

The effect of lactose source on the stickiness of dairy powders

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This thesis is dedicated to my late Grandfather Rev. Basil J. Hilder with much love.

"I see the solution to each problem as being detectable in the pattern and web of the whole. The connections between causes and effects are often much more subtle and complex than we with our rough and ready understanding of the physical world might naturally suppose" : *from "Dirk Gently's Holistic Detective Agency"*

ABSTRACT

The particle gun provides a valuable method to investigate powder stickiness properties. This method gives reproducible results when used under constant testing conditions and allows the isolation of factors influencing stickiness behaviour such as velocity and angle of impact. The $(T-T_g)_{\text{critical}}$ and rate of stickiness development obtained from the particle gun method were functions of the air velocity, angle of impact, powder a_w and ambient air conditions. Under constant testing conditions (feed rate of 0.3 g.s^{-1} , air velocity of 20 m.s^{-1} , ambient air at $< 50 \%RH$, room temperature and constant powder a_w) $(T-T_g)_{\text{critical}}$ was reproducible within $\pm 0.8^\circ\text{C}$ while the rate of stickiness development was reproducible within $\pm 0.45 \text{ \%deposition}/^\circ\text{C}$.

The results obtained from the particle gun were consistently higher than the fluid bed results and can be explained by the different impact time and force experienced by the particles. Particle gun results can successfully be used to predict blockages in cyclones provided the appropriate correction is made for particle impact force and time. Blockage data from Te Rapa D5 indicates that the critical $T-T_g$ where blockages occur in the cyclones is 27°C for SMP. Currently D5 is running satisfactorily for SMP at a $T-T_g$ value of 28°C . Under these operation conditions the cyclone wall temperature results in a $T-T_g$ value of 33°C , the same $(T-T_g)_{\text{critical}}$ value predicted by the particle gun for standardised SMP. This implies that the cyclone is operating correctly at the maximum $T-T_g$ value before particles become sticky enough to cause blockage problems.

Protein standardisation of milk powder via the addition of milk permeate or lactose solution had no detectable effect on the stickiness characteristics of SMP or WMP as measured by the particle gun or the fluid bed rig. No difference was seen in either the bulk or surface composition of the milk powder. This provides evidence to dispel speculation by operators that permeate standardisation produces a more difficult to handle powder.

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TABLE OF CONTENTS

ABSTRACT	II
ACKNOWLEDGEMENTS	III
CHAPTER 1 - PROJECT OVERVIEW	1-1
1.1 INTRODUCTION.....	1-1
1.2 RESEARCH PROBLEM.....	1-1
1.3 PROJECT AIMS	1-2
1.4 PROJECT OBJECTIVES.....	1-2
CHAPTER 2 - DAIRY POWDER STICKINESS: A REVIEW	2-4
2.1 INTRODUCTION.....	2-4
2.2 LACTOSE	2-5
2.2.1 <i>Amorphous Lactose</i>	2-5
2.2.2 <i>Water Sorption Isotherms</i>	2-6
2.2.3 <i>Viscosity Phenomena</i>	2-7
2.2.4 <i>Lactose Crystallisation</i>	2-8
2.3 MILK STANDARDISATION	2-9
2.3.1 <i>Permeate Composition</i>	2-10
2.3.2 <i>Milk Salts</i>	2-11
2.4 GLASS TRANSITION TEMPERATURE.....	2-11
2.4.1 <i>Determination of T_g</i>	2-12
2.4.2 <i>Predicting T_g</i>	2-13
2.4.3 <i>Significance of T_g</i>	2-14
2.4.4 <i>T-T_g</i>	2-15
2.5 STICKINESS MECHANISMS.....	2-15
2.6 SURFACE COMPOSITION OF MILK POWDERS.....	2-18
2.7 MEASURING STICKINESS.....	2-20
2.7.1 <i>Sticky Point Curves</i>	2-21
2.7.2 <i>Review of Stickiness Evaluation Techniques</i>	2-21
2.7.2.1 <i>Pneumatic Methods</i>	2-23
2.7.2.2 <i>Traditional Methods</i>	2-27
2.7.3 <i>(T-T_g)_{critical}</i>	2-29
2.7.4 <i>Predicting (T-T_g)_{critical}</i>	2-30
2.7.5 <i>Particle Gun Result Repeatability</i>	2-30
2.8 AMBIENT CONDITIONS EFFECT ON DAIRY POWDERS	2-31
2.8.1 <i>Water Activity & Relative Humidity</i>	2-31
2.8.1.1 <i>Whey Powder</i>	2-32
2.8.2 <i>Storage, Crystallisation & Relaxation</i>	2-33
2.9 OTHER POSSIBLE FACTORS EFFECTING STICKY POINT	2-34
2.9.1 <i>Angle of Impact</i>	2-34
2.9.2 <i>Material of Construction</i>	2-35
2.9.3 <i>Effect of Velocity</i>	2-36
2.10 CONCLUSIONS.....	2-37
CHAPTER 3 - MATERIALS & METHODS.....	3-38
3.1 INTRODUCTION.....	3-38
3.2 MATERIALS	3-38
3.3 METHODS.....	3-39
3.3.1 <i>Particle Gun Rig Construction</i>	3-39
3.3.1.1 <i>Particle Gun Set Up</i>	3-40

3.3.1.2	Particle Gun Experimental Protocol.....	3-42
3.3.1.3	Graphical Analysis.....	3-44
3.3.2	<i>Bench-top Fluidised Bed Stickiness Rig</i>	3-44
3.3.2.1	Fluidised Bed Rig Set Up.....	3-45
3.3.2.2	Bench-top Fluidised Bed Rig Experimental Protocol.....	3-46
3.3.3	<i>Relative Humidity Probe Calibrations</i>	3-47
3.3.4	<i>Water Activity Measurement</i>	3-48
3.3.5	<i>Error Analysis</i>	3-48
3.4	CONCLUSIONS.....	3-48
CHAPTER 4 - EFFECT OF AMBIENT CONDITIONS ON THE STICKINSS CURVE.....		4-50
4.1	INTRODUCTION.....	4-50
4.1.1	<i>Developments in Ambient Condition Effects on Powders</i>	4-51
4.2	EXPERIMENTAL METHOD.....	4-52
4.2.1	<i>Powder Pre-conditioning</i>	4-53
4.2.2	<i>Ambient Air Conditions</i>	4-56
4.3	FACTORIAL EXPERIMENT RESULTS.....	4-56
4.3.1	<i>Factors Affecting $(T-Tg)_{critical}$</i>	4-57
4.3.2	<i>Factors Affecting the Slope of $T-Tg$ Curve</i>	4-57
4.4	EFFECT OF WATER ACTIVITY & AMBIENT CONDITIONS.....	4-58
4.4.1	<i>Effect of Powder Feed Rate on the Particle Gun Technique</i>	4-58
4.4.2	<i>Effect of Ambient Air RH on Powder Stickiness</i>	4-58
4.4.3	<i>Effect of Powder Initial water activity on Stickiness</i>	4-61
4.4.4	<i>Time Dependent Plasticization</i>	4-62
4.5	INHERENT ERRORS AND REPEATABILITY OF THE PARTICLE GUN.....	4-63
4.5.1	<i>Reproducibility of %Deposition Values</i>	4-63
4.5.2	<i>Reproducibility of $(T-Tg)_{critical}$</i>	4-64
4.5.3	<i>Reproducibility of the Rate of Stickiness Development</i>	4-65
4.6	CONCLUSIONS.....	4-66
CHAPTER 5 - ADDITIONAL FACTORS INFLUENCING STICKINESS AS MEASURED BY THE PARTICLE GUN.....		5-68
5.1	INTRODUCTION.....	5-68
5.2	EXPERIMENTAL PROCEDURE.....	5-68
5.3	EFFECT OF AIR VELOCITY ON THE PARTICLE GUN STICKY POINT.....	5-69
5.3.1	<i>Effect of Air Velocity on $(T-Tg)_{critical}$</i>	5-70
5.3.2	<i>Effect of Air Velocity on the Rate of Stickiness Development</i>	5-71
5.4	COMPARISON OF FLUID BED & PARTICLE GUN.....	5-72
5.4.1	<i>Effect of Powder a_w on Fluid Bed Results</i>	5-73
5.5	RELATIONSHIP BETWEEN VELOCITY, CONTACT TIME, FORCE & T-TG.....	5-74
5.6	EFFECT OF ANGLE OF IMPACT ON T-TG PLOT.....	5-76
5.6.1	<i>Angle of Impact & $(T-Tg)_{critical}$</i>	5-76
5.6.2	<i>Angle of Impact & Rate of Stickiness Development</i>	5-77
5.6.3	<i>Effect of Force on $(T-Tg)_{critical}$ & Rate of Stickiness Development</i>	5-78
5.7	EFFECT OF COLLECTION PLATE MATERIAL ON SMP STICKINESS.....	5-80
5.7.1	<i>Collection Plate vs. $(T-Tg)_{critical}$</i>	5-81
5.7.2	<i>Collection Plate vs. Rate of Stickiness Development</i>	5-82
5.8	CONCLUSIONS.....	5-83
CHAPTER 6 - EFFECT OF LACTOSE SOURCE ON MILK POWDER STICKINESS.....		6-85
6.1	INTRODUCTION.....	6-85
6.1.1	<i>Milk Proteins</i>	6-85
6.1.2	<i>Milk Salts</i>	6-86
6.2	POWDERS INVESTIGATED.....	6-86
6.2.1	<i>Bulk Composition</i>	6-87

6.2.2	<i>Surface Composition</i>	6-88
6.2.2.1	Electron Spectroscopy for Chemical Analysis.....	6-88
6.2.2.2	Confocal Laser Scanning Microscopy.....	6-91
6.2.2.3	Surface Composition Effect on $(T-T_g)_{critical}$	6-95
6.3	SMP RESULTS.....	6-97
6.4	WMP RESULTS.....	6-99
6.5	CONCLUSIONS.....	6-100
CHAPTER 7 - INDUSTRIAL APPLICATION OF STICKINESS WORK		7-102
7.1	INTRODUCTION.....	7-102
7.2	INDUSTRIAL SITUATION.....	7-102
7.2.1	<i>Implementation of Sticky Curves</i>	7-103
7.2.2	<i>Te Rapa Blockage Data</i>	7-105
7.3	POSSIBLE REASONS FOR PLANT BLOCKAGES.....	7-106
7.3.1	<i>Cyclone Air Flow Patterns</i>	7-108
7.3.2	<i>Cyclone Pressure Drop</i>	7-109
7.3.3	<i>Cyclone Temperature Investigation D5 Te Rapa</i>	7-110
7.3.4	<i>Particle Residence Times</i>	7-113
7.4	CONCLUSIONS.....	7-115
CHAPTER 8 - CONCLUSIONS & RECOMMENDATIONS		8-117
NOMENCLATURE		8-120
REFERENCES		8-123
APPENDIX 1 - RH PROBE CALIBRATION CURVES		8-130
APPENDIX 2 - SKIM & WHOLE MILK POWDERS		8-132
APPENDIX 3 - COMMERCIAL POWDERS		8-133
APPENDIX 4 - ADDITIONAL PARTICLE GUN RESULTS		8-134
A.	<i>Factorial results</i>	8-134
B.	<i>Particle gun powder feed rate results</i>	8-135
C.	<i>Particle gun plate height results</i>	8-136
D.	<i>Particle gun results from ambient air condition and initial powder water activity trials</i>	8-137
E.	<i>Effect of impact force on particle gun results</i>	8-139
APPENDIX 5 - CALCULATIONS		8-140
A.	<i>Air drawn into particle gun barrel due to venturi effects</i>	8-140
B.	<i>RH change in particle gun barrel due to powder particle flow</i>	8-141
C.	<i>Temperature, pressure and RH changes in cyclone air in response to centre vortex</i>	8-142
D.	<i>RH and $T-T_g$ calculations from D5 cyclone wall temperature</i>	8-143
E.	<i>Heat transfer calculations for inside wall temperature estimations</i>	8-144
F.	<i>Prediction of $(T-T_g)_{critical}$ using equation (5-1), Palzer (2005)</i>	8-146
G.	<i>Algebraic manipulation of equation (5-1), Palzer (2005)</i>	8-148
APPENDIX 6 - ESTIMATION OF SURFACE LACTOSE COMPOSITION		8-150
APPENDIX 7 - CYCLONE WALL TEMPERATURE DATA		8-152

TABLE OF FIGURES

FIGURE 2-1. DIAGRAM OF AMORPHOUS LACTOSE STICKING AND CAKING MECHANISM, FOSTER (2002).....	2-17
FIGURE 3-1. THE MODIFIED PARTICLE GUN RIG. A VIBRATORY FEEDER, B GUN BARREL, C COLLECTION PLATE, D VORTEX CHAMBER WITH GLASS FUNNEL, E WATER BUBBLE COLUMN.....	3-40
FIGURE 3-2. PARTICLE GUN RIG SCHEMATIC DIAGRAM, ZUO (2004).....	3-41
FIGURE 3-3. SCHEMATIC DIAGRAM OF FLUIDISED BED RIG.....	3-46
FIGURE 3-4. BENCH TOP SCALE FLUIDISED BED RIG, LEFT HAND SIDE SHOWS AIR HUMIDIFICATION COLUMN, RIGHT HAND SIDE SHOWS AIR HEATER WITH INSULATED FLUID BED COLUMN.....	3-46
FIGURE 4-1. MOISTURE CONTENT CHANGE ACHIEVED (Y) WITH TIME FOR SMP. Y_c REPRESENTS CHANGE ACHIEVED IN PARTICLE CENTRE, Y_{AV} REPRESENTS AVERAGE CHANGE ACHIEVED ACROSS THE PARTICLE.	4-55
FIGURE 4-2. EFFECT OF AMBIENT AIR RH ON $(T-Tg)_{CRITICAL}$ AT $20 \pm 5^\circ C$. REPLICATIONS AT VARIOUS AMBIENT RH CONDITIONS INCLUDED.....	4-59
FIGURE 4-3. EFFECT OF POWDER A_w ON $(T-Tg)_{CRITICAL}$ UNDER DIFFERENT AMBIENT RH CONDITIONS AT ROOM TEMPERATURE. OBTAINED USING SMP. THE ERROR BARS REPRESENT THE 95% CI FOR EACH $(T-$ $Tg)_{CRITICAL}$	4-61
FIGURE 4-4. EFFECT OF POWDER A_w ON THE RATE OF STICKINESS DEVELOPMENT UNDER DIFFERENT AMBIENT RH CONDITIONS AT ROOM TEMPERATURE. OBTAINED USING SMP.....	4-62
FIGURE 4-5. STANDARD DEVIATION OF REPLICATES AT VARIOUS DEPOSITION LEVELS.....	4-64
FIGURE 4-6. T-TG PLOT SHOWING THE REPRODUCIBILITY OF THE RESULTS UNDER CONSTANT TESTING CONDITIONS FOR UNSTANDARDISED SMP.....	4-66
FIGURE 5-1. EFFECT OF AIR VELOCITY AND ANGLE OF IMPACT ON $(T-Tg)_{CRITICAL}$ OBTAINED UNDER STANDARD AMBIENT CONDITIONS, SMP 0.24 A_w . THE ERROR BARS REPRESENT THE S.E. FOUND FOR $(T-Tg)_{CRITICAL}$ AND THE ERROR IN VELOCITY.....	5-71
FIGURE 5-2. EFFECT OF AIR VELOCITY AND ANGLE OF IMPACT ON THE RATE OF STICKINESS DEVELOPMENT OBTAINED UNDER STANDARD AMBIENT CONDITIONS, SMP 0.24 A_w	5-72
FIGURE 5-3. EFFECT OF ANGLE OF IMPACT AND VELOCITY ON $(T-Tg)_{CRITICAL}$ OBTAINED UNDER STANDARD OPERATING CONDITIONS, SMP 0.24 A_w . THE ERROR BARS REPRESENT THE S.E. FOUND FOR $(T-$ $Tg)_{CRITICAL}$	5-77
FIGURE 5-4. EFFECT OF ANGLE OF IMPACT AND VELOCITY ON THE RATE OF STICKINESS DEVELOPMENT OBTAINED UNDER STANDARD OPERATING CONDITIONS, SMP 0.24 A_w	5-78
FIGURE 5-5. EFFECT OF FORCE ON $(T-Tg)_{CRITICAL}$ FOR SMP 0.24 A_w UNDER STANDARD OPERATING CONDITIONS. ANGLE OF IMPACT CONVERTED TO NORMAL FORCE VELOCITY.....	5-79
FIGURE 5-6. EFFECT OF FORCE ON THE RATE OF STICKINESS DEVELOPMENT FOR SMP 0.24 A_w UNDER STANDARD OPERATING CONDITIONS. ANGLE OF IMPACT CONVERTED TO NORMAL FORCE VELOCITY..	5-79
FIGURE 6-1. SMP STAINS: A) LACTOSE STANDARDISED 3D FAT IMAGE, B) LACTOSE STANDARDISED DUAL FAT AND PROTEIN STAIN, C) UNSTANDARDISED DUAL FAT AND PROTEIN STAIN, D) PERMEATE STANDARDISED DUAL FAT AND PROTEIN STAIN.....	6-92
FIGURE 6-2. PERMEATE STANDARDISED SMP PROTEIN STAINS: A) CROSS SECTION SHOWING PARTICLE POROSITY, B) SURFACE SHOWING SURFACE INDENTATIONS.....	6-93
FIGURE 6-3. WMP FAT STAINS: A) LACTOSE STANDARDISED, B) UNSTANDARDISED, C) PERMEATE STANDARDISED, D) WMP UNSTANDARDISED 3D FAT IMAGE. NOTE PRESENCE OF SOLIDIFIED FAT BRIDGING IN TOP RIGHT HAND CORNER.....	6-94
FIGURE 6-4. BULK AND SURFACE (10 NM) LACTOSE (%TS) AFFECT ON $(T-Tg)_{CRITICAL}$ FOR VARIOUS POWDERS TESTED BY THE PARTICLE GUN TECHNIQUE.....	6-96
FIGURE 6-5. SURFACE LACTOSE (%TS) AFFECT ON $(T-Tg)_{CRITICAL}$ OF VARIOUS POWDERS TESTED BY THE PARTICLE GUN TECHNIQUE.....	6-97
FIGURE 7-1. DRYER 5 CYCLONE RISER TUBE AFTER SMP BLOCKAGE.....	7-103
FIGURE 7-2. DRYER 5 CYCLONE 4 ROTARY VALVE AFTER SMP BLOCKAGE.....	7-103
FIGURE 7-3. CURRENT MODEL COMPARED TO WMP AND SMP BLOCKAGE DATA PRIOR TO 2004/05 SEASON, N. T. RUSSELL (2005, PERSONAL COMMUNICATION).....	7-104

FIGURE 7-4. EXAMPLE OF A STICKY CURVE USED TO GUIDE DRYER OPERATORS, N. T. RUSSELL (2005, PERSONAL COMMUNICATION).....	7-105
FIGURE 7-5. OPERATING POINT DATA AT THE TIME OF BLOCKAGE FOR D5 PROCESSING SMP, 2005 SEASON.	7-106
FIGURE 7-6. SAMPLE 1: INLET - 2 PROBES UN-INSULATED, SAMPLE 2: TOP OF CYCLONE - 1 PROBE INSULATED, 1 PROBE UN-INSULATED, SAMPLE 3: BOTTOM OF CYCLONE - 1 PROBE INSULATED, 1 PROBE UN-INSULATED, SAMPLE 4: ABOVE ROTARY VALVE - 2 PROBES UN-INSULATED.	7-111
FIGURE 7-7. TEMPERATURE READINGS FOR D5 CYCLONE OPERATING WITH SMP. – CONE TOP INSULATED (68°C) – CONE TOP UN-INSULATED (66°C), – CYCLONE INLET (66°C) – CYCLONE INLET (69°C) – CONE BOTTOM INSULATED (64°C) – CONE BOTTOM UN-INSULATED (52°C) – ROTARY VALVE (46°C) – ROTARY VALVE (44°C).	7-112
FIGURE A1-1. HR1 AND PET 509 PROBE CALIBRATIONS USING SALT SOLUTIONS LiCl (11.3%RH) AND NaCl (75.4%RH) APRIL 2005.	8-130
FIGURE A1-2. HR1 RECALIBRATION AUGUST 2005 USING SALT SOLUTIONS LiCl (11.3%RH) AND NaCl (75.4%RH).	8-130
FIGURE A1-3. HYGROCAL RH PROBE CALIBRATIONS USING ROTRONIC AG CHEMICAL STANDARDS 35%, 65% AND 80%, MAY 2005.	8-131
FIGURE A1-4. FLUID BED RH PROBE CALIBRATIONS USING ROTRONIC AG CHEMICAL STANDARDS 80%, 65% AND 10%, JUNE 2005.	8-131
FIGURE A4-1. 2 ⁴ FACTORIAL RESULTS USING UNSTANDARDISED SMP. FACTORS LISTED IN ORDER OF A, B, C, D. A REFERS TO INITIAL POWDER A_{ps} , B TO AMBIENT TEMPERATURE, C TO AMBIENT AIR RH AND D TO POWDER FEED RATE.	8-134
FIGURE A4-2. EFFECT OF SMP FEED RATE ON T–Tg RESULTS FROM THE PARTICLE GUN RIG.	8-135
FIGURE A4-3. EFFECT OF PARTICLE GUN PLATE HEIGHT ON T–Tg AT 20 M.S ⁻¹ , 90° ANGLE OF IMPACT, UNSTANDARDISED SMP.	8-136
FIGURE A4-4. EFFECT OF PARTICLE GUN PLATE HEIGHT ON T–Tg AT 20 M.S ⁻¹ , 29° ANGLE OF IMPACT, UNSTANDARDISED SMP.	8-136
FIGURE A4-5. PARTICLE GUN RESULTS SHOWING THE EFFECT OF INITIAL POWDER WATER ACTIVITY AND AMBIENT AIR CONDITIONS USING UNSTANDARDISED SMP AT 20 M.S ⁻¹	8-137
FIGURE A4-6. PARTICLE GUN RESULTS SHOWING THE EFFECT OF INITIAL POWDER WATER ACTIVITY AT AMBIENT AIR 39 ± 3%RH AND 24°C ON T–Tg USING UNSTANDARDISED SMP AT 20 M.S ⁻¹	8-137
FIGURE A4-7. PARTICLE GUN RESULTS SHOWING THE EFFECT OF INITIAL POWDER WATER ACTIVITY AT AMBIENT AIR 60 ± 2%RH AND 15.5°C ON T–Tg USING UNSTANDARDISED SMP AT 20 M.S ⁻¹	8-138
FIGURE A4-8. PARTICLE GUN RESULTS SHOWING THE EFFECT OF INITIAL POWDER WATER ACTIVITY AT AMBIENT AIR 70 ± 2%RH AND 20°C ON T–Tg USING UNSTANDARDISED SMP AT 20 M.S ⁻¹	8-138
FIGURE A4-9. ANGLE OF IMPACT AND AIR VELOCITY CONVERTED TO NORMAL FORCE VERSUS (T–Tg) _{CRITICAL}	8-139
FIGURE A4-10. ANGLE OF IMPACT AND AIR VELOCITY CONVERTED TO NORMAL FORCE VERSUS RATE OF POWDER DEPOSITION.	8-139
FIGURE A6-1. ESTIMATION OF SURFACE LACTOSE COMPOSITION FROM BULK LACTOSE (%TS).....	8-151
FIGURE A7-1. EXTENDED TEMPERATURE DATA FROM EYE BUTTON LOGGER TRIALS ON D5 PROCESSING SMP FROM START UP TO SHUT DOWN.	8-152

TABLE OF TABLES

TABLE 2-1. BULK COMPOSITION COMPARED TO SURFACE COMPOSITION FOR SPRAY DRIED MILK POWDERS. 2-20	
TABLE 2-2. CLASSIFICATION OF THE STICKINESS CHARACTERISATION TECHNIQUES FOR FOOD POWDERS, ADAPTED FROM BOONYAI ET AL. (2004).....	2-23
TABLE 5-1. $(T-Tg)_{CRITICAL}$ COMPARISONS BETWEEN PARTICLE GUN AND FLUID BED METHODS.	5-73
TABLE 5-2. FLUID BED RESULTS FOR UNSTANDARDISED SMP WITH VARIOUS INITIAL POWDER A_w VALUES..	5-74
TABLE 5-3. EFFECT OF COLLECTION PLATE MATERIAL ON $(T-Tg)_{CRITICAL}$ USING THE PARTICLE GUN WITH PERMEATE STANDARDISED SMP UNDER STANDARD OPERATING CONDITIONS.....	5-82
TABLE 5-4. EFFECT OF COLLECTION PLATE MATERIAL ON THE RATE OF SMP STICKINESS DEVELOPMENT USING THE PARTICLE GUN WITH PERMEATE STANDARDISED SMP UNDER STANDARD OPERATING CONDITIONS.....	5-83
TABLE 6-1. POWDER PROPERTIES AND MILK COMPOSITION FOR SMP SAMPLES.....	6-87
TABLE 6-2. POWDER PROPERTIES AND MILK COMPOSITION FOR WMP SAMPLES.	6-88
TABLE 6-3. SURFACE AND BULK COMPOSITION (%WT) FOR SMP SAMPLES. SURFACE COMPOSITION ESTIMATED BY ESCA.	6-89
TABLE 6-4. SURFACE AND BULK COMPOSITION (%WT) FOR WMP SAMPLES. SURFACE COMPOSITION ESTIMATED BY ESCA.	6-90
TABLE 6-5. SMP STICKINESS RESULTS FROM PARTICLE GUN AND FLUID BED METHODS.....	6-98
TABLE 6-6. WMP STICKINESS RESULTS FROM PARTICLE GUN AND FLUID BED METHODS.	6-100
TABLE A2-1. SMP PRODUCTION CONDITIONS	8-132
TABLE A2-2. WMP PRODUCTION CONDITIONS.....	8-132
TABLE A2-3. BULK COMPOSITION FOR SMP STANDARDISED BY LACTOSE SOLUTION AND MILK PERMEATE. 8-132	
TABLE A2-4. BULK COMPOSITION FOR WMP STANDARDISED BY LACTOSE SOLUTION AND MILK PERMEATE.	8-132
TABLE A3-1. ADDITIONAL SMP OBTAINED FROM FONTERRA TE RAPA, HAMILTON.	8-133
TABLE A3-2. ADDITIONAL SMP OBTAINED FROM WAITOA, HAMILTON.	8-133
TABLE A4-1. RESULTS FROM SMP FEED RATE TRIALS ON THE PARTICLE GUN.....	8-135
TABLE A5-1. PREDICTION OF $(T-Tg)_{CRITICAL}$ FOR THE FLUID BED RIG USING HERTZIAN THEORY EQUATIONS FOR TWO CONTACTING SPHERES. NOTE THE EQUATIONS USED FOR FORCE AND THE INCLUSION OF COLLISION THEORY CALCULATIONS (XU AND ZHU 2005).	8-147
TABLE A5-2. HERTZIAN EQUATIONS FOR FORCE AND TIME FOR A PARTICLE IMPACTING AGAINST STEEL.	8-148
TABLE A6-1. COMPOSITIONAL DATA FOR POWDERS WITH $(T-Tg)_{CRITICAL}$ RESULTS USED TO PREDICT $(T-Tg)_{CRITICAL}$ FROM SURFACE COMPOSITION.	8-150
TABLE A7-1. AVERAGE CYCLONE WALL TEMPERATURES FOR COMPLETE SMP DRYING CYCLE, TE RAPA, 22/02/2006 – 10/03/2006.....	8-153