# INFLUENCE OF POWDER COATING DEVICES ON COATING EFFECTIVENESS

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# VLIV ÚČINNOSTI ZAŘÍZENÍ NA POVRCHOVOU MODIFIKACI PRÁŠKŮ

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**Abstrakt**

Teoreticky platí, že čím použijeme jemnější hostovské částice pro povrchovou modifikaci hostujících částic prášků, tím je povrchová modifikace účinnější a dochází k efektu snížení úhlu přirozeného svahu a následně k zlepšení tekutosti obtížně tekoucích prášků v dopravních systémech. Ovšem výskyt větších hostovských částic společně s malými částicemi (specifická částicová distribuce) má za příčinu vznik lubrikačního efektu a tím ještě účinnější zlepšení tekutosti v dopravních systémech.

Tento příspěvek popisuje účinnost použitého zařízení pro povrchovou modifikaci v závislosti na výše zmiňovaném efektu specifické částicové distribuce. Uvedené výsledky v podobě měření úhlu přirozeného svahu na Hosokawa Powder Testeru pro povrchovou modifikaci na vyvinutém zařízení MAIC a komerčně vyráběném zařízení Hybrodizer jsou zkoumány a porovnávány.

**Abstract**

Theoretically, the finest guest coating particles may decrease AOR (Angle of Repose, [1]), which is the flowability factor. Although the conjecture is true generally, the effect of guest particle size distribution plays main role in the flow process in storage and handling systems. It means, that both nano and micron particles included inside the size distribution range of coating particles influence the coating process and thus the flowability as well. The wide size distribution causes a lubricant effect among coated particles.

In the paper, for investigation of effectiveness of used coating devices and guest particle size distribution, AOR values of the reference sample are measured on Hosokawa Powder Tester. The AOR measured values show excellent coating effectiveness by coating the referent sample with MAIC and Hybridizer, which are typical commercial coating devices.

**Keywords:** Coating, Particle Size Distribution, Hybrodizer

## Introduction

The surface forces between two body particle systems play a very important role in many scientific and technical areas, e.g. adhesion, wetting, absorption, colloidal and biological systems [2, 3] ceramic processing, flocculation rates, rheological properties, etc. Pure cornstarch and fumed silica are used for coated material properties investigation. Reasons of the choice of cornstarch are: the cornstarch is frequently used as a food-thickening agent and inactive component of pharmaceuticals and irreplaceable ingredient in food industry [1].

Used materials for coating are characterized by the unique physical properties: thixotropy, hydrophilicity and hydrophobicity. The thixotropy is a physical property usually associated with certain gels whose molecular bonds are disrupted by movement. A thixotropic system is one, which exhibits a time-dependent decreasing viscosity or shear stress as a constant shear rate (a fluid become firm when agitated). When the shearing force is eliminated, the viscosity returns over a period of time to its original "at-rest" value.

The property of cornstarch is linked to cohesiveness that brings about stiffness depending on recent history of movement. The stiffness increases with prior immobility/stillness and decreases with prior movement. The properties are undesirable due to problems causing falls during handling and storage in transport systems (piping, hatholing, arching, etc.). Moreover, for example, the cornstarch hydrophilicity limits shelf life in consequence of premature biodegradation or the growth of molds and other microorganisms on the surface.

Cornstarch ($C_6H_{10}O_5$) is composed of two basic types of polymers: the amylose and amylopectin. Amylose is a linear polymer where each of the monometric units (except the terminal units) contains one primary and two secondary hydroxyl groups. The hydroxyl groups impact hydrophilic properties to the polymer, which leads to an affinity for moisture, i.e., the hydroxyl groups act as sites for adsorbing moisture.

Amorphous hydrophobilic (i.e." water-fearing") and hydrophilic (i.e." water-loving") fumed silica is silicon dioxide ($SiO_2$), a material which is generally regarded as unique in industry because of its unusual particle characteristics. The fumed silica is extremely small in particle size, has an enormous surface area, and has high purity. Its chain-formatting tendencies set it apart in a class of its own.

**Effectiveness of coating devices (MAIC, Hybrodizer, Mechanofusion) compared with mixing device (V-Blender Mixing, Hand-Mixing)**

The silica value of 0,1% is sufficient to guarantee very high degree of flowability for transport and storage systems. The sample may be used like a reference sample for further investigations listed below.

To investigate the effectiveness of used coating device, the AOR values of the reference sample are measured on Hosokawa Powder Tester [1, 2]. The AOR measured values show excellent coating effectiveness by coating the referent sample with MAIC and Hybridizer. Processes of mixing devices, i.e. V-Blender Mixing and Hand-Mixing, which display higher AOR value, belong to branch of mixing. Effectiveness of Mechanofusion even worse than mixing with V-Blender has been found.

Here, the foundation of the coating effectiveness is confirmed in Fig.1.

**Conclusions**

Using coating device (MAIC, Hybrodizer) in comparison with mixing device (V-Blender) improves a coated particle cover efficiently. Size distribution of a guest particles influences flowability of the coated sample sufficiently. Even a small particle appearance inside the size distribution of the guest particle improves flowability. Coated material requires more energy by small movement in storage system (requirement to quick and stabile continuous discharge).

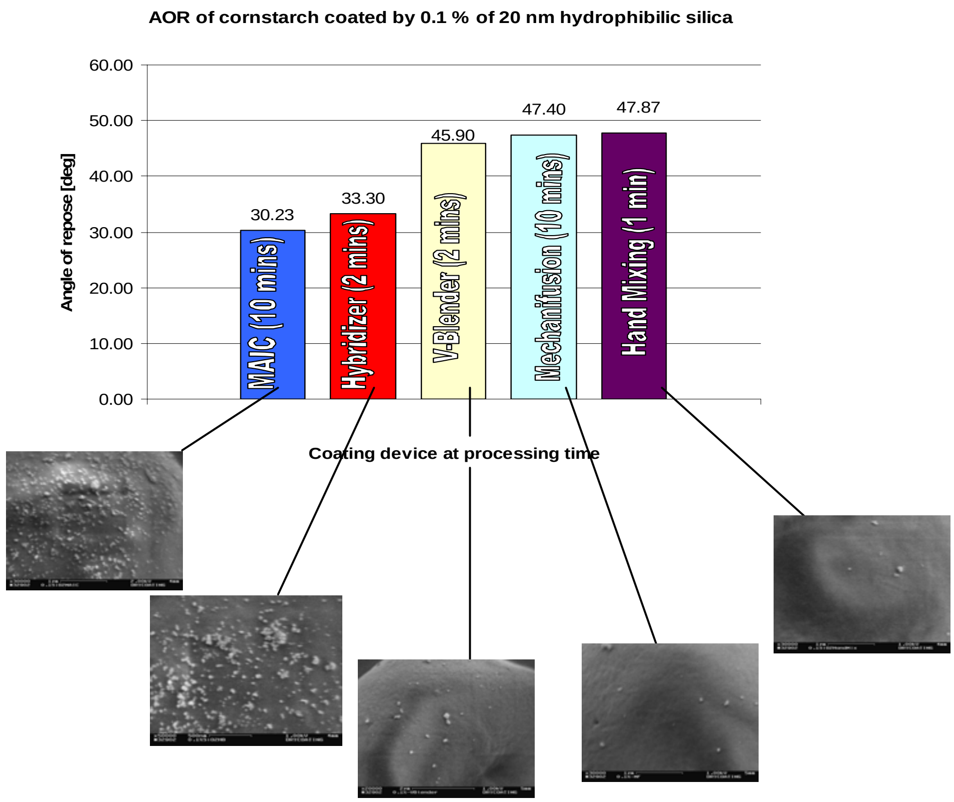


Fig.1 Effectiveness of used coating device by AOR value and SEM observed picture comparison of the cornstarch coated by 0,1 of 20 nm hydrophilic silica

Coating of a material causes to creation of a compact and tendency to dead zone, arc and funnel creation, especially by long-time storage in high silos (high pressure). The tendency is 3 times more with hydrophobic coating material and 5 times more with hydrophilic coating material in comparison with pure uncoated material.

**Acknowledgement**

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## Literature

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