NASA TECH BRIEF
Langley Research Center

New Compression Molding Process of Thermosetting Plastic Compounds

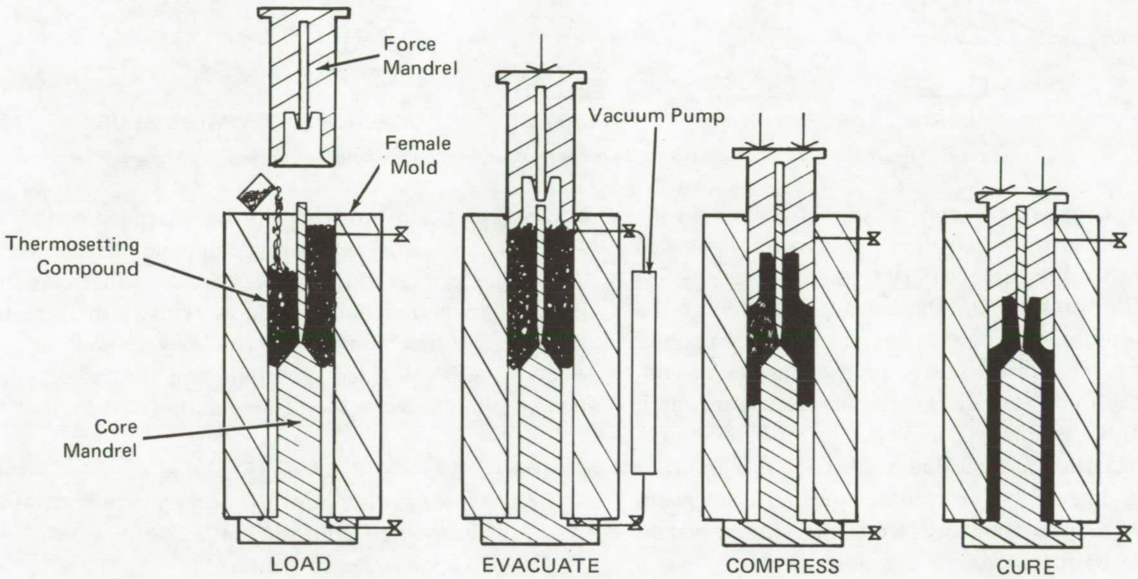

Figure 1. Conventional Compression Molding Process

A process has been developed to mold long thin-wall tubular bodies from thermosetting plastic molding compounds. This process permits the molding of longer and thinner bodies than conventional methods (see Figure 1) while maintaining equal or superior physical properties.

Major advantages:

There are three major features of this new molding process that are decisive advantages over conventional methods. This process provides control of the compound to prevent molding pressure decay between the force mandrel and the cavity extremes and to reduce the resistance against the displacement of the compound into its final formation. It also has a sufficiently large chamber, without undue mold length, which accommodates the compound with little or no prepacking and permits the easy removal of air and moisture from the bulk compound. Additionally, this new mold design and operation eliminate the flow front and its associated problems which, in a conventional mold, is at the forefront of the viscous compound as it is forced into the cavity.

Process operation:

The evacuated and displacement compression molding process is outlined in the five positions shown in Figure 2. In the load position the force mandrel is moved up to seal with the female mold, and a controlled amount of thermosetting compound is loaded into the mold. In the evacuate position the balance mandrel is moved down to seal with the female mold. This allows air to be removed by a vacuum system. All cavity surfaces are now heated to approximately 300K (260°F), and the balance mandrel is moved to press down the compound with a pressure of 1.7×10^7 N/m^2 (2500 psi) until it reaches the condition shown in the compact position (see Figure 2). This pressure and temperature cause the

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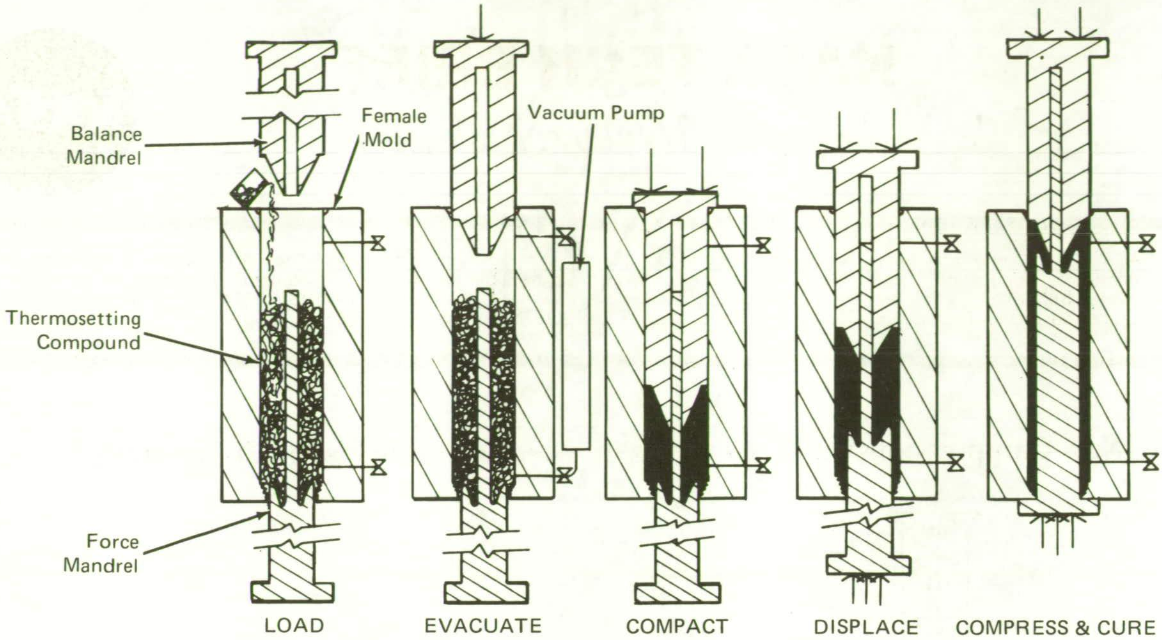

Figure 2. Evacuated and Displacement Compression Molding Process

compound to plasticize and become hydrostatic. To reach the displace position the force mandrel is pushed upward with a pressure sufficient to overcome the 1.7 x 10^7 N/m^2 pressure on the balance mandrel; as the force mandrel moves upward, the plasticized compound is displaced. This displacement of the compound continues as the force mandrel expels the balance mandrel, and the stroke is finally completed to produce the desired configuration as indicated in the compress and cure position in Figure 2. The mandrel pressures are maintained, and the compound is cured at approximately 420K (300°F) for about 45 minutes.

Present use:

This method and equipment are being used in the molding of cylindrical rocket motors whose length may be many times their diameter and whose physical properties are in excess of those usually associated with high-strength thermosetting plastics. It is also capable of molding a rocket motor of this general design with one end closed, with any combination of external or internal threads on either or both ends, or with an integrally molded rocket nozzle of any one of several designs instead of a closed end.

The equipment was engineered for a rapid, evenly dispersed, and finely controlled input of thermal energy. This is necessary since the compound must remain plasticized and at uniform viscosity for extended periods of time to allow for extensive compound displacement. The major equipment components were either cored or jacketed to permit thermal energy transfer to all cavity surfaces. Further control, for molding as well as part ejection, was obtained by equipping the major components with separate thermal regulation devices.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Langley Research Center
Langley Station/Mail Stop 139A
Hampton, Virginia 23365
Reference: TSP72-10356

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel
Langley Research Center
Langley Station/Mail Code 173
Hampton, Virginia 23365

Source: W. C. Heier
Langley Research Center
(LAR-10782)