

# Plate heat exchangers in the food industry

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## 4.1 Introduction

Heat treatment is a common and important unit operation in food plants to increase the shelf life and assure the hygienic safety of food products ( Jun & Puri, 2005; Sharma & Macchietto, 2021). Heat exchangers are extensively used in the food industry for heating, cooling, and heat recovery of food products (Gulenoglu, Akturk, Aradag, Uzol, & Kakac, 2014). Plate heat exchangers (PHEs) are appropriate for liquid–liquid heat-transfer operations that require rapid and uniform heating or cooling of heat-sensitive fluids such as liquid foods (Afonso, Hes, Maia, & Melo, 2003). PHEs are the most successful heat exchangers for liquids in the food industry because of their thermal performance, compactness, flexibility, low cost, ease of cleaning, assembly, and disassembly (Merheb, Nassar, Nongailard, Delaplace, & Leuliet, 2007).

The first use of PHEs in the food industry dates back to the late 19th century (Magnusson, 1985). Nowadays, PHEs are extensively used for heat treatment of low-viscosity liquid foods without particles such as milk, fruit juice, beer, and liquid egg (Aguiar & Gut, 2014). Moreover, PHEs can be used in other food processing operations such as evaporation, heating, and cooling in pretreatment and fermentation (Wang, Sundén, & Richardson, 2004). Generally, the heat-transfer coefficient of a PHE is four to five times higher than that of a shell and tube heat exchanger. PHEs have a very compact heat-transfer area, and their space requirement is 10% of a typical shell and tube heat exchanger. When the fluid flows through a PHE, heat is transferred from hot to cold media. The countercurrent flow in PHEs maximizes the heat recovery, and a very close temperature approach can be obtained. Moreover, temperature cross is also possible in PHEs, meaning that the hot outlet can reach a lower temperature than the cold outlet that makes PHEs more thermally efficient than shell and tube heat exchangers (Alfa Laval, 2022).

The plates of PHEs should be manufactured from resistant materials because they are subjected to high pressure and temperature. Plates should be made from malleable