Biochar Production from Paddy Straw Bales

In India rice is grown in 43million hectares of land and reached to a production capacity of around 100 million tonne per annum. Each kg of milled rice produced, 0.7-1.4kg of rice straw is generated. So one can imagine the solid agricultural waste generated every year from paddy alone. Some part of it is used as cattle feed and rest is burnt before next cycle of cultivation starts. Open burning of paddy straw is affecting our climate and contributing to the air pollution. The excessive use of pesticides is also limiting the use of paddy straw as cattle feed and is adding to the problem.

Biochar is a carbonaceous material formed from any biological matter when it is processed in the absence/limited supply of oxygen/air. Biochar is getting more importance because of its characteristics which makes it suitable as a soil amendment tool. A number of studies point out that the application of biochar to the soil is improving water holding capacity, cation exchange capacity, stable pH. Also, as it is directly added to the soil in the form of carbon, it stays there for hundreds of years in the soil so that the carbon cycle balance is maintained.

Typically rice straw contains 30 – 45% cellulose, 20 – 25% hemicellulose, 15 – 20 % lignin, as well as a number of minor organic compounds. Unlike other biomass, the ash content in the rice straw is very high. The usual process of pyrolysis difficult in case of rice straw because of its low density. In modern agricultural practices, the straw is made in the form of bale with the help of farm machinery. Each of this bale weight around 20-25kg with 610-620mm dia. And 950-970mm height.

Experiments

Initial experiment is carried out on an oil can having perforated sheet welded to the bottom at a gap of 10mm. One single bale is loaded on to the can and ignited at the top and air is supplied from the bottom in the range of 5-15sm/s. Then the can is closed with a top cover. The top cover is only having an opening of 100mm. white dense smoke started coming out of the system and it changed the color to pale yellow. A thermocouple was fitted at the bottom grate. The top opening was closed with glass wool when the thermocouple shoot to a temperature of 650

degrees. The outer surface was cooled by spraying water.it took 60min.for completely converting the straw bales in to char. 22% conversion is achieved in the process.

Based on the insights from the initial experiment, a continuous biochar production unit was designed. The system consists of a long cylinder of 3 metre length which can accommodate three straw bales. Two hinged doors are provided at the top and bottom side, top one is to load the bales and bottom one is to remove the biochar. A perforated sheet welded to the bottom on the cylinder with a gap of 10mm ensures the air flow to the bottom side. A blower will be connected to the bottom of the cylinder along with a valve to supply and control the airflow to the system. The system will be installed at a sloped surface so that the biochar is easy to pull out from the system.

A low cost arrangement was also designed and fabricated at FCRC as shown in the figure. The structure was constructed with red bricks and the roof and front was covered with metal sheet. A hole of 220X90 was given at the bottom on the box for air entry. A 300mm chimney is also given at the top.

Another set of experiments were carried out by burning the bales openly and covering it with fire resistant cloth and keeping it until it is fully converted in to char.

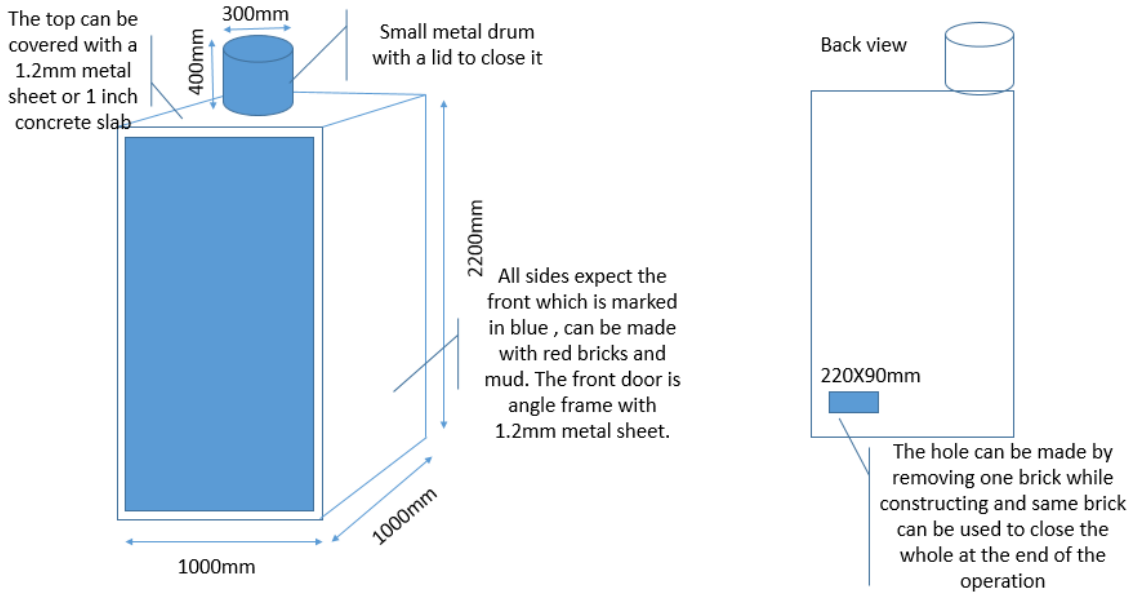

Figure 1 : Low cost biochar production unit for straw bales: 2bales/batch

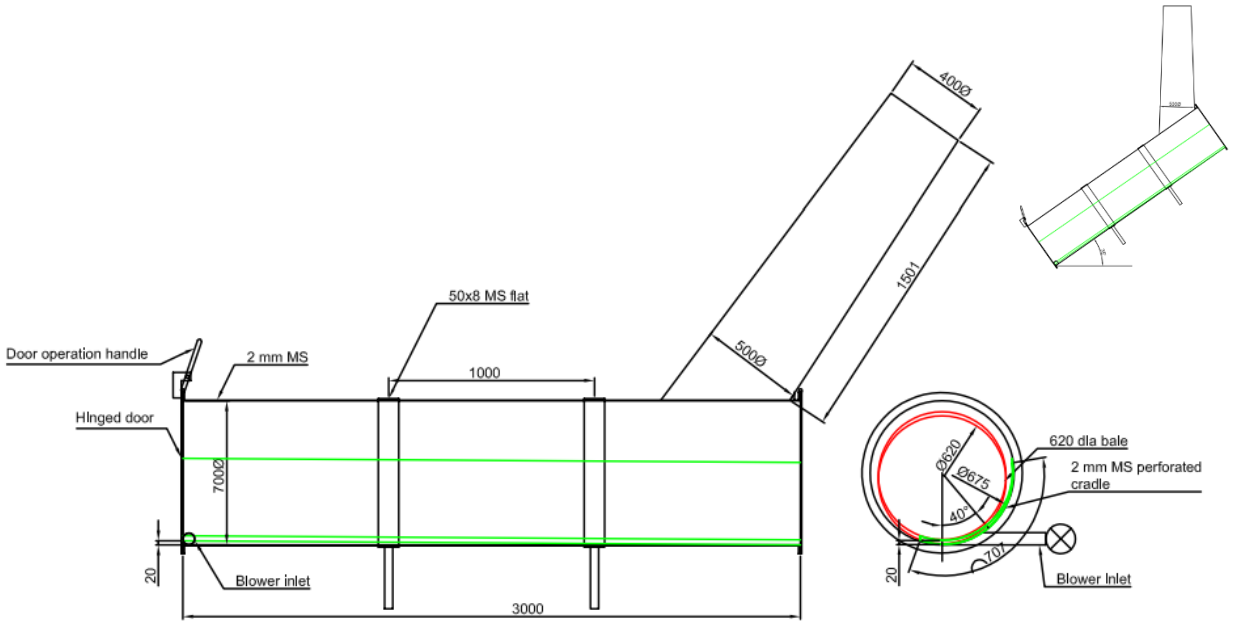

Figure 2 Continuous Biochar Production Unit for straw bales: 3 bales system