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Attension | [Application Note] 7

Wettability of pharmaceutical powders

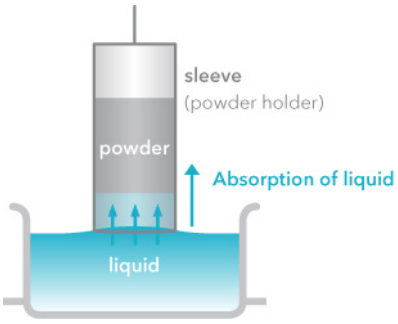
This application note illustrates how the Attension Sigma Force Tensiometer can be used to study lactose wettability.

Introduction

The wettability of a solid material is crucial in pharmaceutical technology when considering the manufacturing processes and the properties of the final product [1,2]. Wetting is a precursor to dissolution and so the wettability of a drug particle has a significant influence on the dissolution rates and the release characteristics in an oral pharmaceutical delivery. Wettability also influences the interactions with other particles during formulation and manufacture.

The wettability of powders can be measured by using the Washburn method (Figure 1). In Washburn method the contact angle is calculated from the weight increase over time when the powder is in contact with the liquid. This method can be used with Attension force tensiometers Sigma 700/701.

The wetting is measured by lowering the cylinder in the liquid phase and looking at the change of mass over time. When the mass starts to remain constant, no more liquid is penetrated and the measurement is complete. The packing of the powder is an essential part of the experiment. It is important that the packing is done in an identical way in each experiment in order to get comparable results. Tapping or other kinds of methods are recommended to obtain an identical orientation for the powder in the cylinder.



[Figure 1]: Schematics of the powder wettability method

ATTENSION SIGMA 701

Case study: Lactose wettability

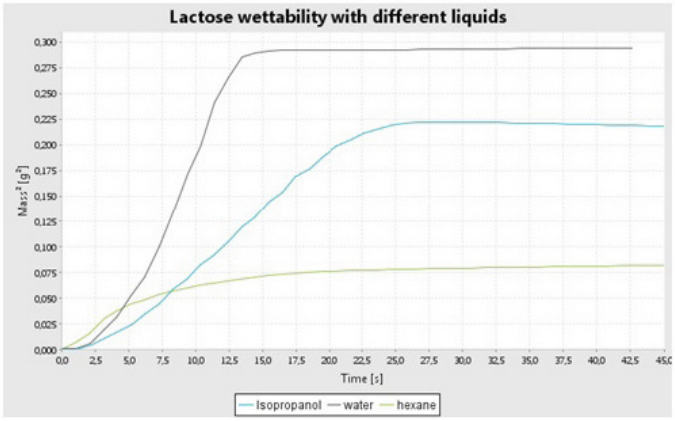
The properties and characteristics of lactose are important to understand in order to improve existing and develop new processing techniques in the fields of food and drug chemistry [3]. By studying the wetting properties of lactose, a widely used pharmaceutical powder, information on the interactions and characteristics of this model compound can be obtained and applied to other powder-like components.

Lactose is a sugar that is found most notably in milk and milk products. Therefore it is a significant compound of our everyday life. Milk contains around 2 - 8 w/w% of lactose. Solid lactose exists in crystalline and amorphous forms. Lactose is one of the heaviest components of milk. It is also very soluble in water, although the solubility of lactose is lower than that of other common sugar compounds.

To demonstrate the Washburn method, the wettability of pure α-lactose with three liquids is investigated. The three test liquids are water, n-hexane and isopropanol. The mass of lactose used is 1g and the experiment is conducted with Attension Sigma 700 force tensiometer using the steel powder wettability device T112A. Three consecutive measurements were made and average of these measurements was calculated.

Hexane is considered as completely wetting liquid having 0° contact angle against lactose powder. By using hexane it is thus possible to define the material constant for the lactose powder. In this study, the material constant was found to be 3,46 mm5. After defining the material constant, the wettability against other liquids is studied and contact angles are calculated. The OneAttension software is able to run these calculations automatically. Wettability graphs are presented in Figure 2 and the contact angle results are shown in Table 1.

Further conclusions can be drawn from these measurements. The surface free energy can be calculated, or the influence of using different powder coatings can be monitored. Lactose is used as a model compound for the behavior of different powders in use in the food and pharmaceutical industry.



[Figure 2]: The wetting curves of lactose with water (black), isopropanol (blue) and hexane (green).

	Contact angle of α-lactose powder
Hexane	0°
Isopropanol	67,5°
Water	85,5°

[Table 1]: Contact angles of α-lactose powder with different liquids

Conclusion

Wetting studies usually involve measurement of contact angles as primary data. Contact angles indicate the degree of wetting when a solid and liquid interact. The lower the contact angle the greater the wetting. The wetting behavior of powders is important to understand especially in pharmaceutical and food industries, where the use of different powder compounds is common.

References:

[1] J. Kiesvaara, J. Yliruusi and E. Ahomäki, "Contact angles and surface free energies of theophylline and salicylic acid powders determined by the Washburn method", International journal of pharmaceutics 97 (1993) 101.

[2] C.A. Prestidge and G. Tsatouhas, "Wettability studies of morphine sulfate powders", International journal of pharmaceutics 198 (2000) 201.

[3] J. Kiesvaara and J. Yliruusi, "The use of the Washburn method in determining the contact angles of lactose powder", International journal of pharmaceutics 92 (1993) 81.

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