THE PREDICTION OF STICKING IN DAIRY POWDERS

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ABSTRACT

Sticking and caking of dairy powders during processing and storage is a serious problem in the dairy industry. The mechanisms for sticking and caking in dairy powders were identified. In high fat powders, fatty liquid bridges form between adjacent particles when the powder is exposed to temperatures where the milk fat is molten. If the powder is later exposed to temperatures where some of the milk fat can crystallise, then the bridges between the particles partially solidify, giving some strength to the powder. The mechanism was shown to be related to the amount of surface fat that solidifies during cooling, after the powder has been exposed to higher temperatures.

Amorphous sugars were also shown to be responsible for the sticking and caking of dairy powders. Stickiness occurs when the glass transition temperature of the powder is exceeded. Above the glass transition temperature, the viscosity of the amorphous glass reduces allowing flow of amorphous material and the formation of bridges between adjacent particles. This mechanism was shown to be viscosity related and the rate of sticking was found to be dependent on the amount that the glass transition temperature is exceeded by, not the temperature and humidity conditions required to achieve this. This mechanism was shown to hold for amorphous glucose, galactose, sucrose, maltose and fructose. Previous work has shown this to be the case for amorphous lactose.

A model was developed for predicting sticking conditions in dairy powders. This model required methods for predicting the isotherms and glass transition temperature profiles for multicomponent powders. It was found that the isotherm can be predicted from the weighted addition of the components isotherms. A new method for predicting the glass transition temperature was proposed and validated in this work. The new method predicts the glass transition temperature from the weighted addition of the glass transition temperatures of the amorphous components at a given water activity. This method gave better predictions than traditional methods used. The model for predicting sticking conditions was validated using a variety of dairy powders.

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