

ENERGY FROM INDUSTRIAL WASTE AS A SUBSTITUTE FOR FUEL & UTILIZATION OF POLLUTANT CO₂ PRODUCED FOR ALGAE FORMATION

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ABSTRACT

Industrial based research project using different types of solid/liquid waste for energy generation and replacing conventional fuel-coal partially by solid/liquid waste has been investigated. Pollutant produced CO₂ during combustion of solid/liquid waste can be utilized conveniently for algae cultivation. Further algae so cultivated can be converted into energy either in the form of carbohydrates or lipids. This can be further converted into bio-fuels like bio-ethanol and bio-diesel. All these aspects have been analyzed critically in this paper for typical Cement Manufacturing Unit wherein fuel utilized-coal has been partially substituted by solid/liquid waste.

Further, use of hydrogen as a fuel-an alternative clean fuel of tomorrow has also been highlighted in this research project.

INTRODUCTION

The three primary sources which accounts for major portion of the energy needs are: Coal, Oil and Natural gas, which are considered as conventional energy sources. These sources are depleting at faster rate. Hence, non-conventional energy sources needs to be considered on large scale.

The stress in this industrial based research project has been given on utilization of different type of waste (Tar, Sugarcane, Baggase, Dry Sugarcane leaves, Cotton stalk, Coconut leaves, Groundnut husk, Mango seeds, plastic waste, Paper mill waste, liquid waste from Pharma company), as a source of energy which has been utilized by a Cement Manufacturing Industry during clinker formation.

Utilization of such waste by combustion produces large amount of CO₂ which has to be utilized effectively. If this process modification is not implemented, it will create severe CO₂ pollution problem and the use of solid waste in this manner will be highly objectionable by Pollution Control Board.

Hence, a novel approach has been suggested in this industrial based research project as under:- CO₂ sequestration has to be done and CO₂ thus stored can be utilized effectively for cultivation of algae which in turn can be converted to bio-fuels.

It has been observed that algae growth obtained in a Photo Bio-Reactor (PBR) is about double than the conventional open system.

PLASTIC WASTE AND TDI TAR UTILIZATION PROJECT:

GPCB has granted special authorization for the receipt, storage and disposal of the plastic waste and TDI Tar waste using as Alternative Fuel Resource (AFR) in Cement Kiln.

Results and Data obtained in this regard are very interesting. Other cement companies should follow the footsteps of this cement company in this regard.

TDI Tar is the process residue of TDI which they are sourcing from GNFC, Bharuch. Sugarcane Baggase, Dry Sugarcane leaves, Cotton stalk, Coconut leaves, Groundnut husk and Mango seeds are the agri. Biomass which they are sourcing from the surrounding areas near their production unit. Plastic waste is a waste from various paper industries of members of Gujarat Paper Mill Association (GPMA), Vapi and members of Morbi Paper Mill Association (MPMA), Morbi. The RDF is a residue derived fuel from municipal solid waste sourcing from UPL DJAI Power, Ahmedabad. Liquid waste mix is a blend of liquid waste from Pharma Company.

They have developed different feeding systems to feed solid and liquid AFR.

At present they are charging AFR at the rate of 2 TPH. They are gradually increasing feed material as per our requirement and in future the feeding rate will be increased up to 6 TPH.

Solid AFR like sugarcane, baggase, plastic waste, dry sugarcane leaves, cotton stalk, coconut leaves, groundnut husk, RDF and mango seeds are charged through crew conveyor to precalciner while TDI Tar & Spent carbon is blended with coal.

The liquid waste mix is stored in the storage tanks located at Liquid AFR yard and pumped to kilns directly.

ALGAE PROJECT BY ONE OF CEMENT COMPANY: AN UNIQUE FEATURE:

Fossil fuel and its use since industrialization till present, has lead to pollution. Pollution has increased the concentration of green house gases (GHG) in the environment. These GHG in turn has led to the increase in temperature causing adverse effect on the environment and finally to animals and humans. Hence there is an immense need to find an alternative source of energy which is less polluting and renewable. One such source is light and its utilization by plants (such as algae) which can fix carbon dioxide from the atmosphere and convert it into energy, either in form of carbohydrates or lipids. This can be further utilized for conversion of carbohydrates and lipids to bio-fuels like bio-ethanol and biodiesel. These bio-fuels create less pollution and can be the alternative source for non renewable fuels (e.g. crude oil, petrol, diesel and coal).

Apart from bio-fuels algae can utilize carbon dioxide from the atmosphere and convert it into oxygen hence will reduce carbon dioxide levels in the atmosphere. Certain algae species are nutritious, commercially and medicinally important. Cultivation of such algae can also turn generate revenue along with carbon dioxide sequestration.

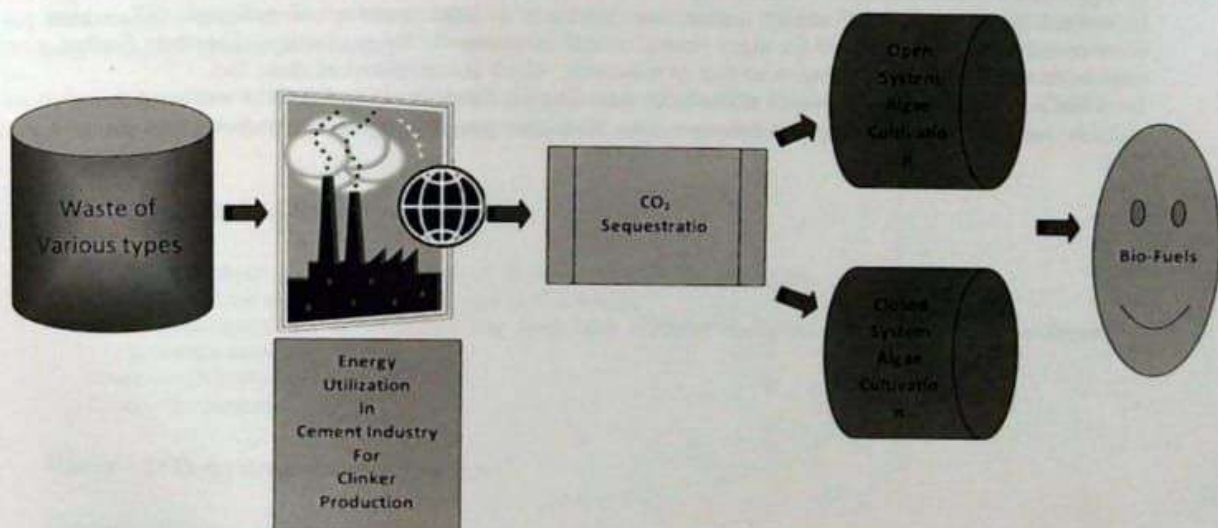
Thus, the objectives of this project are CO₂ sequestration and bio-fuel production.

They have thought to culture two different varieties of algae having different values. One algae species they have selected was spirulina which is having a great nutraceutical value with 50-65% of protein content and the other algal species they choose was oil bearing algae. They have started culturing them in the newly developed algae culture laboratory. They have also constructed racer ponds for mass cultivation of the algae. The total area of cultivation is 3450 sq. meters. The ponds are equipped with a paddle wheel as well as a pipe line which carries stack gases to the racer ponds. All these painstaking efforts of cement company needs to be encouraged.

PHOTO BIO-REACTOR (PBR):

To reduce the environmental factors and to have better yield, they have developed a closed culture system. The plan was implemented to develop a large aquarium type structure having all the sides of toughened glass and the bottom of vitrified tiles. The top of it is of transparent acrylic in order to pass the sunlight through it. It is having two submersible pumps to circulate water inside the tank in order to mix the nutrients in a homogeneous manner. It is also having an exhaust fan to maintain the temperature of the system. This structure can hold 10000 liters of the culture medium. In this kind of structure, the culture system is found fully illuminated with sunlight which is the most required thing for algae to grow. The implementation of this plan of PBR was completed in September 2012. The algal biomass from laboratory was transferred to the PBR as seeds and it is found that the growth obtained in this system was as per their expectations i.e. **double than the open system.**

A typical flow diagram for the formation of Bio-fuel by utilizing different type of solid/liquid waste is as under:



CONCLUDING REMARKS FOR ALGAE PROJECT & PBR PROJECT:

In total two years of time, they have spent about a year to construct the facilities while since last one year they are in to the actual process of R & D for cultivation of algae in mass. They have tried both, open as well as closed system to grow algae and it can be concluded that the closed system gives more significant results as per the environmental factors of this area. They have also completed the toxicological analysis of algae by third party services and it is found that the harvested algae are having good ingredients for the human consumption.

USE OF CNG AND HYDROGEN FROM WATER AS A GREEN FUEL & GREEN CAR

The potential of hydrogen from water and CNG as a green fuel are looked at inclination in Hybrid vehicles - New Concept: Vehicles run on highway with diesel engine and on battery inside the city. Hybrid vehicles are good for congested roads that are common in our country. But it is an emerging technology: Hybrid vehicle it is a battery operated and has diesel engine to charge the batteries. This technology presently is too costly. Every year a new fuel is being flaunted as the clean answer and the old one is decried. Developing country like India can't cope up with such a solution. Hence there has to be a basket of solutions. Thus need of the hour is - "Developing and sustaining clean fuel technology in India" and we need to have unbiased experts for the same. We can't write off diesel as a fuel. What we need is to research to render diesel less polluting. CNG Technology is ready and has matured as a "Cleaned Fuel".

BEST POSSIBLE ALTERNATIVE FOR CLEAN FUEL: ENERGY FROM HYDROGEN

Hydrogen happens to be the clean fuel of tomorrow. However, producing H_2 by electrolysis of water which is available in abundance is techno economically not a viable proposition. New Hydro Power Technology is likely to replace oil with water as a new fuel. In this technology hydrogen is likely to be extracted from water (H_2O) by extraction principles. Thus the new system based on advance Intel Enviro Technology is likely to open the way for new era of Cheap Pollution free fuel for everyone. It is estimated that a small family car will able to cover 80 miles on just 1 litre of water. The pure oxygen released as a by-product will automatically end particulate pollution in cities. Pollutant CO_2 will no longer be released. This "Technological Innovation" is not a dream. It is a reality. It is only question of time. How many years? Certainly not hundred years. Most possible predication is within 5-10 years. Thus, H_2O will become Super Fuel boss. As a result, CO_2 pollution due to automobiles will reduce practically to zero level.

SUMMARY

Solid/liquid hazardous waste produced in chemical industry has to be disposed off effectively to avoid environmental degradation; a novel way has been suggested in this research project by utilizing solid/liquid waste as a fuel and replacement for conventional coal. Energy liberated can be utilized conveniently and fuel consumption of coal can be decreased substantially. However, this technique of energy production produces a large quantity of pollutant CO_2 , which can be conveniently stored and utilized for algae formation and subsequently for production of biofuels. Further, it can be concluded that Hydrogen is going to be fuel of tomorrow, which is considered as clean fuel. Intel Enviro Technology is going to make head way wherein hydrogen is going to be extracted in ionic form by suitable solvent and combining two hydrogen ions Hydrogen gas is likely to be produced, which can be used as fuel.