RD&T Case Study

Effectiveness of a cold store air curtain

Company: Clark Doors

Background

When Andrew Ashley, the MD of Clark Doors wanted an innovative door curtain tested, he scanned the scientific literature for someone that could help. He found that Dr Alan Foster at RD&T had published several research papers on infiltration through cold store entrances[1,2] and that he had experience in measuring air curtain effectiveness[3,4].

The patented Clark Doors rapid roll door, designed for cold stores (Coldmaster), had an innovative recirculation horizontal air curtain, as opposed to the more normal vertical air curtain used for most cold store air curtains. As this was a new design, Clark Doors wanted to ascertain the effectiveness of the air curtain and to optimise its performance by adjusting the curtain air flows, widths and discharge nozzles.

Testing work

The Coldmaster was fitted on a cold room located at the RD&T test facility.

To determine the effectiveness of the air curtain a tracer gas was 'dosed' into the cold store and allowed to mix so that the concentration stabilised. Concentration of the gas was measured during this period using a high resolution vapour analyser. The door was then operated and the decay in the tracer gas measured after the door was closed. By knowing the concentration of the tracer gas before and after the door opening and also measuring the rate that would have leaked through the closed door, the effectiveness of the curtain could be measured:

$$E = 1 - (I_c/I_{nc})$$

Where E is the effectiveness of the curtain, I_c is the infiltration with the curtain operating and I_{nc} is the effectiveness without the curtain operating.

Effectiveness was measured at different fan speeds, nozzle widths and angles.

Results

Using this method a number of tests were carried out to optimise the performance of the air curtain.

The effectiveness of the Coldmaster horizontal air curtain at various settings was measured and found to be more robust than a vertical air curtain previously fitted to the same doorway, with effectiveness being much less affected by changes in air curtain speed. The Clark Coldmaster achieved reductions in refrigerated air loss through the open doorway of 60% to 70%.

The optimum fan speed, nozzle width and angles were ascertained as well as a greater understanding of how the air curtain reduced infiltration.

1. Foster, A.M., Barrett, R., James, S.J., & Swain, M.J. 2003. Measurement and prediction of air movement through doorways in refrigerated rooms. International Journal of Refrigeration. 25(8), 1102-1109.

2. Foster, A.M., Swain, M.J., Barrett, R., & James, S.J. 2003. Experimental verification of analytical and CFD predictions of infiltration through cold store entrances. International Journal of Refrigeration. 26(8), 918-925.

3. Foster, A.M., Swain, M.J., Barrett, R., D'Agaro, P., & James, S.J. 2006. Effectiveness and optimum jet velocity for a plane jet air curtain used to restrict cold room infiltration. International Journal of Refrigeration. 29(5), 692-699.

4. Foster, AM, Swain, MJ, Barrett, R, D'Agaro, P, Ketteringham, LP & James, SJ. Three-dimensional effects of an air curtain used to restrict cold room infiltration. Applied Mathematical Modelling, 31 (6);1109-1123. 2007.

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