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## Bio-CNG, the Promising Biofuel – Minireview.

Aparna Gunjal<sup>1\*</sup>, Sonali Bhosale<sup>1</sup>, and Shital Kadam<sup>2</sup>.

<sup>1</sup>Department of Environmental Sciences, Dr. D. Y. Patil, Arts, Commerce & Science College, Pimpri, Pune - 411018, Maharashtra, India.

<sup>1</sup>Department of Botany, Dr. D. Y. Patil, Arts, Commerce & Science College, Pimpri, Pune - 411018, Maharashtra, India.

### ABSTRACT

The non-renewable resources are very costly and cause pollution. The alternate to this is biofuels which are eco-friendly and economical. The Bio-CNG is one of the important biofuels which has many applications. Bio-CNG can be used in cooking and vehicles as fuel. The review here focuses on Bio-CNG which describes feed stocks, production and market for Bio-CNG. The upgrading of biogas which is further converted to Bio-CNG is also mentioned in the review. The review on Bio-CNG also mentions the recent initiatives regarding biofuels.

**Keywords:** Biological, environment, microorganisms, sustainable

*\*Corresponding author*

## Problems with Non-renewable Resources

The problems with non-renewable resources are they are very less and also cause pollution. The non-renewable resources such as petrol and diesel for running of the vehicles are now limited [1]. Hence, renewable resources such as biofuels will be easy to use and will be a solution for the non-renewable resources. The advantages of biofuels are they are eco-friendly and renewable.

## Biofuels and their Types

Biofuels are the liquid fuels usually made from plant or animal wastes [1]. The types of biofuels include bioalcohol, biodiesel, biogas, vegetable oil and Bio-CNG (Fig. 1).

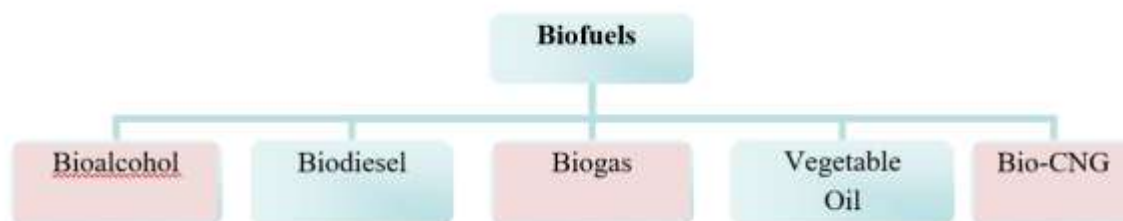


Figure 1: Types of biofuels

## Classification of Biofuels

There are three generations of biofuels (Fig. 2). The first generation includes sugar, starch and vegetable oil. The second generation of biofuels include lignocellulose materials such as sawdust, rice husk and wheat straw [2], and the third generation include extract from algae. The crops for production of biofuels are sugar beet, sweet sorghum, *Miscanthus*, corn stover, Poplar, mustard, *Camelina*, *Jatropha*, soybeans and grass.

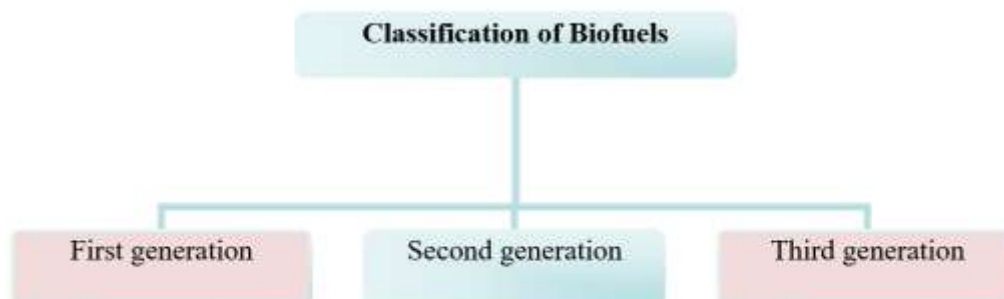


Figure 2: Classification of biofuels.

## Microorganisms in Anaerobic Digestion

The microorganisms involved in anaerobic digestion for biogas production include methanogens which belong to the genus *Methanobacterium*, *Methanobrevibacter*, *Methanococcus*, *Methanoculleus*, *Methanosaeta*, *Methanomicrobium*, *Methanosarcina*, *Methanospirillum*, *Methanothermobacter*, *Methanosarcina*, *Methanocaldococcus* and *Methanopyrus*. These methanogens are the main group of microorganisms which play a very important role in anaerobic digestion process.

## Feed stocks for Biogas Generation

The feed stocks for biogas production are animal manure (e.g., poultry dropping, cattle manure), kitchen waste (e.g., food waste, raw fruits and vegetable waste) and agriculture waste (e.g. rice straw). Napier grass also called as elephant grass is the best feedstock for Bio-CNG production. Napier grass has immense potential of bioenergy [3]. The calorific value of Napier grass is 3850 kcal/kg, which makes it great bioenergy source. The biomass yield of Napier grass is high which makes it as a good biomass and

important crop for agriculture. Napier grass can produce 80 tons of dry matter per hectare annually and hence can be used as feedstock for Bio-CNG production. This ensures steady feedstock for Bio-CNG production. The use of Napier grass reduces greenhouse gas emissions and also helps in reduction of wastes.

### Removal of Hydrogen sulphide from Biogas

The composition of biogas is represented in Table 1. The biogas contains traces of hydrogen sulphide ( $H_2S$ ). This makes biogas not high quality and therefore  $H_2S$  needs to be removed by the use of scrubbers.

The upgrading of biogas for Bio-CNG production needs to be done by removal of  $H_2S$  [4]. Sulphur present in traces is also removed with the use of wet scrubbers.  $CO_2$  present in Bio-CNG is also removed by wet scrubbers [4]. The other technologies for  $CO_2$  removal are adsorption, absorption and membrane separation (Fig. 3).



**Figure 3: Technologies for  $CO_2$  removal**

**Table 1: Composition of biogas**

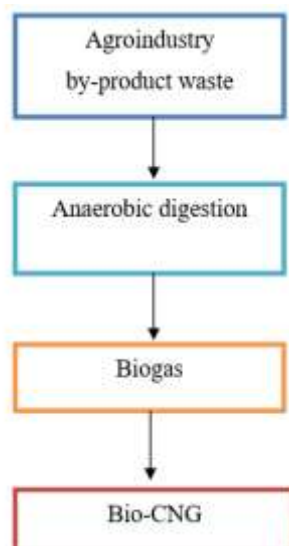
| Contents                     | %     |
|------------------------------|-------|
| Methane ( $CH_4$ )           | 50-70 |
| Carbon dioxide ( $CO_2$ )    | 25-50 |
| Hydrogen sulphide ( $H_2S$ ) | 0-3   |
| Hydrogen ( $H_2$ )           | 0-1   |
| Nitrogen ( $N_2$ )           | 0-10  |

### Bio-CNG

Bio-CNG is renewable fuel produced by anaerobic digestion using various organic wastes. The production of Bio-CNG is sustainable and easy. This is the best alternative to the fossil fuels. Bio-CNG is gaining wide importance now and has many industrial applications. Bio-CNG is also known as biomethane. This fuel can be used widely for cooking purposes which is economical and clean compared to liquefied petroleum gas (LPG). Bio-CNG is used in automobiles and for electricity generation. Bio-CNG contains  $CH_4$  (98%) and  $CO_2$  (2%). Bio-CNG in India is a sustainable energy production offering environment benefits such as reduced greenhouse gas emissions, alternate to fossil fuels, etc. The Government has adopted new schemes and plans for promotion of Bio-CNG. Bio-CNG serves as good source of energy.

### Production of Bio-CNG

The production of Bio-CNG is represented in Fig. 4. There is a report on production of Bio-CNG using locally available biomass [5].



**Figure 4: Production of Bio-CNG**

### Recent Initiatives Regarding Biofuels

Following initiatives regarding biofuels are taken.

- ❖ The Department of Biotechnology (DBT), Ministry of Science and Technology has developed 2G Ethanol.
- ❖ The Government has transferred 2G ethanol technology to Oil Marketing Companies (OMCs).
- ❖ Have initiated micro algae based technology for the treatment of sewage.
- ❖ The Government has started programs e. g., Mission Innovation; Bio future Platform.
- ❖ Pradhan Mantri JI-VAN Yojana, 2019:  
Research in 2G Ethanol sector
- ❖ Ethanol blending:  
The Centre plans to move with ethanol blending target of 20% of petrol containing ethanol by 2025-26.
- ❖ GOBAR (Galvanizing Organic Bio-Agro Resources) DHAN scheme, 2018:  
To convert wastes into compost, biogas, Bio-CNG, etc. It was launched under Swachh Bharat Mission.

### Bio-CNG Market in India

The market for Bio-CNG is gaining importance and will increase more in the coming years. The market for Bio-CNG in 2016 in USA was \$4.1 billion USD and is expected to increase to \$ 9.0 billion USD in 2025. The global market for Bio-CNG is now increasing in large-scale [6].

### Bio-CNG at Mahindra World City, Chennai, India: A Case Study

At Mahindra World City, Chennai about 10 tons of food wastes are generated which produces 1000 cm<sup>3</sup> biogas and 4.0 tons of by-products. The by-product can be used as fertilizer for different plants and crops. This biogas produced is further converted to 400 kg Bio-CNG which is used as fuel in buses by Mahindra Tourister bus which can cover 2800 km distance.

### Applications of Bio-CNG

Bio-CNG can be used as fuel in vehicles and cooking purposes. There is a report on Camden, UK, where Bio-CNG has been as better fuel for vehicles in comparison to conventional CNG. This also shows Bio-CNG can be used instead of conventional CNG in vehicles (Ministry of Petroleum and Natural Gas [7].

## CONCLUSION

Bio-CNG will be eco-friendly and economical biofuels with many applications. This will be alternate to non-renewable resources as fuels. The Bio-CNG is gaining immense importance and the Government is trying to implement the use of this Bio-CNG more in the future. More research needs to be done to increase the production of Bio-CNG and to install more plants of Bio-CNG.

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