ENERGY DISTRIBUTION IN THE COMPACTION OF A TWO-COMPONENT SYSTEM

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The addition of a diluent to a single component may affect the compression properties of that component and such effects have been observed with respect to capping (Ritter and Sucker 1980) and tensile strength (Sakr and Pilpel 1982). Energy variations during compaction will also be modified by the second component and the purpose of the present study was to monitor the energy distributions of a binary mixture of lactose and polyethylene, respectively a brittle compound and a plastic/elastic material.

In order to measure the energy utilised during compaction, the binary mixture of lactose and polyethylene was compacted in a ⅜" die on an Instron testing machine. Three different compaction pressures (5.6, 8.4 and 11.22 KN cm^{-2}) and three different compaction speeds (2, 5 and 10mm min^{-1}) were evaluated. An Instron extensiometer was used to measure displacement, via a specially constructed jig, and the output fed to the X-axis of an X-Y recorder. The Y-axis measured the force applied via the load cell of the Instron machine.

Two different particle size fractions (45-63 μm and 90-125 μm) were separately studied. Polyethylene of particle size 180-250 μm was mixed with each size fraction of lactose to produce compositions containing 0,10,25,50,75 and 100% w/w polyethylene. Each binary mixture was compressed (5.6KN cm^{-2}) 12 times and for polyethylene alone, of the total energy involved in compaction (1.85×10^{-2}J), 70% of this energy was recovered as elastic energy, of which a significant amount was used in the second compression. Consolidation was consequently poor after the first compression with the compact just retaining some degree of cohesion. On subsequent compressions, the ratio of plastic to elastic energy remained fairly constant at 6:4 respectively.

The initial total energy for lactose alone was 1.30×10^{-2}J and approximately 74% of this energy was recovered as elastic energy. However, only 45% of this was used in the second compression, the ratio of plastic:elastic energy being 87:13. In this instance, the brittle fracture of lactose, on third and subsequent compressions (to a total of 12) continues with only slight relaxation of the compact after each compression. At all intermediate dilutions of lactose with polyethylene a relationship between plastic and elastic energy is observed, with elastic energy increasing as polyethylene content increases and decreasing as the lactose component dominates. These results apply to lactose size fraction 45-63 μm.

Energy differences are also observed when increased pressures and/or compression speeds are applied, such differences can be directly related to modification of the brittle component by the elastic properties of polyethylene. Although, in the case of increased speed, the effect is not greatly marked, the precision of the measuring technique indicates that such effects are real.

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