

## **Design and Development of Moving Bed Continuous Down Draft Gasifier for Powdery Biomass and other Powdery Fuels – A promising technology for electrical power generation**

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Gasification, a thermochemical conversion of solid fuel, has proved to be an economically viable process in converting not-to-easy transport solid fuel in to easy-transport gaseous fuel. Down draft, updraft and cross draft are some of the types of gasifiers commonly used. Since these units are used as stand by, these gasifiers are mostly designed for batch operations. Biomass has proved to be the best alternate for energy source due to its renewable nature within a short period of time. Further no new carbon dioxide is emitted into the atmosphere while burning the biomass.

The interlocking forces between the solid particles results in arching thus preventing the free flow of powdery biomass. Therefore the biomass of large in size should be cut into chips or if powdery should be palletized so as to ensure free flow. However both operations consume considerable amount of energy reducing the net available energy.

Studies on the development of gasifier for powdery materials have been under taken in the present investigation. Several models were designed and tested for flow of powdery biomass such as rice husk, sawdust, deoiled rice brawn, coir pith and poultry litter. The proposed unit consists of a rotating arm to break arching at several places so as to ensure continuous feeding at any desired level and a rotating grid to remove the ash continuously.

Due to change in food habit in tropical countries, several poultry farms have come into existence resulting in generation of thousands of tons of poultry litter. The proximate analysis of poultry litter shows the presence of 46.35 % volatile matter, 7.05 % fixed carbon, 7.24 % moisture and 39.36 % ash on air-dried basis. While the ultimate analysis indicates 23.96 % carbon, 3.93 % hydrogen, 0.34 % sulfur and 0.26 % nitrogen. The ash fusion temperature is more than 1163° C, with initial deformation temperature around 1139° C.

Poultry litter has high calorific value of 9550 kJ/kg. It is not bulky and is available in both quality and quantity within a narrow area. Further seasonal variation will not affect the availability. The following factors heavily weighing in favor using poultry litter as fuel for power generation through gasification route.

- Gross Calorific Value is 9550 kJ/kg
- Each chick produces 1.0 W and there is potential for 800 MW power generation in India
- 8000 Tons of phosphatic fertilizer can be produced daily as a by product
- As there is no heavy metal contamination, the phosphate fertilizer can fetch much higher price
- No new CO<sub>2</sub> is emitted and the process is Eco-friendly & environmentally benign
- Each Poultry farm is a renewable coal mine
- Power generation through gasification is economical at all capacities

The flow and gasification characteristics of the poultry litter were investigated in the gasifier described earlier. It is observed that the gasifier has performed well at all flow rate conditions without any malfunctioning due to choking etc. An economic analysis indicated that 1.0 MW power plant break evens at plant load factor of 65 % which includes the cost of diesel for dual fuel mode operation. Application of gasifiers for fuel needs becomes more economically viable and environmentally desirable if along with gas, any other value added by-product is also obtained. In this respect, poultry litter on gasification yields producer gas and a good phosphate fertilizer in the form of ash.