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THE PREDICTION OF STICKING IN DAIRY POWDERS

A thesis presented in partial fulfilment of the requirements for the degree of
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Kylie D. Foster

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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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TABLE OF CONTENTS

ABSTRACT	II
ACKNOWLEDGEMENTS	III
TABLE OF CONTENTS	IV
LIST OF FIGURES	VII
LIST OF TABLES.....	X

CHAPTER 1 PROJECT OVERVIEW

1.1	PROBLEM DEFINITION	1-1
1.2	PROPOSED STICKING AND CAKING MECHANISMS	1-1
1.2.1	Amorphous Sugar Caking.....	1-2
1.2.2	Humidity Caking	1-2
1.2.3	Fat Melting Mechanism	1-2
1.2.4	Protein Sticking	1-3
1.3	OVERALL PROJECT AIMS	1-3

CHAPTER 2 STICKING AND CAKING PROPERTIES OF LACTOSE – A REVIEW

2.1	INTRODUCTION.....	2-1
2.2	PROPERTIES OF LACTOSE RELATING TO STICKING AND CAKING PROBLEMS	2-1
2.2.1	Crystalline Lactose	2-3
2.2.1.1	Crystalline Lactose Isotherms	2-4
2.2.1.2	Sticking and Caking of Crystalline Lactose.....	2-5
2.2.2	Amorphous Lactose.....	2-6
2.2.2.1	Amorphous Lactose Isotherm	2-6
2.2.2.2	Sticking and Caking of Amorphous Lactose	2-8
2.3	CLOSURE.....	2-10

CHAPTER 3 PREDICTION OF MOISTURE SORPTION ISOTHERMS FOR DAIRY POWDERS

3.1	INTRODUCTION.....	3-1
3.2	MOISTURE SORPTION ISOTHERMS.....	3-1
3.2.1	Isotherm Measurement.....	3-3
3.2.2	Isotherm Models	3-4
3.2.2.1	BET Model	3-4
3.2.2.2	GAB Model.....	3-5
3.2.2.3	T.S.S. Model	3-6
3.2.2.4	Peleg's Double Power Model	3-7
3.2.2.5	FF Equation.....	3-8
3.2.2.6	Lewicki's Three Parameter Model.....	3-8
3.3	MOISTURE SORPTION ISOTHERMS FOR DAIRY POWDER COMPONENTS	3-9
3.3.1	Protein.....	3-9

3.3.1.1	Whey Protein.....	3-9
3.3.1.2	Casein.....	3-11
3.3.2	Glucose.....	3-12
3.3.2.1	Crystalline Glucose.....	3-12
3.3.2.2	Amorphous Glucose.....	3-14
3.3.3	Galactose.....	3-15
3.3.3.1	Crystalline Galactose.....	3-15
3.3.3.2	Amorphous Galactose.....	3-16
3.3.4	Sucrose.....	3-16
3.3.4.1	Crystalline Sucrose.....	3-16
3.3.4.2	Amorphous Sucrose.....	3-17
3.3.5	Fructose.....	3-18
3.3.5.1	Crystalline Fructose.....	3-18
3.3.5.2	Amorphous Fructose.....	3-20
3.3.6	Maltose.....	3-20
3.3.6.1	Crystalline Maltose.....	3-21
3.3.6.2	Amorphous Maltose.....	3-21
3.3.7	Maltodextrin Powders.....	3-22
3.3.8	Cocoa.....	3-23
3.4	PREDICTING MOISTURE SORPTION ISOTHERMS FOR MULTICOMPONENT POWDERS.....	3-24
3.1.1	Experimental Validation of the Additive Isotherm Prediction Approach.....	3-26
3.1.1.1	Materials and Method.....	3-26
3.1.1.2	Results and Discussion.....	3-27
3.5	CONCLUSIONS.....	3-31

CHAPTER 4 PREDICTION OF THE GLASS TRANSITION TEMPERATURE

4.1	INTRODUCTION.....	4-1
4.2	GLASS TRANSITION TEMPERATURE.....	4-1
4.2.1	Measurement of the Glass Transition Temperature.....	4-2
4.2.2	Glass Transition Temperature Prediction.....	4-5
4.3	GLASS TRANSITION TEMPERATURE PREDICTION FOR DAIRY POWDER COMPONENTS.....	4-9
4.3.1	Amorphous Glucose.....	4-9
4.3.2	Amorphous Galactose.....	4-11
4.3.3	Amorphous Sucrose.....	4-12
4.3.4	Amorphous Fructose.....	4-14
4.3.5	Amorphous Maltose.....	4-15
4.3.6	Maltodextrin Powders.....	4-17
4.3.7	Protein.....	4-18
4.4	PREDICTION OF THE GLASS TRANSITION TEMPERATURE FOR MULTICOMPONENT POWDERS.....	4-19
4.5	CLOSURE.....	4-25

CHAPTER 5 AMORPHOUS SUGAR STICKING MECHANISM

5.1	INTRODUCTION.....	5-1
5.2	AMORPHOUS SUGAR STICKING MECHANISM.....	5-1
5.3	AMORPHOUS SUGAR STICKING EXPERIMENTS.....	5-6
5.3.1	Objective.....	5-6
5.3.2	Materials.....	5-6

5.3.3	Method	5-7
5.3.3.1	Temperature/Relative Humidity Rig.....	5-7
5.3.3.2	Preconditioning of Powder	5-10
5.3.3.3	T-T _g Sticking Trials	5-10
5.3.3.4	T _g Profiles	5-10
5.3.4	Results and Discussion	5-11
5.3.5	Conclusions.....	5-21
5.4	CLOSURE.....	5-21

CHAPTER 6 FAT MELTING MECHANISM

6.1	INTRODUCTION.....	6-1
6.2	PHYSICAL PROPERTIES OF MILK FAT.....	6-1
6.2.1	Melting Profile for Milk Fat	6-2
6.2.2	Milk Fat Crystallisation.....	6-3
6.3	FAT MELTING MECHANISM.....	6-5
6.4	CAKING EXPERIMENTS.....	6-9
6.4.1	Initial Work.....	6-9
6.4.1.1	Confocal Laser Scanning Microscopy	6-10
6.4.2	Surface Fat Measurement	6-12
6.4.3	Relationship Between Total Fat and Surface Fat.....	6-14
6.4.4	Caking Experiments	6-15
6.4.4.1	Powder Selection	6-15
6.4.4.2	Method.....	6-16
6.4.4.3	Results and Discussion	6-17
6.5	CLOSURE.....	6-21

CHAPTER 7 PREDICTION OF STICKING AND CAKING CONDITIONS IN DAIRY POWDERS

7.1	INTRODUCTION.....	7-1
7.2	STICKING PREDICTION MODEL.....	7-1
7.3	MODEL VALIDATION	7-4
7.3.1	Prediction of Isotherms.....	7-5
7.3.2	Prediction of Glass Transition Temperature Profiles	7-7
7.3.3	Stickiness Trials	7-10
7.4	SENSITIVITY ANALYSIS.....	7-13
7.5	CLOSURE.....	7-14

CHAPTER 8 CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK

8.1	CONCLUSIONS.....	8-1
8.2	SUGGESTED FUTURE WORK	8-2

REFERENCES	9-1
APPENDIX A1 NOMENCLATURE.....	A1-1
APPENDIX A2 AMORPHOUS SUGAR STICKING	A2-1
APPENDIX A3 MODEL VALIDATION	A3-1

LIST OF FIGURES

Figure 2.1	α-lactose chemical structure	2-1
Figure 2.2	Moisture sorption isotherm of α-lactose monohydrate	2-4
Figure 2.3	Humidity caking mechanism	2-5
Figure 2.4	Amorphous lactose moisture sorption isotherm	2-6
Figure 2.5	Amorphous lactose caking mechanism	2-8
Figure 3.1	Moisture sorption isotherm for whey protein	3-10
Figure 3.2	Moisture sorption for high micellar casein powders	3-11
Figure 3.3	Moisture sorption isotherm for crystalline glucose	3-13
Figure 3.4	Moisture sorption isotherm for amorphous glucose	3-14
Figure 3.5	Moisture sorption isotherm for crystalline galactose	3-15
Figure 3.6	Moisture sorption isotherm for crystalline sucrose	3-17
Figure 3.7	Moisture sorption isotherm for amorphous sucrose	3-18
Figure 3.8	Moisture sorption isotherm for crystalline fructose	3-19
Figure 3.9	Moisture sorption isotherm for amorphous fructose	3-20
Figure 3.10	Moisture sorption isotherm for amorphous maltose	3-21
Figure 3.11	Moisture sorption isotherms for maltodextrin powders [Roos and Karel 1991d]	3-22
Figure 3.12	Moisture sorption isotherm for cocoa powder	3-23
Figure 3.13	Comparison of measured versus predicted moisture contents for powders from literature	3-25
Figure 3.14	Moisture sorption isotherm for micellar casein	3-27
Figure 3.15	Predicting isotherms for low and high fat cream powders	3-28
Figure 3.16	Moisture sorption isotherm showing amorphous lactose crystallisation	3-29
Figure 3.17	Comparison of measured versus predicted moisture contents from isotherms for lactose, whey protein, casein and milk fat containing powders	3-30
Figure 3.18	Comparison of predicted and measured moisture contents for amorphous sugar mixtures	3-31
Figure 4.1	Typical DSC curve showing the glass transition	4-3
Figure 4.2	T _g versus moisture content for amorphous glucose	4-10
Figure 4.3	T _g versus water activity for amorphous glucose	4-10
Figure 4.4	T _g versus moisture content for amorphous galactose	4-11
Figure 4.5	Estimated T _g versus water activity profile for amorphous galactose	4-11
Figure 4.6	T _g versus moisture content profile for amorphous sucrose	4-12
Figure 4.7	T _g versus water activity for amorphous sucrose	4-13
Figure 4.8	T _g versus moisture content profile for amorphous fructose	4-14
Figure 4.9	T _g versus water activity profile for amorphous fructose	4-15
Figure 4.10	T _g versus moisture content profile for amorphous maltose	4-15
Figure 4.11	T _g versus water activity profile for amorphous maltose	4-16
Figure 4.12	T _g versus moisture content profiles for maltodextrin powders [Roos and Karel 1991c,d]	4-17
Figure 4.13	T _g versus water activity profiles for maltodextrin powders	4-18
Figure 4.14	T _g versus water activity profile for a hydrolysed whey protein concentrate powder	4-19
Figure 4.15	Comparison of predicted and measured T _g values for amorphous lactose, protein and fat powders using equation 4.5	4-21
Figure 4.16	Comparison of predicted and measured T _g values for amorphous lactose, protein and fat powders using equation 4.3	4-21
Figure 4.17	Comparison of predicted versus measured T _g values for dry amorphous sugar mixtures	4-22

Figure 4.18	Comparison of predicted versus measured T_g values for dry amorphous sugar mixtures using equation 4.3	4-23
Figure 4.19	Comparison of predicted versus measured T_g values for three component powders, using equation 4.5	4-23
Figure 4.20	Comparison of predicted versus measured T_g values for three component powders, using the extended Couchman and Karasz equation	4-24
Figure 5.1	Amorphous sugar caking mechanism	5-2
Figure 5.2	Polarising microscope image for an amorphous lactose and glucose mixture	5-7
Figure 5.3	Relative humidity air supply apparatus	5-8
Figure 5.4	Testing chamber and modified blow tester	5-9
Figure 5.5	Segmented distributor plate	5-9
Figure 5.6	Caking strength versus time for amorphous sucrose	5-11
Figure 5.7	Caking strength versus time for amorphous sucrose	5-12
Figure 5.8	Rate of sticking versus $T-T_g$ for amorphous sucrose	5-13
Figure 5.9	Rate of sticking versus $T-T_g$ for amorphous maltose	5-13
Figure 5.10	Rate of sticking versus $T-T_g$ for amorphous glucose/lactose powder	5-14
Figure 5.11	Rate of sticking versus $T-T_g$ for amorphous galactose/lactose powder	5-15
Figure 5.12	Rate of sticking versus $T-T_g$ for amorphous fructose/lactose powder	5-15
Figure 5.13	Frenkel/WLF model fit to rate of amorphous sucrose sticking data	5-18
Figure 5.14	Van Krevelen model fit to rate of amorphous sucrose sticking data	5-20
Figure 6.1	DSC thermogram for milk fat	6-2
Figure 6.2	Solid fat content versus temperature for milk fat	6-3
Figure 6.3	Change in solid fat content with time [Herrera <i>et al.</i> 1999]	6-4
Figure 6.4	Milk fat melting mechanism	6-6
Figure 6.5	Change in caking strength with temperature for a low fat cream powder and a skim milk powder	6-9
Figure 6.6	CLSM observation of fat bridging and pooling	6-11
Figure 6.7	CLSM observation of fat pooling	6-11
Figure 6.8	Free fat content versus extraction time for a low fat cream powder	6-12
Figure 6.9	Free fat content versus extraction time (up to 10 minutes)	6-13
Figure 6.10	Relationship between total fat content and surface content expressed in terms of the specific surface area	6-14
Figure 6.11	Effect of heating temperature and flow rate	6-17
Figure 6.12	Relationship between caking strength and temperature powder cooled to for a low fat cream powder	6-18
Figure 6.13	Overall comparison between solidified surface fat content and caking strength of various powders	6-18
Figure 6.14	DSC profiles for fat extract from cheese powder 1	6-19
Figure 6.15	DSC profile for fat extracted from a high fat cream powder	6-20
Figure 7.1	Comparison of predicted and measured isotherms for powder 3	7-5
Figure 7.2	Measured versus predicted moisture content for dairy powders	7-6
Figure 7.3	Comparison of predicted and measured T_g profiles for powder 3	7-8
Figure 7.4	Glass transition temperature profile for powder 1	7-8
Figure 7.5	Comparison between measured and predicted T_g values for dairy powders	7-9
Figure 7.6	Comparison of predicted and measured T_g profiles for powder 6	7-10
Figure 7.8	Caking strength versus time at constant $T-T_g$ for powder 3	7-11
Figure 7.9	Caking strength versus time at different $T-T_g$ values for powder 5	7-11
Figure 7.10	Caking strength versus time for powder 4	7-12

LIST OF TABLES

Table 2.1	General properties of α -lactose monohydrate and β -lactose anhydride	2-3
Table 3.1	Equilibrium relative humidities of saturated salt solutions at different temperatures	3-3
Table 3.2	Concentration of protein in milk [Otter <i>et al.</i> 1997]	3-10
Table 3.3	General properties of crystalline sucrose [Reiser <i>et al.</i> 1995]	3-17
Table 3.4	Composition of lactose, whey protein and micellar casein powders	3-27
Table 4.1	Residual moisture content for freeze-dried sugars [Bonelli <i>et al.</i> 1997]	4-5
Table 4.2	k values and specific heat capacity data for amorphous sugars	4-7
Table 4.3	Dry T_g and the change of the specific heat at the glass transition region (Δc_p)	4-20
Table 5.1	$T-T_g$ values for instantaneous sticking	5-16
Table 5.2	Constants from fitting Frenkel/WLF model to rate of sticking data	5-19
Table 5.3	Constants from fitting the van Krevelen model to rate of sticking data	5-20
Table 6.1	Avrami-Erofeev equation parameters (setting $n = 3$) [Herrera <i>et al.</i> 1999]	6-5
Table 6.2	Composition and specific surface area data of powders used in caking experiments	6-15
Table 7.1	GAB constants for components	7-2
Table 7.2	T_g prediction information for amorphous sugars (predicted from water activity)	7-2
Table 7.3	Composition of powders used for validation work	7-4
Table 7.4	Potential variation in the compositions of powders 3 and 4	7-13
Table 7.5	Sensitivity of water activity, moisture content and T_g to a 20% variation in composition	7-13