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Application of transverse ventilation in grain storage in China

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Extended abstract

In China, mechanical ventilation technology has been researched and applied since the 1950s. Beginning in 1998, large-scale grain warehouses started to be built with national government support. The mechanical ventilation technology, namely the "four-in-one" technology, was promoted enormously during this period. In the “four-in-one” system, the aeration technology was based on the vertical aeration system with ventilation ducts temporarily fixed on the floor of the warehouse. The airflow passed vertically through the grain bulk from the bottom to the surface or vice versa with air being pushed by fans, and the heat and moisture from the grain exchanged with the air during vertical aeration. This vertical ventilation system has been widely used for the last twenty years, but it is complex and inconvenient, and also air distribution is uneven.

To fix these problems, Chinese researchers developed a new transverse ventilation technology as shown in Fig. 1. In this system, aeration ducts are mounted along the opposite interior walls of the warehouse and air travels horizontally through the grain mass. A large number of pilot scale tests and warehouse applications have been done from 2010 to 2014.

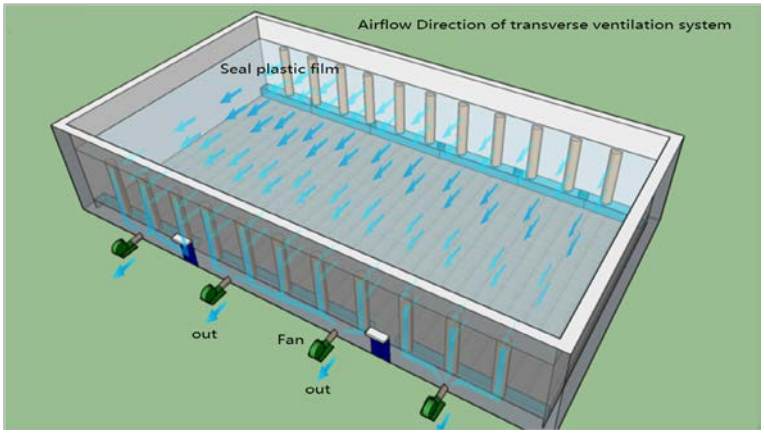

Fig. 1 The new transverse ventilation system.

The grain surface is sealed by plastic film during storage to prevent air from escaping through the surface layer during aeration and gas during fumigation. During aeration, the airflow is sucked from

one side of the aeration ducts and exhausted out the fans after horizontally passing through the grain bulk. With nearly five years of application, it has been demonstrated that the storage technologies in this new ventilation system, such as aeration, grain cooling, fumigation and controlled atmosphere treatment can be done effectively, ande grain moisture loss during ventilation can be reduced by 0.3-0.5 percentage points. Alos, the efficiency of loading and unloading grains can be increased by 100% as compared to the vertical ventilation system because on-floor ducts do not need to be removed during the unloading process.

Therefore, application of the granary transverse aeration system will obtain better economic and operational benefits as summarized in Tab. 1.

Tab. 1 Evaluation of vertical and transverse ventilation system.

No.	Evaluation index	Vertical ventilation	Transverse ventilation	Remark
1	Ventilation uniformity	80-85%	90-95%	Increase of 10%
2	Percent of moisture loss during ventilation	0.7-1.0%	0.2-0.3%	Reduced by 3-5 times
3	Capacity of grain load/unload/hour	50 t/hour	＞100 t/hour	Increase of 100%
4	The load/unload cost of per ton	5.0 ¥/t	3.0 ¥/t	Reduced by 40%
5	Labor cost	high	low	Reduced by 50%
6	Depreciation expense	high	low	Reduced by 20%
7	Labor intensity	high	moderate	
8	Mechanization level	low	high	

Until now, the transverse ventilation system has been applied in more than twenty provinces throughout China, and the quantity of stored gain has reached 3 million tons of warehouses storage capacity that is equipped with the new transverse system.

Technical and Economic Evaluation of Ambient and Chilled Aeration Strategies to Maintain the Quality of Paddy Rice During Storage in a Tropical Climate

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Abstract

Warm and moist conditions of some tropical climate regions make it difficult to use ambient aeration to cool stored grain, which contributes to pest problems and increases dependence on chemical control as part of grain management strategies. Grain chilling is a non-chemical alternative to cool grain stored under high risk climatic conditions. The objective of this research was to use computer simulation to evaluate the technical and economic viability of using grain chilling compared to four ambient aeration strategies developed for paddy rice stored under the tropical climatic conditions of the North Pacific coast of Costa Rica. The minimum grain temperature achieved through ambient aeration at the end of the six-month simulated storage period was 30.8°C, using an aeration strategy based on a grain-ambient temperature differential greater than 10°C. Grain chilling lowered the average grain temperature from 35°C to below 15°C in 117 hours and the maximum average temperature it registered after six months of storage was 15.5°C. The economic evaluation of the ambient aeration and chilling strategies determined that the operational costs of grain chilling were 1.83 US $/t lower than ambient aeration plus chemical control of pests. However, the initial cost of the grain chiller made the net present cost (NPC) of the grain chilling strategy 0.22 US $/t higher than the cost of ambient aeration plus