

7 Other Processes

This chapter discusses briefly other processes not already covered in this book such as thermoforming, blow moulding, and expanded polystyrene (EPS) foaming.

7.1 Thermoforming

7.1.1 Introduction

Thermoforming is among the oldest of the plastic shaping techniques and is a manufacturing process for thermoplastic sheets or film. The sheet or film is heated to its forming temperature and stretched over, or into, a temperature controlled, single surface mould. The sheet is held against the mould surface unit until cooled and the formed part is trimmed from the sheet. There are several categories of thermoforming including vacuum, pressure, twin-sheet, drape forming, free blowing and simple sheet bending. The five main steps when thermoforming are shown in **Figure 7.1**.

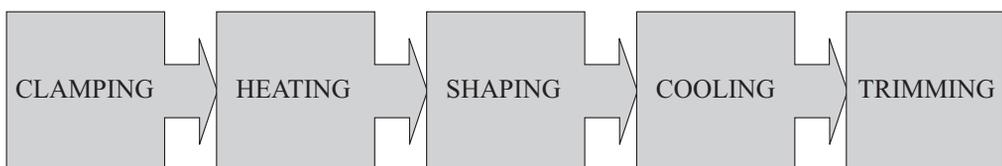


Figure 7.1 The five main steps in thermoforming

7.1.2 Energy Consumption

Thermoforming is an energy intensive business and good energy management is the key to productivity improvement, quality and positive public image. In the benchmarking

survey, carried out by the ‘RECIPE’ project [1], thermoforming was found to be the highest energy consuming process on the basis of kWh/kg of finished product. The survey was conducted in 2005 and included offices and infrastructure in the overall energy figures that were collected. It is also likely that some of the thermoforming companies that responded produced their own sheet, so in reality the specific energy consumption would have included both the sheet manufacture and the thermoforming process. Figure 7.2 shows how the different processes compared with each other, and in general terms we could say that the extrusion operations were around 1 kWh/kg, injection and compression moulding were 3 kWh/kg, and rotational moulding and thermoforming were 6 kWh/kg. Therefore, even if the sheet extrusion component is deducted from the total, then thermoforming would still have a specific energy consumption of 5 kWh/kg. This high figure is not surprising when we consider that the process includes, individual heating and cooling of each sheet, a large amount of mechanical movement, and subsequent trimming which results in a significant amount of in house recycling, and hence reprocessing of the trimmed material.

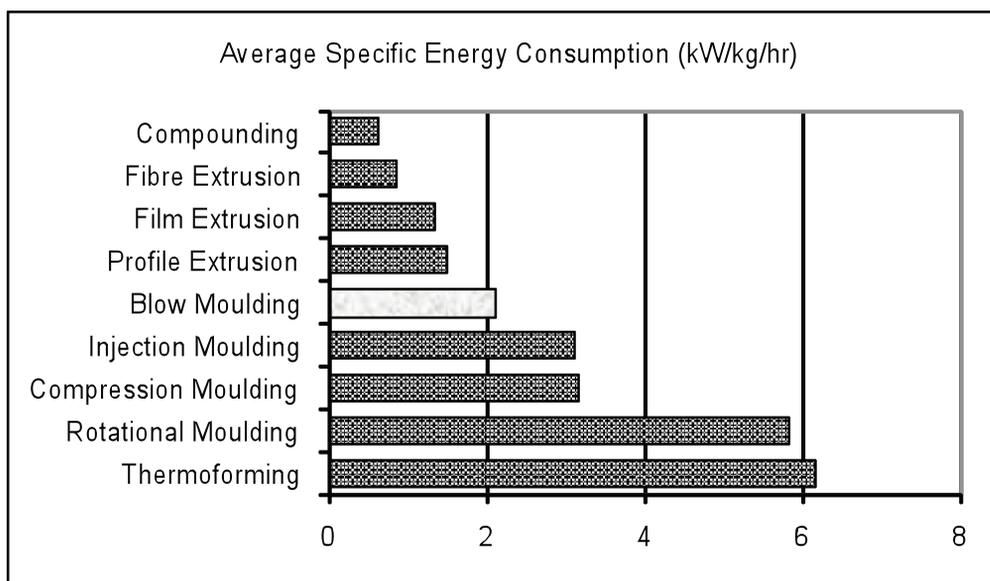


Figure 7.2 Specific energy consumption of a range of processes. Reproduced with permission from the *Low Energy Plastics Processing - European Best Practice Guide*, RECIPE/IEE project, 2006, p.33