CASE STUDY

Turning fridge unit around improves airflow distribution in box stores

Figure 1. Commercial testing 180° turned fridge unit in overhead throw store at WLS. The unit was turned so the evaporators face the store wall rather than the boxes

Ventilation is an integral part of storage, as it enables potatoes to be dried and cooled. In UK box stores, overhead throw ventilation systems are the prevalent set-up. Fans at one end of the store project air over stacked boxes, into the store headspace. The air then returns to the evaporator through apertures in slatted boxes. As this system is not positively ventilated, air tends to take the quickest route through the store, i.e. through the sides and top boxes, and short-circuit back to the main fan.

Recent research has highlighted the inefficiencies of overhead throw systems. A semi-commercial trial, funded by Innovate UK, demonstrated that only 31% of air projected over boxes reached the end of the store. Boxes located in back corners were particularly prone to poor airflow.

These systems may provide a low-cost solution but poor air distribution and lack of uniformity result in longer cooling periods and poor sprout growth control.

Putting research into practice

The semi-commercial trial at Sutton Bridge Crop Storage Research (SBCSR) was an opportunity to test out different store layouts, with the view to improve air distribution. One of those set-ups included turning the fridge unit around so return air fans face the rear store wall rather than the boxes. With this configuration, the trial showed that greater airflow was passing through boxes.

Winters Lane Storage, a grower cooperative facility storing potatoes on behalf of its members, was aiming to improve its overhead throw stores and decided to test this set-up (Figure 1), following a visit of the semi-commercial trial at SBCSR and seeing the benefits of the system in action.

A comparison study between one of their conventional overhead throw stores and the store with the 180° turned unit was assessed for airflow by Assimilate Systems, in collaboration with SBCSR.

Benefits of turning fridge unit around

Airflow comparison data showed that the 180° turn system resulted in more airflow to the furthest store wall compared to the conventional system (Figure 2). The difference was particularly striking in the central and lateral parts of the store. At the centre, an average 22% of air reached the far end of Store A, contrasting with an improved 32% on average in Store B. Similarly, with boxes along the right side of stores, airflow data showed that nearly double the amount of air was flowing through in Store A (42%) when compared to the same location in Store B (25%). Turning the fridge unit around also achieved better airflow distribution in Store A than in Store B, as indicated by the colour scale in Figure 2.

The 180° turned fridge unit system was easy to set up and required little new structural work, so the general store structure could be maintained. As a result, the team at Winters Lane Storage Ltd. can continue to use their box design, with stored box capacity remaining unaffected. The monitoring equipment remains unchanged and, overall, their store management strategy has been improved by the change in unit orientation.

Store A

Back of store

0.36	0.30					0.38	0.56	0.22
0.16	0.20					0.56	0.58	0.11
0.25	0.30	0.46	0.04	0.16	0.16	0.59	0.63	0.09
0.11	0.19	0.44	0.23	0.05	0.09	0.67	0.56	0.03
0.23	0.46	0.59	0.40	0.37	0.20	0.66	0.56	0.34
0.20	0.46	0.58	0.43	0.37	0.44	0.68	0.51	0.31
0.32	0.44	0.65	0.32	0.47	0.38	0.81	0.61	0.33

Front of store (fridge unit)

		0.78	1.02	1.10	1.27	0.50	0.80	
0.80	0.80	0.80	1.00	1.10	1.12	0.48	0.81	0.76
0.74	0.80	0.81	1.03	1.11	1.15	0.53	0.81	0.83
0.74	0.82	0.80	1.14	1.17	1.22	0.49	0.84	0.75
0.74	0.59	0.76	1.19	1.24	1.31	0.29	0.77	0.80
0.66	0.72	0.75	1.26	1.41	1.41	0.18	0.74	0.79
0.74	0.71	0.74	1.21	1.47	1.39	0.27	0.79	0.79

Store B

Back of store

0.48	0.55					0.69	0.59	0.59
0.32	0.48	0.56	0.44	0.64	0.51	0.71	0.49	0.38
0.41	0.41	0.65	0.46	0.42	0.48	0.75	0.45	0.30
0.39	0.51	0.65	0.46	0.49	0.49	0.66	0.46	0.44
0.40	0.40	0.64	0.53	0.35	0.27	0.67	0.59	0.51
0.42	0.57	0.79	0.41	0.53	0.35	0.81	0.61	0.58
0.41		0.90	0.52	0.60	0.42	0.91	0.69	0.45

Front of store (fridge unit)

	0.95	1.08	1.82	1.64	1.64	1.26	1.19	
1.45	1.29	1.06	1.66	1.57	1.57	1.06	1.25	0.96
1.36	1.29	0.89	1.18	1.38	1.50	1.11	1.25	0.90
1.36	1.29	0.98	1.48	1.55	1.51	1.02	1.14	0.95
1.24	1.07	0.98	1.48	1.18	1.43	0.98	1.07	1.15
1.29	1.26	1.02	1.33	1.51	1.54	1.07	1.09	1.26
1.18	1.23	0.95	1.51	1.37	1.54	1.01	1.15	1.37

Poor Medium Good

Back: poor (0.03–0.28), medium (0.29–0.54), good (0.55–0.81)
Front: poor (0.18–0.60), medium (0.61–1.03), good (1.04-1.82)

Figure 2. Comparison of airflow between an overhead throw system (Store A) and the 180° turned fridge unit system (Store B). Speeds (m/s) are based on the mean of six airflow sensor readings per box. Figures are based on 9 boxes across and 7 boxes high. Greyed out areas are where there are no boxes.

About Winters Lane Storage Ltd.

Winters Lane Storage (WLS) is a progressive potato storage cooperative. Seven local farming businesses collectively store over 11,000 t in centralised stores at Long Sutton. The refrigerated stores are operational for 11 months of the year, using renewable energy produced on site with a 0.8 MW turbine and 100 kw of photovoltaic panels.

WLS does all it can to maintain the quality of growers' potatoes in its stores. To provide this level of service, we employ a variety of different storage systems.

1. **25% of our tonnage is positively ventilated using Pirie Aspire Systems.**
2. **75% within overhead throw stores (half of which have improved airflow with reversed evaporators).**

"The efficiency and airflows of these overhead throw stores should be greatly improved using the technique of reversing the evaporators developed with AHDB potatoes and their team at SBCSR."

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