OVERVIEW OF GRAIN DRYING AND STORAGE PROBLEMS IN INDIA

Javed Ali*, Aaushi Sharma and Poonam Rani
College Of Technology, G. B. Pant University of Agriculture & Technology,
Pantnagar, India
*Email: javedali28@gmail.com

Abstract- India produces about 150 million tons of food grains per year and production is rising due to higher cropping intensities and the introduction of high-yielding varieties. However, annual post production losses are 10%, which means that about 15 million tons of food grains are lost during harvesting, threshing, and storage. So these losses can be minimized by a drying operation that can preserve grain. In India, 70% of the grain stored is sun dried which is not a best method to drying crops. Farmers use sun drying due to the non-availability of dryers within their reach; high initial capital investment required. So my main concern is to provide farmers a modern drying-cum-storage complex for drying crops and their proper storage. An awareness of availability of dryers and of their use and advantages in drying food grain for better storage and marketing is lacking among crop growers. This paper describes the use of various types of dryers in the Indian food industry and the efforts of research and development organizations to devise dryers suitable for individuals or small groups in the rural population. And what can be done to minimize the losses of food grain with the help of various scientific drying method or different scientific storage structures.

Keywords: Food grain; Drying; Storage; Dryers; Food safety; India.

Introduction

India produces about 150 million tonnes of food grains per year. The major components of production are 47 million tonnes of wheat, 64 million tonnes of rice, and 13 million tonnes of pulses (Anon. 1987). Due to technological advances in agriculture and the introduction of high-yielding varieties, this may increase. From this production, an average 10% is lost during postharvest operations between the field and the consumers. This means that about 15 million tonnes of food grain, valued at about $A240 million (Indian Rupees 2400 million) goes to waste. The major share of the loss occurs during storage of surplus stock. Among the various causes of losses, the most important one is improper drying before storage. The preservation of agricultural produce by drying is a long-established technique. Sun drying in the open, on mud-plastered or concrete floors, is the conventional method of drying grain and also cash crops like chilies, and plantation and horticultural crops. The drying time required in the open sun for these crops ranges from 5 to 45 days depending upon the crop to be dried. Unfavorable weather conditions are likely to occur during the drying period and degradation in quality of the final produce therefore becomes unavoidable. Annual postproduction losses by crop in India, expressed as a percentage of total production, are estimated to be as follows: wheat, 8%; paddy, 11%; pulses, 9.5%; and all food grains, 9.3%.

It is well-known that deterioration in quality caused by improper drying cannot be eliminated until improved drying systems based on mechanical dryers have been adopted. However, for many reasons, these systems have not been adopted. The main reason that is encountered is a lack of organizational or government incentive to the farmer to deliver a quality product that might command a premium price. This results in not only a negative attitude, but also leads to the overall quality of the product gathered at market points being alarmingly poor.

A second important reason for not using dryers is their high initial costs. Most of the commercially available dryers are designed to suit the needs of the processing industry and their output capacity is therefore far above the needs of individuals, or even of farmer groups.An awareness of availability of dryers and of their use and advantages in drying food grain for better storage and marketing is lacking among crop growersThis paper describes the use of various types of dryers in the Indian food industry and the efforts of research and development organizations to devise dryers suitable for individuals or small groups in the rural population. However, even with properly dried grain, scientific storage remains important and recent advances in developing various storage structures are also described.

DRYING

Drying is one of the most practical methods for primary preservation. A corollary to the hypothesis is that system dryers offer an advantage over the traditional drying practices under certain conditions. The agricultural commodities that are traditionally dried are paddy, maize, groundnuts, soybeans, coffee berries, some fruits (e.g. mangoes and longan), spices (e.g. chill), garlic, onions), fish, meat, chipped root crops (e.g. cassava and sweet potato), and coconut meat (cope). Direct sun drying or free/natural convection drying over a fire is the traditional practice.

Methods of grain drying

Generally speaking, grain drying can be classified into sun drying and mechanical drying.

India is a large agricultural country at a low level of agricultural mechanisation. particular, mechanical grain drying capacity cannot keep pace with the increase in grain production. At present, only about 30% of wet grain in state depots is mechanically dried; the rest has to be sun dried. All grain retained at farm level for consumption by farmers is sun dried.

Sun Drying

As is well known, sun drying has greater requirements of labour and space, especially in the case of large-scale and centralized treatment Although labour is relatively cheap in India, the cost of commercial-scale sun drying is still very high.In addition, sun drying depends very much on the weather, and takes more time. If there are long spells of bad weather, there is a high risk of grain losses. Also, the handling losses during sun drying are not insubstantial. However, sun drying does have some advantages. There appears to be no appreciable reduction in grain quality associated with the process, and grain can be kept fresh, of good colour, and free of contaminants.There are many ways of sun drying in India. The most popular method is to spread wet grain on the ground, turning it from time to time to remove extra moisture.

In the north-east, farmers usually put maize cobs into hubs. Moisture is removed by natural aeration during storage. Farmers also take measures before maize is harvested. When it is in its waxy ripening stage, farmers tear the husks off the cobs for sun drying while on the stalk. This method not only removes moisture but also promotes maturity, thus increasing yield. Under the climatic conditions of the north-east, it takes about 10 days to reduce maize moisture by 4%.Clearly, the main disadvantages of sun drying are that it is more labour intensive and takes longer. Some local governments give farmers incentives to encourage sun drying at farm level so as to solve the problem of insufficient capacity in state depots. This has not been successful to date.

Mechanical Drying

A mechanical way to remove the water from wet grains by blowing (heated) air through the grain. This drying is done until the grain has the desired moisture content.

Mechanical drying has some advantages over sun drying:

- Better control over the temperature and moisture content
- Drying can be done day or night
- Less labor (especially if mixing is mechanical e.g. re-circulating dryers)
- Mechanical drying will lead to more even drying of grain and higher milling yield and head rice recovery.

Since rice quality is becoming more important to rice consumers, medium-sized grain dryers have become a common sight throughout Asia. For production of premium quality rice or seed, mechanical drying with heated air dryers is highly recommended.

Commercial use of dryers

Dryers are used extensively in grain processing industries such as rice milling, pulse milling, and oil extraction. Here the need for dryers has been realised not only for proper storage of stock but also for timeliness of subsequent operations where wetting of grain and redrying are involved.

In the case of the rice milling industry, parboiling of rice is a common practice. The population of the coastal belt of the country consumes parboiled rice and about 70% of production is processed in this manner. The paddy is soaked in water for variable lengths of time depending on the process used and is then steaming.

Dryers are also used in the pulse milling industry. Here both LSU-type and flat-bed perforated-floor dryers are wed, ranging in capacity from 1-4 t/h. There are about 4000 pulse mills in India having an average processing capacity of 10-20 t/day. Dryers are required in industry for the following reasons:

- to dry the stock purchased from market before storing it; and
- to dry the grain which has become wet during processing.

Use of dryers at farmer level or in community drying systems

About 70% of total grain production in India is retained at farmer level: only 30% is sold on the open market. This means that a sizeable quantity of about 105 million tonnes is kept by farmers. The losses here, though perhaps not felt by individuals, on a collective basis have a substantial impact on the country. It is therefore essential that drying technology be disseminated to this group which is a major custodian of the nation's grain.To promote the use of dryers in rural areas, the concept of a community drying-cum-storage system was put forward by T.P. Ojha in 1984. He suggested that changes in ecological balances and the introduction of high-yielding varieties of field crops necessitated the use of mechanical dryers and other devices to protect the food grains from spoilage due to untimely rains.

If rain-soaked food grains are not dried properly, farmers have to sell their excess stocks at low prices to meet urgent financial needs. A community drying-cum-storage centre would therefore serve them well by way of protecting the grain from spoilage and also by advancing temporary loans on their grain deposits. As soon as grain prices stabilise, stocks can be sold and payments can be made to the farmers after deducting dues such as rental and service charges, loans paid, and interest on advances. Such a system would no doubt benefit farmers. They would not be required to make forced sales of their produce and, as a result, storage losses would be minimised.

For such complexes, selection of a dryer of the correct design is very important. The largecapacity dryers used in grain-processing industries are not economical or feasible for most farmer groups. In India, the average village has a population of about 1000 and the small amount of surplus grain available for drying at this level suits dryers of 2-4 t/day capacity operating for 60 days per year. In India, many research organizations have developed, or are currently developing dryers for village groups, but so far with little success. The main considerations for selection of a grain dryer suited to this level are:

- The dryer should be of a size that matches the amount of grain available in a village or a cluster of villages;
- The dryer's cost should be within the reach of users;
- It must be simple in construction and operation and easily understandable to users;
- The dryer should be simple in design so that it is easy for local artisans to repair, and
- The dryer should be suitable for drying a range of crops.

Grain dryers suitable for rural level use

Some important grain dryers developed at different R&D institutions and agricultural universities are described in the following sections.

Small-Capacity, Continuous Grain Dryer

The dryer developed at G.B. Pant University of Agricultural and Technology, Pantnagar, is a continuous type consisting of a frame, grain column, plenum chamber, feed hopper, discharge hopper, heating unit, and blower (Fig. 2). The grain column consists of two vertical columns sandwiched between two vertical screens. Each screen wall consists of an expanded metal netting and wire mesh screen on the inner and outer sides. The plenum chamber has been provided between the two grain columns in order to distribute the air uniformly and at right angles to the direction of grain movement. A centrifugal blower forces the air at 37 m3/min airflow against 2.5 cm of Hg. The air is heated from 40°C to 70°C by 20 kW electric heaters. The dryer has capacities of 0.8 t/h for wheat, 0.8 Ah for paddy, 0.96 t/h for maize, and 0.8 t/h for red gram. The cost of the dryer, excluding the heater and fan, is about $A330 (Indian Rupees 3300), based on 1982 estimates, and the cost of drying is around $A0.50/t (Singh et al. 1982).

Cup and Cone Dryer for Paddy Drying

A somewhat different design of dryer has been tested at the Paddy Processing Research Centre (PPRC) at Thiruwarur in India. It consists (Fig. 3) of five cups each having a diameter of 1070 mm and a slope of 52°. Each cup and cone is made of mild steel rod and wire mesh. A hot-air duct of 300 mm diameter passes through the centre of the dryer from the top; the bottom end of the duct is closed.

Individual cups and cones are mounted one above the other by means of bolts and nuts. Paddy passes through the inner surfaces of the cups and exteriors of the cones. To divert the flow of paddy from the outer surfaces of the cones to the inner surfaces of the cups, cylindrical retainers of mild steel sheet are provided. A two-way valve is provided just beneath the bottom of the dryer. A slide is provided at the junction of the two-way valve and the bottom of the cup. This is kept completely open during recirculation and bagging. The hot air generated in a husk-fired furnace passes through a vertical duct and enters the paddy column by means of a central duct having perforations at points covered by cones and the top portion. A circulation rate of 3.5 to 4.5 tonnes per hour is maintained while drying.

Trials conducted during high humidity weather indicated that 950 kg of parboiled paddy of 30% m.c. can be dried to 14% in 2 hours at a drying temperature of 120°c and an airflow rate of 127.5 m^3/min. The drying cost is calculated at $A2.10(Rs 21.33)/t (Pillaiyar et al. 1982).

Community Grain Dryer

The dryer developed at the Central Rice Research Institute (CRRI), Cuttack, is useful for village communities or small-scale rice millers (Fig. 5). It consists of a drying chamber, a husk-fired furnace (inclined grate 0.5 m² at 45° inclination, horizontal revolving grate 0.15 m², and fluted roller-type husk feeding mechanism), solar collector (flat plate, black painted galvanised iron corrugated sheet with 23° slope towards south, 43.5 m² surface area provided with 40 mm thick insulation of paddy straw and tar-felt sheet combination), blower {backward curved fan operated by a 5 hp motor with airflow capacity of 160 m³/min at 25 mm water gauge static pressure), and a bucket elevator (2 t/h capacity operated by a 0.5 hp electric motor). Generally, it takes 6.5 hours to dry 1 t of paddy from 24% to 1496 m.c. The cost of the dryer is estimated at $A5000 and the cost of drying $A10.6/t (Kachru et al. 1986).

Solar cum Husk-Fired Paddy Dryer

This dryer has been developed at the Indian Institute of Technology (IIT.), Kharagpur (Fig. 6). The system consists of an unglazed flatplate collector which houses an inclined-type husk-fired grated furnace, a 3 hp electric blower and a batch-type dryer. Dampers are provided to put either the collector or the furnace into operation, depending on weather conditions. The absorber surface is a corrugated galvanised iron sheet coated with ordinary blackboard paint. A false roof of bamboo functions as an insulator. Two sides are closed to form channels for airflow. The blower assembly forces the heated air to pass it onto a batch dryer. The capacity of the dryer is I t/day. The cost of the dryer has been estimated at $A2000 and drying cost at $A8.8 /t (Kachru et al. 1986).

Storage Structures at Farmer Level

The major construction materials for storage structures in rural areas are mud, bamboo, stones, and plant materials. They are neither rodent-proof, nor secure from fungal and insect attack. On average, out of a total 6% loss of food grain in such storage structures, about half is due to rodents, and half to insects and fungi. Some of the major considerations in building a storage structure to minimise losses are:

- the structure should be elevated and away from moist places in the house;
- as far as possible, the structure should be airtight, even at loading and unloading ports;
- rodent-proof materials should be used for construction of rural storages;
- the area surrounding the structure should be clean to minimise insect breeding; and
- the structure should be plastered with an impervious clay layer to avoid termite attack, or attack by other insects.

Various research and development organizations in India have identified some proven, age-old structures from certain areas of the country and based on these, some improvised storage structures have also been developed and recommended for use at farmer level.

For scientific storage, drying of food grains to a safe moisture level is a top priority. In India there are about 35 000 dryers in the rice and pulse milling industry, but all of them are used to process the grain. The use of dryers to dry surplus grain kept for storage is not common. The main reasons for this are a lack of awareness among the rural populations, high capital cost, and no incentive given for farmers to produce properly dried grain. An immediate answer to this problem would therefore be to develop and select a proper size of dryer which is simple in construction and operation, and lower in cost.

Setting up a community drying-cum-storage complex as suggested by Ojha (1984) has great potential as it will help to reduce losses and to provide a better return for the grower. The types of dryers suitable for this level are identified and described. They need to be popularised among potential users. Storage of grain in India is done at many levels. The major production is stored at farmer level and the root cause of massive storage loss lies here. The suitable low-cost structures developed have been identified.

Conclusions

India produces about 150 million tonnes of food grains per year. Production has been steadily increasing due to advancement in production technology, but losses have remained static at 10%. This means that the loss of food grains is also increasing with the increase in food production. The main reason for this is improper storage, and an average of 6% out of a total 10% loss takes place during storage of food grains. The various are described in this paper by which we can minimise the loss of food grains.

On-farm storage is also important as it stores the surplus for a short duration and appropriate structures are explained with design features and construction procedures. Large-scale structures like silos and organizationally maintained structures are also explained. The use of dryers and scientific storage practices, if followed, can reduce the loss by about 6% and this will save Rs 13 500 million ($A1350 million) every year, and make available an additional 9 million tonnes of grain to feed the people.

REFERENCES:

Anonymous 1987. India 1986, a reference manual. Allied Publishers. 772 p.

Birewar, B.R. 1985. Recent development in storage structures. In: Storage of agricultural durables and semi-perishables. CIAE, Bhopal, 90-93.

Chouksey, R.G. 1985. Bag and bulk storage of food grains at farmers level. In: Storage of agricultural durables and semi-perishables. CIAE, Bhopal, 5556.

Ojha, T.P. 1985. Problems and prospects of community type drying-cum-storage complexes in rural areas. In: Storage of agricultural durables and semi-perishables. CIAE, Bhopal, 1-6.

CHIEF."Grain conditioning, storage, aeration guide". IRRI, Safe storage condition for grain.

North Dakota State University, Cooperative Extension Service, 1974, Grain Drying on the Farm.

Pillaiyar, P., Yusuff, K.M., Narayanswamy, R.V., Venkatesan, V., and Ramachandran, K. 1981. Drying parboiled paddy with cup and cone dryer. Journal of Agricultural Engineering, 18, 122-126