Chapter 6

Reaction Injection Moulding (Liquid Injection Moulding)

Reaction injection moulding (RIM), alternatively and probably more realistically called liquid injection moulding (LIM), or sometimes high-pressure impingement mixing (HPIM), is essentially a 'one-shot' process for moulding polyurethane elastomers by carrying out the reaction and moulding process through the sequence of steps shown in Fig. 6.1, which represents a true one-shot process in which all the liquid components are individually metered and pumped to the mixer, where they are thoroughly mixed and then dispersed.

A number of variants of this basic principle are possible and usually practised for convenience in industry, and these are referred to, respectively, as the two-component (Figs 6.2 and 6.3) and quasi-prepolymer systems (Fig. 6.4). These flow-diagram metering arrangements are used to simplify the otherwise very difficult problem of synchronizing the feed of several liquid pumps in a chemical operation where accuracy of component ratio is critical. In the two-component system the polyol, silicone, catalyst and blowing agent are premixed (component B). The isocyanate (component A) is then reacted with this premix. The advantage of this system is that only two components enter the mixer. However, changing the formulation is not as easy as with the one-shot system.

In a true prepolymer all the polyol is reacted with the isocyanate, and this mixture, having an excess of isocyanate, is then reacted with chain extender to give the final elastomer. The difference in volumes between prepolymer and chain extender or alternatively between polyol containing chain extender and other additives, mix A, and the isocyanate component, mix B, is considerable and creates formidable problems of metering accuracy. This has given need for a system where metering could be simplified by feeding together the reactants A and B in approximately equal volumes, thus resulting in the quasi-prepolymer system. In this process only a part of the
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polyol is prereacted with the isocyanate giving a so-called quasi-prepolymer which has an excess of isocyanate. This is then reacted with the remaining part of the polyol in the presence of catalyst, surfactant and other additives. This two-step reaction results in better control of the foaming process. The ingredients are much more compatible and the heat of reaction is spread over two steps, resulting in less risk of scorching. Figure 6.4 is a line diagram of the quasi-prepolymer process.

**Fig. 6.1.** Outline of typical steps in the RIM process (from Sweeney, 1979).