AN INDIRECT-FIRED 6-TON CAPACITY GRAIN DRYER WITH BIOMASS FURNACE

by

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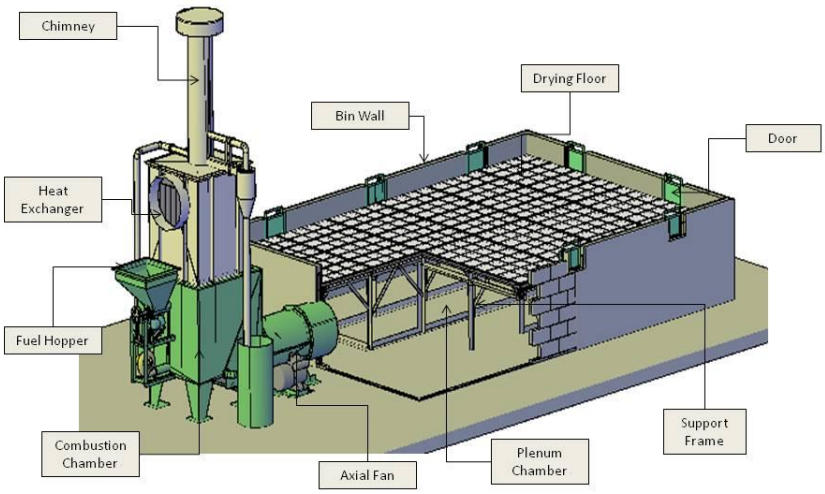
Glory to God!

Drying grains, such as paddy and shelled corn, is one of the postharvest problems in the Philippines. This is especially true when the harvest season coincides with long rainy and cloudy weather condition. Delay in drying causes deterioration and spoilage of grains, which demand low selling price. Prolonged delay in drying could even cause the grains to sprout, which tender the product of no value.

A simple design of an indirect-fired flat-bed grain dryer using biomass furnace was developed in 2009 to provide group of farmers, traders, and/or millers a technology that makes drying of grains possible, even during the wet season. The technology uses locally available resources and skills making on-site construction possible. Thus, eliminating the cost required to transport the dryer and the furnace. As shown schematically, the dryer system consists of the following major



MAJOR COMPONENTS OF SIX-TON CAPACITY FLATBED GRAIN DRYER WITH BIOMASS FURNACE

components: (1) a biomass furnace which burns biomass (rice husks, corn cobs, etc.) that is available in the farm; (2) an axial fan which moves hot air from the furnace to the drying bin; and (3) a drying bin where grains to be dried are held for several hours until the desired level of moisture is reached.

The furnace consists of an inclined grate made of a 10-mm thick mild steel plate which burns 40 to 60 kg of biomass (rice husks, corn cobs, coconut husks, wood wastes, etc.) by direct combustion with excess air. It has a 0.9-m^3 combustion chamber made of the same material as with the furnace and 0.1-m diameter by 1.5-m high vertical pipes as heat exchanger. An outer casing is provided for the combustion chamber with an annular space of 0.1 m to allow the air to pass through for cooling purposes and, at the same time, to utilize the captured heat for drying.

Biomass is fed through a hopper equipped with 0.2-m diameter screw conveyor which pushes biomass inside the combustion chamber. Combustion air is supplied to the furnace by a 7.5-cm diameter electric blower, which is controlled by a thermostat to maintain the required temperature for drying. Flue gases leave through a chimney on top of the heat exchanger. Char and ashes are discharged using a manually-operated screw conveyor for subsequent

DESIGN AND PERFORMANCE SPECIFICATION OF THE DRYER

Rated Capacity	120 to 135 sacks per load	
Bin Size	1.5 m high x 4.8 m wide x 7.2 m long	
Material for Bin Wall	Concrete or metal	
Heating Device	Inclined grate biomass furnace model 44W with vertical heat exchanger and 0.9 m^3 combustion chamber	
Fuel	Rice husks, corn cobs, coconut husk, wood wastes, etc @ 40 to 60 kg of biomass per hour	
Air Moving Device	0.8 m diameter vane axial fan with 5 hp, 220 volt single-phase motor	
Grains to be Dried	Paddy	Shelled Corn
Drying Temperature	50 – 60 C	60 – 70 C
Drying Time	8 -10 hrs (dry season) 10-12 hrs (wet season)	10-12 hrs (dry season) 12-14 hr (wet season)
Loading Time	30 min	
Unloading Time	1 hour	
No. of Operator	One person can attend up to 3 units of dryer	
Mixing Requirement	Two persons to mix 2 to 3 times during the duration of drying	

disposal. The axial fan is 80 cm in diameter with 6 pieces of blades. It is driven by a 5-hp, 220-volt single-phase electric motor at a speed of 800 rpm. The drying bin is 1.5-m high by 4.8-m wide by 7.2-m long, which can be made either of concrete or steel as walling material, depending on the preference of the client.

The dryer has a capacity of 120 to 135 sacks of paddy, which are loaded for about 30 minutes. Drying time lasts for 8 to 10 hours during dry season and for 10 to 12 hours during wet season at a temperature of 50° to 60°C. For shelled corn, drying time is within 10 to 12 hours during dry season and 12 to 14 hours during wet season at 60° to 70°C, depending on the moisture content and weather condition. It requires about an hour to unload the dryer.

As of March 2012, the dryer alone costs at the range of P450,000.00 to P550,000.00 FOB from the Manufacturers' fabrication shop, depending on the material used for the drying bin and the fan. Commercial operation of the dryer revealed that one person can operate 1 to 3 units of the dryer at a time, at a prevailing cost of labor of P1.50 per sack. Two persons are required to do the mixing of grains 2 to 3 times during the drying period, depending on the loading capacity and initial moisture content of the grains. Loading and unloading of grains are done by the customers who own the grains being dried.

Advantages of the dryer system are: (1) Uses agro-waste fuel such as rice husks, corn cobs, wood wastes, etc.; (2) No odor imparted on the grains being dried; (3) No discoloration of grains; (4) Low power consumption; (5) Does not require the use of engine; (6) Automatically-controlled drying temperature during operation; (7) High-quality dried grains, based on feedback received from users; (8) Low investment and operating costs; and (9) Can be easily built by users themselves thus saving cost on investment.

Based on actual operation, the cost of drying per sack is around P35.00. Investment for the dryer can be recovered within 1½ years provided it will be operated 20 days per month, and 9 months per year.

Units or working models of this dryer system are presently installed in the provinces of Iloilo, Capiz, Palawan, and Pangasinan. So far, cooperating manufacturers are the following: BMC in Pavia, Iloilo; BEST-E in Munoz, Nueva Ecija; and Suki Trading Corporation in Lapu-Lapu City, Cebu.

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