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Dual Fuel System Mock – up

Jorge C. Nadera
Bohol Island State University – Main Campus
CPG North Avenue, Tagbilaran City, 6300, Bohol, Philippines

Abstract

The main objective of this study was to assemble and assess the functionality of the Dual Fuel System Mock-up in the aspects of acceleration, pressure generated and emission output as device for instruction. The study was primarily conducted at Bohol Island State University Main Campus, Tagbilaran City in the Academic Year 2018-2019. The study used the experimental method of research in the making of the product. It was supplemented with observation guides to determine the functionality of the Dual Fuel System Mock-up. The respondents were Automotive Technology students and experts. The researcher used the experimental design in the conduct of the study. Observation guides were used in the locale of the study was at Bohol Island State University – Main Campus, Tagbilaran City in the Academic Year 2018 – 2019. BISU is an educational institution that offers Engineering and Technology Courses particularly Automotive Technology. collecting the quantitative data during the testing phase. The researcher used an observation guide as one of the instruments in gathering data during the test of the functionality of the Dual Fuel System Mock-up. The Dual System Mock-Up is an internal gasoline combustion engine which completes four separate strokes while turning the crankshaft. This dual fuel LPG system allows the engine to operate on either LPG or Petrol. The petrol tank still remains in the mock-up. The operator can switch from gas to petrol or vice versa. It has a safety device in case there will be an electrical problem. Dual fuel system mock-up is an effective tool instruction because it could help the students observe and trace acceleration, pressure and emission output of the fuel when used with LPG and gasoline fuel. Researcher will introduce the Dual Fuel System Mock-up to automotive technology and allied courses as a tool for instruction. Improve the mock-up with the latest type of engine. Recommend the study to be patented for its protection. School administrator shall encourage their instructors to construct instructional materials that can replicate the actual functions of the machines or devices found in the industry.

Keywords*: Dual Fuel System Mock-up*

Introduction

In an ever-changing technological world, technology seems to be at the forefront of education. At the same time, the exact impact of using technology for instruction is still unknown. Some questions how technology affects students' learning and how it improves their ability to retain information. More specifically, it would be useful to know whether students respond in a more positive manner to participate in a social studies class when using technology (mock-up tools) than using paper-based methods.

Man can see numerous positive effects of technology in different aspects of human life like in the aspect of education. Incorporating technology to education will build an adequate level of competitiveness to the fast-growing economy. Thus, students will be equipped not only with an adequate education in their field of study, but will also be armed with the skills and knowledge required to influence technology effectively in the workplace (Nacorda, 2015).

Integration of technology will result in many factors, but the most important factor is the teacher's competence and ability to shape instructional technology activities to meet students' needs (Albert, 2007). As one of the outstanding and top performing schools in the field of engineering and technology, Bohol Island State University (BISU) is an institution whose intention is to consistently produce and cultivate field professional workers carrying with sufficient knowledge, skills and values. Consequently, the institution must become an effective training ground which can provide advance technology to reality.

The problem faced by the country today is not only economic but also technological, that is, there is lack of trained technicians who have thorough knowledge about the present technological set-up and requirements in the industry. The technical vocational schools play an important role in solving these problems. However, it cannot be denied that most of the instructional equipment that the vocational schools have are different from those utilized in the industries and that shortage of instructional equipment specifically instructional

engines that could facilitate understanding of engine operating principles make it almost impossible for them to perform their functions and responsibilities.Instructors are aware of this inadequacy of facilities in instruction and these include lack of shop facilities, laboratory equipment, and library resources. If possible, quality education requires latest facilities in order to equip the students with the necessary skills and knowledge to keep them abreast with the present technological trend. With these concepts and realities, the researcher was motivated to assess the effectiveness of the dual fuel system mock-up as an instructional tool to cater the needs of the learners.

Methodology

The researcher used the experimental design in the conduct of the study. Observation guides were used in collecting the quantitative data during the testing phase. The locale of the study was at Bohol Island State University – Main Campus, Tagbilaran City in the Academic Year 2018 – 2019. BISU is an educational institution that offers Engineering and Technology Courses particularly Automotive Technology. The said institution is to be chosen for the conduct of the research due to the fact that it lacks the instructional materials in the shop rooms for smooth delivery of the lesson particularly in automotive technology.The researcher used an observation guide as one of the instruments in gathering data during the test of the functionality of the Dual Fuel System Mock-up.

Results And Discussion

1.1 Preparation

After the approval to conduct the study was given, the researcher approached the thesis adviser to plan the design of the project including the entire technical plan. The success of the proposal led to the appropriate preparation and selection of materials needed to construct the project. Proper materials selection was essentials in the design and construction of the Dual fuel System Mock-up. Materials were properly and carefully selected with the consideration of the cost and benefit before proceeding with the procurement process.

1.2 Design

The Dual System Mock-Up is an internal gasoline combustion engine which completes four separate strokes while turning the crankshaft. This dual fuel LPG system allows the engine to operate on either LPG or Petrol. The petrol tank still remains in the mock-up. The operator can switch from gas to petrol or vice versa. It has a safety device in case there will be an electrical problem. The actions in the internal combustion engine can be divided into four parts. These are the intake, compression, power and exhaust. During the intake stroke of a spark ignition engine, the piston is moving down. The intake valve is open. Air-fuel mixture flows through the intake manifold and into the cylinder. The fuel system supplies the mixture as the piston passes through BDC, the intake valve closes. After the piston passes BDC, it starts moving up. Both valves are closed. The upward moving piston compresses the air fuel mixture into a smaller space, between the top of the piston and the cylinder head. This space is the combustion chamber. As the piston nears TDC at the end of the compression stroke, an electric spark jumps the gap at the spark plug. The heat from the sparks ignites the compressed air fuel mixture. The air fuel mixture then burns rapidly, producing high temperatures of up to 6000F. These high temperatures cause very high pressure which pushes down on the top of the piston. As the piston approaches BDC on the power stroke, the exhaust valve opens. After passing through BDC, the burned gases escape through open exhaust valves. As the pistons near TDC and starts down again, the exhaust valves close. Another intake stroke begins and the whole cycle-intake, compression, power and exhaust repeats. This goes on continuously in all engine cylinders as long as the engine runs.

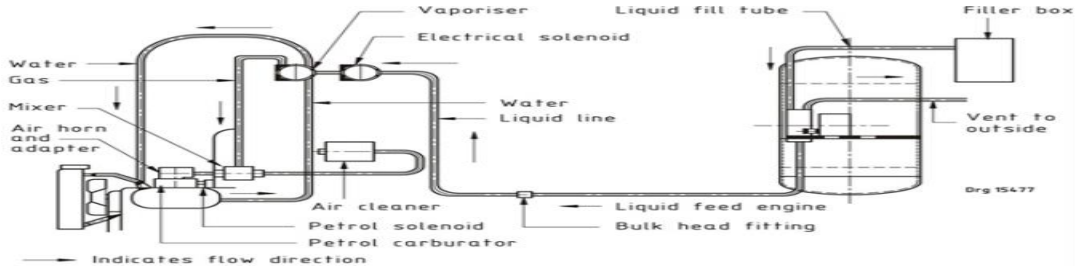


Figure 1. Pictorial Diagram of the LPG Fuel system

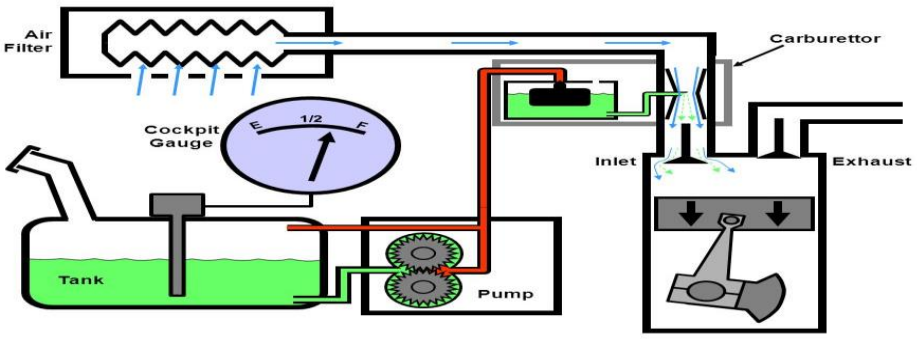


Figure 2. Pictorial Diagram of an Internal Gasoline Combustion Engine

1.3 Procedure

A well-developed was one of the critical factors in constructing the Dual Fuel System Mock-up. The plan consisted of a series of task organized in a sequence of steps to optimized in a sequence of steps to optimized the use of man power, equipment, tools and materials. The plan also served as a guide to ensure performance and consistency in the assembly of the Dual Fuel System Mock-up.

1.3.1 Assembly

Assembly was a vital phase in constructing the device. Components were assembled and installed together to produce the Dual Fuel System Mock-upon the given perspective and design. All the materials, tools and equipment used in the assembly were checked and laid out in the working area.

The process was divided into three parts: Chassis Assembly, Electrical Component Assembly and Fuel System Assembly.

1.3.1.1 Chassis Assembly

The chassis assembly consisted of a pre-fabricated metal frame as the skeleton of the device. Between the engine and the chassis is made up of rubber served as the dampening for the vibration of the engine.

1.Pre-fabricated metal frame

An engineering square was used to check the correctness and preciseness of the angles between the pre-fabricated metal frame. A pull-push rule was used to check the dimension of the chassis. A pencil was used to mark the orientation guide for mounting. Arc Welding Machine was used to weld in joining the metal.

1.3.1.2 Electrical Component Assembly

Observation of safety when dealing with electrical components is very important. In assembling the electrical components for the Dual Fuel System mock-up, all tools and materials involved were properly checked and organized. The workplace was secured from trashes and other hazardous materials. The following steps were employed in assembling the components:

1.Checking and Testing Electrical Components

All the components were physically checked for irregularities. The contacts of the contactors and solenoid, the switch, and the terminals were tested the voltage and resistance by using multi-tester.

2.Installing and Wiring the Components

The standards prescribed in the Philippine Electrical Code were observed during the installation and wiring of the Dual Fuel System mock-up. The researcher installed all the parts of the instructional device which consisted of the ignition switch, Solenoid switch, Ignition coil, electronic fuel pump, Starter motor, voltage regulator and the alternator. All the wirings were in accordance with the constructed wiring diagram. With the used of multi-tester, the researcher tested every part of the electrical system to ensure that there would be no open connections, ground faults or exposed conductors.

1.3.1.3 Fuel System Assembly

The Dual fuel system assembly both LPG and Gasoline has different component. The component of gasoline fuel system is Gasoline tank, electronic fuel pump, Fuel filter, Solenoid switch. The component of LPG fuel system is LPG tank, LPG gauge, vaporizer and the mixer. Both fuel system has the output when it comes to internal combustion chamber. Observation of safety when dealing with fuel system is also very important. All the components were properly checked in-case of leakage for the fittings, connectors, pumps and the tank.

1.3.2 Operation

The following are the prescribed steps to properly operate the Dual Fuel System Mock-up:

1.Turn the main load in finger tight-then open the main load screw six (6) to seven (7) turns or until

approximately 1/2" of threads are visible past the nut as a starting point –further adjustment may be necessary.

2.Turn on the fuel supply and depress the primer button on the zero governor for and instant approximately one (1) second and start the engine. If the engine fires but does not continue to run, turn the main load screw out one-half (1/2) turn, re-prime if necessary and restart. You may have to repeat this step several times to allow the engine to run well enough to proceed to the next step.

3. Adjust the main load screw for maximum RPM and smoothest engine performance at governed speed. In most cases turning screw in leans the mixture and turning the screw out enriches the mixture.

4.If the engine is required to run at idle speed, slowly let the engine run at idle speed, then slowly let the engine return to idle speed. Adjust the idle gas needle screw to obtain the smooth idle. To set the proper idle speed, adjust the idle on the throttle shaft. Do not attempt to set speed with the gas mixture adjustment.

5.To check the adjustment, put the engine under its normal load adjustment, then return to idle and re-check this setting.

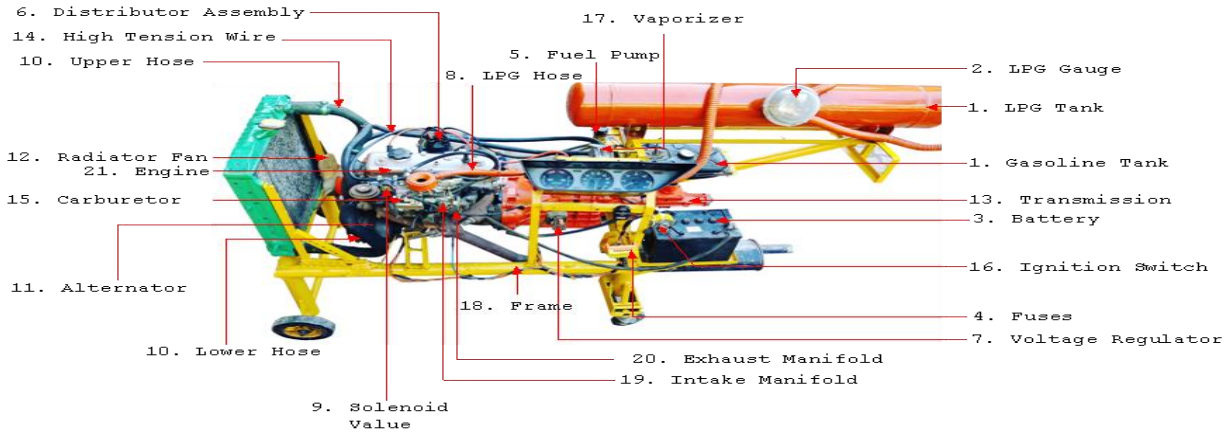
1.4 Tools, Materials and Cost

Table 1
Materials and Cost

Item	Unit	Quantity	Unit Price	Cost
Engine (4k)	Assy.	1	10,000.00	10,000.00
Fuel Tank	Pc.	1	200.00	200.00
Fuel Pump	Pc.	1	1,500.00	1,500.00
Muffler	Pc.	1	300.00	300.00
Ignition switch	Pc.	1	280.00	280.00
Fuse Box	Set	1	120.00	120.00
Voltage Regulator	Pc.	1	180.00	180.00
Radiator	Assy.	1	3,000.00	3,000.00
Battery(9plates)	Pc.	1	4,800.00	4,800.00
Pipe (#3)	kilos	8	14.00	112.00
Welding Rod	kilos	5	150.00	750.00
Angle Bar (#1x1)	kilos	10	14.00	140.00
Wheels	Pcs.	4	200.00	200.00
Thinner	liter	2	125.00	250.00
Primer Paint	liter	1	140.00	140.00
Paint	liter	1	280.00	280.00
LPG tank	Pc.	1	8,000.00	8,000.00
LPG KIT	Set	1	8,000.00	8,000.00
			Total	php42,252.00

Total cost php 42,252.00
Labor cost php 15,000.00
Total cost php 57,252.00

1.5 Parts and Functions



1.LPG and Gasoline Tank- is typically to part of an engine system in which the fuel is stored and propelled (fuel pump) or released (pressurized gas) into an engine.

2.LPG Gauge- is an instrument use to indicate the amount of fuel in a fuel tank.

3.Battery- is a source of energy which provides a push a voltage of energy to get a current flowing in a circuit.

4.Fuses- are used to protect the wiring in an electrical circuit from being destroyed in the event of a short circuit.

5.Fuel Pump- pump gasoline from vehicles fuel tank to the engine and also distribute fuel under low pressure to the carburetor or to the fuel injection system under higher pressure.

6.Distributor Assembly- is to route secondary or high voltage, current from the ignition coil to the spark plugs in the correct firing order, and the correct amount of time.

7.Voltage Regulator- is to regulate the amount of power output from the alternator.

8.LPG Hose- used to bring the fuel or gas from one point in a vehicle to another or from storage tank to a vehicle.

9.Solenoid Valve- is an electromechanical actuated valve to control the flow of liquid and gases.

10.Upper and Lower Hose- as the coolant flows through these passages, it picks up heat from the engine.

11.Alternator- is used in automobiles to charge the battery and to power electrical system when its engine is running.

12.Radiator Fan- can push air through the radiator core or pull it through.

13.Transmission- is transferring engine power to the driveshaft and rear wheels in front wheel-drive wheel.

14.High Tension Wire- are the wires that connect a distributor, ignition coil, or magneto to each of the spark plugs in some types of internal combustion engine.

15.Carburetor- the section of the engine intake system where fuel and air are mixed and passed into the engine for combustion.

16.Ignition Switch- is the switch in the control systems for the vehicle including accessories.

17.Vaporizer- a device which includes a regulator and a heat exchanger to convert liquid propane to a gaseous state and reduce the pressure.

18.Frame- to support the vehicles mechanical components and body.

19.Intake Manifold- is to evenly distribute the combustion mixture or just air in a direct injection engine to each intake port in the cylinder head.

20.Exhaust Manifold- is to collect the exhaust fumes from the engine cylinders and direct them to the exhaust pipes.

21.Engine- is a self propelled mechanical device that convert from chemical to heat to mechanical energy.

22.Cycle- a series of events that repeat themselves.

23.Compression- reduction in the volume of a gas by squeezing it into a smaller space.

24.Piston-a movable part, fitted into a cylinder, which can receive or transmit motion as a result of pressure changes in a fluid.

25.Stroke- in an engine cylinder, the distance that the piston moves in travelling from BDC to TDC or from TDC to BDC.

26.Combustion Chamber- the space between the top of the piston and the cylinder hear, in which the fuel is burned.

Table 1
Functionality of the Dual Fuel System Mock-up in terms of Acceleration

Fuel	Rate	Operation	Trials	Speed (RPM)
LPG	Idle Speed	Manipulate the Engine	1	750 – 800
			2	700 – 750
			3	700 – 750
			Average	700 – 750 (Normal)
	High Speed	Manipulate the Engine	1	900
			2	1000
			3	900
			Average	900 (Normal)
Gasoline	Idle Speed	Manipulate the Engine	1	750 – 800
			2	800 – 850
			3	750 – 800
			Average	750 – 800 (Normal)
	High Speed	Manipulate the Engine	1	950
			2	1000
			3	1000
			Average	1000 (Normal)

As shown in the table 2, LPG fuel has 700 – 750 revolution per minute for idle speed and 900 revolution per minute for high speed when operated manually. Meanwhile, gasoline fuel has 750 – 800 revolution per minute for idle speed and 1000 revolution per minute for high speed when operated manually. Both fuel system reveals normal engine speed during the operation.

Table 2
Functionality of the Dual Fuel System Mock-up in terms of Pressure Generated

Fuel	Rate	Operation	Cylinder	Trials	Pressure (psi)
LPG	Idle Speed	Start the Engine	1	1	26
				2	25
				3	25
				Average	**25.33**
			2	1	24
				2	24
				3	25
				Average	**24.33**
			3	1	23
				2	26
				3	24
				Average	**24.33**
			4	1	25
				2	25
				3	25

				Average	**25**
Gasoline	Idle Speed	Start the Engine	1	1	30
				2	28
				3	30
				Average	**29.33**
			2	1	25
				2	26
				3	25
				Average	**25.66**
			3	1	26
				2	25
				3	25
				Average	**25.33**
			4	1	32
				2	31
				3	32
				Average	**31.66**

In table 3, the pressure generated using the LPG fuel in cylinder 1, 2, 3, and 4 are 25.33, 24.33, 24.33, and 25 respectively. Meanwhile, the pressure generated using the gasoline fuel in cylinder 1, 2, 3, and 4 are 29.33, 25.66, 25.33, and 31.66 respectively. This shows that the pressure generated using gasoline is higher than LPG fuel.

Table 3
Functionality of the Dual Fuel System Mock-up in terms of Emission Output

Fuel	Rate	Trials	Emission Output
LPG	Hydrocarbon	1	6627 ppm
		2	6615 ppm
		3	6611 ppm
		Average	**6617.66 ppm**
	Carbon Monoxide	1	8.70 %
		2	8.66 %
		3	8.82 %
		Average	**8.72 %**
Gasoline	Hydrocarbon	1	1489 ppm
		2	1556 ppm
		3	1506 ppm
		Average	**1517ppm**
	Carbon Monoxide	1	0.25 %
		2	0.23 %
		3	0.20 %
		Average	**0.22**%

Table 4 shows the emission output of LPG fuel and gasoline fuel. In the LPG fuel, the hydrocarbon is 6617.66 parts per million and 8.72% carbon monoxide. Thus, the test results conducted for the LPG fuel failed since the standard emission is 50 –

750 ppm hydrocarbon and 0.2 – 2.0% carbon monoxide.

In the gasoline fuel, the hydrocarbon is 1517 parts per million and 0.22% carbon monoxide. Thus, the test results conducted for the gasoline fuel also failed since the standard emission is 450 ppm hydrocarbon and 2.50% carbon monoxide.

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