New rice husk furnace takes off in Vietnam

Commercial furnace in operation installed in Long An Province with a 4-ton reversible airflow paddy dryer (Photo by M. Gummert)

To maintain the quality of harvested paddy, mechanical dryers are needed, especially in the wet season when sun-drying is often not possible. However, conventional mechanical dryers need around 10–15 liters of kerosene for each ton of paddy. Further, prices for kerosene are steadily increasing. Luckily, cheaper alternatives can be used, such as rice husk.

Rice husk, a byproduct of the rice milling process, is available in abundance, is low in cost, and can be used in specially designed furnaces. Using rice husk is also more environment-friendly than kerosene because, when burned, it emits only carbon that was accumulated by the rice plant from the environment into the atmosphere and thus does not increase the atmospheric greenhouse gas carbon dioxide balance. Burning rice husk also poses less risks because it does not produce soot and aromatic polycyclic hydrocarbons or other hazardous substances, which are contained in the flue gas of kerosene (especially when burners are not maintained properly or are of simple design). When it comes to clean combustion, simple designs do not work properly, but more complex designs do.

Due to its physical properties such as low bulk density, high abrasiveness, and low flowability (e.g., how grains flow from a feed hopper into a machine), rice husk is difficult to handle and transport. Existing small-scale furnace designs are thus very labor-intensive, experience problems with uneven temperature, and often pollute the environment with ash, smoke, and carbon monoxide from incomplete and uneven combustion.

In 1996, the International Rice Research Institute, in collaboration with the Institute for Agricultural Engineering in the Tropics and Subtropics of Hohenheim University, Germany, and the Center for Agricultural Energy and Machinery of Nong Lam University (NLU) in Ho Chi Minh City, Vietnam, developed the concept of a downdraft furnace with an automatic husk feeding and ash removal system that solves these problems. In 2005, the Irrigated Rice Research Consortium (IRRC) Postproduction Work Group and its collaborators in the Philippines and in Vietnam further improved this concept by producing commercial prototypes that can be fitted into commonly used flat-bed dryers with a 4-ton paddy capacity.

The furnace (see diagram) uses a new ramdrive (g, h, i, j) to transfer the rice husk from the feed hopper (f) into the combustion chamber, where it is burned on top of a grate (d). The ash is then moved to the ash outlet (c) from new husk that is pushed into the combustion chamber by the ram. The combustion air enters at the primary air inlet (b) on top of the furnace chamber and is sucked through the burning rice husk bed by the blower of the dryer, which is positioned at the flue gas outlet (k). The small traces of ash that fall through the grate are separated in the furnace chamber by a series of baffles (i.e., sheets that block the air from flowing directly) (l), which results in clean drying air. The feed rate is around 25

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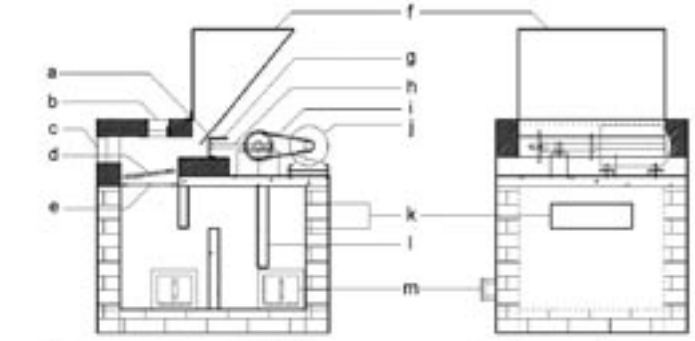

Schematic diagram of the automatic downdraft rice husk furnace.

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kilograms of rice husk per hour for a dryer with a 4-ton capacity. It is adjusted by setting the interval between piston strokes using an electronic timer.

A 4-ton seed dryer, a prototype of the furnace, was installed for evaluation at the Philippine Rice Research Institute (PhilRice), replacing an older furnace type that was due for reconstruction. Research farm laborers who tested the dryer became excited since the automatic feeding and ash disposal reduced their need to stir the husk and remove ash to a minimum in the hot, dirty work environment next to the furnace.

In Vietnam, NLU developed and tested several prototypes of different sizes. By August 2006, three commercial furnaces had been installed—two for 4-ton paddy dryers in Long An Province, and one for a peanut dryer in Tay-Ninh Province.

The furnaces provide a stable drying air temperature of 45 °C, and require feeding the hopper with new husk and emptying the ash container only every 30 minutes, compared with the 5-minute interval in rice husk furnaces commonly used in Vietnam. This type of furnace has an efficiency (energy contained in the drying air as percentage of the total energy content of the rice husk) of more than 60%, and costs between $200 and $300. Electricity is required for the drive and the electronic controller. A small generator attached to the shaft of the diesel engine (that drives the dryer fan) can provide electricity in areas without a grid connection.

Dr. Phan Hieu Hien, head of the research team at NLU, says they plan to include long-term monitoring of the installed commercial furnaces to address potential durability issues and the upscaling of the furnace design to a rice husk capacity of 50 kilograms per hour for use with 8-ton dryers. The team envisions technology transfer to other countries such as Cambodia, Myanmar, Lao PDR, and possibly Indonesia in late 2007, after gaining sufficient experience with the commercial units in Vietnam.

A high-capacity furnace for 8-ton dryers can also be an option in replacing kerosene burners in the popular recirculating batch dryers. This could significantly reduce drying cost, and thus help promote mechanical drying to improve paddy quality.

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