

## ABSTRACT

Penner, Amy Lynn. M.S.A.B.E., Purdue University, December, 2008. An Evaluation of Extrusion Parameters and Application to the Scaling of Extruders. Major Professor: Martin R. Okos.

The scaling of extruders is difficult due to the complex relationships that exist between material properties and equipment configuration. NASA desires the development of a small scale extruder (0.1kg/hr) for long term missions. Results for the optimal processing conditions using a scaled down extruder (60 PPH) are presented for soybean chips, defatted soy flour, peanuts, wheat flour, and rice flour as input materials. For future scaling, the specific mechanical energy (SME)/specific energy consumption (SEC) and the residence time distribution should be held constant. These are considered the primary parameters in defining final product characteristics. Operating adiabatically, the net energy input to the product was confirmed to equal the temperature rise after evaluating energy drawn from the motor operating conditions. Through equating SME and SEC, one is able to understand the interrelationships between: the rheology of the material (viscosity as a function of shear rate), the extruder operating conditions (torque, rpm, and flow rate), and the temperature rise within the product. A master curve was used to predict the viscosity of soybean and soy flour as a function of shear rate, moisture content, oil content and temperature (Leung, 2004). Shear rate was calculated from the corrected flow profile within the extruder (Harper, 1989). In conclusion, understanding the relationship between rheological properties, machine operating conditions, and temperature rise is useful to determine future operating settings based upon given product properties.