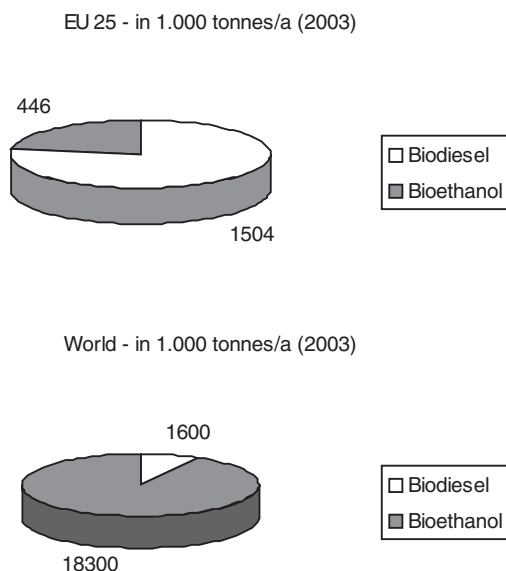


Fig. 8.1. EU-25 and World bioethanol production (from Biofuel Barometer, June 2004).