

6 Moulds and Tooling

The mould, tool and die industry is one of the most important sectors in the European Union (EU) dominated by Small and Medium Sized Enterprises (SME), but is currently facing major challenges. Reducing overheads through energy saving can help with increasing cash flow, and in times of economic uncertainty this can be a great benefit. Furthermore, the increasing amounts of new legislation make it even more important.

Moulds, tools and dies are involved in the design and manufacturing supply chain of almost all industrial products from aeronautical and automotive to electronics and household products. They are on the critical path of the product development process and are the key to a short ‘time to market’.

Increased pressure from low cost countries, new technologies and the demand for short cycle time and limited quantities are putting pressure on an intensively competitive industry.

Energy and environmental management are important issues that are already on the agenda for many leading European businesses. There are many ways to improve the energy and environmental impact of organisations but for many companies the financial benefit is the key motivator.

6.1 Introduction

Despite the amount of information available in the literature, rapid heating and cooling of moulds does not represent a well-developed area of practice. Development of suitable techniques for rapidly heating and cooling a mould with the relatively large mass is technically challenging because of the constraint set by the heat transfer process and the endurance limits set by the material properties.

The ideal condition is to have a hot mould during the filling stage and a cold mould during the cooling stage [1]. A large number of strategies for cooling injection moulds can be used - these include those relating to mould technology, equipment technologies and process technologies.

The research makes clear that there are many unanswered questions surrounding variable mould temperature control. They range from basic work in the field of heat transfer to practical aspects such as: How does the cost/benefit analysis work out? What temperature should be provided for a particular material and a defined quality improvement?

What temperature difference is still acceptable on economic grounds? Cooling time, alone, consumes up to 60 to 80% of the cycle time.

The mould heating methods can be classified into four categories depending on the type of heat supply (see **Figure 6.1**).

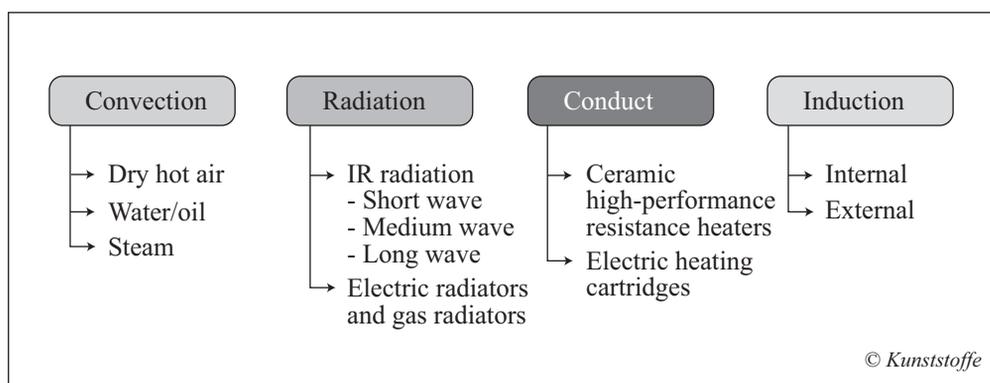


Figure 6.1 Mould Heating Methods. Reproduced with the permission from H. Ridder and H.P. Heim, *Kunststoffe International*, 2009, **99**, 5, 12 [1]. ©2009, Carl Hanser Verlag, Munich, Germany

6.2 Variable Temperature Control

Variable temperature control involves heating the mould cyclically for the injection phase and cooling it down for the cooling phase [1].

The baseline temperature level of the injection mould is determined by the material used and should be as low as possible in the interests of a short cycle time as far as is permitted by the required part properties. The maximum required heating temperature of the cavity surfaces can only be determined by considering the particular application