1 Laura Kuskopf (2016) Infrared thermal image analysis for the determination of bulk particle properties in cascading particle curtains, Bachelor of Engineering (Honours) Chemical.

1.1 Chapter1: Introduction to particle curtains

1.2 Chapter2: Examples of IR and VIS image integration (Literature Review)

1.3 Chapter3: Methodologies of developing hot particle curtains.

1.4 Quotable

1.4.1 Introduction

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1.5 General Ideas

1.5.1 Introduction

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2 Afshar, Sepideh (2015) Modelling and infra-red thermal imagery of hot particle curtains. PhD thesis, James Cook University.

2.1 Quotable

2.1.1 Introduction

- Particle curtains are defined as a stream of particles falling a fixed distance through a gas or fluid phase.
- They are very common in industrial drying, particularly in the minerals and food industry.
- Typical unit operations in drying industry are fluidised beds, spray dryers, flighted rotary dryers (FRD) and solid particle receivers (SPR).
- Flighted rotary dryers are used widely in industry because of their simplicity and their ability to handle very large throughputs.
- Particle curtains are important in flighted rotary dryers.
- Researchers have found that the properties of the individual particles, such as particle temperature and particle size, and the operational characteristics such as flow rates and curtain

depth, solid volume fraction and rates of heat transfer are important in characterising the behaviour of particle curtains.

- CFD has applied successfully to model particle curtains in isothermal conditions; however, there are relatively few CFD studies of hot particle curtains. Furthermore, the use of CFD to approximate bulk curtain behaviour has not been described.
- There are a few examples of the use of image analysis to characterise particle curtains. These have shown promise and suggest that infrared thermal imagery might provide good data for characterising the thermal properties of particle curtains. However, there are no examples of this application to two-phase systems. This illustrates a gap in our understanding.

2.2 General Ideas

2.2.1 Introduction

- Drying is governed by two-phase heat and mass transfer processes.
- Characterising the interaction between gas and particles has spurred the interest of researchers for decades.
- Despite the importance of particle curtains in flighted rotary dryers, a comprehensive model that describes the influence of these properties has yet to be developed.
- There are a few examples of the use of image analysis to characterise particle curtains.

3 Andrew LEE, (2008) Modelling the Solids Transport Phenomena Within Flighted Rotary Dryers. PhD Thesis, James Cook University

3.1 Quotable

3.1.1 Introduction

- Flighted rotary dryers are used extensively in a range of industries for the control of temperature and moisture content of free flowing, particulate solids such as grains, sugar and mineral ores.
- Despite the extensive use of rotary dryers in industrial applications for many years, a general model for a rotary dryer that is applicable to all dryer geometries and operating conditions has yet to be developed.
- A number of models have been developed for specific dryers and operating conditions, however these models are generally limited to a small range of conditions.

3.2 General Ideas

3.2.1 Introduction

- Whilst flighted rotary dryers are widely used, their complex solids transport behaviour, and the difficulty of separating solids transport and heat and mass transfer phenomena within the dryer, has proved to be a significant stumbling block in the quest to understand their behaviour. Given the complex behaviour of flighted rotary dryers, and the lack of design and control procedures, there is a need for a model for flighted rotary dryers.

4 Piotr Hellstein, Mariusz Szwedo, (2016) 3D thermography in non-destructive testing of composite structures, AGH University of Science and Technology, Mickiewicza 30 Ave., 30-059 Krakow, Poland & MONIT SHM, Lublanska 34, 31-476 Krakow, Poland

4.1 Quotable

4.1.1 Introduction

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4.2 General Ideas

4.2.1 Introduction

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5 Sepideh Afshar, Madoc Sheehan, (2005) CFD and Experimental Study of Convectional Heat Transfer in Free Falling Particle Curtains, Department of Chemical Engineering, James Cook University, Townsville, Queensland 4814, Australia

5.1 Quotable

5.1.1 Introduction

- Optimisation of heat transfer in drying industries is very essential, particularly in flighted rotary dryers

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5.2 General Ideas

5.2.1 Introduction

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6 J. Hruby, R. Steeper, G Evens, C. Crowe, (1998) Am Experimental and Numerical Study of flow and convective Heat Transfer in a Freely Falling Curtain of Particles, Sandia National Laboratories, Livermore, Calif, Washington State University, Pullman, Wash

6.1 Quotable

6.1.1 Introduction

- The results suggest that the drag coefficient inflows where the particles are hot compared to the air is larger than predicted using conventional methods to account for nonisothermal effects.

6.2 General Ideas

6.2.1 Introduction

- For the heated particles, both data and predictions show the same trends with regard to particle velocity, particle temperature, and air temperature. However, the calculations of these quantities over-predict the data.