OPTIMIZATION OF ICE AND CONCRETE SLAB THICKNESS

BACKGROUND

Reference conditions

In most arenas, ice thickness varies from 20 to 40 mm with 25 mm of concrete slab above the embedded brine-tube network.

Proposed improvements

To reduce the refrigeration system energy consumption:

- Keep the ice at an optimal thickness, generally 25 mm.
- On a new arena or when replacing the concrete rink floor, ensure that the concrete thickness above the embedded coolant pipes is not in excess of 25 mm.

BENEFITS

Direct impacts

The refrigeration system energy consumption and performance are directly affected by the thickness of the ice and the concrete. The thicker these are, the more electricity it takes for the refrigeration system to maintain the top surface of the ice at the desired temperature: i.e. 10,000 kWh/yr/inch of ice and 3,000 kWh/yr/inch of concrete.

Indirect impact

With increased ice or concrete thickness, the additional electrical consumption of the refrigeration system provides more recoverable energy to meet space-heating needs in the arena.

REFRIGERATION SPECIALIST'S REMARKS

Figure 2 indicates that reduced ice or concrete thickness has a significant effect on the refrigeration system consumption. However, total energy consumption is merely unaffected, as the cooling system's increased energy consumption is offset by the quantity of heat recovered. We nevertheless recommend reducing ice and concrete thickness for two reasons: the refrigeration system provides more capacity with better performance with a reduction in mechanical work, therefore life expectancy is extended. A network of heat pumps to recover refrigeration system heat rejection will significantly reduce energy consumption for space heating (see fact sheet No. 7: Using a Network of Heat Pumps).

ARENA'S ANNUAL GREENHOUSE GAS (GHG) EMISSIONS

	Total emissions* Tonnes CO_2-eq./yr
Ice thickness 20 mm; concrete thickness 25 mm	*266 (-1%)*
Ice thickness 20 mm; concrete thickness 50 mm	*267 (-0.5%)*
Ice thickness 25 mm; concrete thickness 25 mm	*267 (-0.5%)*
Ice thickness 50 mm; concrete thickness 50 mm	*268 (Ref.)*
Ice thickness 50 mm; concrete thickness 25 mm	*268 (-)*

NOTE* Calculations of GHG emissions include electricity, fossil-fuel energy and refrigerant leaks.

NOTE: Energy consumption and energy savings were estimated on the basis of Montréal's 1996 climatic profile. Readers may refer to the technical fact sheet "Reference Arena".

Natural Resources Canada
CANMET Energy Technology Centre - Varennes
1615 Lionel-Boulet Blvd, P.O. Box 4800
Varennes (Quebec) J3X 1S6
Phone: (450) 652-4621 E-mail: CTEC-CETC.Varennes@NRCan.gc.ca
Web site: http://cetc-varennes.nrcan.gc.ca

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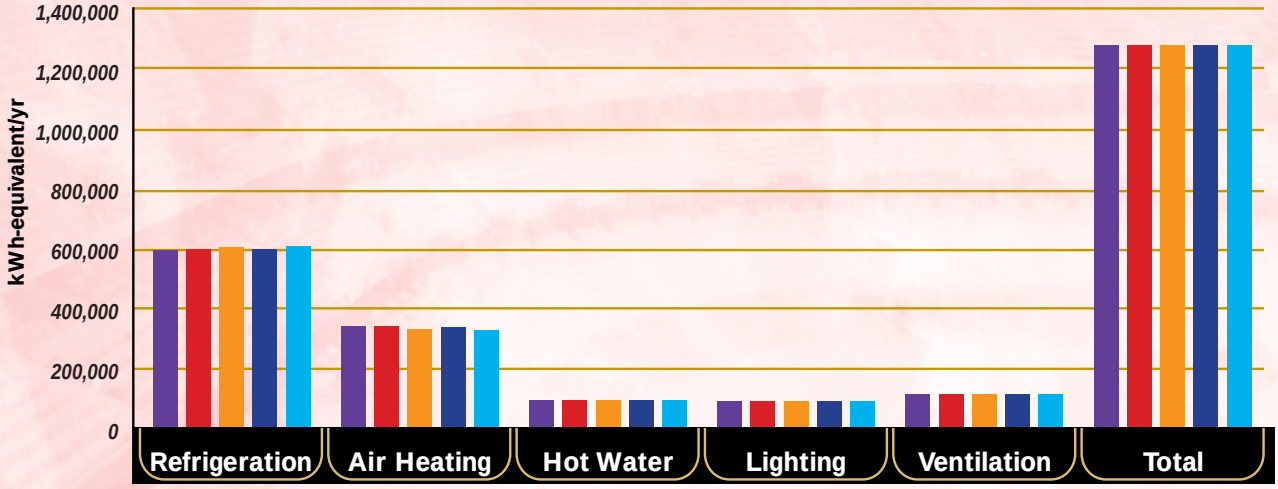
http://cetc-varennes.nrcan.gc.ca/fr/publication/2003-066-8f.html.

OPTIMIZATION OF ICE AND CONCRETE SLAB THICKNESS

Arena's Energy Consumption



Ice 20mm/Concrete 25mm	605,000 (-2%)	352,000 (4%)	105,000	102,000	124,000	1,288,000 (-)
Ice 25mm/Concrete 25mm	607,000 (-2%)	350,000 (3%)	105,000	102,000	124,000	1,288,000 (-)
Ice 50mm/Concrete 25mm	616,000 (-1%)	340,000 (1%)	105,000	102,000	124,000	1,287,000 (-)
Ice 20mm/Concrete 50mm	608,000 (-2%)	349,000 (3%)	105,000	102,000	124,000	1,288,000 (-)
Ice 50mm/Concrete 50mm	619,000 (Ref.)	338,000 (Ref.)	105,000	102,000	124,000	1,288,000 (Ref.)

Figure 1

Impact of the refrigeration system's energy consumption in terms of ice and concrete thickness

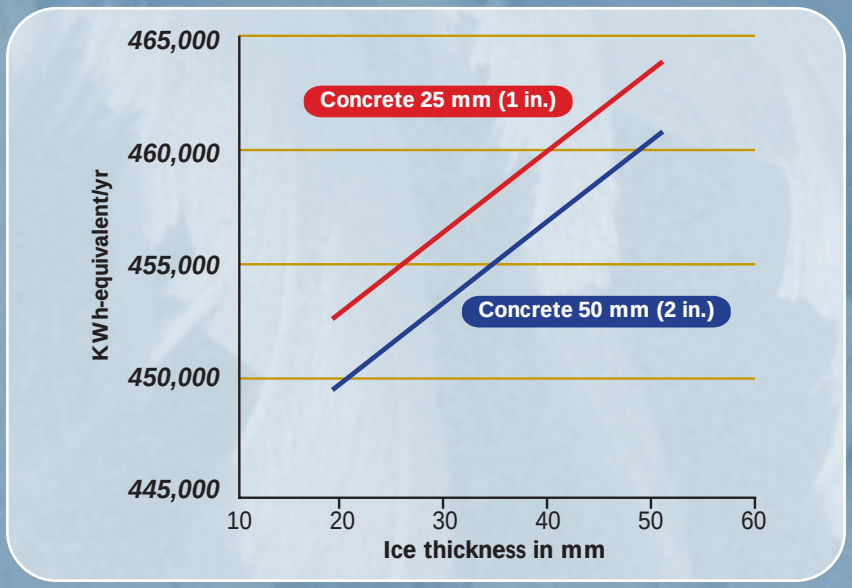


Figure 2

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