Functionalized Calcium Carbonate (FCC)

FCC: Newly developed structured minerals as multifunctional excipients

Omya

- Founded in 1884 in Switzerland, Omya has a global presence extending to more than 180 locations in over 50 countries with 8,000 employees.

- Omya is a leading global producer of minerals and a worldwide distributor of specialty additives.

- Omya has been present in the life sciences market for decades (food, pharmaceuticals, cosmetics, environmental products, feed and agriculture).
Omya FPC (Food, Pharma, Cosmetics)

- Bulking agent
- Gelling agent
- Extrusion aid
- pH buffer
- Facial cream
- Body lotion
- Toothpaste
- Anti-caking agent
- Carrier
- White pigment
- Hard surface cleaners
- Body/ facial scrub
- Soap bars
- Laundry bars
- Color cosmetics
- Body lotion
- Body/ facial scrub
- Facial cream

Omya in the Pharma market

- **Active ingredient** in antacids
- **Natural source** of calcium in osteoporosis treatment and mineral supplements
- Omya has been active in Pharma market for over 10 years
- To serve this market, two plants are available
  - Arizona US
  - Orgon FR
Omyapure 35 OG

Omya became the first producer of natural calcium carbonate to achieve the certificate of suitability (CEP/CoS) in accordance with the European Pharmacopoeia as an active pharmaceutical ingredient (API) by the European Directorate of the Quality of Medicines (EDQM).

Functionalized Calcium Carbonate (FCC)

- Co-processed excipient
- Recrystallization process
- Monographed starting material
- Final product mixture of monographed minerals
  - Calcium carbonate
  - Hydroxyapatite
Functionalized Calcium Carbonate (FCC)

- Lamellar structure
- High porosity
- High specific surface area

Case studies FCC as an excipient

- University of Basel, Switzerland, Department of Pharmaceutical Science, Division of Pharmaceutical Technology.

  - 3 PhD students: Dr. Tanja Stirnimann
    Daniel Preisig
    Veronika Eberle

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Case studies FCC as an excipient

• Drug loading onto FCC

• Compaction of FCC

• FCC in orally dispersible tablets (ODTs)
Drug loading onto FCC and release kinetics


The study proved the feasibility of the method to load porous particles like FCC

- 21 different drugs were tested
- 14 successfully loaded up to 25%
- 10 successfully loaded up to 40%
- Nifedipine (NP), Ibuprofen (IBU) and Losartan Potassium (LK) were further investigated
Drug loading onto FCC and release kinetics

• Amorphous drug (DSC)
  • NP 8.9%
  • IBU 6.7%
  • LK 100%

• Dissolution rate (USP2)

Case studies FCC as an excipient

• Drug loading onto FCC
• Compaction of FCC
• FCC in orally dispersible tablets (ODTs)
Flowability enhancement

- **High-shear granulation**
  - 5% (w/w) HPMC E5PLV as a liquid binder solution
  - Impeller speed 150 rpm
  - Chopper speed 1500 rpm

- **Roller compaction**
  - Roll pressure 20 bars, roll gap 1 mm, roll speed 4rpm
  - FCC direct compressible
  - Roller compaction preserves the unique structure of FCC

Compaction of FCC

- **Low compressive pressure**
  - Particles are intact
  - Particles with high volume of large intraparticle pores on the surface can build type I bonds between the particles (lamellae bonds)
  - High tensile strength already at low compressive pressures

- **High compressive pressure**
  - Particles break
  - Intraparticle pores provide surface for new contacts
  - Particles with a high volume of very small pores collapse and form type II bonds
Formulation with active pharmaceutical ingredient (API)
- Tensile strength is higher (especially at low compressive pressures) or comparable to reference material
- Porosity decreases but is still higher compared to reference material

Case studies FCC as an excipient
- Drug loading onto FCC
- Compaction of FCC
- FCC in orally dispersible tablets (ODTs)
• Orally dispersible tablets (ODTs)
  • Fast disintegration in the mouth / in a spoon
  • Particularly suitable for children / elderly people (swallowing problems)
  • Can be swallowed without the need of water

• Requirements for ODTs
  • Combination of high porosity and high hardness
    • Opposite properties
  • Easy manufacturing process
    • Direct compression (without increasing disintegration time)
  • Allow
    • High drug load
    • Standard packaging

• Tensiometer based method
  • More sensitive than existing methods
  • Mass vs Time
  • Water-uptake can be measured with same device
  • Allows to determine residence time
  • Analysis of disintegration kinetics
Based on the tensiometer profiles of 25 different formulations, 4 different disintegration types were distinguished:

- **Type I:**
  - Idealized behavior
- **Type II:**
  - No disintegration
- **Type III:**
  - Nonuniform disintegration
- **Type IV:**
  - Combination between type I and type II

**Note:**
- Market formulation: Type I, 15 N
- FCC: Type I, 100 N
Orally dispersible granules

2 seconds

FCC + 3% disintegrant
Conclusion / Outlook

• FCC is a co-processed mineral excipient
• FCC is a highly suitable excipient to produce tablets with **high tensile strength** and **high porosities**
  • Fast disintegrating granules
  • ODTs
• FCC has high loading capability

• Outlook
  • 2 new PhD students at University of Basel
    • ODT formulations with different APIs, taste masking, mouth-feel improvement
    • FCC potential in different applications
  • Clinical trials with ODTs or Floating drug delivery systems (FDDS)

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