

Design Requirements and Specifications for

Biofuel

by

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Introduction:

As biodiesel process becomes more commercialized, the possibility of an economically and environmentally friendly fuel is possible. The base of this derivable fuel source is a readily available component; vegetable oil. This knowledge in addition to the fact that Villanova Dining Services throws away gallons of used cooking oil per week and have maintenance trucks that require diesel fuel renders a possible solution: A renewable energy source could efficiently run these maintenance trucks while saving Villanova Dining Services money and help to create less harmful emissions. Thus the needs of the dining services and the mechanical aspects of the fuel must be defined in order to satisfy all requirements. The following QFD and PDS report will define these aspects of consumer wants and engineering parameters.

	rate of consumption	man power hours	gel temperature	engine performance	fuel viscosity	material availability	time to produce	cost of manufacture	customer importance	diesel fuel on market	B20 (20%) biofuel	straight (100%) biofuel	improvement ratio	sales points	improvement ratio	relative weight
customer requirements:																
1. get rid of waste	9								5	1	4	5	4	1.5	30	0.22
2. lessen car pollution				9					3	1	4	5	4	1	12	0.09
3. save gas money		3							5	1	4	5	4	1.5	30	0.22
4. run dining truck			3	3					5	5	5	3	1	1.5	7.5	0.05
5. replenishable fuel source						9			3	1	4	5	4	1	12	0.09
Fuel Properties:																
6. efficiency				9					4	5	5	4	1	1	4	0.03
7. reduce engine wear				3	3				4	3	4	5	1.3	1	5.2	0.04
8. long term engine use			3		3				5	5	5	3	1	1.5	7.5	0.05
9. power diesel engine				9					5	5	5	4	1	1.5	7.5	0.05
10. cold weather fuel			9		9				5	5	4	2	0.8	1	4	0.03
Process Features:																
11. automated process		9							3	5	4	4	0.8	1	2.4	0.02
12. consistency		9					3		4	5	4	4	0.8	1	3.2	0.02
13. short production time		3							3	5	4	3	0.8	1	2.4	0.02
14. cost								9	5	3	4	5	1.3	1.5	9.75	0.07
Abs. Importance	1.98	1.08	0.57	1.8	0.54	0.81	0.06	0.63	7						137	1
Rel. Importance	0.28	0.15	0.08	0.26	0.08	0.12	0.01	0.09								
Present diesel fuel			-50	200	22.8			2								
Target value			-4	190	74			1.5								
Units		cars/hour	C		*10 ⁶ (-6) m ³ /s			dollars/gallon								

To formulate the Quality Function Deployment diagram we first listed the customer requirements on the left margin. The first of these were outlined by the Dining Services Department of the University in a request submitted to the engineering department. We next listed specific fuel properties which are desirable for a fuel used to power the Dining Services truck. To round out the customer requirements we listed process features which are desirable for this project.

The next task was to list the engineering characteristics along the top row. To do this we thought of measurable constraints on the realization of the customers requirements. Essentially we thought of characteristics that could either help or hinder the customer requirements.

After completing the first two steps we were able to fill in the matrix, showing how much correlation there is between the customer requirements and the engineering characteristics. A 9 indicates a strong correlation, 3 is moderate, and 1 is weak.

We next made a column for customer importance and rated each customer requirement from 1 to 5 with 5 being the most important to the customer. We made columns for the three types of fuel we are comparing: diesel, B20 biofuel, and straight biofuel; then we rated each fuel on how well it satisfies each of the customer requirements on a scale of 1 to 5.

To compare traditional diesel fuel and B20 biofuel we formed an improvement ratio column in which we compared the ratings for each customer requirement of the two fuels. For the sales points column we assigned a 1.5 for each customer requirement which makes the product attractive to buyers. For all other requirements we assigned a value of 1. For the second improvement ratio column we multiplied the customer importance, sales points, and first improvement ratio for each customer requirement. The relative weight column is the second improvement ratio divided by the sum of the second improvement ratios.

At the bottom the absolute importance shows how important each engineering characteristic is. We attained these values by multiplying the numbers in the column by their relative weight and then summing them up. Relative importance was determined by dividing the absolute importance by the sum of the absolute importance.

Product Title

Biofuel

Purpose

To provide the Villanova Dining Services with a way to convert their used cooking grease from the various kitchens into a usable fuel for their trucks.

New or Special Features

Automated processing of the fuel
Less time to create the fuel
Higher efficiency and lower emissions

Competition

Will compete against companies currently producing a biofuel/diesel mixture and companies creating modification kits to allow the engine to run off unrefined biofuel.

Intended Market

This product will be created for the Villanova Dining Services with the possibility to sell the technology to outside vendors.

Need for Product

Villanova Dining Services has asked that this technology be created so as to handle their waste grease removal and diesel fuel consumption problems.

Relationship to Existing Products Line

This is a continuation of a project that was started last year by the previous senior design group.

Market Demand

There is an unlimited market demand for a renewable fuel source.

Price

The price to produce the fuel is not yet known as it will vary depending on the usage of different chemicals. However we expect to be able to produce it at a price lower than the national average of diesel fuel which is currently \$2.12 per gallon

Functional Performance

Run an unmodified diesel engine.

Maintain all of the positive qualities of diesel fuel such as lubrication and longer engine life.

Produce better emissions numbers than a typical diesel fuel.

Cost less than diesel fuel.

Eliminate cost of waste removal for Villanova Dining Services.

Physical Requirements

Must have same lubrication properties as regular diesel.

Must have similar operating temperature range as regular diesel fuel.

Easy and safe to make and store.

Service Environment

Biofuel must keep its properties from a temperature of -25°C to 320°C

Human Factors

Must be easy for one person to operate.

Must meet or exceed all safety standards for similar products on the market.

Corporate Constraints

Must be ready for use within twelve (12) months.

Manufacturing cost will be covered by both the design group and the Villanova University Mechanical Engineering Department.

Conclusions:

The main requirement for this project is that we must make a renewable fuel source using used cooking oil provided by the Villanova Dining Services and have it function properly in the maintenance vehicle. The specifications in making this fuel are that the biodiesel fuel functions the same as regular diesel so as not to cause any engine complications or breakdown. In addition, the biodiesel must be cheaper to make than diesel fuel so that it is cost effective for Dining Services.