

Ceolus KG and UF: Modified Microcrystalline Cellulose grades to address formulation challenges

Microcrystalline cellulose (MCC) is one of the most widely used and versatile excipients with application as a diluent, binder, and disintegrant in solid oral dosage forms. MCC is a purified, partially depolymerized cellulose prepared by treating wood pulp from fibrous plant material with mineral acids. This excipient is known to be one of the best diluent-dry binder-cum disintegrant. However, there are some inherent drawbacks in MCC. This excipient is more sensitive to lubricants than other brittle excipients. The concentration of lubricant, lubrication time will affect the hardness of tablets containing MCC. This is due to the fact that lubricated MCC particles deform under pressure and do not fracture to create new surfaces. Another drawback of MCC is its Strain Rate Sensitivity (SRS). Although MCC is a plastic material, at high tableting speeds, when there is insufficient time for plastic deformation, the tableability of MCC decreases due to elastic recovery of the material. This can result in tablets with lower hardness or capping defects, especially during high speed tableting.

Ceolus KG and UF grades are modified MCC grades that are manufactured by a Japanese company Asahi Kasei. These modified MCCs are utilized to address multiple tableting issues faced by formulators that cannot be addressed by conventional MCC. These grades are chemically 100% MCC, but morphologically different than the standard MCC grades due to modified manufacturing process. The morphology of Ceolus KG, Ceolus UF as well as standard MCC grade Ceolus 101 is depicted in Figure 1.



Figure 1: Morphology of modified and conventional MCC

From the figure it becomes evident that Ceolus KG and UF grades are morphologically different compared to the standard MCC grade (PH 101).

The KG grades are fibrous in nature having high aspect ratio. The aspect ratio is the ratio of the length of the particle to the diameter. Particles with higher aspect ratio are elongated in nature and possess smaller elastic recovery. The aspect ratios of MCC grades PH 101, PH 102, KG 802 and KG 1000 are 1.8, 1.5, 2.8 and 3.5 respectively. Replacement of standard MCC grades with KG grades in tablet formulations results in increase in tablet hardness.

The UF grades are porous in nature. These grades have high plastic deformation and superior flow properties compared to standard MCC grades. The porous nature along with optimum particle size helps to improve content uniformity of low dose APIs as well as in adsorption of liquid ingredients in the formulations.

Thus, modified MCC has several unique properties that are useful in addressing the limitations of standard grade material as well as resolve many tableting issues faced by the formulators.

Key Applications:

- 1. Addressing tableting issues:** Tableting issues such as sticking and capping may arise in case of APIs with high dose and low compactibility. For such APIs, tablet hardness decreases with the increase in machine speed and can increase the friability of the tablets. Such issues are often observed with poorly compactible APIs such as clopidogrel, where, addition of 5-10% of Ceolus KG 1000 can completely resolve these issues. This is attributed to highly compactible nature of KG grades and its fibrous structure.
- 2. Maintaining blend uniformity:** UF grades can be effectively utilized to maintain blend/dose uniformity of low-dose APIs. This is true for enzyme tablets, where the concentration of the API in the tablet can be as low as 0.1%. UF -711, being a porous material, can interact with the API due to the roughness in its surface and increase the blend uniformity.
- 3. Formulation of MUPS tablets:** Multiple Unit Pellet System (MUPS) tablets have many manufacturing challenges. These dosage forms contain pellets that are usually having functional coating, which are compressed into tablets. Poor API uniformity due to segregation of pellets and low compactibility of film coated pellets are issues that are challenging to address. Ceolus KG along with PH 200 grade have been successfully utilized to prevent segregation and improve compactibility of such systems. These excipients disturb the free motion of pellets and cause inter-particulate friction, thereby prevent the segregation. KG grades, due to their fibrous nature, help to provide high tablet hardness at lower compression forces, thereby preventing damage to coated pellets.
- 4. Roller compaction of large dose APIs:** In roller compaction, tablet hardness as well as friability are insufficient due to decreased compactibility of MCC after roller compaction. It is observed that the modified MCCs contribute to improved tablet hardness and low friability in roller compaction process.
- 5. Mitigation of nitrosamine in formulations:** All Ceolus grades, the standard as well as modified ones, feature low levels of nitrite and nitrate impurities, which can allow mitigation of nitrosamine formation in the API products.

For more information on Ceolus and for sample request kindly contact us.

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