



Year 12 Chemistry 2010 – Production of Materials Assessment

Alcohols as a Fuel Source – Laboratory Verification of a Company Claim

A new biofuels company has produced a set of experimental results from tests on a variety of alcohols. As a Senior Chemistry student, you have decided to test their claim of energy content in the school laboratory. You set up a series of spirit burners so that you can use them to heat a known quantity of water in an aluminium container. Using the change in the temperature of the water and the mass of the fuel used, you can determine the heats of combustion (ΔH_c) of these fuels and verify if the claims are correct. The experimental results you wish to verify are below:

| Energy Density Values for Some Potential Fuels (BTU/gal) | |
|--|---------|
| Methanol | 64,000 |
| Ethanol | 84,000 |
| Butanol | 110,000 |

Constants:

| | |
|----------------------------|--------------------------------------|
| Quantity of Heat | 1 BTU = 1.055 kJ |
| Volume | 1 gal = 3.78 L |
| Heat capacity of water | $4.18 \text{ J K}^{-1}\text{g}^{-1}$ |
| Density of methanol (g/ml) | 0.91 |
| Density of ethanol (g/ml) | 0.88 |
| Density of Butanol (g/ml) | 0.89 |

Some potentially important constants and conversions you may need are:

The Task:

Your task is to use the attached results to construct a formal laboratory report. You are to use the standard report format (refer to EPI format on wiki), making sure to include the following sections: **Title**, **Background Information**, **Aim**, **Hypothesis**, **Materials** (you will need to provide me with a list), **Safety**, **Method** (including a detailed step-by-step method, clear identification of all relevant variables and a diagram of the setup), **Results** (clearly showing all relevant tables, graphs and calculations including units), **Discussion** (making sure you give a complete chemical explanation of the results including balanced chemical reactions and an explanation of the differences in the energy densities of the different fuels, as well as a discussion of any possible sources of error (accuracy), reliability and validity), and a **Conclusion**. Be sure to include all reference using in-text referencing and a complete **Bibliography**.

Background Information:

As you will recall, this section of a scientific report includes the relevant scientific theory behind the experiment that you will be conducting. For this report, there are specific areas that you will need to discuss concerning the chemistry of ethanol. These are as follows:

- Outline the use of ethanol as a fuel and explain why it can be called a renewable resource.
- Summarise the processes/chemistry involved in the production of ethanol from sugar cane
- Provide information on the current use of ethanol as an alternative fuel for cars and discuss the advantages and disadvantages of its use with supporting evidence.
- Evaluate the success/potential success of ethanol as an alternative fuel (i.e. provide your opinion)

Results:

During your experiment, you will obtain the following results in the laboratory and your data tables may look something like those below:

| | |
|---|--|
| Mass of Aluminium container (g) | |
| Mass of Aluminium container + water (g) | |
| Mass of water (g) | |

| Alkanol | Initial Mass of fuel (g) | Final Mass of Fuel (g) | Initial Temp of Water (°C) | Final Temp of Water (°C) |
|----------|--------------------------|------------------------|----------------------------|--------------------------|
| Methanol | | | | |
| Ethanol | | | | |
| Butanol | | | | |

Outcomes assessed: H2, H4, H5, H7, H9, H12, H13, H14

Issue Date: **29 October 2010**

Due Date: **22 November 2010, 3:15pm**

Task weighting: **15% of your Internal HSC mark.**

Please note that the penalty for late submission of tasks or plagiarism is a zero mark.

Alcohols as a Fuel Source

Formal Report 2010

Marking Criteria

| ASSESSMENT CRITERIA | Marks | | | |
|---|-------|---|---|------------|
| | 0 | 1 | 2 | 3 |
| Title | 0 | 1 | | |
| Background Information: | | | | |
| Process/chemistry of EtOH from sugar cane | 0 | 1 | 2 | 3 |
| Information on the current usage of EtOH as fuel | 0 | 1 | 2 | |
| Advantages/Disadvantages of EtOH as a fuel | 0 | 1 | 2 | |
| Evaluation of success/potential of EtOH | 0 | 1 | 2 | |
| Hypothesis: | | | | |
| Correctly phrased into a testable hypothesis | 0 | 1 | 2 | |
| Aim: An aim that includes the dependent and independent variables. | 0 | 1 | 2 | |
| Design (method & apparatus): | | | | |
| Accurately and fully identifies equipment required | 0 | 1 | 2 | |
| Identifies the independent variable | 0 | 1 | | |
| Identifies the dependent variable | 0 | 1 | | |
| Identifies the control variables | 0 | 1 | 2 | |
| Diagram (pencil/computer, ruled, 2D, labelled) | 0 | 1 | 2 | 3 |
| Logical sequence of method described and includes reliability | 0 | 1 | 2 | |
| Safety: Safety hazards identified and appropriate safety measures listed | 0 | 1 | 2 | |
| Results: | | | | |
| All relevant calculations accurately and clearly shown | 0 | 1 | 2 | 3 |
| Clear and accurate table of data included | 0 | 1 | | |
| Correct units used throughout calculations | 0 | 1 | 2 | 3 |
| Discussion: | | | | |
| Describes the relationship / patterns found | 0 | 1 | 2 | |
| Suggests probable reasons to explain relationship | 0 | 1 | 2 | |
| Evaluates experiment for possible sources of error | 0 | 1 | 2 | |
| Provides chemical explanations including balanced chemical equations | 0 | 1 | 2 | 3 |
| Discussion demonstrates a sophisticated level of analysis of the investigation | 0 | 1 | 2 | 3 |
| Conclusion: | | | | |
| Short and specifically answers the aim | 0 | 1 | | |
| States whether hypothesis is supported or rejected | 0 | 1 | | |
| Presentation: | | | | |
| Correct format / overall neatness | 0 | 1 | 2 | |
| TOTAL | | | | /50 |

