Tribo-electrification and Adhesion Properties of Cellulose Ethers

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Purpose:
The generation of tribo-electric charge during pharmaceutical processing can lead to the exacerbation of a range of problems including segregation, content heterogeneity and particle surface adhesion. The excipients, methylcellulose (MC) and hypromellose (HPMC) are often used in drug delivery to develop control release tablet formulations. The aim of this study was to understand the impact of material attributes (particle size, hydroxypropoxyl (Hpo) to methoxyl (Meo) ratio and molecular size) on the charging and adhesion characteristics of cellulose ethers.

Methods:
Charge was induced on powder particles and measured using a custom built device based on a shaking concept consisting of a Faraday cup connected to electrometer. The surface adhesion of powder particles was calculated from mass difference by deducting the final amount recovered (post shaking and tapping) from the initial amount of sample loaded into the shaking vessel.

Results:
All the MC and HPMC grades were charges positively against stainless steel surface and presumably have a lower effective work function than the steel surface. Therefore, it is assumed that the electrons from the polymer particle surfaces moved to the interface of the contacting surface inducing a positive surface charge on the donor, with a negative charge on the steel surface (acceptor), Figure 1. The diversity in physicochemical properties has shown a significant impact on the tribo-electric charging and adhesion behaviour of MC and HPMC. The increase in particle size, molecular size and hydroxypropoxy substitution levels the net tribo-electric charging (nC/g) and particle adherence to stainless steel vessels was declined.

Conclusion:
The study revealed that particle size, chemical heterogeneity and molecular size of cellulose ethers have an inverse relationship with the charging and adhesion tendency of powders. A significant impact ($P < 0.05$) on their charging and adhesion properties was confirmed.

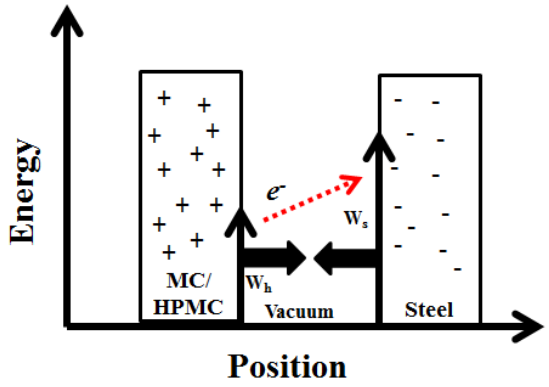

Figure 1, Mechanism of MC/HPMC charge generation.