Ethanol as a fuel source

Environment, Nature

Year 12 Chemistry Assessment Task 1| Ethanol as an alternative fuel| | | | Melissa Weber| 22/11/2010| | Overview The commercial production of ethanol fuel in Australia is the use of sugar cane and wheat using yeast in the fermentation process. Yeast is a fungus which can multiply in the absence of oxygen by using enzymes (e. g. zymase) to catalyse the decomposition of sugars. Those sugars are sucrose or maltose. Suitable conditions The conditions that promote the fermentation of sugar are: * A suitable micro-organism such as yeast * Water * A suitable temperature for the fermenting yeast Low oxygen concentrations favouring the fermenting yeast * A small amount of yeast nutrients such as phosphate salt. * Once the ethanol concentration reaches 14-15% by volume, the yeast cannot survive, and the fermentation process stops. Costs Biomass fuels such as rice straw and sugar cane bagasse are being investigated as raw materials for ethanol production but the transportation costs are very high and do not justify their use. Genetically modified crops are being analysed and this could provide a cheap source of biomass fuels for the production of ethanol.

Production from Sugar Cane Sucrose extracted from sugarcane accounts for little more than 30% of the chemical energy stored in the mature plant; 35% is in the leaves and stem tips, which are left in the fields during harvest, and 35% are in the fibrous material (bagasse) left over from pressing. Most of the industrial processing of sugarcane in Brazil is done through a very integrated production chain, allowing sugar production, industrial ethanol processing, and electricity generation from by-products.

The typical steps for large scale production of sugar and ethanol include milling, electricity generation, fermentation, distillation of ethanol, and

dehydration. Replacement for distillation With increasing attention being paid to saving energy, many methods have been proposed that avoid distillation altogether for dehydration. Of these methods, a third method has emerged and has been adopted by the majority of modern ethanol plants. This new process uses molecular sieves to remove water from fuel ethanol.

In this process, ethanol vapour under pressure passes through a bed of molecular sieve beads. The bead's pores are sized to allow absorption of water while excluding ethanol. After a period of time, the bed is regenerated under vacuum or in the flow of inert atmosphere to remove the absorbed water. Two beds are used so that one is available to absorb water while the other is being regenerated. This dehydrationtechnologycan account for energy saving of 3, 000 btus/gallon (840 kJ/l) compared to earlier azeotropic distillation. .

Diagrams DISTILLATION| | STRUCTURE| FORMULAC6H12O6 ; gt; 2CO2 + 2C2H5OH (ethanol) 180. 00g ; gt; 88. 00g + 92. 00g| Ethanol vs. Fuel Arguments for ethanol as a fuel| Arguments against ethanol as a fuel| It is a clean and efficient use of energy. It is much safer then petrol (Ethanol is biodegradable without harmful effects on theenvironment) and will greatly reduce the spread ofpollution. Seeing that it is not a fossil-fuel, manufacturing it and burning it does not increase the greenhouse effect. Ethanol can reduce net carbon dioxide emissions by up to 100% on a full life-cycle basis. High-level ethanol blends can reduce emissions of Volatile Organic Compounds (VOCs) by 30% or more (VOCs are major sources of ground-level ozone formation) * High-level ethanol blends reduce nitrogen oxide emissions| Ethanol is clean but it only produces two-thirds the energy

of octane, hence more is needed| It is a much healthier alternative for people: * Sulphur dioxide and Particulate Matter (PM) emissions are significantly decreased with ethanol. As an octane enhancer, ethanol can cut emissions of cancer-causing benzene and butadiene by more than 50% * It provides high octane at low cost as an alternative to harmful fuel additives. * Ethanol can be used as an additive instead of lead which is a toxic pollutant in major cities. It will significantly reduces harmful exhaust emissions meaning more healthy in urban areas| The increased need for land clearing for crops (sugar cane) has led to huge problems of soil erosion, salination and the over use of water resources e. . Brazil| It is renewable and relatively cheap to produce, whereas oil supplies are limited to perhaps 50-60 years| Oil reserves are depleting but new reserves are being found with sophisticated techniques| Addition of ethanol to petrol reduces the amount of oxygen in combustion and reduces the emission of carbon. Ethanol blends can be used in all petrol engines without modifications| The cost of producing ethanol in 2008 was twice the cost of petrol.

Australia has a 10% blend which is competitive at the moment| Ethanol can be produced anywhere in the world (Brazil, Tanzania, Australia) and will reduce the monopoly of Arab nations. As it is easily accessible for each country the difficulty and hazards in transporting will be reduced| 80% of the world's transport is dependent on fossil fuels. Changing to an ethanol base will be an economic nightmare| Current use of ethanol Continent| % of energy needs supplied by biomass| Continent| % of energy needs supplied by biomass| Australia| 5%| Oceania| 35%|

Africa| 55%| North America| 4%| South America| 26%| Europe| 2-3%| Asia| 38%| former USSR| 3%| Sydney buses have trialled the use of Diesohol. Diesohol is a mixture of 10-15% ethanol in diesel fuel - it has been made possible by the development of a process which emulsifies the ethanol in the diesel. Using Diesohol reduces smoke, carbon monoxide and nitrogen oxides in the vehicles exhaust. Up to about 10% ethanol can be added to petrol without requiring any alteration in car engines. Cars can run on 100% ethanol, but this requires engine modification.

Ethanol does not release as much energy per gram as hydrocarbons do on burning. However, ethanol does reduce pollutants in vehicle exhaust. This is particularly advantageous when using Diesohol in trucks and buses in large polluted cities. The use of ethanol as a fuel is neutral as far as releasing carbon dioxide into the atmosphere. When ethanol is burned, it produces carbon dioxide, however, this carbon dioxide is taken out of the atmosphere by growing plants to produce more ethanol.

If crops are grown specifically to produce ethanol by fermentation, very large areas of land would be required. It has been estimated that if Australia used all its cereal and sugar crops to produce ethanol, this would still only provide enough fuel to replace about 10% of its current petroleum use. Obviously, this amount of land could not be devoted to the production of transport fuel rather thanfood. However, it may be that in the future, with improvements in fermentation technology, plant waste material could be used to produce ethanol.

It may be that there are better ways to harness energy from the sun than by growing plants which are then fermented to produce ethanol. Combustion of

ethanol only releases about one third of the energy from sunlight which was originally trapped by, for example, sugar cane plants. Ethanol is still much more expensive to produce than petrol. The expenses involved in the production of ethanol include the effort put into growing the plant material, transporting plant material to processing plants and the energy required to separate the ethanol from the fermentation mixture by distillation.

Ethanol consumption in an engine is approximately 51% higher than for gasoline since the energy per unit volume of ethanol is 34% lower than for gasoline. However, the higher compression ratios in an ethanol-only engine allow for increased power output and better fuel economy than could be obtained with lower compression ratios Cost of ethanol in Australia Taxation * Domestically produced fuel ethanol is currently effectively exempt from excise tax until July 1, 2011 (an excise of 38. 43 cents per litre is payable on petrol). From this date, excise will be increased at 2. 5 cents per litre annually until it reaches 12. 5 cents per litre in 2015 Government Support * Federal Government support for fuel ethanol includes a voluntary industry biofuels target (encompassing ethanol, biodiesel, and other biofuels) of 350 million litres per annum by 2010, capital grants to current and prospective producers, fuel excise relief, and an effective tariff on imported ethanol until July 1, 2011. In 2006, the Premiers of both New South Wales and Queensland proposed mandating the blending of ethanol into petrol. Marketing * E10 is available through service stations operating under the BP, Caltex, Shell and United brands as well as those of a number of smaller independents. E10 is most widely available closer to the sources of production in Queensland and

New South Wales. E10 is most commonly blended with 91 RON " regular unleaded" fuel.

Bibliography

- Biofuel in Australia. (2010, 11 20). Retrieved 11 22, 2010, from Wikipedia: http://en. wikipedia. org/wiki/Ethanol_fuel_in_Australia Catalyst Teaching Resouces. (2001).
- Investigating ethanol as a fuel , 1-5. Ethanol from glucose (2010, http://hsconline. nsw. edu. au/). [Motion Picture]. Ethanol from sugar (2010, http://hsconline. nsw. edu. au/). [Motion Picture]. Ethanol Fuel. (n. d.). Retrieved 11 21, 2010, from Journey to forever: http://journeytoforever. org/ethanol. html
- Ethanol Fuel. (2010, 11 10). Retrieved 11 22, 2010, from Wikipedia: http://en. wikipedia. rg/wiki/Ethanol_fuel_in Ethanol fuel in Brazil. (2010, 10 31). Retrieved 11 18, 2010, from Wikipedia: http://en. wikipedia. org/wiki/Ethanol_fuel_in_Brazil MONCEAUX, P. M. (2008, 08 28).
- Fuel ethanol production. Retrieved 11 17, 2010, from bioethanol: http://www. bioethanol. ru/images/bioethanol/Fuel%20ethanol %20production%20-%20Katzen. pdf