

Title Simulation of effect of stack dimensions and stacking arrangement on cool-down characteristics of potato in a cold store by computational fluid dynamics

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Abstract

Storage loss beyond permissible limits is one of the major problems in the Indian potato cold storage industry. The existing stack dimensions and arrangement of the stacks within the cold store is one of the reasons behind these storage losses. Therefore, the present work was undertaken to simulate the effect of stack dimensions and stacking arrangement on heat transfer characteristics in a stack of bagged potatoes during cooling, developing a computational fluid dynamics (CFD) model and validating the same with the existing prevailing situation. A satisfactory agreement was found between the experimental transient temperature data, as obtained in a commercial potato cold store, and simulated one, with an average temperature difference of 1.4 ± 0.98 °C. Thereafter, the effect of aspect ratio (width/height), volume, width and height of the stack on average product temperature and cool-down time was studied using the validated CFD model. Under the stacking arrangement, the effect of horizontal gap between the bags in a stack and vertical gap between the stacks was also investigated on the average product temperature and cool-down time. It was observed that an increase in the aspect ratio of the stack decreased the average product temperature and cool-down time. On the other hand, the volume and height of the stack showed just the reverse effect. The width of the stack did not make any significant change in terms of temperature of the product which increased slightly with increase in the width. The effect of increasing horizontal gap on product temperature and cool-down time was appreciable only up to a value of 0.05 m. However, increase in vertical gap showed a continuous improvement in heat transfer within the stack. The results of present study would help in selecting the stack dimensions and stacking arrangement with a view to improve the heat transfer characteristics within the stack.