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Hypothesis on Using Biogas and Hydrogen obtained from waste biomass and waste water in HCCI engine

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Abstract— Automatic sweeper under the vehicle automatically sweeps the waste from road and collects it to container at the rear side though a blower From where, the waste is separated into 2 chambers: 1 for fermentation, where organic and inorganic biomass is separated though screening, and organic biomass are converted into fertilizer, whereas the inorganic waste are sent to recycling centre. The 2nd chamber is anaerobic digester where already used biomass stimulates the production of biogas within 6 hours. The waste water photo catalytic action stimulates the production of hydrogen from organic compounds from waste water. When combined at correct proportions (biogas large proportion) when fuelled will give better efficiency in HCCI engine.

Keywords—screening, photo catalytic action, fermentation, biomass, anaerobic digester, homogenous charge compression ignition (HCCI)

I. INTRODUCTION

India is poor in keeping their environment clean. Roads are filled with waste like mud, biomass (food waste),paper, plastic, cloth, etc. There should be some advanced techniques to be optimized but its very costly for developing countries like us.So a optimum technique of automatically sweeping the waste and creating biogas and hydrogen from waste organic compounds in water using photo catalytic effect. The exhaust gases especially NOx, SOx, can be neutralized using the coating made of tio02+ grapheneoxide, when stimulated by UV light. The concept of waste treatment biogas project in koyambedu is producing electricity which is good. But what about the road waste present. With this method, we can reduce both mixed waste (organic inorganic) especially in the roadside of India and the main aim is to reduce waste and creating any useful things out of it. Biogas alone was tried but it didn't give enough output and the retention time is also troublesome. Biogas is a clean fuel, when combined with diesel, it gives almost same efficiency but the hydrogen addition improves combustion stability, improves thermal efficiency, and decreases CO emissions.

Researches about biogas and its use for generation of heat, electricity generation has increased in the last decades.Engines especially for biogas is not economical and not commercially available for powers less than 100kw.10% hydrogen was found to be best suitable and even in homogenous charge combustion engines too, They find good application in the future, higher hydrogen needs the ignition timing to be retarded or else knocking will be significant due to the rise in pressure and so the peak pressures and high heat release rate was found to be reduced when blended with excess hydrogen and CO_2 in biogas are found and increased burning velocity. The cylinder pressure at full load with 10%hydrogen reduces CO emissions and gives good pressure peak than at part load of 40%.

II. EXPERIMETAL DEVELOPMENT

A. Setup

There is a sweeper brush at the bottom of the vehicle with motor 1 h.p. which is in turn split into 2 pipes. At the beginning of it,there is a shredder blade setup, which intern connected to 2 pipes, where 1 is for mixed waste treatment(fermentation),and another chamber is anaerobic digester. The hydrogen production unit is on the top side of the vehicle. From both anaerobic digester and hydrogen chamber, there is a common pipe connecting both and are mixed in correct proportions of 50%diesel and 40%biogas and 10%hydrogen.the biogas is enteresd into water chamber where co2 is somewhat removes and h2s scrapping is done through rusting nails.

Total setup line diagram is shown in Fig.1

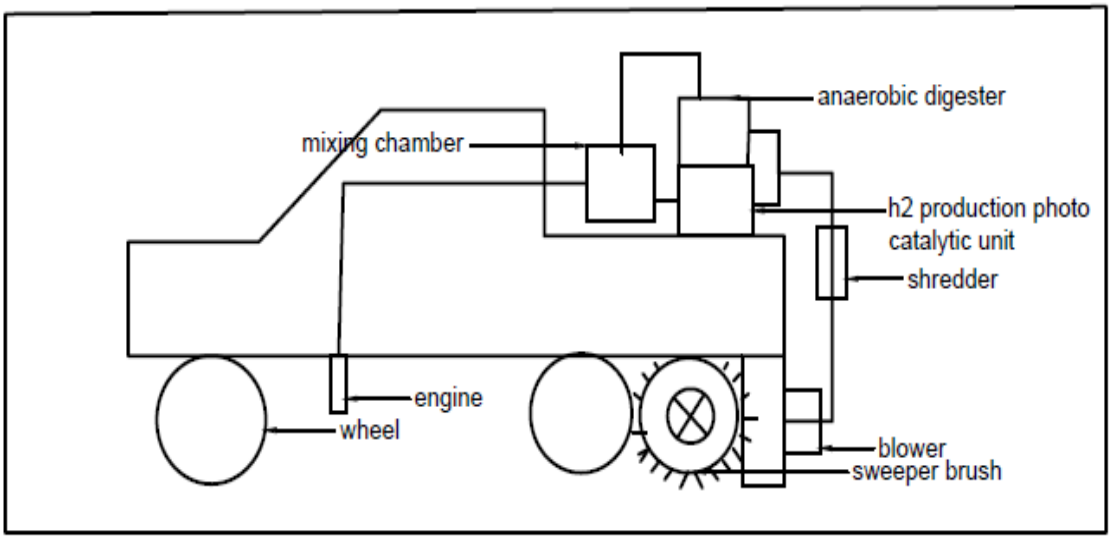


Fig.1.shows line diagram of total setup.

B. Working

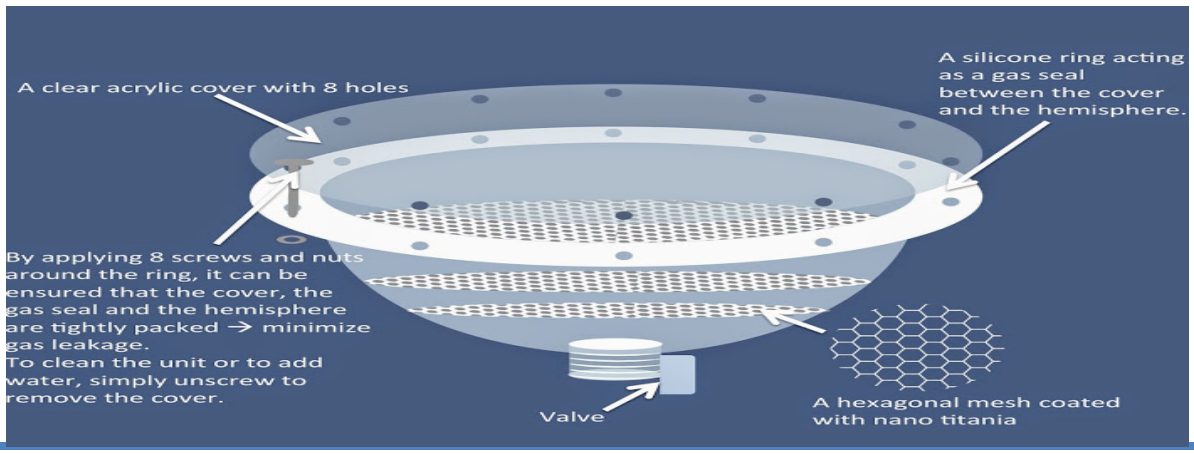
The biogas is produced by anaerobic digestion of organic waste which is collected through sweeper brush at 500 rpm .and shredding it stimulates the retention time and fermentation chamber screened inorganic waste is sent to recycling centre, where biogas produced is scrapped to reduce Co2 and H2s.The Co2 is used to control high heat release rate and so the durability of components is improved. So some Co2 is kept in the stream. The hydrogen production unit consists of a hexagonal mesh(cloth) coated with TiO2 and grapheme oxide, which when kept in sunlight for 2 hrs produce hydrogen, which is stored in container of Fe coated, which reduces it to water and hence can be stored in more amount. The biogas produced is stored in 3 stage compressor at about 100 bar, which changes it to liquid and moreover as the density of biogas is 1.2 kg/m^3,it requires a large volume than to store in compressed form. At the mixing chamber,H_2 is at 10%,with almost equal proportions of homogenous charge ignition engine, with pure 90% methane. At full load, engine gives good efficiency in thermal and all brake effective pressures.

C. Components

Engine*:* Biogas in HCCI(homogenous charge Compression Ignition),the CO_2 reduces high heat release rate and reduced smoke,NOx and hydrocarbon emission, producing high thermal efficiency. With biogas, CO emission, a product of incomplete combustion due to inadequate air, is reduced when compared with that of gasoline.

1) Engine: Biogas in HCCI(homogenous charge Compression Ignition),the CO_2 reduces high heat release rate and reduced smoke, NOx and hydrocarbon emission, producing high thermal efficiency. With biogas, CO emission, a product of incomplete combustion due to inadequate air, is reduced when compared with that of gasoline.

2) *H_2 production photo catalytic unit:* There is a hexagonal mesh coated with a composite solution of TiO_2-



GrapheneOxide(TiO_2 should not be dominant),is placed in a glass container and top was closed by a acrylic cover with bolts, from where a Fe coated container, where in the liquid phase, it is stored and the design of container with mesh is shown in fig.2.It shows the photo catalytic setup with hexagonal mesh coated with Graphene oxide+TiO_2

3) *Photo catalytic mechanism:* The coating of graphene oxide+TiO_2 was used but previously good H_2 production is not achieved. So grapheme is placed as it has unique electron transport properties, which allow it to stop electrons recombining with the TiO_2 surface. But unfortunately it is insoluble in water, so Graphene Oxide is used as a precursor to Graphene. Graphene oxide is soluble as the introduced oxygen molecules induce hydrogen bonding. Graphene is also been proven to protect against radical attack, helping to combat binder degradation and promoting external radical production. Thus is has a potential to be used as paint which removes pollutants(air) and so in our setup it promotes organic compounds present in water to hydrogen efficiently

4) The photo catalytic mechanism is shown below in fig.2

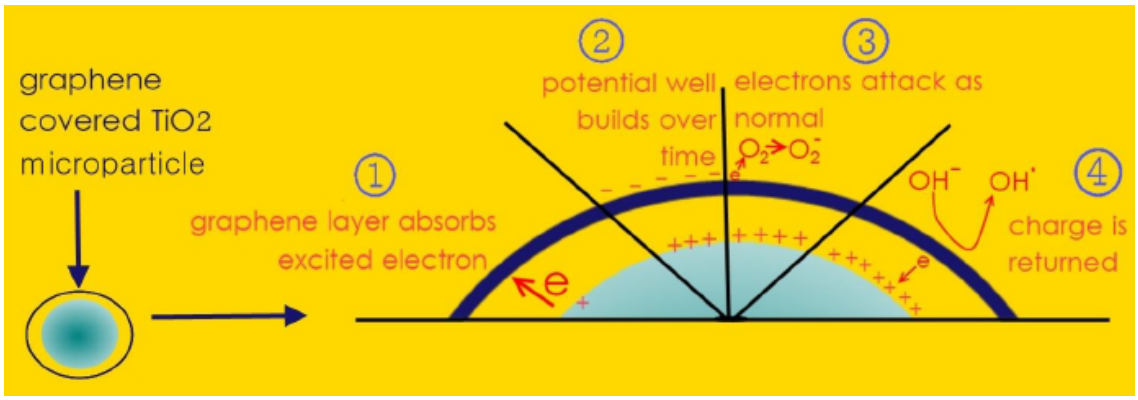


Fig.3. shows how graphene involved effectively in photocatalytic effect in H_2 production.

5) Shredder: In the case of anerobic digester, the waste cowdung or pig manure is already present in the inoculum, and the retention time is reduced in the 2nd time,the biogas is compressed to about 100 bar through 3 stage compressor, which makes easy recycling along with collecctd waste though sweeper brush. In case of inorganic waste, it can be screened and sent to fermentation chamber, where organic waste is converted into fertilizer, the shredding mechanism speeds the hysrolysis and so the retention time. The shredder design can be shown below in fig.4.

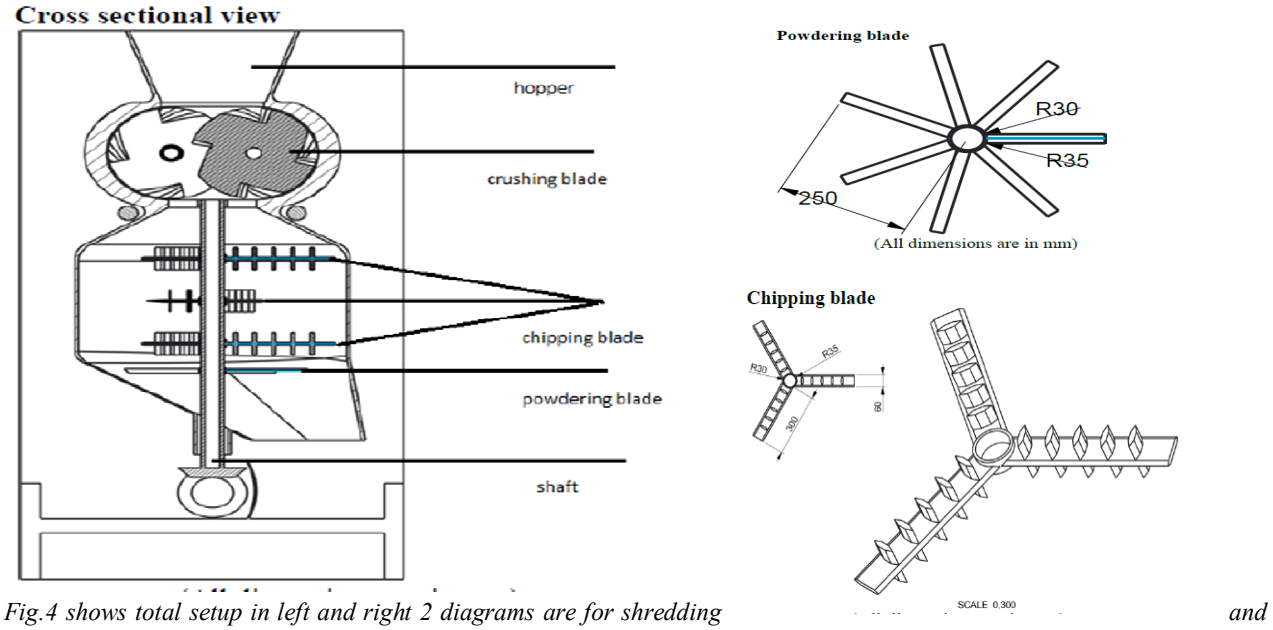


Fig.4 shows total setup in left and right 2 diagrams are for shredding and powdering purposes in the main setup.

6) *Mixing chamber:* Here the H_2 is mixed at 10% on an average and 40%biogas with 50% diesel as a pilot one.If H_2 is sent more than 20%,then ignition timing is altered,and knocking phenomenon is dominated and from where it is sent to HCCI engine.

III.CONCLUSIONS

Thus the efficiency of engine can be increased using this concept and to Nox,HC,CO emissions are reduced when compared to conventional diesel engine. But SOx can be reduced using same photo catalytic coating in the silencer and in the future we are working on it.Hence this concept will not only clean the environment by automatically collecting but the highlight is to be used as biofuel with slight modification in conventional CI engines, which makes it a optimum process, while moving in a vehicle.

IV.ACKNOWLEDGMENT

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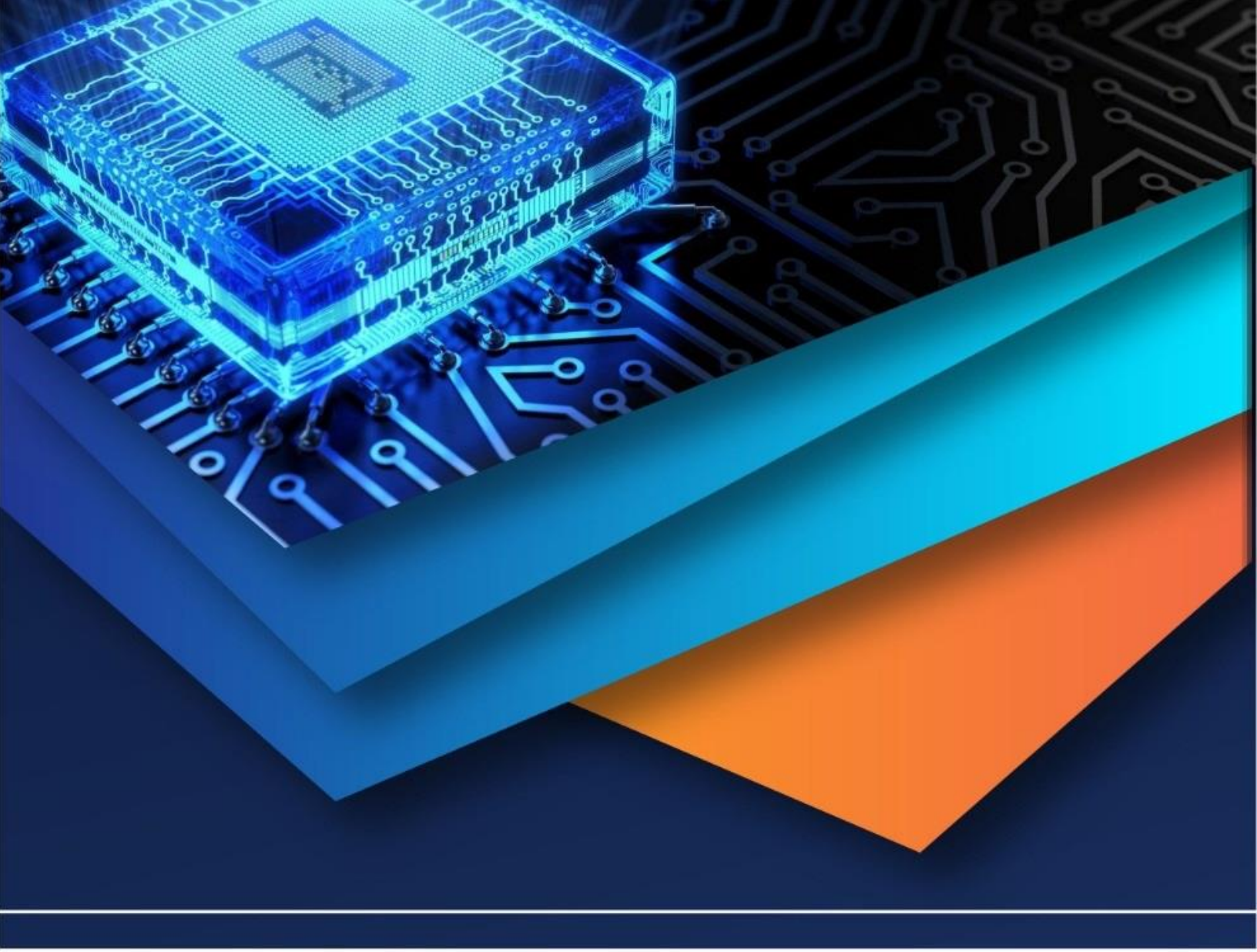

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