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Impact of microstructure on compaction behaviour of aspirin-paracetamol eutectic system

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Mechanical properties are of vital importance as they affect the compaction behavior of material under consideration. Crystallographic features like slip planes contribute to the mechanical properties and thus in turn may affect the compaction behavior of the material.

Eutectics may be defined as a mixture of two components that are completely miscible in liquid state but immiscible in the solid state. They have melting point lower than that of the individual components. Eutectics are generally formed due to simultaneous crystallization of the components in definite shape and size. Differential behavior of the crystallization may lead to formation of different structural domains within the eutectic known as microstructure.

The present research work investigates the impact of microstructure on mechanical behavior of aspirin-paracetamol (ASP-PCL) eutectic system (EU). Eutectic system containing lamellar microstructures consists of micro-domains arranged side by side and is expected to behave like slip planes of the crystal lattice. Thus, it was hypothesized that the microstructure of eutectic system can affect the type of deformation during compaction, thus affecting tabletability.

Solvent evaporation method was used to prepare EU of ASP-PCL. Solid state characterization [Powder X-ray diffraction (PXRD) and Differential scanning calorimetry (DSC)] confirmed eutectic formation at the composition of 53:47 (ASP:PCL). Compaction behaviour of EU and physical mixture (PM) of ASP and PCL was studied using a fully instrumented rotary tablet press equipped with Portable Press Analyzer™ (PPA). The obtained data were compared for compressibility, tabletability, compactibility profiles and Heckel analysis. EU has shown higher compressibility, tabletability and plastic deformation over PM. EU exhibited better plastic deformation as evidenced by lower Py (46.9 MPa) for EU as compared to PM (222.8 MPa). The better deformation behaviour of EU was attributed to its layered microstructure. As hypothesized, sliding of the adjacent layer over each other during compaction offered higher plastic deformation and consequently provided greater interparticulate bonding area in EU as compared to PM. However, there was no significant difference in the compactibility profiles indicating similar interparticulate bonding strength of the two powders. Thus, EU showed better tabletability compared to PM by virtue of its greater compressibility and plastic deformation.

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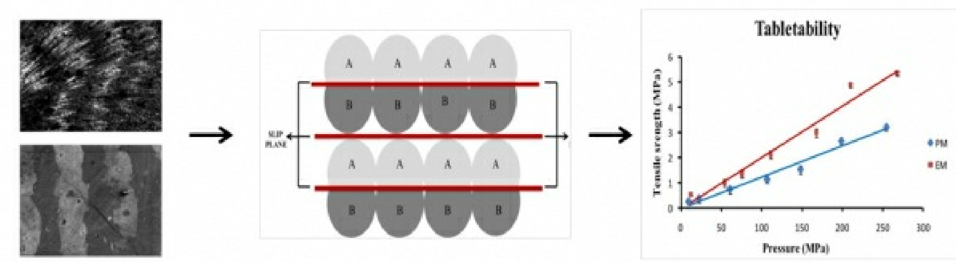

Lamellar microstructure in Eutectic

Slip plane like behavior of lamellar microstructure during compaction

Improved tabletability of Eutectic over physical mixture

Keywords: Eutectic microstructure, mechanical properties, compaction