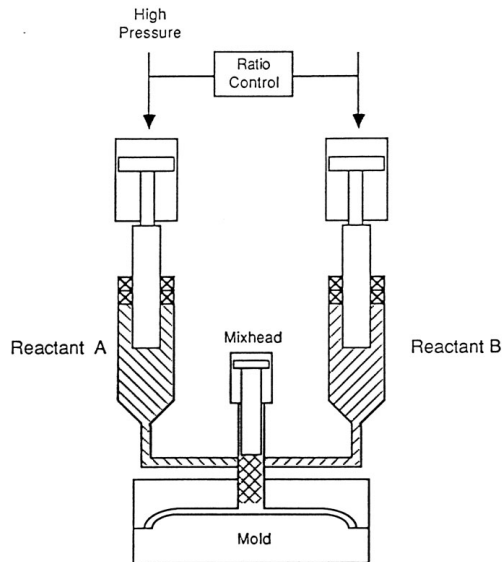
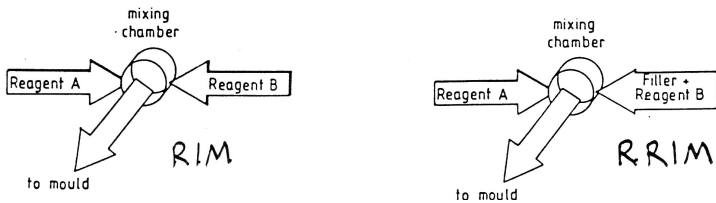


Reaction Injection Molding



Schematic of a RIM machine. When the mixhead ram moves back, two or more liquid reactants flow at high pressure (100-200 bar) into the mixhead chamber. There they impinge and begin to polymerize as they flow into the mold.

Figure 1: C.W. Macosko, **Fundamentals of R.I.M.** (Hanser, 1989).



Reaction Injection Molding

BASIC CHEMISTRY

polyol + isocyanate → polyurethane
with no volatile byproduct

Polyols: chains are PEO, PPO

Diol:

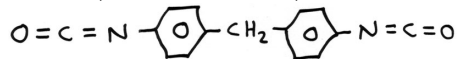


Triol:

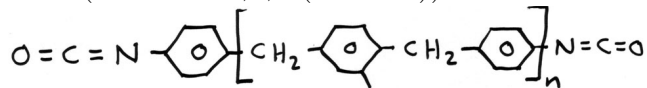


Isocyanates:

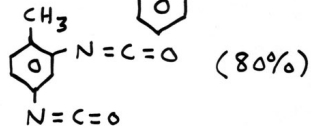
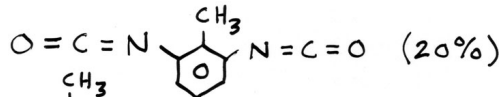
MDI: (most common)



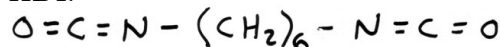
PPI: (where n=3,4,5 (mixture))



TDI:

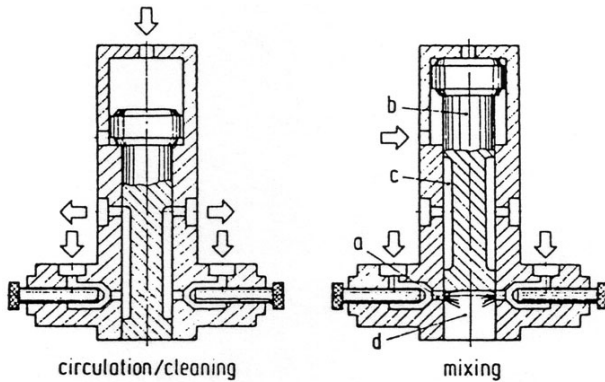


HDI:

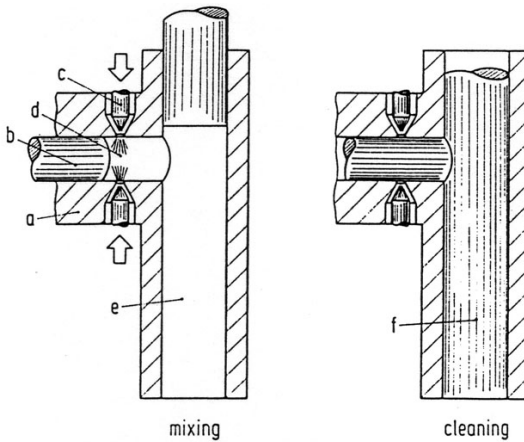


Reaction Injection Molding

IMPINGEMENT MIXING FOR RIM AND RRIM



Keurleber and Pahl (1970) mixhead. In the closed or recirculation position. Reactants recirculate through grooves (c) along the cylindrical cleanout piston (b). In the open position. Reactants flow at high velocity through circular orifices (a), impinge in the chamber (d) and flow out to the mold cavity (diagram from Oertel, 1985).



L shaped throttling system (Schülter, 1973; Florentini, 1982; diagram from Oertel, 1985).

Reaction Injection Molding

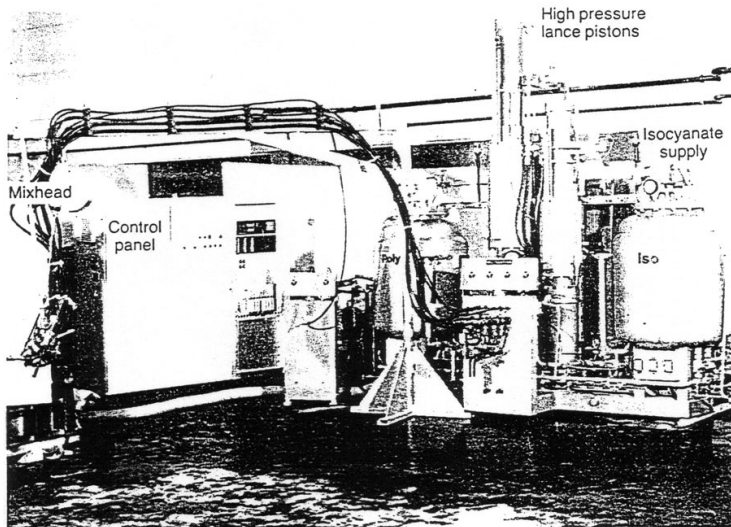


Figure 3.1 A typical RIM machine, without mold (from Battenfield product literature, 1986).

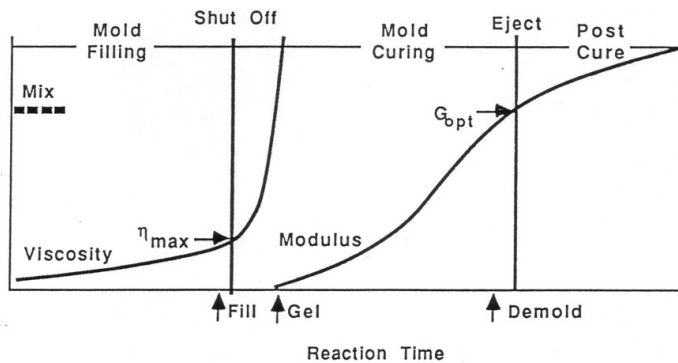
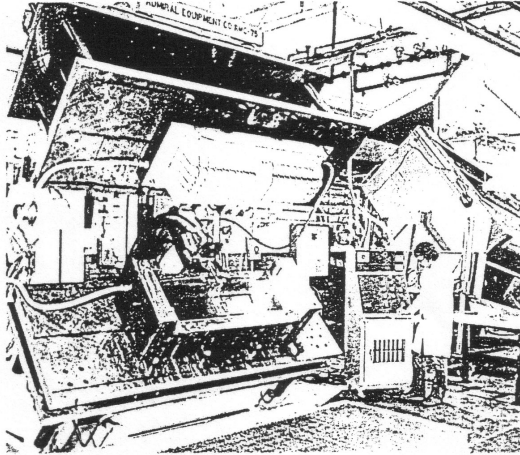


Figure 2.1 Rheological changes during a RIM cycle (adapted from Broyer and Macosko, 1976).

Reaction Injection Molding



• RIM booking press with bus bumper mold [ADMIRAL]

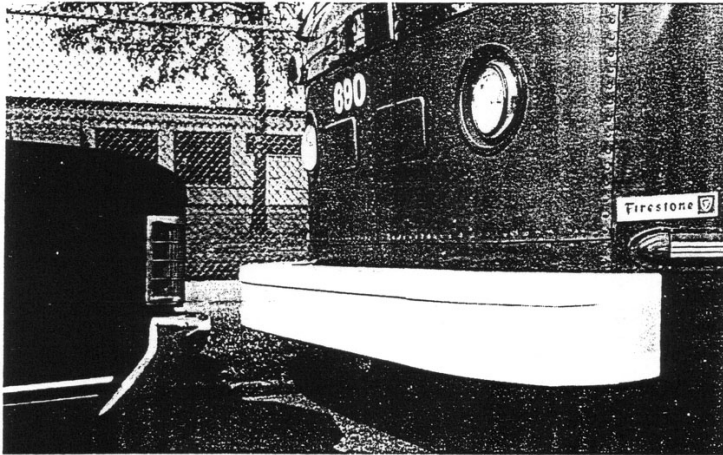


Fig. 1-3. Closeup of HELP bumper. Courtesy of Firestone Tire & Rubber Co.

Reaction Injection Molding

Advantages:

1. Low viscosity - large parts with thin sections are no problem.
2. Easy to incorporate fillers
3. No regrind
4. No weld lines

Problems:

1. Incomplete mixing
2. Toxic monomers (isocyanates smell bad)
3. Chemistries are limited to those that form crosslinks without a volatile byproduct (chiefly polyurethanes)
4. No way to recycle thermosets