หอสมุดกลาง
จุฬาลงกรณมหาวิทยาลัย

CHAPTER I

INTRODUCTION

At present shelled corn is one of the largest agricultural export in Thailand and the demand is evenly increasing as shown in Fig. 1.1

The moisture content of the exported corn regulated by foreign-country customers must be less than 15%[1] ; however, the moisture content of corn at the point of collection is in the range of 20-30%[1], so preliminary drying before export is necessary otherwise water will damage the corn. Therefore, corn dryers have become very important in maintaining the quality of the exported corn.

In the rural areas of Thailand, sun drying of corn is used extensively to reduce the moisture content to 12-13% within a few days[2]; however, such method requires a large area and the problem of deterioration due to moisture may arise when the harvest time is in rainy season. Small batch dryers using hot air heated by liquefied petroleum gas are also used; unfortunately, the drying temperatures are limited and uncontrollable. There are also a few commercial continuous dryers located around Bangkok where corn export is made. The shelled corn dried by these methods may be made to flow by gravity while the rate of discharge is controlled by mechanical means; air is passed through the grain as it moves downwards, and this may be done in different ways. Some of the continuous corn dryers employed in foreign countries are shown in Fig. 1.2, Fig. 1.3, and Fig. 1.4. These continuous dryers require less manual handling than the batch

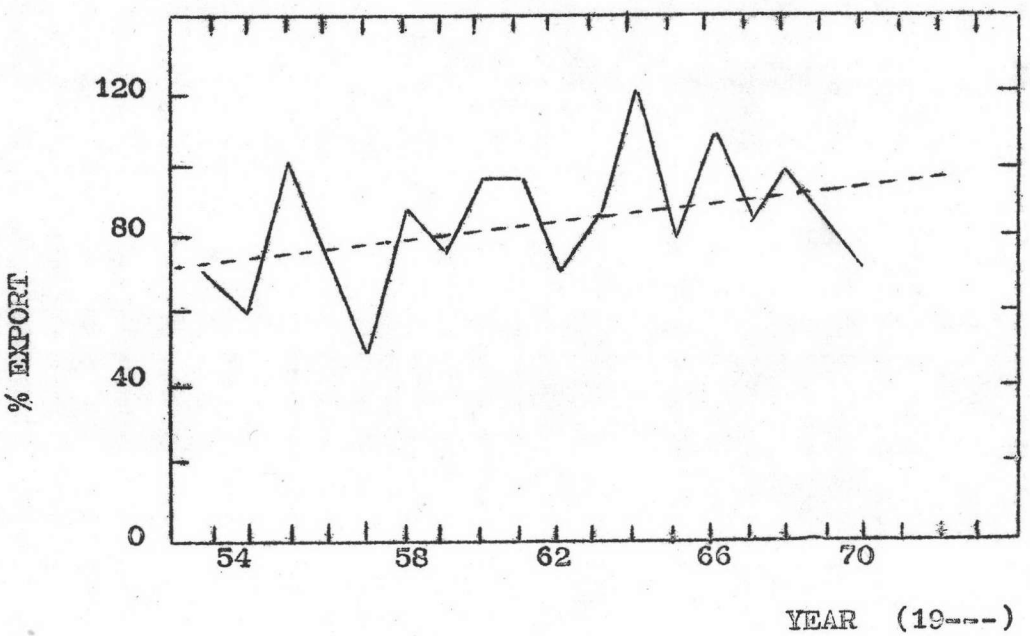

Fig. 1.1 The trend of corn export from year 1953 to 1972 (In years 1964 and 1966, corn exports exceeded 100% since the accumulated corn in the previous years was also exported.)

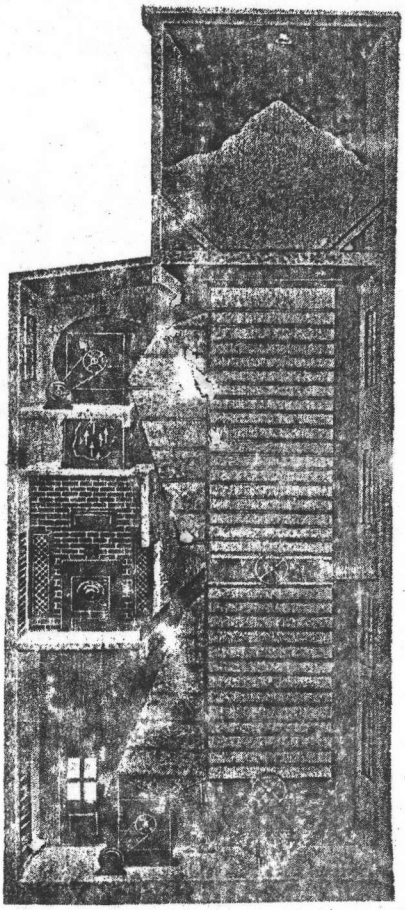

Fig.1.2 View of drying and cooling section of a Randolph Grain dryer

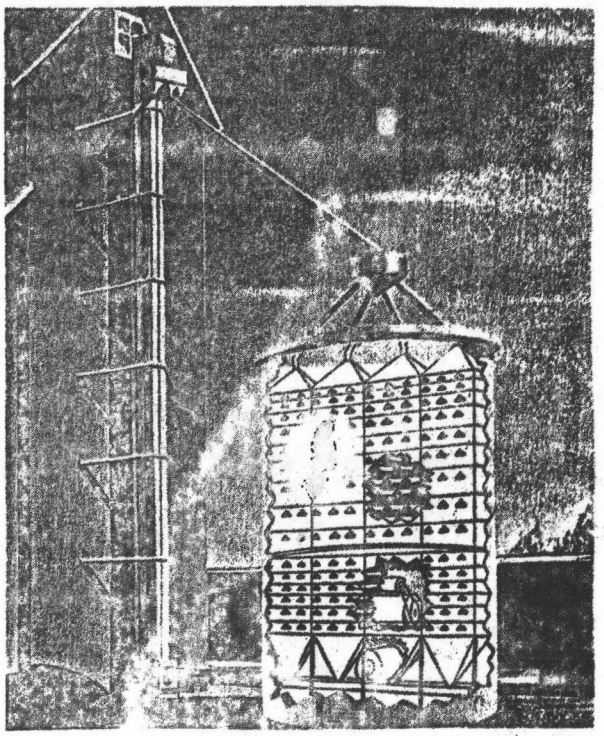

Fig.1.3 Runaway view of Campbell Dryer

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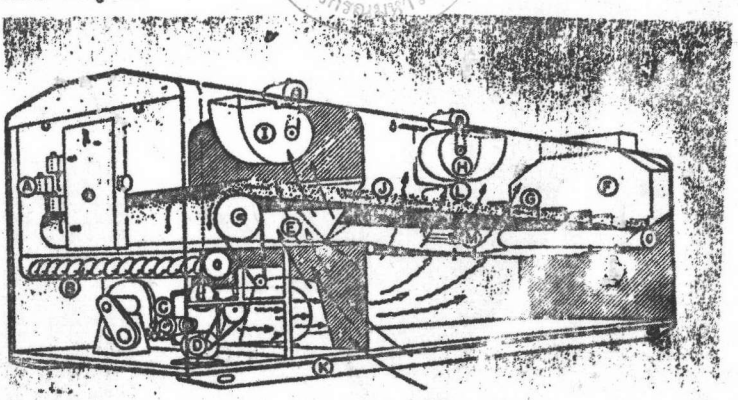

Fig.1.4 View of Aridaire Grain Dryer in which the air passes through grain on a continuous belt. A. Temperature controllers. B. Discharge auger. C. Oil burner. D. Conveyor belt drive. E. Cooling damper. F. Wet material hopper. G. Rake bar agitators. H. Drying blower. I. Cooling blower. J. Material being dried. K. I-beam skid. L. Bulb for upper temperature controller. M. Bulb for lower temperature controller.

handling than the batch ones, yet there is no vigorous mixing of corn with the result that the disadvantage due to local overheating still exists and limits the air temperature used in corn drying.

In a fluidized bed, fine solids can be vigorously agitated and therefore dried continuously; however, corn kernels, being large and uniform in size, tend to rise up as slugs when subjected to fluidization and cannot therefore be agitated satisfactorily by this method. The desired agitation of corn can be accomplished by using the spouted-bed technique which is suitable for large and uniform in size as shelled corn.

Spouted bed technique pioneered by Mathur and Gishler is an applied technique of fluidization. Drying particles are fed into a spouting column with conical base, and then heated and agitated by hot-air jet introduced from the lower part of the base. By flowing upwards in the central core and downwards in the annular region, the particles in the spouting column are then well circulated and dried uniformly throughout the bed. A spouted bed dryer is therefore looked upon as one of the best means to be applied to corn drying and may reduce the aforementioned problems.

1.1 Purpose and Scope of Research

The purpose of the present investigation is to obtain a mathematical solution to guide the design and operation of a spouted bed dryer.

The solution is derived from the assumption of the continuous drying of solids in a well mixed, isothermal bed in the case where

diffusion within the solid governs the drying rate and the diffusion coefficient is independent of concentration.

1.2 Advantages

The mathematical solutinn obtained from research results related the effect of feed moisture content, residence time, and drying air-temperature on the rate of moisture removal; this will be of value as follows:

1.2.1 The mathematical solution will guide the design and evaluation of a spouted bed corn dryer.

1.2.2 The spouted bed corn dryer consists of simple units of equipment and occupies a small area; therefore, it should be constructed and installed at any locally drying center.

1.2.3 When the facility of corn drying is accessible, farmers can take advantage of higher corn prices which normally occur after the harvest season by storing on the farm.

1.2.4 The corn dryer can be applied to dry other agricultural products; however, their drying equations must, at first, be studied.

1.3 Plan of Investigation

The material used in this study is field corn bought from Field Crop Division, Agriculture Department. It is the flint type of the variety of bogor number 2 grown in Prabuddhabaht area in Changwad Saraburi. Conditioning of the shelled corn to the desired feed moisture

contents is necessary before drying processes.

The drying equipment consists of the air compressors, the heat exchanger, the rotameter, the air pre-heater, the temperature controller, and the spouted-bed heater. The last one was designed and constructed; all the others were provided by Chemical Technology Department, Chulalongkorn University. The thermo-hydrograph was borrowed from Chemistry Department, Ramkhamhaeng University to measure room humidities and temperatures. The electric moisture tester was borrowed from Field Crop Division, Agriculture Department to determine the approximately feed moisture centents. The sampling tool (Fig. 3.5) was made to take samples in the spouted-bed heater. The accurate moisture contents were determined by drying samples contained in the petri dishes in the hot-air oven (BTL, England) equipped with thermostat (Rika Kogyo Co., Ltd, Japan) and the weights were measured by the electrical balance (Mettler H33, Switzerland). The hot-air oven and the electrical balance were provided in the laboratory of Chemical Technology Department.