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Drying and Storage of Rice in New South Wales

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Trocknen und Speichern von Reis in New South Wales
Séchage et entreposage du riz en Nouvelle Galles du Sud
Secado y almacenamiento de arroz en Nueva Gales del Sur

ニュー・サウス・ウェールズにおける米の乾燥と貯蔵

新南威尔士的稻米催干和存贮

تجفيف وتخزين الأرز في نيو ثوث ويلز

Summary

An award winning storage/drier system for paddy rice, consisting of circular storage bins, is introduced. This system is capable of continuously batch drying paddy and maintaining a high quality and high volume product.

1. Introduction

The Rice Marketing Board for the State of New South Wales is the authority which receives the entire paddy rice crop from the growers of this State. In the past few years production has been as high as 730,000 tonnes per annum comprising about 97 % of Australia's rice production.

Farmers are encouraged to harvest their rice while it is still at a relatively high moisture level (up to 23 % moisture) in order to enhance the milling qualities of the grain. To ensure the rice is in a safe condition for prolonged storage the moisture must be reduced after receival to approximately 14 % moisture.

In the N.S.W. Rice Industry this drying is performed after the rice is placed into store, and in recent years the Rice Marketing Board has incorporated some unusual materials handling techniques into its storages in order to improve functionality.

Conventional paddy rice storage in N.S.W. is carried out in flat bed, rectangular plan storage, with a rice depth of between 6 and 7.5 m. Drying is achieved by blowing ambient air upwards through the bed in suitable climatic conditions. Until recently the grain has been laid in horizontal layers by mechanical throwers mounted in the head space above the bins.

2. Gantry Type Inloaders

Rectangular storages constructed since 1979 have generally been equipped with an inloading machine which resembles a gantry crane mounted in the head space above the bins. In a storage shed of 40 m width, the gantry is 21 m long and travels the full length of the shed on overhead carrying rails.

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Housed within the gantry is a reversible shuttle belt conveyor of 19.4 m length running laterally across the shed. With the belt set to run in one direction (say towards the east) the whole of that (eastern) half of the shed can be filled by dropping rice directly off the discharge point of the conveyor and steadily moving this discharge point until rice has been spread in a thin and even layer throughout this half of the shed. By regular intermittent reversal of the belt direction the west side of the shed can be simultaneously filled in this manner. Inloading rates are generally either 100 t/h or 200 t/h (Figs. 1 and 2).

The advantages of this type of inloader over the traditional method include significantly less dust generation and reduced incidence of pockets of trash in the rice bulk. Furthermore, the facility lends itself to automation, and this has been incorporated in several of the installations by means of a programmable logic controller (P.L.C.) in conjunction with ultra-sonic level detectors, a belt weigher and an AC variable speed controller.

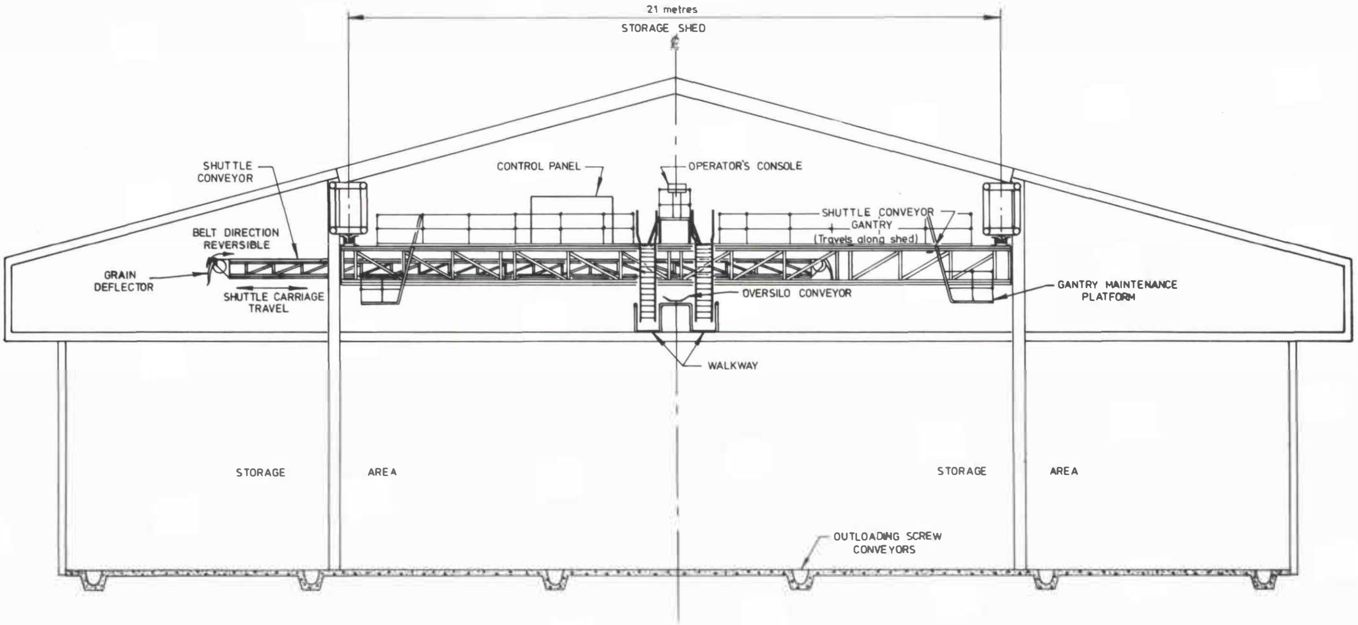
There are several bins within any one shed and the P.L.C. is programmed to remember how far the inloading machine has gone in filling any one bin. Its speed of traverse across the bin can be varied in proportion to the rate of feed of grain as measured on the belt weigher, and it can indicate on a V.D.U. in the control area the percentage full of the bin as measured by the ultrasonic level detectors.

3. Award Winning System

A highly original design of rice storage was commissioned in April, 1980 at the Board's Deniliquin Depot (Figs. 3 and 4).

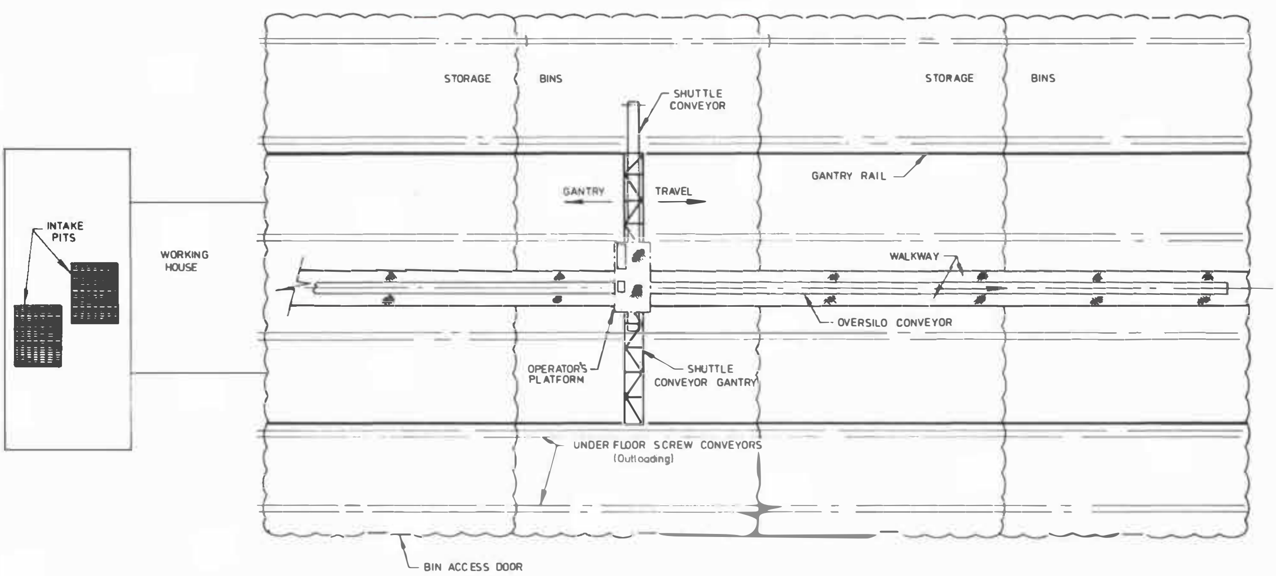
The storage/drier system won an Australian Institute of Materials Handling Ltd. (N.S.W. Division) 1980 award for its "high degree of engineering planning". In its citation the Institute said "The reclaim and feed system are worthy of particular note".

In this new plant the storage bins are all circular. There are four bins of 28 m diameter. Three are 12.8 m high each with a storage capacity of 5,000 tonnes. The other is 7.5 m high and 3,000 tonnes capacity. Grain is brought into the silos by an overhead conveyor from the working house whence it is discharged onto the rotating filling conveyors which are pivoted about the centre of the silos by a turntable underhung from the oversilo belt gantry. The other end of the rotating con-



RICE STORAGE SHED CROSS SECTION

Fig. 1



RICE STORAGE SHED PLAN
(ROOF OMITTED FOR CLARITY)

Fig. 2

veyor runs on the top lip of the bin wall. The conveyor travels through 359° once every hour at which time its direction is automatically reversed. Simultaneously a discharging plough travels back and forth along the conveyor and the plough's speed is controlled by a variable voltage unit in such a way that the rate of travel of the plough is inversely proportional to its distance from the centre of the silo. By these means a steady rain of grain is dropped into the storage to provide a uniform depth layer. The concept and arrangement of this conveyor is totally original.

Reclaiming of the grain is achieved by means of a central reclaiming belt conveyor set in a tunnel under the floor of the silos. A specially developed reclaiming screw conveyor has been installed above the floor of the silos and is buried under the grain. This conveyor is operated remotely once it is exposed after reclaim by gravity of all "live" grain. It is pivoted about the centre of the bin and propels itself automatically around the silo and recovers all the "non-gravity" grain from the circular bin. The floor reclaiming conveyor of the capacity required of this installation is not believed to be commercially available in Australia or overseas. Considerable research and development went into ensuring a long life, trouble free unit which will operate in one of the more abrasive materials encountered in bulk materials handling practice.

All of the processes in the new plant, including flow control, cleaning, dust control, aeration and monitoring of the storage level and condition of grain in the storage is controlled by a micro-processor located in the control room at the grain receival area.

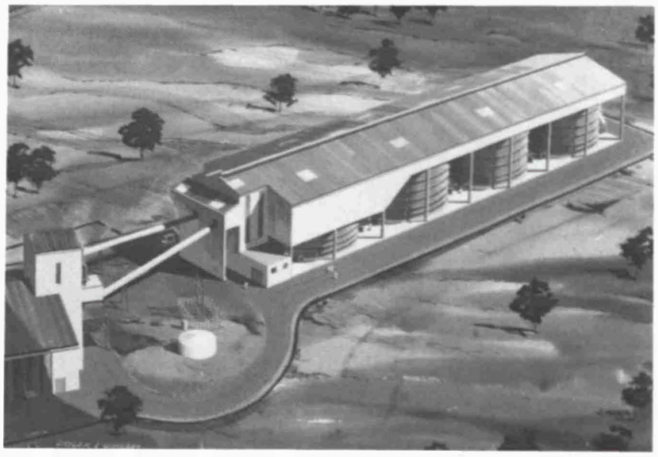


Fig. 4

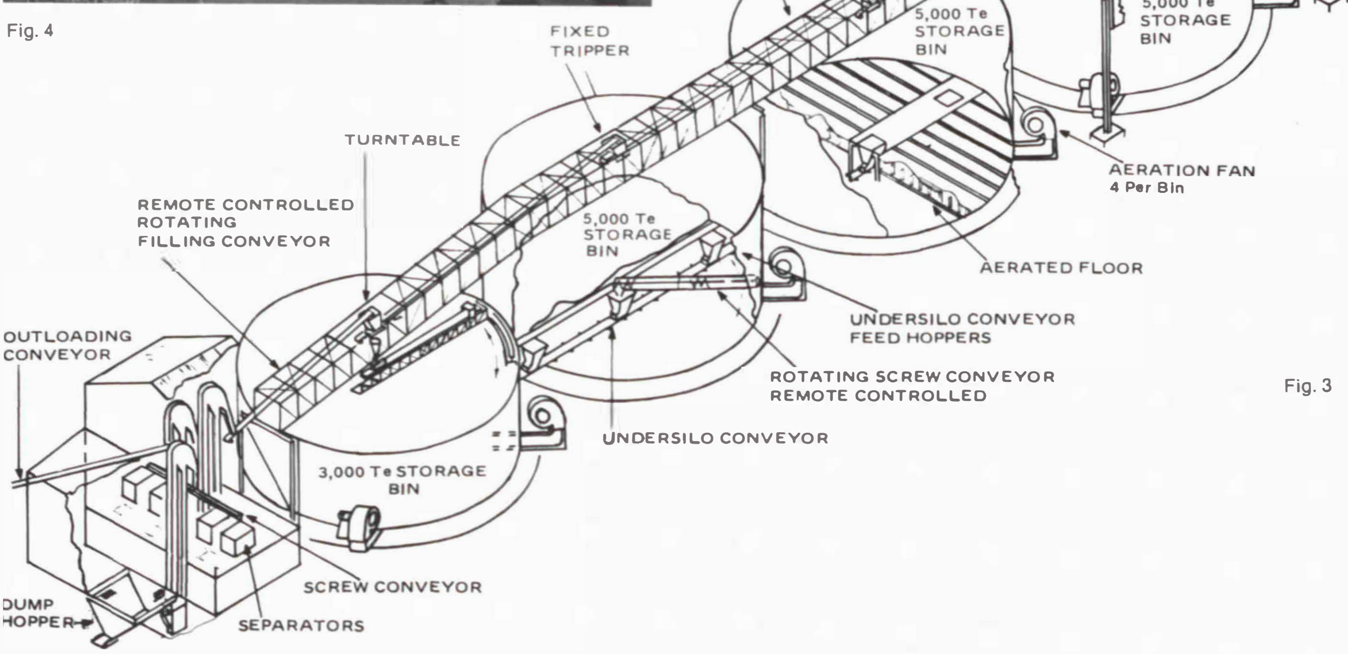


Fig. 3

4. Method of Operation

The paddy rice is cleaned and placed in storage in layers of two to three metres deep in an individual bin. The fans to the bin are then turned on and the grain is dried at a very high volume of aeration — perhaps three times the aeration rate which it would have in a deep bed storage.

The next bin is then filled to a similar shallow depth in the same manner and aerated and approximately on each successive day the process is repeated for the remaining two bins in the four bin complex.

By the time all of the bins have been filled to a shallow depth the first bin has been dried sufficiently for milling or safe storage in a non aerated bin and it is then unloaded from the new storage complex and transhipped to its new destination.

The bin from which this grain has been taken is then ready for a new shallow layer of high moisture, freshly harvested paddy and so the process is repeated in successive bins instituting a high volume batch drying process.

To ensure that the drying is possible within the time period required, provision has been made for heating the inlet air to the aeration fans using L.P. gas burners.

As the harvest is tapering off, number 4 bin is filled with rice dried in the other bins. This rice is stored there until needed. The process is repeated with bins 3 and 2.

Finally bin number 1 is partially or completely filled from the remaining harvest. If it is completely filled it is then operated as a convential deep-bed aeration storage bin. For this reason it is of a lesser height.

5. Concluding Remarks

The overall efficiency of the new complex is demonstrated in the capacity of the plant to fulfill its stated objectives, that is to perform functions which have previously not been possible or economical. These objectives were:

a) to continuously batch dry paddy and maintain a high quality and high volume product;
b) to achieve vastly improved outloading with respect to capacity, manpower and safety;
c) significant reduction of in-bin moisture gradation with consequential loss in product quality and sales revenue;
d) reduction of unpleasant working conditions;
e) to operate the storage largely by remote control with a high degree of automation and safety in the equipment;
f) to greatly improve drying capacity facilitating faster supply of dried rice to the mills during harvest and thus reduce the need for capital outlay on further static storage since bins emptied during harvest to supply the mills can be refilled with freshly harvested grain.