

Particulate Mass Flux Sensor



En'Urga Inc.



765-497-3269



765-463-7004

<http://www.enurga.com>



En'Urga Inc.

1201 Cumberland Ave., Ste. R, West Lafayette, IN 47906

innovations in quality control



Motivation

- Currently, most processed foods and pharmaceuticals are produced using batch processes
- Switching production to continuous processes will increase efficiency, lower waste, and improve quality significantly
- One of the key technological challenges in monitoring and controlling continuous processes in this domain is the development of a reliable sensor for measuring flux of particulate systems



1201 Cumberland Ave., Ste. R, West Lafayette, IN 47906

innovations in quality control



Objective

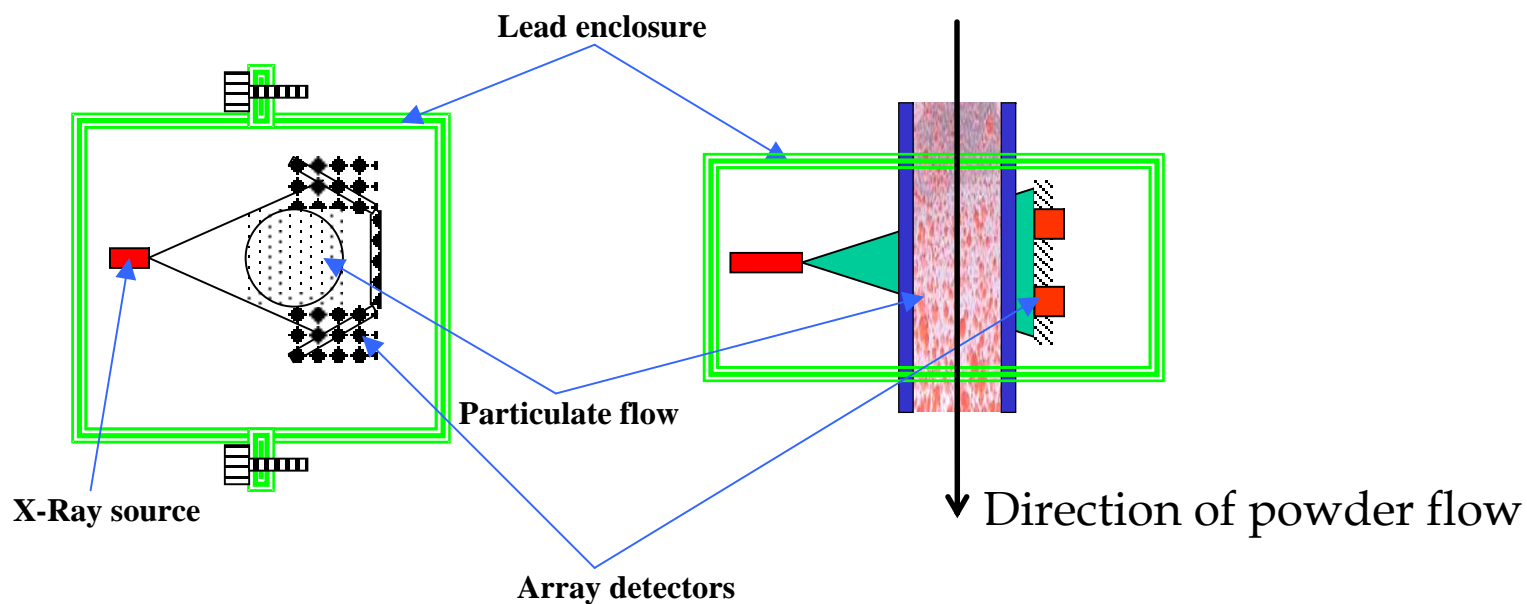
- Develop a reliable and accurate instrument to estimate mass flux of particulates systems
- Evaluate the instrument using ingredients commonly used in processed foods



1201 Cumberland Ave., Ste. R, West Lafayette, IN 47906

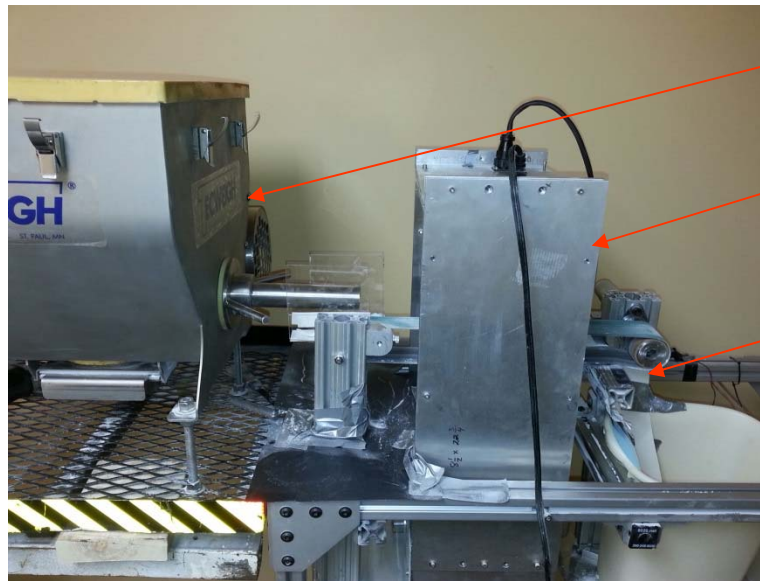
innovations in quality control

Technology



- X-Ray extinction for mass concentrations
- Multiple plane correlation for velocity

Experimental configuration (1)



Particulate feeder

X-ray System

Conveyor belt

- Particulates dropped onto a horizontal conveyor belt that runs through the X-Ray system
- X-ray beam is vertical with array detectors located under the conveyor belt

Experimental configuration (2)



Particulate feeder

Feeder pipe

- Particulates flow through a vertical pipe
- X-ray system (not shown) surrounds the vertical pipe with horizontal x-ray beam



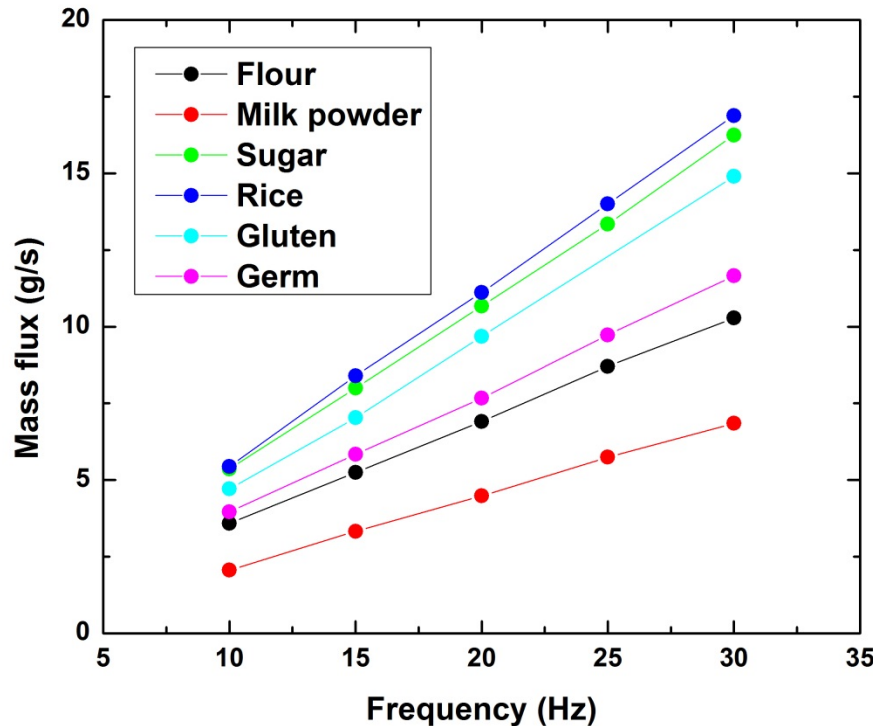
Sample Results

1201 Cumberland Ave., Ste. R, West Lafayette, IN 47906



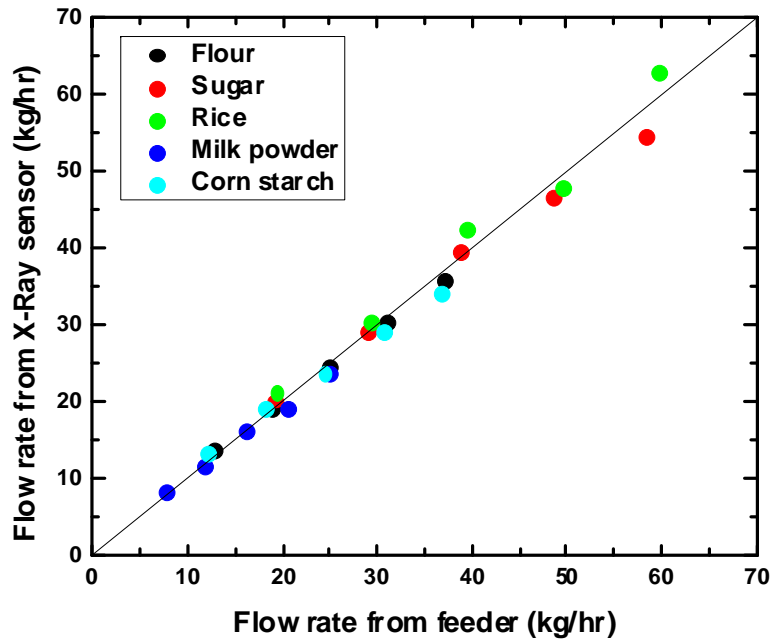
innovations in quality control

Calibration of feeder



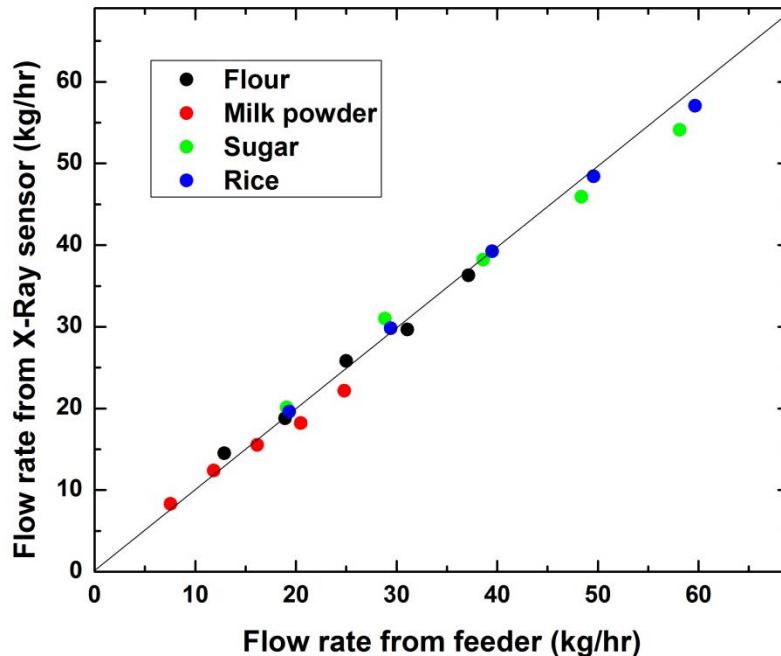
- Feeder is very unsteady
- Continuously ran feeder for 5 minutes
- Weighed amount dispensed as a function of feeder shaft frequency
- Shows very linear calibration

Belt configuration results



- **Approximately 4 % absolute error with 30 KeV**
- **Velocity of the belt estimated within 1%**
- **X-Ray can easily penetrate belt material to get concentrations**
- **Sticking of powder on belt is an issue**

Pipe configuration results



- **Approximately 4 % absolute error with 30 KeV**
- **Improvements made by using 50 KeV and inserting plates into path to harden beam**
- **Approximately 1% error with these improvements**



Conclusions

- **Feasibility of X-Ray based mass flux sensor completely demonstrated during Phase I**
- **Prototype system designed and built during Phase II**
- **System to be installed at Purdue University for monitoring mass flux of powders in drug product manufacturing**
- **System to be installed at Virginia Tech. University for monitoring gas-liquid flows**



1201 Cumberland Ave., Ste. R, West Lafayette, IN 47906

innovations in quality control