Characterising Stickiness of Dairy Powders

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ABSTRACT

The stickiness phenomenon, one of the major operational problems, in the spray drying process is strongly related to changes in the powder particle surface. During the course of drying, powder particles with intermediate moisture pass through a very cohesive and adhesive 'plastic' phase. This phase has shown to be influenced by surface composition, moisture content, particle size, manufacturing method, surrounding air humidity and temperature.

During spray drying, the powder particle experiences varied temperature and humidity conditions, which were replicated under controlled dynamic conditions to some extent in a 'Bench-top-scale Fluid Bed Rig' or in a 'Particle Gun Rig'. In these two set-ups, stickiness-end-point or deposition rates at a particular temperature and humidity combination were plotted to develop 'Stickiness Curves' after testing different dairy-based powders. Further improvements in the 'Particle Gun Rig' has been identified to minimise heat loss for future experimentation.

It has been demonstrated that the stickiness property is a surface phenomenon. This is governed by the composition of a particular powder, manufacturing methods and the temperature / humidity conditions surrounding the powder particles. The low fat powders (<42%) tested followed a single step 'Lactose based stickiness model' and high fat powders (>42%) followed a combined ' Fat and lactose based stickiness model'. The 'lactose based model' followed the predicted glass transition (T_g) trend of amorphous lactose, shifted by some degree (X) upwards, depending on the product composition or the amount of amorphous lactose present – to be specific.

These quick and easy methods to identify a safe and non-sticky operating window to minimise product adhesion to the equipment wall would be of huge benefit to the dairy industry in process optimization, as fore knowledge of likely difficulties and specified operating conditions will help efficient and economic operation. Attempts have been made to rectify the humidity tracking system in a spray drier and relate the 'stickiness curves' with its drying parameters. Further work should be done by taking commercial

trial runs at recommended or allowable operating conditions with reference to 'Stickiness Curves', in order to maximise the throughput and to minimise the drying cost without compromising the product quality. Looking into the effects of other variables like air velocity, angle of impact, different impact surface materials and particle size on powder stickiness would be of much interest to the dairy industry.

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