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Generic Closed Control Loop of a High Efficiency Low Volume Bioethanol Distillery

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Foreword

To my adoring mother who always believed that I could obtain anything that I wanted, and who supported me throughout my University Career and to Johan, thank you for teaching me over the last 8 years, you have been a great role model for me and many other students.

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1.0 Abstract

Bioethanol is a type of biofuel that is created by fermenting organic materials into a solution called mash. This mash contains water, dead yeast cells, feed stock solids, and 10% - 15% bioethanol (alcohol). The bioethanol is extracted by heating the mash above the boiling point of ethanol to create a vapour which is then condensed in to a liquid that is greater than 93% bioethanol in a process called distillation.

bioethanol is a viable replacement for petrol, however comparisons between the two fuel types show that with the current processes used petrol has a higher net energy yield. Bioethanol contains 30% less energy than petrol, so to compete with petrol bioethanol must be created in a way that greatly reduces its total energy cost. The most energy intensive process in the production of bioethanol is distillation, an Advanced Process Control algorithm (APC) must be implemented to make this process more efficient.

My project is based on the implementation of an APC to increase the efficiency of a bioethanol still. By using a Siemens PLC (Programmable Logic Controller), combined with their PID (Proportional, Integral, and Differential) control algorithms I intend to monitor and control the distillation of a mash containing 14% bioethanol.

With this approach I have been able to manufacture a low volume still that can produce high quality bioethanol consistently. This approach increased the total bioethanol yield by 10%, also producing a solution that is consistently above 93% ethanol which can be fed straight into a molecular sieve for dehydration, producing 100% bioethanol that can be used as a biofuel.