Characterizing Deformation Properties of Directly Compressible Excipients using a Compaction Emulator

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PURPOSE

The purpose of the present study is to describe and predict the deformation nature by using a set of commonly used mathematical equations and multivariate analysis based on continuous compression profile. The materials used are Micro crystalline cellulose (Emcocel® 90M), Anhydrous calcium hydrogen phosphate (Emcompress® 200M), D Mannitol (Mannitol® M200) and partially pregelatinized starch (Starch1500®)

OBJECTIVE(S)

Presster compaction emulator was used to simulate the FETTE PT 2090 IC 43 stations tablet press with a speed of 38,800 tablets per hour.All the Tablets were compressed at constant volume of 628 mm^3.Three different compression pressure were applied to yield the material independent deformation behavior.

METHOD(S)

- **Powder Preparation**

All the materials used were sieved using 250-micron sieve to maintain the particle size.

- **Continuous Compression Analysis**

Yield pressure of plastic deformation (Yppl), Yield pressure of elastic deformation (Ypel), work of compression (WoC), work of elasticity (WoE), and Ejection force were measured by using continuous compression Profile.

- **Post Compression Analysis**

Tensile strength was measured to evaluate the tablet fracture strength.

- **Data Analysis**

Multivariate analysis (PCA and PCR) was used to identify the material independent deformation behavior based on continuous compression profile.

RESULT(S)

Material Type	Compression Pressure (MPa)	WoC (Joules)	WoE (Joules)	YPpl (MPa)	YPel (MPa)	Ejection (N)	Porosity	TS (MPa)
Emcocel	50.00	1.46	0.12	71.73	876.85	99.50	0.23	4.08
Emcocel	100.00	3.11	0.26	102.36	1090.58	91.33	0.21	5.52
Emcocel	150.00	4.96	0.32	144.28	1256.88	65.53	0.16	6.53
Emcompress	50.00	1.30	0.05	78.32	1492.60	496.60	0.27	0.47
Emcompress	100.00	2.11	0.16	159.56	2300.61	1712.91	0.23	0.77
Emcompress	150.00	3.37	0.21	251.29	2840.36	2327.96	0.17	1.35
Mannitol	50.00	1.70	0.06	103.37	2297.14	2289.39	0.29	0.87
Mannitol	100.00	2.55	0.14	147.33	1922.11	2704.49	0.21	1.37
Mannitol	150.00	3.27	0.21	204.10	2309.08	2909.44	0.16	2.34
Starch 1500	50.00	1.44	0.27	102.12	571.20	144.20	0.35	0.17
Starch 1500	100.00	2.72	0.42	112.94	657.37	181.20	0.28	0.34
Starch 1500	150.00	3.69	0.68	115.70	746.88	205.53	0.21	0.74

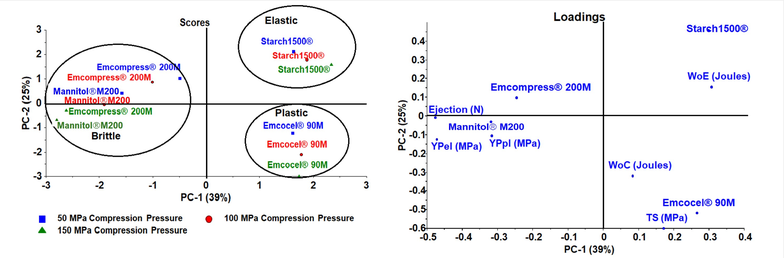

Fig. 1. PCA Score plot of compaction characteristics showing grouping of scores representing different materials. PCA Loadings plot of compaction characteristics responsible for the grouping in the scores plot

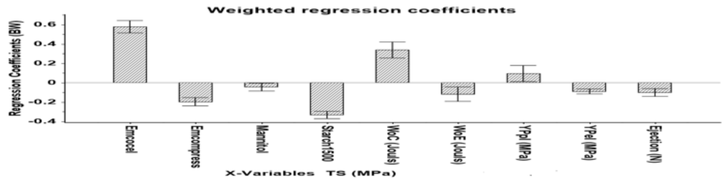

Fig. 2. Principle component regression plot of compaction characteristics on tablet tensile strength.

CONCLUSION(S)

- Mechanical parameters namely **YPpl, YPel, WoC, WoE,** Ejection force were estimated using continuous compression profile.
- Material predominant deformation nature was identified using qualitative analysis (PCA).
- Effect of deformation behavior on tablet tensile strength was estimated using quantitative regression analysis (PCR).
- It was observed that brittle materials are associated with high YPpl along with high YPel, plastic materials are associated with high WoC, elastic materials are associated with high WoE.

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