Chapter 2

Transport Phenomena

2.1 Perspective

The study of transport phenomena is concerned with the transfer of mass, momentum, and heat. The analysis of these processes is based on the basic laws of physics, namely conservation of mass, momentum, and energy.

Consider, for example, injection molding of a thermoplastic part, Figure 2.1. The polymer is melted and then forced under pressure through channels or runners and then a narrow gate into the mold. The melt cools and solidifies in the mold and is next ejected as the final part.

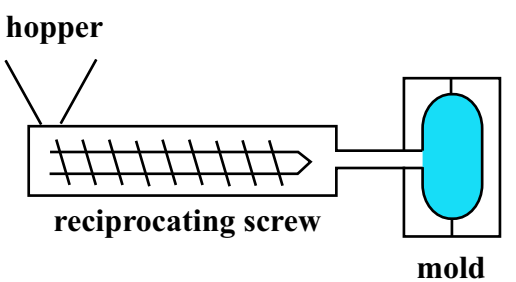

Figure 2.1: Schematic of the injection molding process.

In a manufacturing operation where the goal is to produce parts as quickly as possible to an acceptable quality standard, several questions naturally arise. How much injection pressure is required to fill the mold? How much clamping force is needed to keep the mold closed during injection? How long

must the part be allowed to cool in the mold before it can ejected without damage or warping? Can process parameters such as the melt temperature be altered to increase the production rate?

These questions may be answered using the tools of transport phenomena.