

Kansas State University Bulk Solids Innovation Center



Kansas State University Bulk Solids Innovation Center is used to study and develop the understanding of bulk solids material handling, in turn enhancing the businesses that use these materials or manufacture the systems that convey, store and dispense them. This university-level research center is the only one of its kind in North America.



Center Includes:

- Two-Story 13,000 ft² (1,208 m²) Building
- Research Areas - Six Laboratories for University and Industry-Sponsored Research
- Training/Education, Conference and Lecture Rooms
- Material Properties Test Lab - Bulk solid and particle properties can be evaluated and modeled in a test bench environment. Equipped with a full range of lab instruments.
- Full Scale Bulk Solids Test Bay - Full Scale Systems include: Vacuum and Pressure Dilute Phase, Vacuum Sequencing, Vacuum and Pressure Vessel Dense Phase, Rotary Valve Dense Phase, Batch Weighing, Silo Zone Blender, Gravity Flow, Air Filtration, Feeding, Mixing and Silo Storage
- University Researchers, Doctoral Candidates and Students
- Continuing Education and University Level Courses about Bulk Solids

KANSAS STATE
UNIVERSITY

Bulk Solids
Innovation Center

bulksolids.k-state.edu

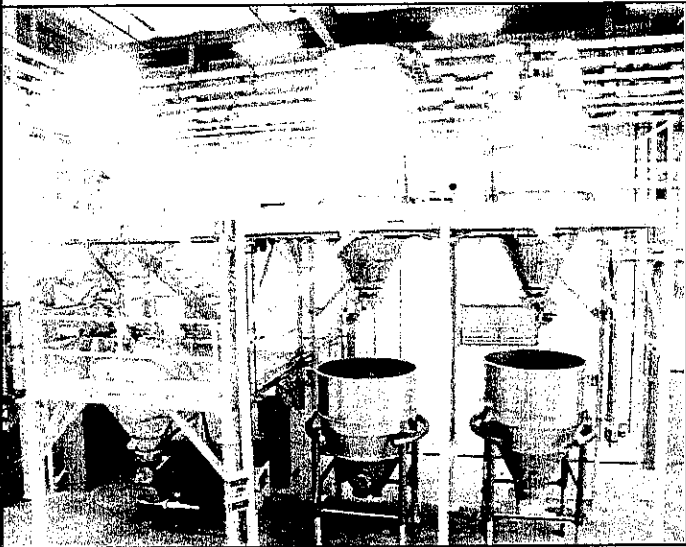
**K-State Bulk Solids
Innovation Center**

607 N Front St.
Salina, KS 67401



Bulk Solids Innovation Center

Research Capabilities:

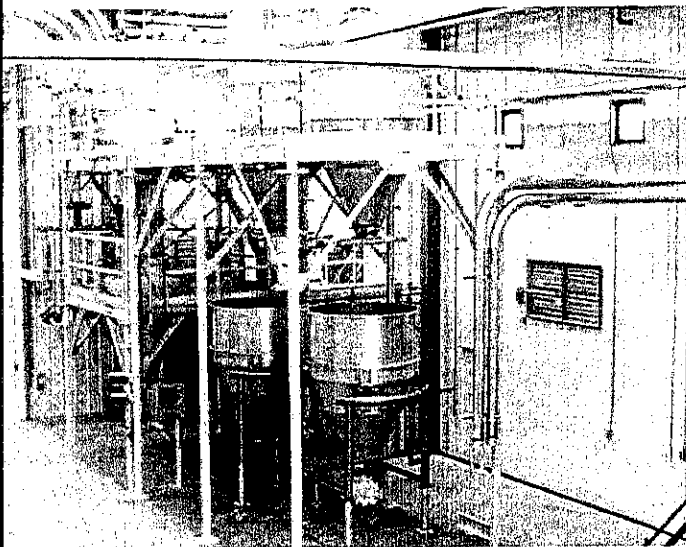


A. **Full Scale Pneumatic Conveying Systems**, up to 920 ft (280m) horizontal and 65 ft (20m) vertical

1. Vacuum Dilute Phase
2. Pressure Dilute Phase
3. Vacuum Sequencing
4. Vacuum Dense Phase
5. Pressure Vessel Dense Phase
6. Rotary Valve Dense Phase

B. **Bulk Solids Processing Systems**

1. Feeding, Weighing, Scaling
2. Blending / Segregation
3. Silo Blending
4. Particulate Air Filtration
5. Instrumentation and Controls



C. **Storage and Gravity Flow** from various hopper geometries including a 3,420 ft³ (100 m³) Silo

D. **Lab Analysis, Material Characterization and Properties Testing, with Report Summary**

E. **Computer Modeling**

KANSAS STATE
UNIVERSITY

Bulk Solids
Innovation Center

bulksolids.k-state.edu

**K-State Bulk Solids
Innovation Center**

607 N Front St.
Salina, KS 67401



KANSAS STATE UNIVERSITY

Bulk Solids Innovation Center

About BSIC

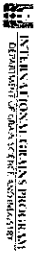
- Two story building (13,000 sq ft) owned by Salina Commerce
 - Six Laboratory Spaces for University and Industry Sponsored Research
 - Training/Education, Conference and Lecture Rooms
 - Material Property Test Lab
 - Full Scale Bulk Solids Test Bay
- Collaborative Partnership**
- Salina Economic Development Corporation
 - Owners of the KSU-BSIC
 - Responsible for capital improvements and insurance
 - Industry partner commitment:
 - Provide and install all equipment and controls
 - Maintain all equipment
 - Maintain the facility
 - Pay expenses: utilities, maintenance, upkeep, housekeeping
- KSU Role in the Center:**
- Provide top level research candidates
 - Solicit research with industry
 - Develop curricula and teach college courses on bulk solids
 - Organize continuing education short courses for industry
 - Coordinate publicity for the center



Vision

- The Kansas State University Bulk Solids Innovation Center will be valued resource to companies that produce bulk solids or design or utilize systems for bulk solids.
- The center will study and gain understanding of how to handle bulk solids, enhance efficiency and productiveness in those businesses operations.
- The center will do research, teaching and consultancy on bulk solids problems.

University Collaborators:



KANSAS STATE UNIVERSITY
 INTERNATIONAL MINERALS PROGRAM
 DEPARTMENT OF CHEMICAL ENGINEERING



DONORS:



Capabilities

Conveying Systems:

- Design and Dilute Phase Pneumatic Conveying
- Vacuum
- Pressure
- Vacuum Sequencing
- Problems in Dilute Phase Conveying
- Attrition and Wear
- Segregation

Process Systems:

- Feeding, Weighing, Scaling
- Silo Blending / Segregation
- Gravity Flow
- Particulate Air Filtration

Material Properties Testing:

- Particle size and distribution
- Particle shape
- Loose and compacted bulk density
- Particle density
- Angle of repose
- Angle of internal friction
- Moisture content
- Flow function and wall friction angle

Modeling:

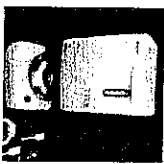
- CFD, FEM and DEM
- Flow patterns
- Stress distribution
- Velocity profile
- Segregation patterns
- Particle distribution
- Power consumption

Experimental Data: Monitoring and Acquisition

- It has controls, interfaces, monitoring, and data acquisition of all parameters.
- Real-time data from hundreds of sensors measuring parameters such as pressure, temperature, flow rate, velocity, amperage, power consumption, weight, and time.
- The data will be stored on a server from which raw data, trending information, and graphs can be displayed.



Sensors & Controls



Flow Property Tester



Vertical Pipelines (65 feet high)



Dilute Phase System



Training



- The following short courses are offered at the center
- Refresher Course on Bulk Solids Handling
- Pneumatic Conveying of Powder and Bulk Solids
- Powder and Bulk Solids Flow in Bins, Hopper, Chutes and Feeders

About the Courses:

These courses cover various topics related to the bulk solids both basic as well as advanced. The course focuses on the common bulk solids flow problems during storage and conveying as well as solutions to these problems. Students will participate in a full-scale test laboratory practical session of bulk solids handling particularly about dilute and dense phase pneumatic conveying.

Who can attend?

Anyone who is responsible for designing, improving, or troubleshooting pneumatic conveying systems, such as Engineers, Operators, Managers, technicians in food, pharmaceutical, plastics, chemical, grain and feed industries; and R&D scientists and engineers. The course is appropriate for new employees who are not familiar with pneumatic conveying as well as those who want to increase their knowledge and experience.

Education

Professional Certified Course

One-year 12 credit hours certified course on bulk solids handling. It will have four core courses related to bulk solids handling. These are on-line courses people from anywhere in the world can enroll in this course.

Undergrad Program

- BS (Mechanical Engineering Technology) specialized in Bulk Solids
- MS (Powder and Bulk Solids)
- MS (Powder and Bulk Solids) (equal, part-time and distance learning)
- PhD (Powder and Bulk Solids) (equal)

What is Bulk Solids?

Bulk solids are loose dry commodities such as sugar, starch, minerals, chemicals, pigments, fillers, plastic resin and recycled plastics. These materials make up more than 80 percent of items transported around the world. Research at the Innovation Center mainly focuses on the process industries of plastics, foods and chemicals.

Research

Research Scope

Emphasis on bulk solids handling in the process industries such as Food, Plastics, Pharmaceuticals & Chemicals.

Why do Research on Dry Bulk Solids needed?

- It is not well defined, like gases or liquids
- The fundamentals of bulk solids properties are not well understood
- Both Applied and Basic Research are needed
- A better understanding of bulk solids handling will help industries

Consortium Research

- Conduct research on the problems determined by the consortium members/familiar meeting.
- The outcome of the research output will be shared among the consortium members
- There will be annual fee for the each member company enrolled in the consortium research
- The center uses the fee money to hire research fellows to work on various projects as well as over-head expenses.

Contract Research

Conduct research on specific problems for a particular industry and give recommendation for process improvement such as reducing the operational cost, solving flow problems.

- The research activity involves:
- Material flow property testing
- Material conveying property testing
- DEM modeling
- Large-scale flow study
- Large-scale pneumatic conveying study

Problems in Bulk Solids Handling

- Ratchling
- Arching
- Segregation
- Funnel flow



Full Scale Laboratory

Contact Info



Contact Person
 Dr. Johnnie Lawrence
 Research Director
 Email: lawren@ksu.edu
 Phone: 785-829-1110

Address
 607 N Front St
 Salina, KS 67401