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BRICKWORKS COMMUNICATIONS

Energy Savings Through Temperature Adjustment in Commercial Freezers: A Case for Changing the Standards

Executive Summary

A temperature adjustment study and food safety and quality analysis completed in Toronto has supported a change in provincial regulations to help businesses and the province save energy. The study was conducted with funding raised through the Independent Electricity System Operator's Conservation Fund (IESO), and with support from organizations including the Ontario Restaurant, Hotel, and Motel Association (ORHMA), Toronto Public Health, and Toronto Hydro. Until 2018, Ontario's food establishments have been regulated to keep frozen foods at a temperature of -18°C or lower. This pilot project was conducted to determine if the energy consumption of a commercial freezer is affected by adjusting its internal temperature from -18°C to -15°C without impact of food safety or quality. Ontario regulation will now be enacted on July 1st, requiring food simply to be kept in a frozen state while stored by commercial end-users.

Introduction

The Freezer Temperature Monitoring Project took place at various commercial locations in Toronto. The project was divided into three 2-month phases from May 2017 to November 2017, with 10 freezers metered in each phase. The metered freezers varied in size and use, from small chest freezers to stand-up freezers and large walk-in freezers. In addition, a detailed analysis of 3rd party research was conducted by NSF to assess the potential food safety and food quality impacts of this temperature change. At the end of the project, two surveys were conducted: one to individuals connected to the frozen food cold chain, and one to the business owners who participated in the Freezer Temperature Monitoring Project.

Freezer Temperature Monitoring Project

Each freezer was adjusted initially to a temperature set-point of -18°C, the regulated temperature set-point mandated by Toronto Public Health. Two temperature loggers were installed inside the freezers to record the internal temperature every 30 minutes. The ambient air temperature near the compressor was also recorded at the time of meter installation, and a logger was installed to record the ambient temperature every 30 minutes. An electricity meter was installed on the freezer to record the electricity consumption at one hour intervals.

After four weeks of metering, the temperature set-point of the freezer was adjusted to -15°C (3°C warmer). After an additional four weeks of metering, the metering equipment was removed and the freezer set-point returned to -18°C.

The preliminary results showed an average internal temperature increase of 2.2°C for the 28 freezers used in the analysis, not quite the 3.0°C targeted. The total weighted energy savings over the course of the project was 7.4%. The non-weighted average savings per freezer, which is the average of each freezer's individual energy savings, was 10.0%.

The energy savings for the post-adjustment period was the least in Phase 1 (1.7%), when the ambient temperature around the compressor increased on average by 1.4°C as the season moved from spring to summer. The energy savings for the post-adjustment period was the greatest in Phase 3 (10.8%), when the ambient temperature decreased on average by 3.0°C. This suggests that the ambient temperature around the compressor influences the energy usage of the freezers. In previous research, it has been shown that an increase in ambient air temperature of 1.0°C around the compressor can increase electricity usage by 5-7%. In order to determine the true energy savings caused by changing the internal freezer set-point, the effect of the ambient temperature had to be calculated.

Using linear regression and the post-adjustment ambient temperature data, the baseline energy consumption for each freezer was calculated. Each collected ambient temperature point was used in the linear regression equation to determine what the freezer energy consumption would have been, prior to the internal temperature adjustment. For Phase 1, because of the positive linear correlation and higher ambient temperatures, the baseline kWh was typically higher than the pre-adjustment kWh from the preliminary results. For Phase 3, due to the lower ambient temperatures, the baseline kWh was typically lower. Of the 28 tested freezers, 16 showed a significant correlation with changes in ambient temperatures. On average, the energy consumption increased by 2.8% for every 1°C increase in ambient temperature.

Food Safety/Quality Research and Response Surveys

Food safety was treated as a primary focus in this study, with experts from NSF International conducting a detailed review of literature on time/temperature tolerance studies. Based on this research, the policy change to freezer temperature adjustment will not have an impact on food safety. Bacteria are inert when frozen, so food can be stored for consumption equally safely at any temperature below 0°C as it can at -18°C.

NSF International's research highlighted that food quality (colour, texture, etc.) may be more at risk from warmer freezing temperatures. Food stored for longer periods at warmer temperatures is more likely to experience food quality degradation. Specific products such as ice cream need to be kept at colder temperatures.

Manufacturing, storage, and retail companies which operate along the frozen food cold chain were surveyed regarding their views and concerns about a change in the standard freezer temperature set-point. The majority of the respondents (73.33%) supported a change in regulation to lower frozen food storage temperature to -15°C, even along

the cold chain. Those who did not expressed clear concerns that long storage periods from shipping of product to other countries would have a food quality impact. This study, however, is focused on freezer temperatures within commercial food establishments.

Finally, following each phase of the freezer testing, a survey was administered to the business owners. This test was to determine if any issues were uncovered from a modified temperature set-point over the one month Phase 2 testing at -15°C. For the majority of respondents, frozen food is held and used in a very short period of time. Most businesses try to hold very low inventory for cash flow reasons and with regular deliveries, they are able to move through food quickly, most in a 1-2 week period. In some cases food will be in store for a 2-month period. In all cases, business owners expressed no concern regarding a temperature set-point adjustment to -15°C.

Summary of Results

The total cumulative daily energy savings of all the tested freezers over the project was 36.7 kWh per day, which was an energy reduction of 7.4%. The non-weighted average energy savings was 10% per freezer. The freezers averaged an internal temperature increase of 2.2°C, below the target adjustment of 3.0°C. The energy savings, both weighted and unweighted, would increase if the temperature adjustment increased from 2.2°C to 3.0°C.

Conclusion

The findings of this pilot project supported a call for facilitating a change in the acceptable temperature set-point for commercial freezers in Ontario. The study demonstrated that regulating a three degree adjustment to the freezer temperature set-point would not compromise frozen food safety or quality (though products like ice cream or those held in food establishments for many months would still benefit from colder temperatures), and would result in immediate energy savings for businesses and the province.

New Ontario regulation will be enacted on July 1st, 2018, requiring only that “Food that is intended to be distributed, maintained, stored, transported, displayed, sold or offered for sale in a frozen state shall be kept in a frozen state until sold or prepared for use.” This research also offers a strong basis for other jurisdictions in Canada and the United States to consider similar policy changes and examine other opportunities.