

# **PERFORMANCE OF ACETYLENE IN MARINE DIESEL ENGINES**

This paper deals with the use of **Acetylene** as a **Marine fuel**. Thus the work or experiment is performed on Acetylene with Diesel on both two stroke and four stroke engines.

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## **Abstract:**

The present energy scenario is undergoing a period of transition as the inevitability of depletion of fossil fuels is understood by more and more users. Researchers all over the world focus attention on development of various alternative fuels including renewable resources and blending of renewable resources. These include biogas, producer gas, methanol, ethanol, vegetable oils, LPG, CNG and etc. Here we are concentrating on the use of acetylene on marine engines which will lead to increase in Mechanical efficiency, Brake thermal efficiency, effectiveness and increase in performance level of the marine diesel engines. Here when a mixture of acetylene and diesel is injected together it can create an innovation in the world of marine engines.

## **Keywords:**

Introduction

Requirements of Alternate Fuels

Why acetylene? Properties of acetylene as a fuel mixture.

Procedure for conducting the experiment and how is it used.

Storage, safety on board and Conclusion

## **Introduction:**

- In today's modern world, energy has assumed a pivotal role and has become inevitable in the field of transportation, industry, agricultural and domestic applications.
- Petroleum fuels derived from crude oil, mainly petrol and diesel are the main sources of energy for all these applications.
- The demand for diesel is increasing day by day in transportation sectors.
- The present energy scenario is undergoing a period of transition as the inevitability of depletion of fossil fuels is understood by more and more energy users.
- Researchers all over the world focus attention on development of various alternative fuels including renewable resources and blending of renewable resources.
- In today's commercially available diesel engines, the thermal efficiency of the existing diesel engines can be increased by using other fuels. One of the best propositions is a dual fuel engine with low cost, highly knock resistant and clean burning characteristics.

## **Requirements of Alternative Fuels:**

- In abundant supply or preferably derived from a continuously renewable source.
- At competitive price and compatibility.
- They should permit easy transportation.
- They should give good safety.
- They should have high energy content.
- Alternative fuels should be able to be used in existing engines without any major modifications.

**ACETYLENE provides the opportunity as an alternative fuel.**

### **Why Acetylene:-**

- Does not pre-ignite easily because of higher ignition temperature.
- It gives better manifold distribution and mixes easily with air.
- Crankcase oil dilution is very less resulting in increased engine life.
- Residue and oil contamination is less as it burns cleanly.
- Pollution is less, as the percentage of CO may be much lower than ordinary engines.
- Its calorific value is more than that of diesel and gasoline and much more than alcohols.

### **FEASIBILITY OF ACETYLENE AS A FUEL:**

- The advantage of the gaseous fuel is its ability to run lean because of better fuel distribution.
- This characteristic also holds true during cold starting and hence eliminates cold enrichment.
- As a result the hydrocarbons and monoxide emission levels of gaseous fuel engines are significantly lower than that of liquid fuels.
- It burns more cleanly than liquid fuels, this leads to less crankcase contamination and comparatively less wear and tear of piston rings and liner.
- It is high resistant to knocking, this allows it to be used at a higher compression ratio.
- The cost at present, acetylene is more or less equal to that of diesel.

### **Procedure for conducting the experiment**

Precautions before starting the experiment:

- Check the availability of engine cooling water.
- Check the valve of acetylene cylinder to be closed.
- Open the valve of the engine jacket cooling water.
- See that there is no load on the engine while starting.

- Keep the mass flow rate of cooling water constant throughout the experiment
- See that there is sufficient diesel in diesel tank.

#### For diesel engine:

Open the fuel valve and start the engine by cranking and applying the decompression lever. Allow the engine to run for some time. Check the speed of the engine to ensure whether the engine is running in rated speed or not. Note down for no load, the time taken for 10cc consumption for the burette, the manometer reading's of air and exhaust gas temperature .also note down the inlet and outlet temp of the engine cooling water. Then by applying load of 2.5kgf, for short moment the speed decreases. This will be compensated by supplying more fuel with the help of governor. The time taken for 10cc fuel consumption and respective temp are noted down. The above procedure is repeated in step of loading like 6, 8, 10, 12 kgf. The readings are entered in the tabular column. After applying maximum load all readings are noted down. Then load on engines stopped and also the supply of fuel.

#### For dual fuel engine:

- Open the fuel valve and start the engine by cranking and applying the decompression lever. Allow the engine to run for some time. Check the speed of the engine to ensure whether the engine is running in rated speed or not. Note down for no load, the time taken for 10cc consumption for the burette, the manometer reading's of air and exhaust gas temperature. Also note down the inlet and outlet temp of the engine cooling water. Then by opening the acetylene cylinder valve gradually acetylene is allowed to pass through the orifice meter and then into the inlet manifold of the engine. It is so adjusted that the manometer connected in the orifice meter shows the difference of 10mm. then the speed of the engine increases, this will be brought back to the rated speed with the help of governor. Apply the load of 2.5 kgf and allow the engine to run for some time. Then supply of acetylene is constant throughout the experiment. Readings are noted and above procedure is repeated in steps of loading 2, 4, 6...12 kgf and the readings of all the parameters are noted in tabular column. The load is gradually removed and the engine is stopped and also the fuel supply.

#### **Engine Specification:**

Engine: 4 stroke, vertical single cylinder, fixed compression, constant speed, water cooled diesel engine

- Bore : 80mm
- Stroke : 110mm
- Rated speed : 1500rpm
- Fuel injection timing : 27BTDC
- Fuel injection pressure : 100bar
- Injection type : MICO BOSCH make
- Compression ratio : 17:1
- Combustion system : Open chamber
- Fuel injection nozzle : 3 hole type
- Fuel pump system : Ruston 1 HR engine

### **Storing:**

An acetylene cylinder should be protected by pressure release devices, which normally consists of a fusible plug located at the bottom of the cylinder. It should not be combined with any object that contains more than 70% copper as a highly explosive compound is formed. Nor, should it be stored or used at pressures greater than 15 psi, though some of the cylinder pressures are rated for 250 psi but this is acceptable only when the gas is dissolved in acetone.

Several other guidelines that should be followed while storing Acetylene are:-

- Always use cylinder manufactured from steel and wrought iron; avoid copper, silver and mercury, as explosive acetylides can be formed on copper and aluminum bronze.
- These cylinders should always be chained when either in use or in storage.
- Never store acetylene, within 25 feet of oxygen cylinders.

- Do not place acetylene cylinders near furnaces, boilers or other sources of high temperature.
- Take care whether the gas system is suitable for the pressure rating and the hoses are connected without any leaks.
- Acetylene cylinders should be stored in a designated storage area, which is dry, well ventilated and protected from the elements, heat and flammables.
- Sparks and flame should be kept away from acetylene gas cylinders.
- Never attempt to transfer acetylene from one cylinder to another or to mix any other gas with it in the cylinder.
- Acetylene gas is lighter than air so any gas leakage could rise. However, certain atmospheric conditions can prevent this.
- Do not use a partly discharged acetylene cylinder to supply a large welding or heating tip for outdoor work in very cold weather.
- Always cap and secure stored cylinders upright to prevent them from falling over and damaging the valve or cylinder.
- After use of acetylene welding or burning gear, cylinder valves must be closed and the gas lines purged, regulators removed and all equipment stored in a safe place.

**Safety:**

Storage Temperatures: 40°C Minimum.

- It does not pre ignite easily because of higher ignition temperature
- Considering the normal temperature and surrounding environment in E/R which is approx 45 degrees max. We can safely store the acetylene in the CO2 chamber where fixed CO2 bottles are kept to be used during fire fighting
- Hence for storage it must be pressurized and stored in special storage cylinders.
- These cylinders are filled with absorbent material like diatomaceous earth and a very small amount of acetone.
- Thus when stored in cylinders it is pumped into the cylinders at a pressure of about 300 psi, where it is dissolved in acetone.
- Once dissolved it loses its explosive capability making it safer.
- When cylinder valve is opened the pressure drop causes acetylene to vaporize into gas again and flow to the manifold.
- Acetylene is not toxic.

## Connection Diagram



### INDEX:

- Test engine
- Fuel tank
- Fuel metering device
- Diesel injector
- Air filter
- Air flow meter
- Gas mixer
- Orifice meter
- Acetylene cylinder
- Manometer
- Temperature meter 1
- Temperature meter 2
- Exhaust

### TEST RESULTS FOR SPECIFIED ENGINE:

<b>Parameters</b>	<b>TEST 1</b> Acetylene at 0 mm	<b>TEST 2</b> Acetylene at 10 mm	<b>TEST 3</b> Acetylene at 15 mm
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Brake Power in KW	2.0999	2.1732	2.2339
Indicated power in KW	4.423	4.0064	4.0339
Fuel power in KW	2.3	2	1.8
Mechanical $\eta$ in %	44.605	48.998	52.21
Brake Thermal $\eta$ in %	28.32	23.78	27.068
Indicated $\eta$ in %	64.91	47.968	51.663
Volumetric $\eta$ in %	54.55	57.09	58.16
S.F.C Kg/kw-hr	0.29145	0.35055	0.29712

**TEST RESULTS AND CONCLUSIONS:**

- Acetylene can be used successfully in the existing diesel engines with very little modifications in the induction manifold.
- Acetylene combustion was comparatively better, with a considerable brake thermal efficiency and brake thermal efficiency is lower at low load and improves with the increase in load.
- Acetylene can replace diesel to a value of 50%.
- The thermal engines of dual-fuel engine can surpass that of diesel engine with advanced IT, induction manifold heating.
- Thermal efficiency increases with load for dual-fuel engine also.
- Drivability is smooth, at low gas supplies.
- Noise was considerably reduced due to smooth burning of gas.

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