

## Determination of Heat Transfer Coefficients for the Freezing of Foods

Bryan R. Becker, Ph.D., P.E. – Corresponding Author  
Professor  
Mechanical Engineering  
University of Missouri-Kansas City  
5100 Rockhill Road, Kansas City, MO 64110-2499  
Phone: 816.235.1255  
Fax: 816.235.1260  
e-mail: beckerb@umkc.edu

and

Brian A. Fricke, Ph.D.  
Visiting Assistant Professor  
Mechanical Engineering  
University of Missouri-Kansas City  
5100 Rockhill Road, Kansas City, MO 64110-2499  
Phone: 816.235.1273  
Fax: 816.235.1260  
e-mail: frickeb@umkc.edu

### ABSTRACT:

To maximize the efficiency of cooling and freezing operations for foods, it is necessary to optimally design the refrigeration equipment to fit the specific requirements of the particular cooling or freezing application. The design of food refrigeration equipment requires estimation of the cooling and freezing times of foods, as well as the corresponding refrigeration loads. The accuracy of these estimates, in turn, depends upon accurate estimates of the surface heat transfer coefficient for the cooling or freezing operation. This project reviewed heat transfer data for the cooling and/or freezing of foods. A total of 777 cooling curves for 295 food items were obtained from an industrial survey and a unique iterative algorithm, utilizing the concept of “equivalent heat transfer dimensionality,” was developed to obtain heat transfer coefficients from these cooling curves. The 777 heat transfer coefficients for 295 food items, resulting from this algorithm, as well as the 144 heat transfer coefficients for 13 food items, collected from the literature, were summarized in tabular format, with only a small portion of that data presented in this paper. The data and correlations resulting from this project will be used by designers of cooling and freezing systems for foods. This information will make possible a more accurate determination of cooling and freezing times and corresponding refrigeration loads. Such information is important in the design and operation of cooling and freezing facilities and will be of immediate usefulness to engineers involved in the design and operation of such systems.