Investigating the Heat Energy Released from Biofuels

Aim: This report will aim to compare the heat energy released when biomethanol, bioethanol and biobutan-1-ol are combusted.

Underlying environmental science: Fuels are substances which release large amounts of energy when combusted and an alcohol not only fills the requirement to be a fuel but can also be classed as a biofuel as alcohols can be derived from plant material after it has fermented.

The current sources of power for humanity are fossil fuels which are finite and produce large amounts of greenhouse gasses which cause global warming whereas alcohols produce little greenhouse gasses compared to fossil fuels and are a renewable resource because they are created when plants undergo fermentation. Several countries including Brazil have begun to use bioethanol mixed with gasoline as a fuel to power vehicles. There are downsides to biofuels in that large plots of land must be cleared to make room for crops to produce biofuels meaning habitats are destroyed and biodiversity is reduced.

Biofuels are fuels that are derived from living materials such as plants. Plants are a natural resource. They are also part of the biosphere as well as being a renewable and biological resource. The Biosphere is one of the Earth's main systems and encompasses all living things. Biofuel are humanity's main alternative to using fossil fuels. Fossil fuels such as oil and gas were formed billions of years ago when microscopic sea creatures died and fell to the seabed. Over time layers formed on top of them and the intense heat and pressure caused a chemical change turning them to oil and gas. Fossil fuels produce carbon dioxide when combusted which contributes to the greenhouse effect. Biofuels however are carbon neutral and don't contribute to this effect as they release the same amount of carbon when burned as the plant takes in during growth. This does not take into account fossil fuels used in the production of biofuels. Fossil fuels are also a finite resource. Finite means that there is a limited amount of a specific resource and that it will eventually run out. This brings us to the topic of sustainability. Sustainability is the ability to use a resource in a way that doesn't compromise the ability of future generations to use it. This is similar to the concept of sustainable development. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs taking into account social, economic and environmental issues. I previously mentioned that alcohols are renewable because they are produced when plants undergo fermentation. The chemical equation for fermentation is

Glucose → Alcohol + Carbon dioxide

Large areas of land are cleared to make room for crops to produce biofuels and this destroys habitats and reduces biodiversity. These large areas then become home to monocultures which are fields that contain only one type of crop. This farming technique increases the yield of crops but an infection can spread quickly through the field destroying all crops.

Description of experiment: the energy content of a biofuel was found by calculating the change in water temperature after heating it with a biofuel for a set time. The experiment was run using biomethanol, bioethanol and biobutan-1-ol.

Experimental data:

The data I obtained from the experiment conducted in class is shown in the table below.

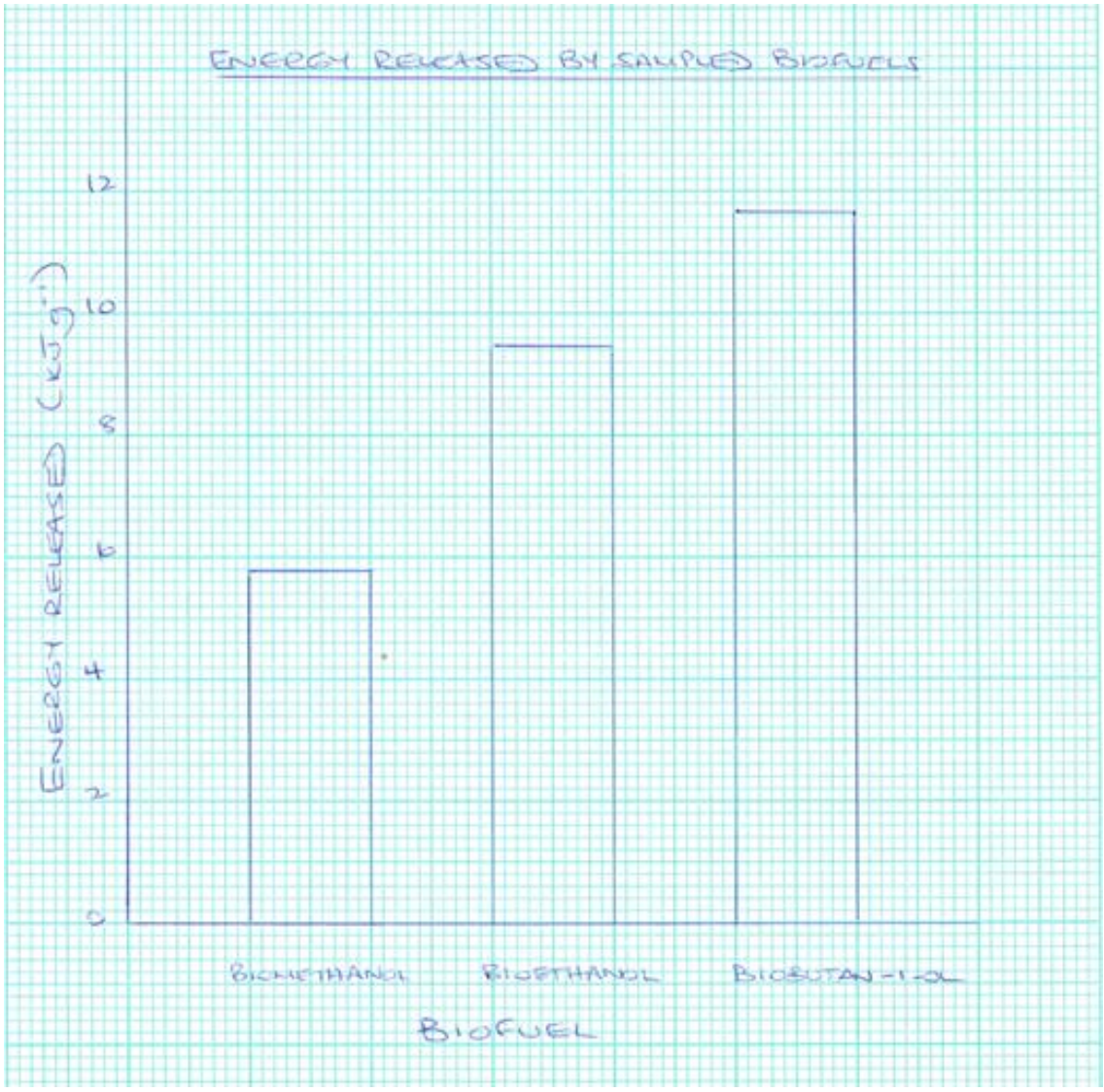
	Energy content (kJ g^{-1})			Average
Biofuel	Test 1	Test 2	Test 3	
Biomethanol	6.65	3.66	7.02	5.78
Bioethanol	14.30	5.64	8.67	9.54
Biobutan-1-ol	12.30	13.93	13.93	11.73

My second source was https://www.creative-chemistry.org.uk/gcse/documents/Module7/N-m07-24.pdf

Alcohols	Number of carbon atoms present	Average heat energy released (kJ g^{-1})
Methanol	1	22.7
Ethanol	2	29.7
Propan-1-ol	3	33.6
Butan-1-ol	4	36.1

Graphical presentation:

I have created a bar graph using the energy released by each sampled biofuel data which came from my experiment.



Analysis: Both sources show that biomethanol releases the least heat energy per gram, Biobut-1-ol releases the most heat energy per gram and Bioethanol's amount of heat energy released was between the other two biofuels.

Conclusion: Based on my data, Biobutan-1-ol released the most heat energy per gram when combusted, biomethanol released the least heat energy per gram when combusted and the amount of heat energy released by bioethanol when combusted was larger than the amount released by biomethanol but smaller than the amount released by biobutan-1-ol.

Evaluation: my experimental data is relevant as it provides information on the energy released when biomethanol, bioethanol and biobutan-1-ol are combusted. This source is reliable as the experiment was repeated for each biofuel three times and an average energy released calculated.

My second source of information is relevant as it provides information on the heat energy released when methanol, ethanol and butan-1-ol are burned to heat a set amount of water. All though this source refers to alcohols they have the same molecular structure as there corresponding biofuels and give off the same amount of energy when combusted.

Bibliography:

Experimental data collected from 'Measuring the heat energy released when alcohols burn' practical. Aim of practical: to investigate the energy released when three different alcohols are combusted.

Source 2: https://www.creative-chemistry.org.uk/gcse/documents/Module7/N-m07-24.pdf

http://www.bbc.co.uk/schools/gcsebitesize/science/aqa/crudeoil/hydrocarbonsrev3.shtml

http://study.com/academy/lesson/what-are-fossil-fuels-definition-advantages-disadvantages.html

http://sugarcane.org/sugarcane-products/ethanol