

Analyzing the Effects of Conduction, Convection, and Radiation in a Rotary Drum

Erik Miller, Chemical Engineering

Mentor: Dr. Heather Emady, Assistant Professor

Arizona State University School of Engineering of Matter, Transport, and Energy

Research Overview: Analyzing heat transfer methods and the impact that they have on particles in a rotary drum to minimize energy consumption

Introduction:

Rotary drums are essential tools used in several industries for heating and drying particle batches. On an industrial level, the process of heating and drying particle batches consumes large quantities of energy. By studying how fill levels and rotation rate affect heat transfer through the processes of conduction, convection, and radiation, optimal heat transfer conditions can be determined, and overall energy consumption can be reduced.

Conclusions and Future Work:

- Complete construction on the new rotary drum setup
- Calibrate the thermal camera and begin experimental tests
 - The first set of tests will use conduction, then convection, then radiation and conduction together
 - Tests will use fill levels of 10%, 17.5%, and 25% and rotation rates of 2 RPM, 4 RPM, and 6 RPM



Figure 1. Working Heated Wiring Loop

Developments:

The primary objective this semester is to complete the construction of a new rotary drum setup. The following milestones have been achieved.

- Completed electrical schematics for the new drum setup
- Completed construction of the wiring components with a working loop (Figure 1)
- Completed construction of new drum setup box (Figure 2)
- Began necessary modifications of old drum setup (ongoing)



Figure 2. Completed New Drum Setup Box

Reference: Figueroa I, Vargas WL, Mccarthy JJ. Mixing and heat conduction in rotating tumblers. Chemical Engineering Science. 2010;65(2):1045-1054.