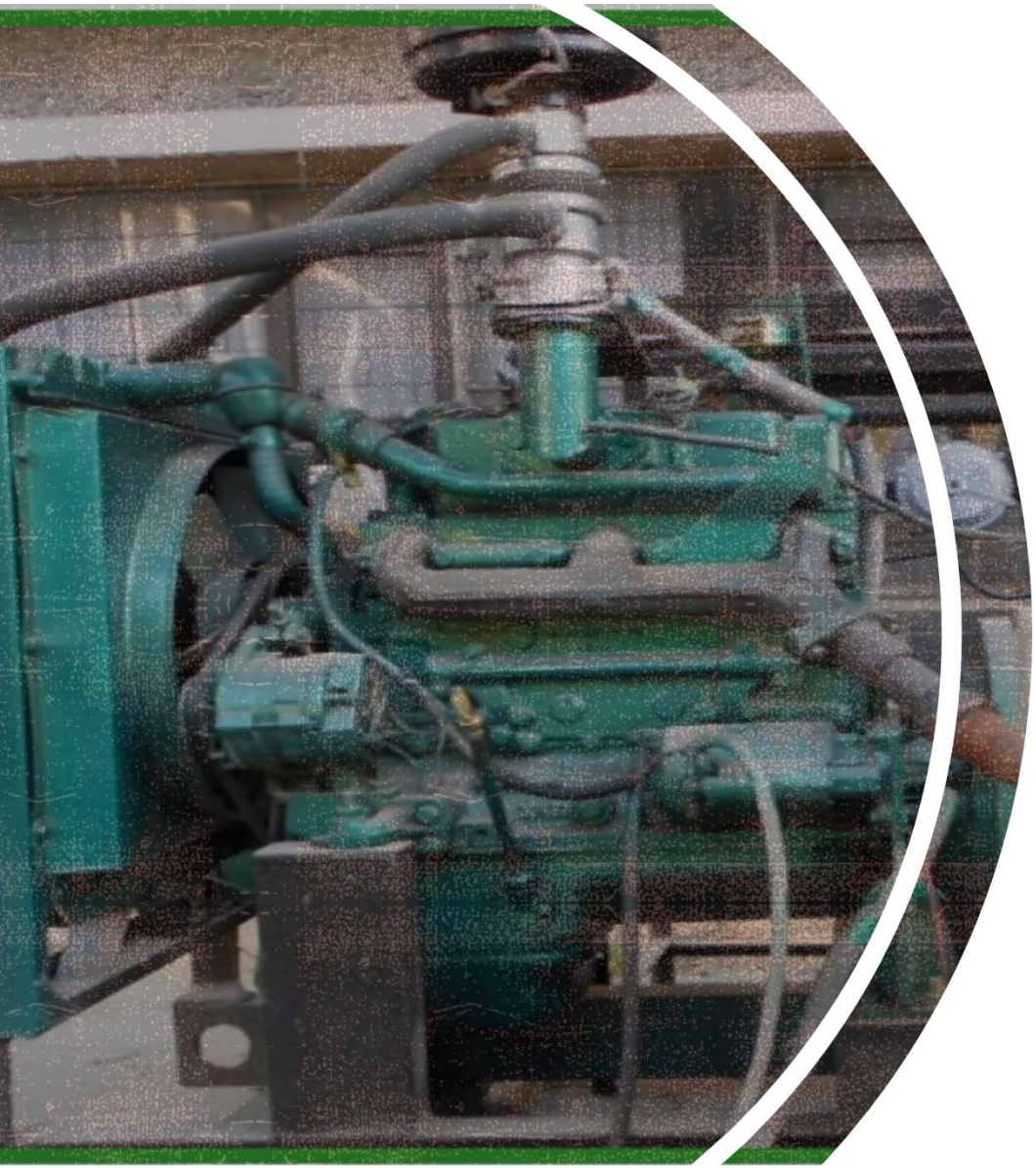

APL100 PROJECT:

BIOGAS CONVERSION KIT FOR DIESEL ENGINE

GROUP-38E

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MOTIVATION OF DESIGN

- Availability of substantial quantity of wet and dry biomass in rural areas
- Renewable Energy generated in form of biogas and biomanure (slurry)
- Improvement of rural sanitation
- Promotion of organic farming
- Prospering of rural economy, ecology as well as energy self-sufficiency
- Augment the entrepreneurial activity in rural population by value addition to agriculture

CONCEPT OF DESIGN

A diesel engine operates on the **principle of compression ignition** of the diesel fuel. It has relatively higher compression ratio (around 15-22) and a heterogeneous mode of combustion. It also uses a fuel injection system which injects the liquid fuel into the engine cylinder at very high pressure towards the end of compression stroke. For gaseous fuels, the air and fuel are homogeneously mixed in an appropriate ratio and then inducted into the engine cylinder. Towards the end of compression, a spark is applied to initiate the ignition of the compressed charge. The air-fuel mixture is throttled to control the power output. In the case of biogas which contains methane as the fuel element, the self-ignition temperature is quite high and much higher compression ratios can be used, which leads to improved efficiency.

SIMILAR DESIGNS

125 KVA Koel Biogas Generator

- Product Price: Rs 20 Lakh/unit
- Power: 125 KVA
- Voltage: 480V AC
- Power Factor: 0.8 lagging
- Noise level: 86 DBA

The biogas is converted to mechanical energy through an internal combustion engine. The mechanical energy then rotates an electric generator to produce electricity.

SIMILAR DESIGNS

ESB-RBG15 - 15KVA Biogas Generator Set

Price: Rs 2,80,000/unit

Basic steps involved:

- Feedstock Preparation
- Gasification Reactor
- Cooling and Cleaning System

1KG of wood with **15%** moisture when passed through gasifier, generates **2.3 M^3** Producer Gas. Now, when this is passed through cooling & cleaning system, gas generator set, **0.76KW** renewable energy is obtained.

COMPARISON WITH SIMILAR DESIGNS

Electronic vs Mechanical Governor

Advantages of ELECTRONIC GOVERNORS

- Fast, no-droop response to load changes
- Isochronous speed control for gensets
- Easy change of governor properties through the set parameters
- Protection to prevent wrong or mis-settings

Cost

The cost of kit is estimated to be around Rs 2.5lakh/unit which is less than similar designs

Noise level

Optimum noise level is 60-70 DBA. Noise level of the converted biogas engine lies in this range and is lesser than that compared to similar designs.

*highlighted information correspond to our design of study

NOVEL DESIGN IMPROVEMENT SUGGESTIONS

- **Compression-Ratio:** The relatively low compression ratios result in a higher fuel consumption of natural gas. Hence, modifications to the ignition system are required so that compression ratio is levelled, and power output is higher.
- **Separating mixture components:** Using fractional distillation, we can segregate biogas into components to improve efficiency as different gases burn at different ignition temperatures.
- **Combined Heat and Power (CHP) Systems:** Using Biogas engines in CHP systems to maximize efficiency by utilizing waste heat for other applications.
- **Gas Cleaning:** Ensuring the biogas is well-cleaned and free from impurities like Hydrogen Sulfide and moisture, we prevent engine damage and increase efficiency.

COMPREHENSIVE LITERATURE REVIEW

- **Engine Modification Techniques:** Changing fuel injection systems, adjusting compression ratios, and optimizing ignition timing to adapt diesel engines to biogas use.
- **Performance and Efficiency:** Impact of biogas conversion on engine performance, including power output, thermal efficiency, and emissions to explore the trade-offs between power and efficiency.
- **Emissions Reduction:** Emphasis on the environmental benefits of using biogas, including reduced CO2, NOx, and particulate matter emissions when compared to traditional diesel fuel resulting in improved local air quality.
- **Cost-Benefit Analysis:** To determine the economic viability of converting diesel engines to biogas. This includes assessing initial conversion costs, ongoing operational expenses, and potential savings or revenue generation.