



ANTEC 2008

Kneader Technology
for the Direct Devolatilization
of Temperature Sensitive Elastomers

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LEADER IN HIGH VISCOSITY PROCESSING TECHNOLOGY

Conventional Process

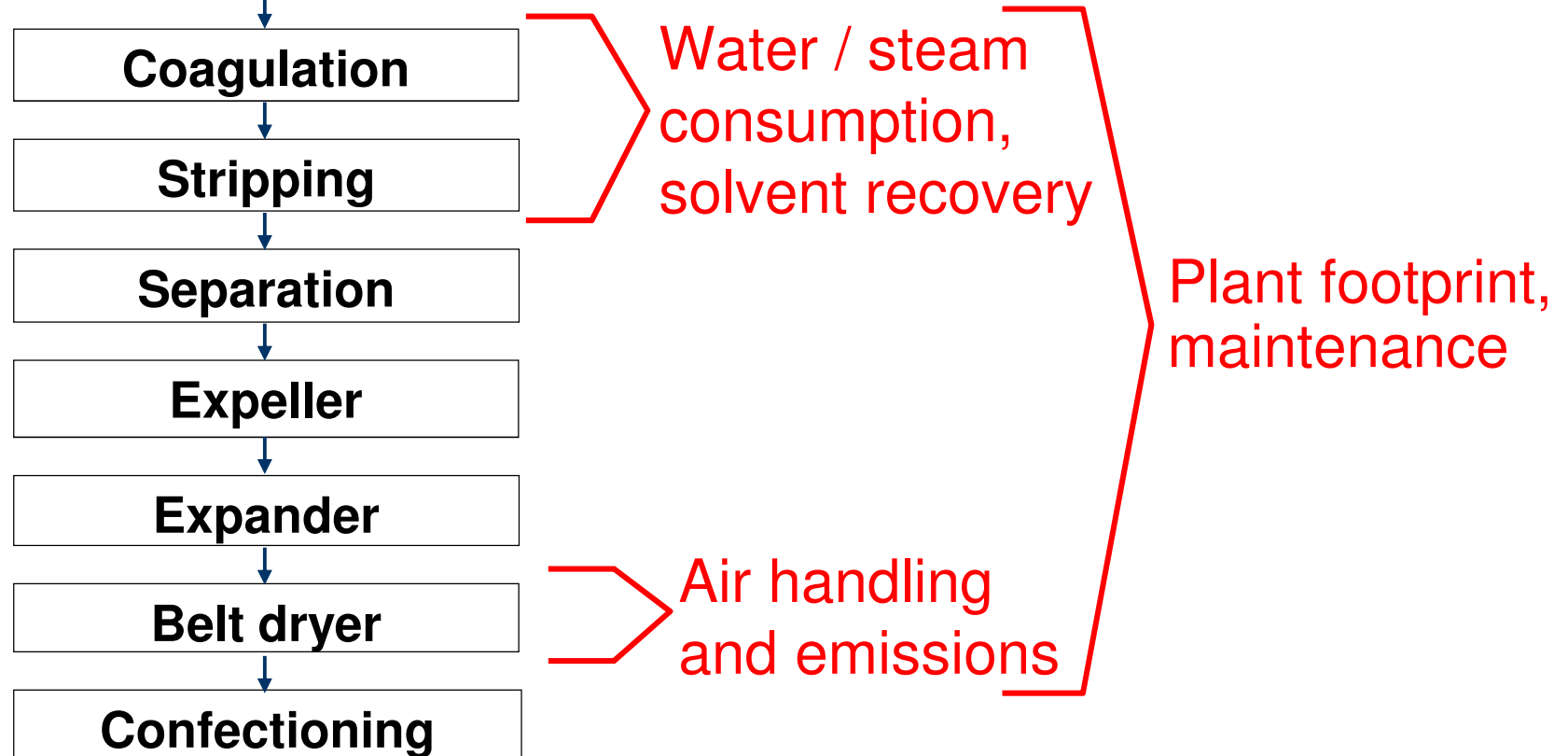
- ◆ Polymerization exothermic
- ◆ Temperature control important
- ◆ Polymer temperature sensitive
- ◆ Viscosity increases with MW build



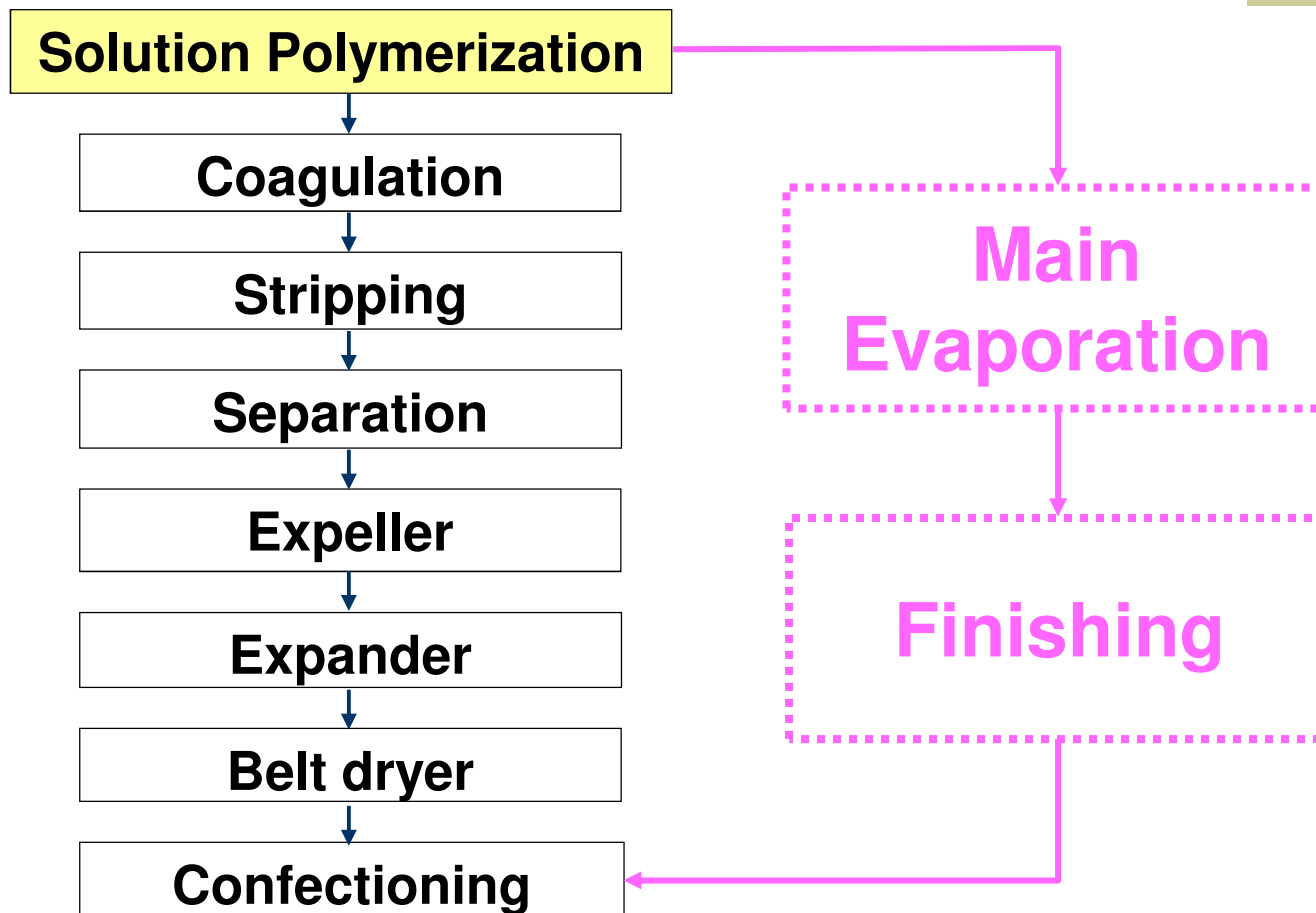
- ◆ Solution polymerization
- ◆ Stirred tank reactors
- ◆ Steam stripping for solvent removal

Conventional Process

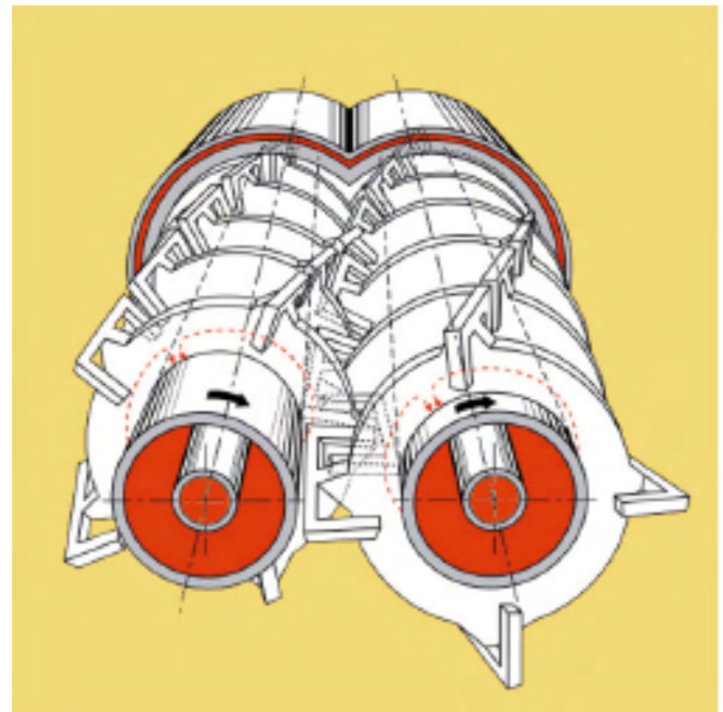
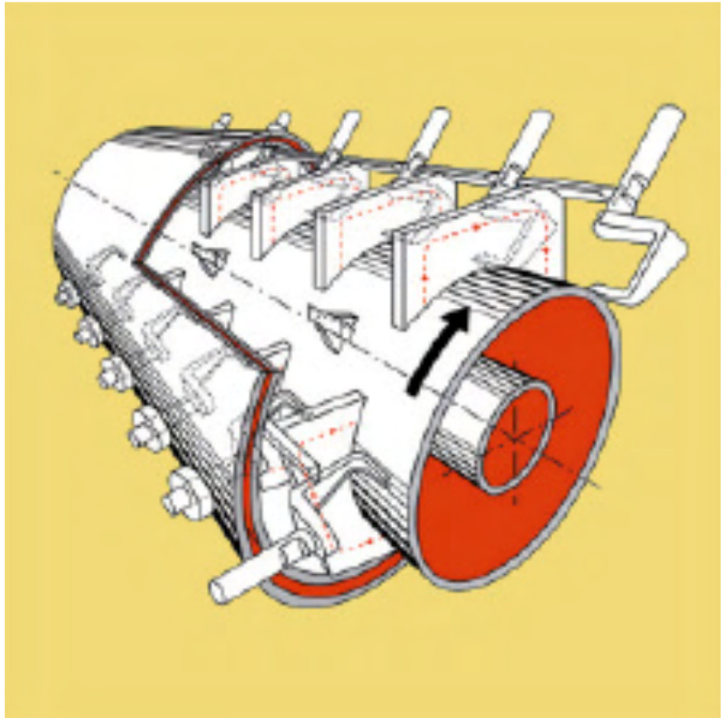
Solution Polymerization



Conventional vs. Direct Devolatilization



Kneader Technology



Main Evaporation

- ◆ Cement feed of 75-90% solvent
- ◆ Maximum temperature of 100 °C
- ◆ High energy duty for solvent evaporation



- ◆ Back mixed kneader reactor
- ◆ Discharge target of 2-10% solvent
- ◆ High mechanical energy input

Finishing

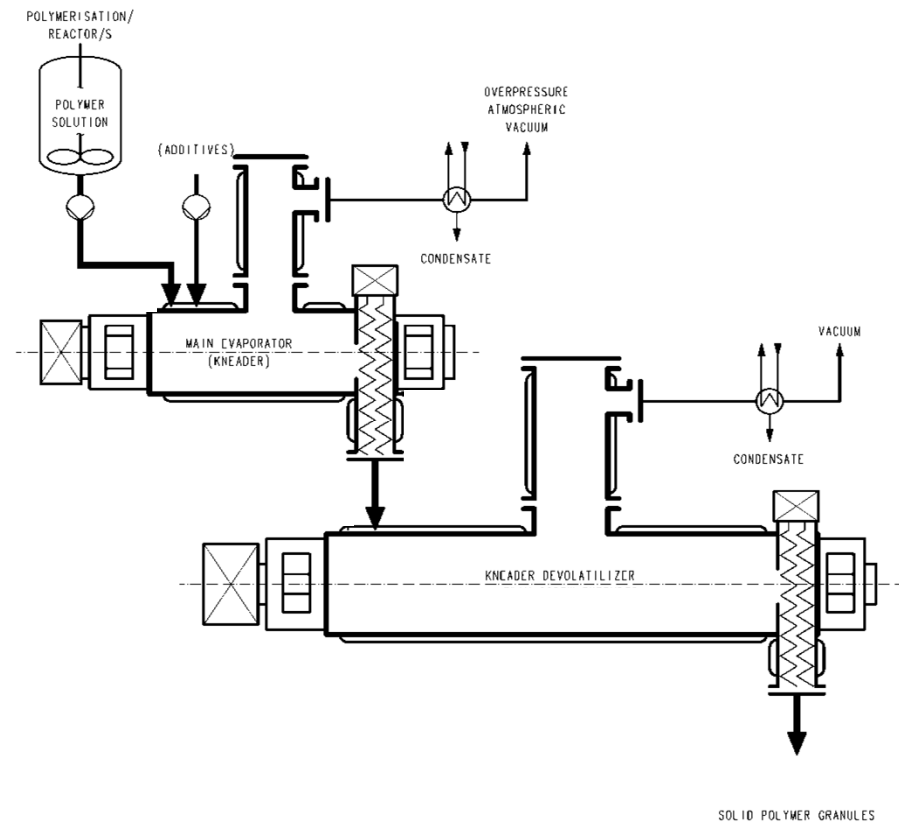
- ◆ Pasty feed of 2-10% solvent
- ◆ Maximum temperature of 100 °C
- ◆ High viscosity \Rightarrow high mechanical energy
 \Rightarrow overheating of elastomer



- ◆ Plug flow kneader reactor
- ◆ Discharge target of 200-2000 ppm solvent
- ◆ Process elastomer as crumbles

Two Step Process for Direct Devolatilization

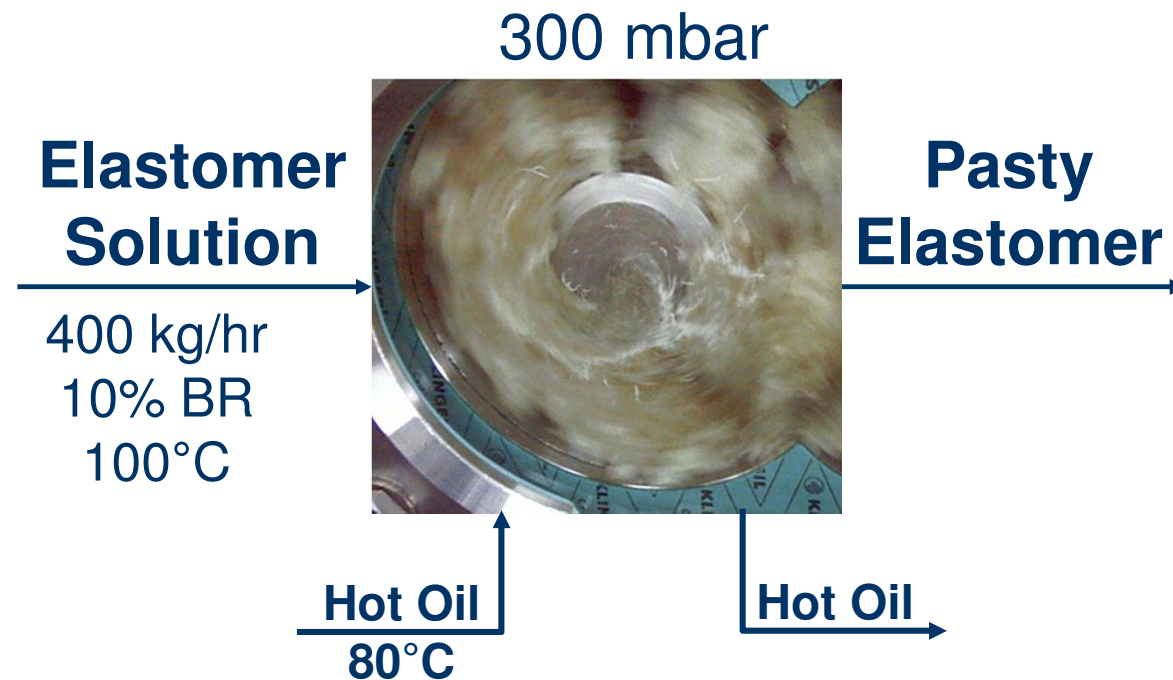
- ◆ Installed at Fraunhofer Gesellschaft, Schkopau, Germany
- ◆ Part of larger semi works plant for polymer synthesis, production, and testing



Main Evaporation

Experimental

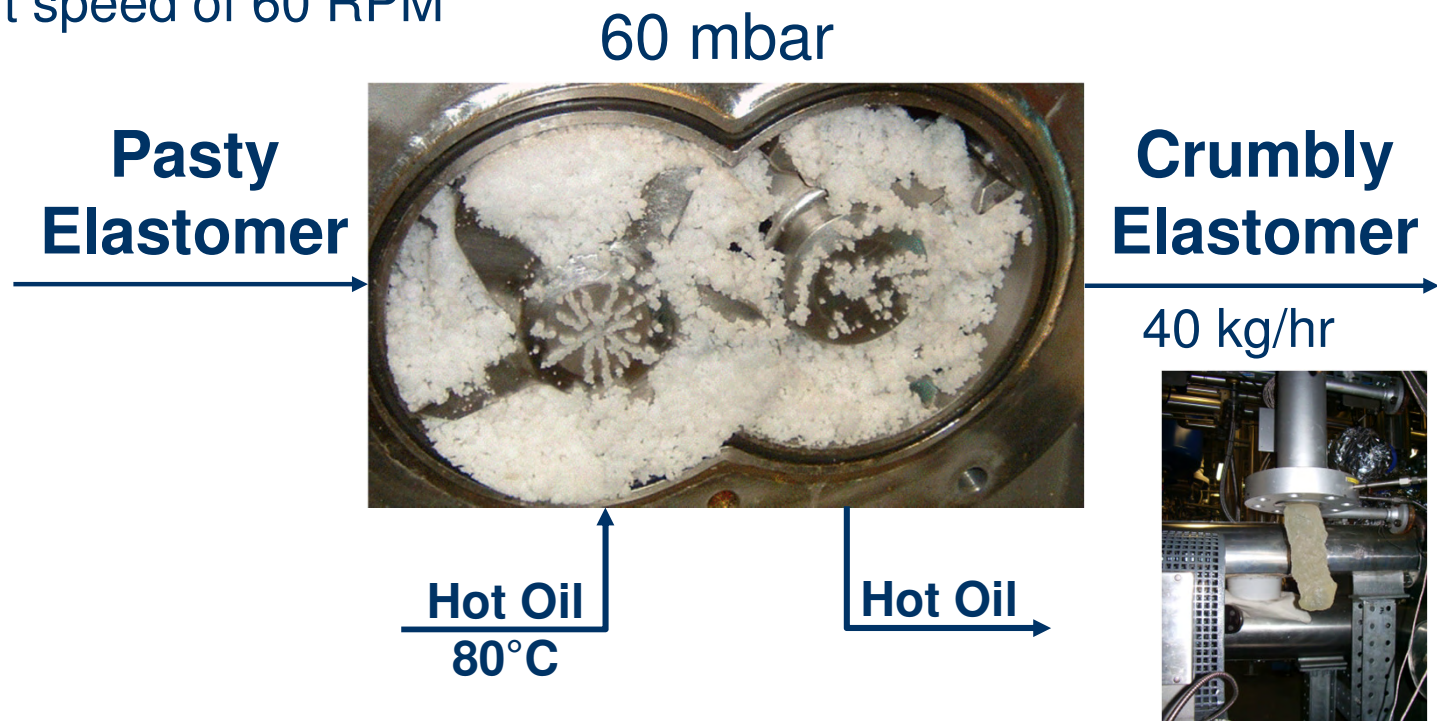
- ◆ 100 liter single shaft kneader reactor
- ◆ Residence time of 15 minutes
- ◆ Shaft speed of 50-80 RPM



Finishing

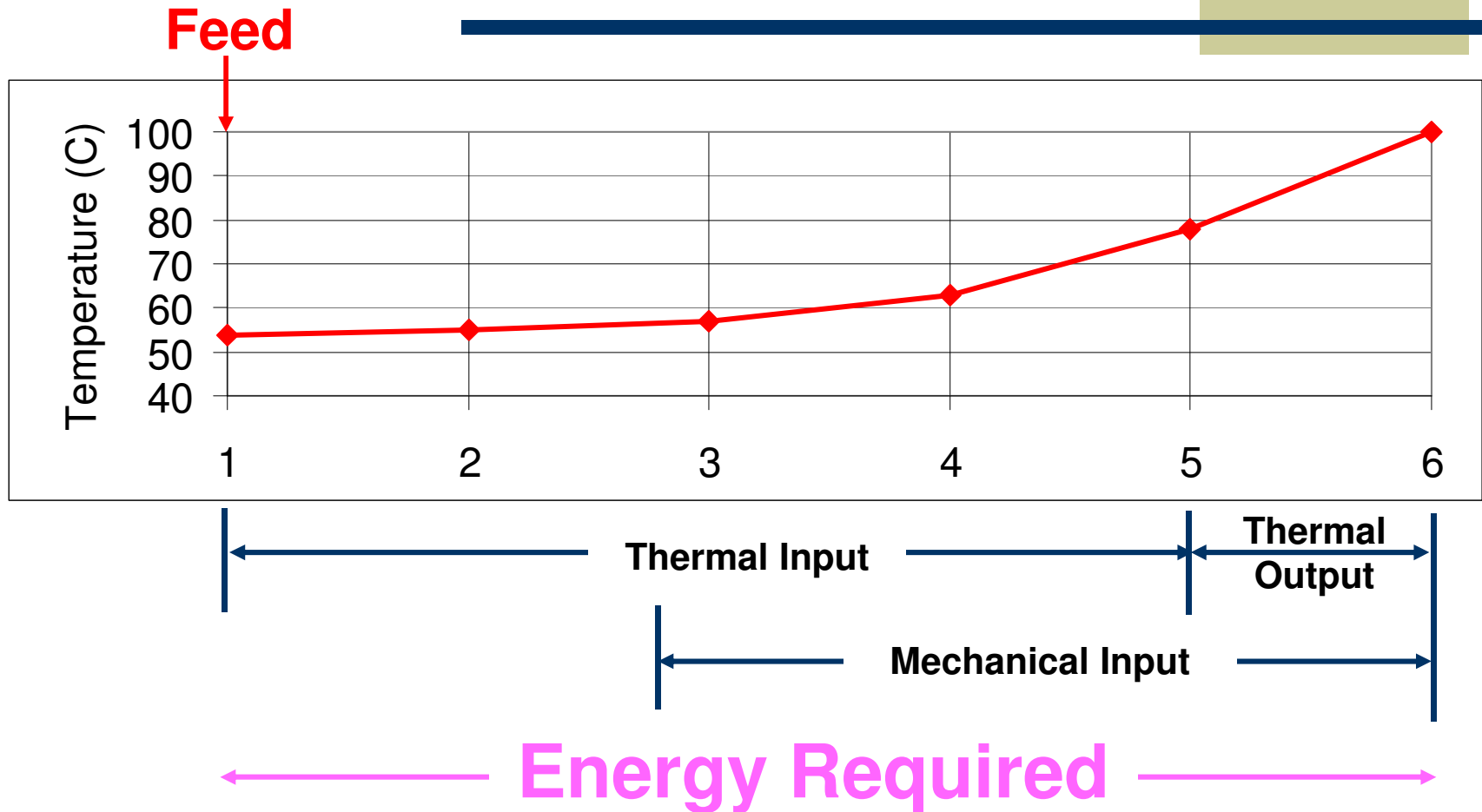
Experimental

- ◆ 200 liter twin shaft kneader reactor
- ◆ Residence time of 30 minutes
- ◆ Shaft speed of 60 RPM



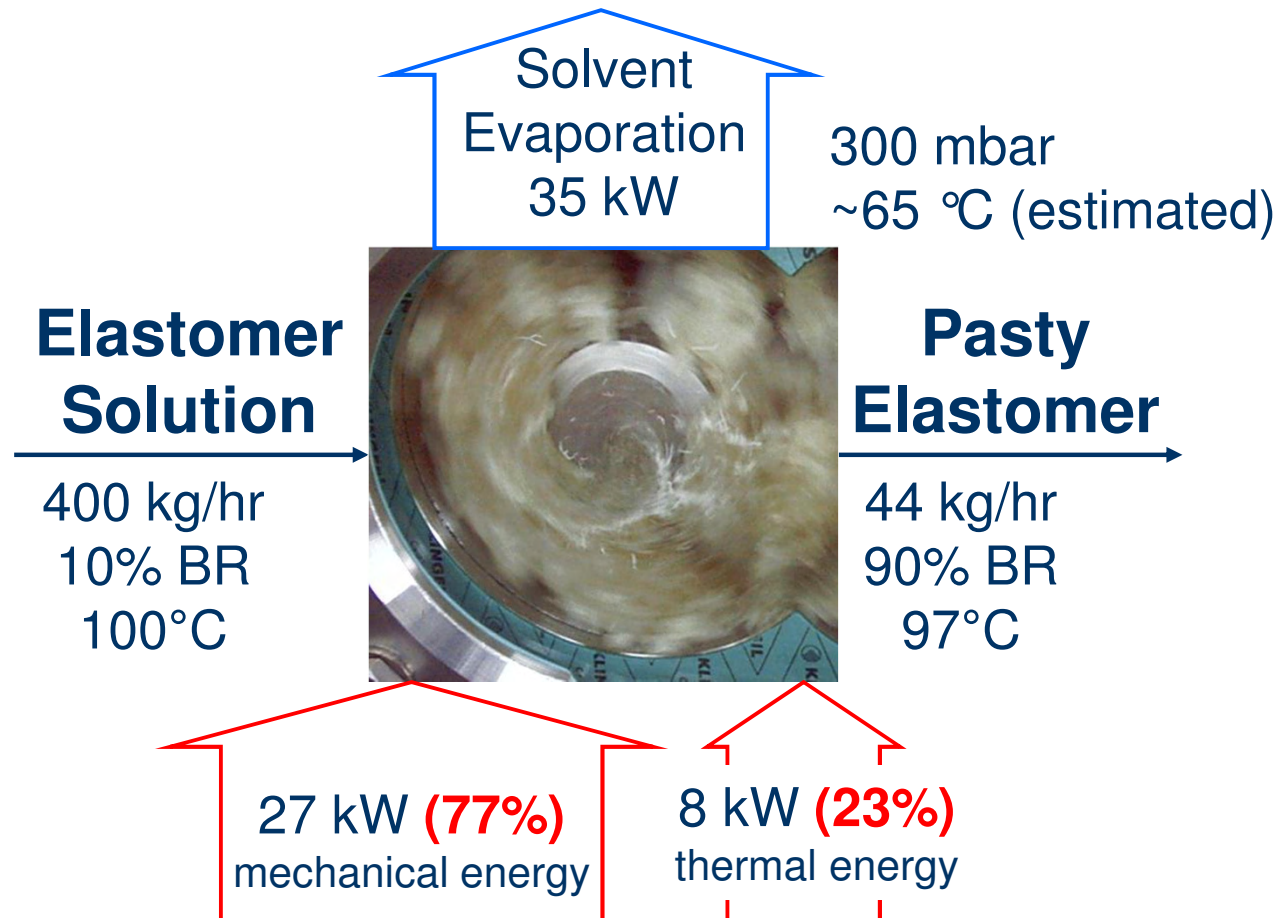
Main Evaporation

Temperature Profile



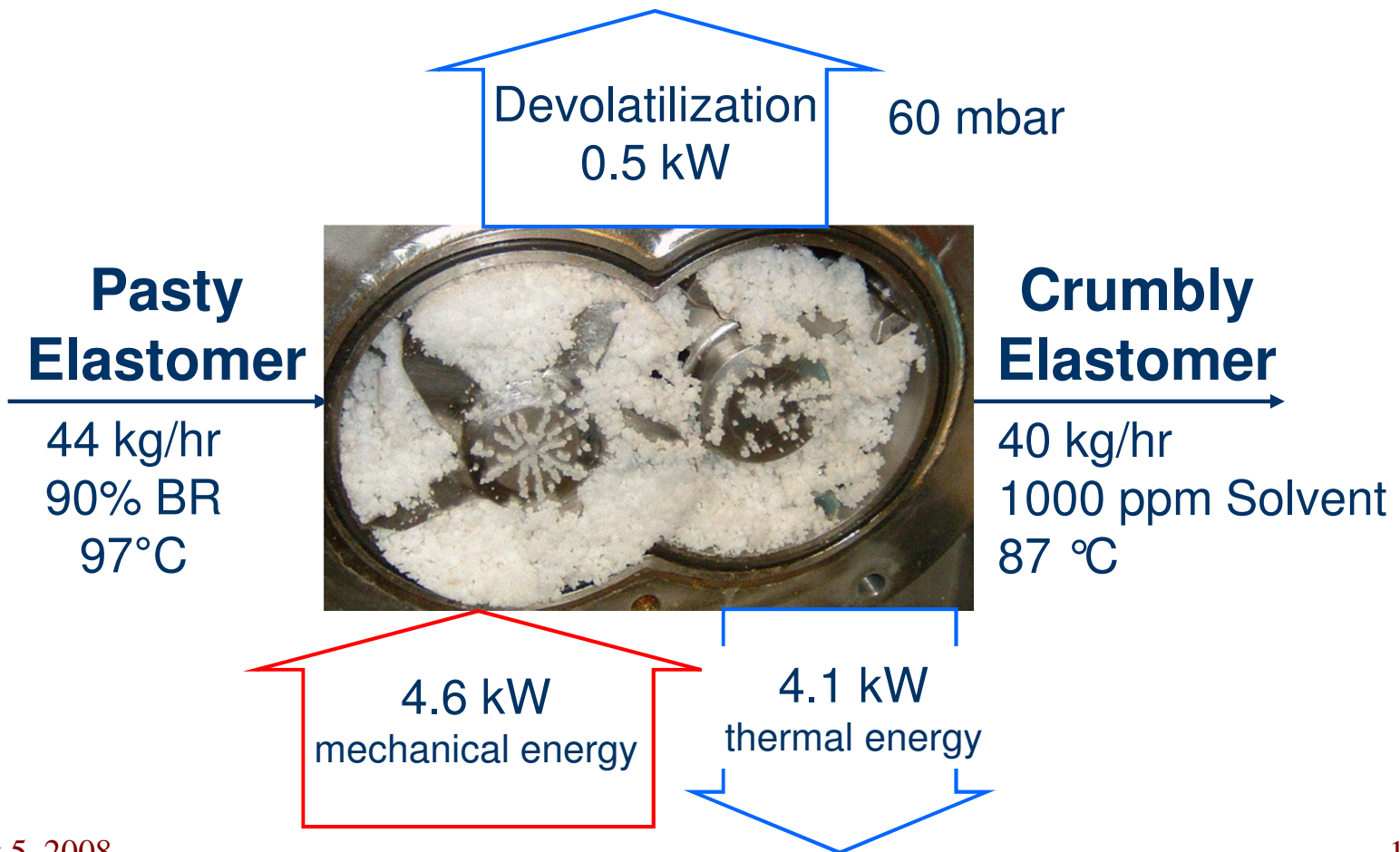
Main Evaporation

Energy Balance



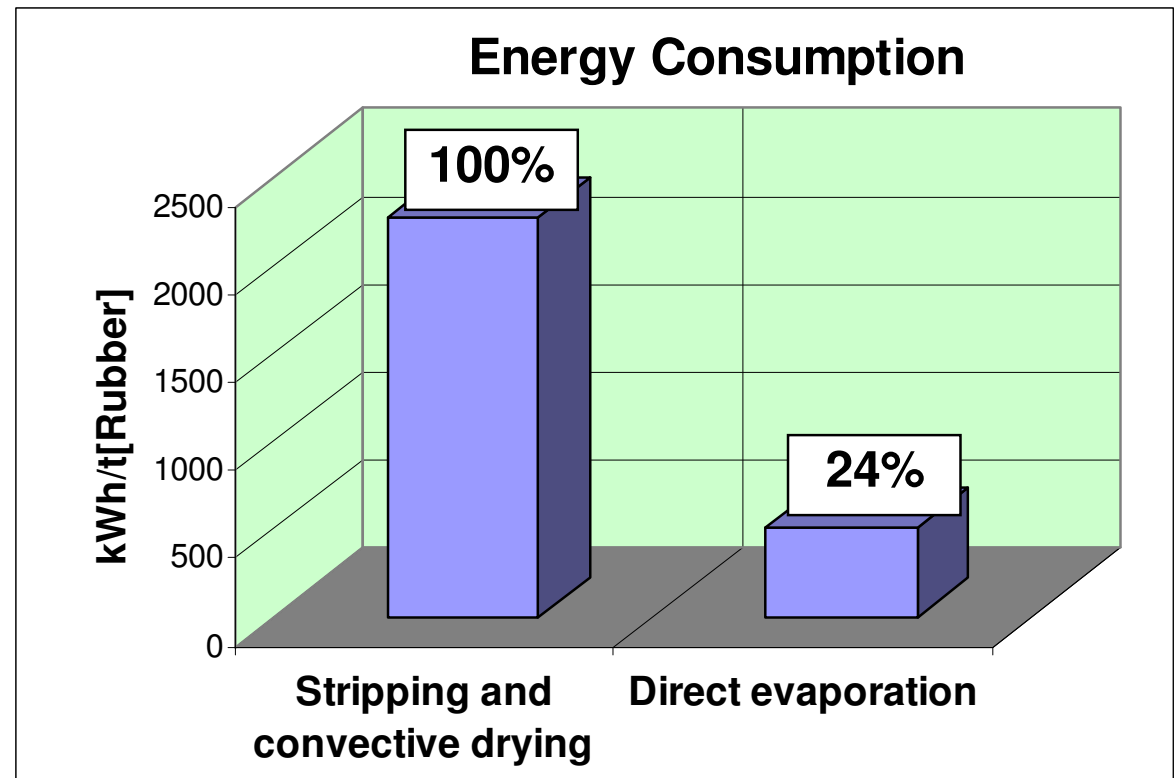
Finishing

Energy Balance



Comparison to Conventional Process

- ◆ Energy
- ◆ Environment
- ◆ Flexibility
- ◆ Operation
- ◆ Footprint
- ◆ Quality



Conclusion

- ◆ Conventional process for temperature sensitive elastomers
 - Mature and proven technology
 - Several key disadvantages
- ◆ Two step process for direct devolatilization
 - Kneader reactor technology
 - Removes water from process
 - Demonstrated process on semi works scale