

Analysis:

The results show that the proposed design can analytically meet the 5 min cooling requirement, but the final margin is relatively small. The preliminary calculation predicted 4.43 min because the entire bath was treated as remaining at about 18°F . The final analysis included a water to ice convection check. This increased the predicted the cooling time to about 4.81 min.

The performance of the actual device would depend on maintaining the required salted ice water temp, achieving sufficient pump flow, directing the water evenly around all 6 cans, and maintaining good contact between the warmer return water and ice. The drink side convection coeff and the effective ice surface area are modeling assumptions and would ideally be verified experimentally. Larger ice pieces, reduced pump flow, or poor circulation could increase the cooling time beyond 5 min. Smaller ice pieces and better flow distribution would increase water to ice heat transfer and improve cooling performance.

Therefore, the calculations provide analytical proof that the design can meet the project requirement under the stated design conditions, but physical testing would be needed to verify the exact cooling time.