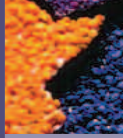


Flow of Solids

Bulk Solids: Science / Engineering / Design

The Newsletter of Jenike & Johanson, Inc.

Fall 2005



The Inside View

These are exciting times at Jenike & Johanson. We have added new staff to our engineering, design, and laboratory teams, one of whom you will meet on pg. 2. In addition, I was pleased to participate recently in groundbreaking ceremonies for our new world headquarters in Tyngsborough, Massachusetts. I can think of no better way to celebrate the 40th anniversary of our company when this building is completed next spring. This new facility will not only provide much needed room for growth, but it will also have a state-of-the-art bulk materials characterization laboratory and a bulk solids training center.

As always, helping our clients overcome challenging solids handling problems is our top priority. With the above developments, we continue to strengthen our ability to serve your solids handling and processing needs.

John W. Carson, Ph.D.,
President, Jenike & Johanson, Inc.



Canadian Oil Mining Provides a World-Class Bulk Solids Handling Challenge

When you think of countries with large petroleum deposits, Canada is not likely to be near the top of your list. So, it may come as a surprise to learn that the Province of Alberta sits atop the largest petroleum deposit outside the Persian Gulf - as many as 300 billion recoverable barrels and another trillion-plus barrels that could one day be within reach using new retrieval methods.

There is, however, a catch. Unlike most petroleum deposits around the world, the oil in this one doesn't gush up out of the ground.

delivered to the silo by a 2400 mm (8 ft.) wide belt conveyor at more than 10,000 mt/hr and fed from the silo by two huge apron feeders each capable of discharging up to 7,000 mt/hr. The entire silo can be emptied in less than one hour!

Unusual material properties

Oil sands are not easy bulk solids to handle. They can be extremely free-flowing making them difficult to control, or they can be sluggish and poor-flowing. Oil sands are sometimes likened to "toothpaste." Oil content can vary from a few percent to over 12%. Moisture content can range from almost dry to saturated. Clay content can vary in both percentage and type.

As a result of these variations, oil sands present some unique challenges when it comes to testing and design - utilizing the full range of Jenike & Johanson's testing capabilities and engineering expertise.



Oil Sands Tailing Settling Pond

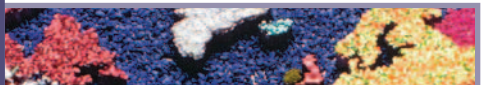
Instead it's more like a mix of Silly Putty and coffee grounds, and it's trapped beneath hundreds of feet of clay and rock. It's called Oil Sands, or Tar Sands.

The shear magnitude of oil sand mining operations is hard to grasp. Consider, for example, a surge silo with a capacity of more than 10,000 tonne, installed to smooth the flow between the mine and extraction plant at one operation. Crushed ore from the mine is

highly temperature sensitive, so controlling this variable during testing is extremely important. Our environmental chamber allows testing at the freezing temperatures required to accurately simulate field conditions. Indeed we have one of the few testing laboratories in the world equipped to measure flow properties of bulk solids at subfreezing temperatures.

Second, oil sands are very abrasive, so having the capability to accurately measure their wear characteristics on samples of hopper wall materials is a must. Our patented abrasive wear tester is ideal for this application.

continued on page 2



Canadian Oil Mining Provides a World-Class Bulk Solids Handling Challenge



Third, oil sands are strain-rate sensitive. This is unlike most bulk solids, whose shearing stresses within the flowing mass can be considered independent of the rate of shear and dependent on

Jenike & Johanson's experience

Our engineers have been involved in providing services to the Canadian oil sands industry for over four decades.

Our first oil sands project, which we performed in 1964, involved the testing of oil sands and design of bins for the Great Canadian Oil Sands' Athabasca Project. Since that time we have worked on numerous other oil sands projects. Our work has included measuring the sand's flow properties at subfreezing conditions as a function of strain rate, and design of bins, feeders, surge piles, truck loading hoppers, surge bins, reclaim hoppers, feeder breakers, and vessels to

separate oil from sand.

Your material may not be as unique as oil sands or your handling requirements may not be as demanding, but our engineers have the know-how to tackle the most challenging applications. And even if your material is more well behaved or your application more standard, we pride ourselves in developing cost-effective recommendations that ensure reliable flow and performance.



Particle Sizer Handling Oil Sands

the mean pressure acting within the solid. For such materials, the rate of flow of material from a bin or silo does not affect the stress distribution (i.e. stress and velocity fields are uncoupled).

Oil sands are quite different: the bitumen content adds a viscosity component, and their behavior in bins and silos could more accurately be described as visco-plastic. As bitumen content increases or temperature decreases, minimum dimensions to prevent arching increase significantly. Furthermore, for a given ore grade, increasing discharge velocity results in larger minimum arching dimensions. We have modified our test equipment to allow measurement of flow properties at variable strain rates.



Behind the Scenes: Meet Jesus Chavez

Title: Project/Structural Engineer

Joined J&J: 2005

Experience: Jesus comes to J&J with a unique background in structural design and granular solids behavior. He received his Ph.D. in Civil Engineering from the University of Edinburgh. His Ph.D. research involved the investigation of honking in metallic silos during discharge. The main objectives of his research were the study of the free vibration characteristics of a honking silo structure and its transient dynamic response due to different dynamic load scenarios. Additionally, tests such as wall and internal friction were conducted to characterize the bulk material

stored in the honking silo. The theory related to the free vibration characteristics in silo structures also applies to other vibration problems such as "silo quaking".

Of note: Jesus was born in Chihuahua, Mexico where he received his civil engineering degree (with special distinction) from the Universidad Autonoma

de Chihuahua. He worked as a structural engineer before moving to Scotland to pursue his doctorate degree at the University of Edinburgh. During his research study, Jesus was awarded the Overseas Research Student (ORS) Award.

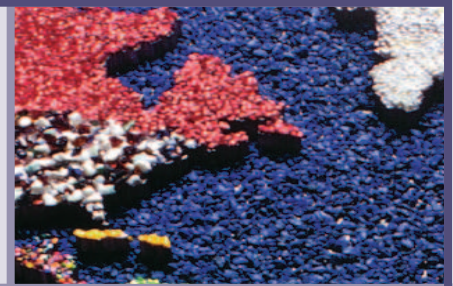


"While studying in Edinburgh, I was attracted by J&J's problem solving philosophy, based on the scientific theories developed by Dr. Jenike more than 40 years ago. However, in addition to theory, engineering and detail design are necessary to solve a particular problem. The engineers at J&J successfully combine theory and engineering with many years of experience in the bulk solids handling field. In addition to the interesting mix of theory, engineering, and experience, I was also interested in the continuous research work and teaching which put J&J as the leader in its field."



J&J builds new headquarters

In October, we broke ground on our new headquarters in Tyngsborough, MA. The laboratory in the new facility will allow the simulation of process conditions up to 2,200°F, as well as testing at ambient weather extremes ranging from hot humid days to cold winter nights. Completion is scheduled for spring, 2006.



John Carson Recognized with Solids Handling Award

For over thirty years, Dr. John Carson, president of Jenike & Johanson Inc., has been solving tenacious production problems in plants that process products as diverse as pharmaceuticals, foods, plastics, chemicals, and minerals. All these industries, and many more, handle powders and loose solids in bulk form. Anyone who has experienced a problem shaking salt from a salt shaker will appreciate the greater difficulty of getting material of this nature from a 100 ton silo. Likewise, to open a packet labeled "Corn Flakes" and find only dust is not acceptable. The technology of ensuring that materials are delivered reliably and in an appropriate condition is a comparatively recent branch of science pioneered by the founders of Jenike & Johanson.



Dr. Carson (right) with Lyn Bates

In recognition of the continuous, outstanding contribution that Dr. Carson has made to this field, the UK Institution of Mechanical Engineers recently conferred on him the honor of their "Solids Handling Award" in recognition of his "Outstanding professional excellence in the technology." This award is a measure of the unique international standing of Jenike & Johanson, as both the original founders of the company are amongst the comparatively few previous recipients of this prestigious award.

Presenting the award before more than 2,000 delegates to the 7th World Congress of Chemical Engineering in Glasgow, Lyn Bates, Managing Director of Ajax Equipment paid tribute to Dr. Carson's contribution to Solids Handling. "Bulk Technology is a complex subject, where processing particulate solids in a pharmaceutical pill to a million ton stockpile calls for professional specialists of a high order, capable of blending science with experience and innovation," he said. "Dr. Carson has all these qualities in abundance, and his technical contributions in this field have been matched by a lifelong commitment to educating engineers in the complexities of solids handling."

Dr. Carson thanked the Institution of Mechanical Engineers for the

award. "I am delighted to receive this award. Much has changed since I began working in the bulk solids industry, yet there is a greater need than ever for specialists in bulk handling where academic knowledge is no substitute for practical experience. Advances in chemical and materials engineering in the process industries have led to increasing use of materials with highly unusually flow characteristics and exceptionally low bulk density, making knowledge of powder flow as relevant today as when I first entered the profession."

Q&A with J&J

It is always gratifying to hear about the positive ways that our work has altered people's lives and the companies for which they work. We recently received the following unsolicited testimonial, and although not a question, typically reserved for this space, we wanted to share it with our readers:

"I have been indebted to your company since 1982.

As a young engineer, I had just finished the design of a silo complex of 18 contiguous bins, all of which had steep hoppers and were to be continuous cast using reinforced concrete. I used as my design basis a silo code that only considered funnel flow conditions.

The contractor was on site, the reinforcing ready, and the concrete pour due to start. A discussion paper by Dr. Andrew Jenike on silo theory and design had just been published and given to me. I quickly realized that I was dealing with mass flow, so the wall pressures were going to be much higher than what I had calculated.

Even though we had to double the amount of wall reinforcing, we were able to rectify the design just in time. We also learnt the name of the real experts on silos: Jenike & Johanson.

Your company prevented me from making a mistake that would have had serious consequences. Hence, my sincere THANK YOU to Jenike & Johanson."

Best regards,

Victor Lopes
Chartered Eng.
Reg. Director - Michael Punch & Partners

Did you know?

Jenike & Johanson has clients in just about every industry, and we take pride in being able to provide solutions to a wide variety of problems. However, we also realize that each industry has unique processes, equipment, and terminology, and that it is important for our engineers to be knowledgeable in these areas. To accomplish this, we have engineers that specialize in various industries, such as pharmaceuticals, power, plastics, and cement. So while our cover story discusses oil sands mining in Canada, our experience and time tested solids flow theory can also be put to use to solve your pharmaceutical content uniformity problem, eliminate hot spots in your coal bunker, or ensure that your plastic is uniformly purged.

This combination of specialization and generalization has other benefits. Based on a primary need in the pharmaceutical industry, our engineers developed the only particle segregation testers that have been recognized with ASTM standards. However, our Sifting and Fluidization Segregation Testers are also now used in such industries as food and powdered metals (and others), to quantify segregation tendencies. Put our wide range of knowledge and experience to work in solving your specific problem.

Flow-of-Solids Industry Calendar

"You get the benefit of years of experience."
"Instructors were very knowledgeable, well prepared, and professional"
- From course attendee evaluations of recent Jenike & Johanson presentations



January 18-19, 2006 Coconut Grove, FL

EUCI Conference - The Nuts & Bolts of PRB. J&J senior project engineer Rod Hossfeld will present a paper titled, *PRB Coal Flow Reliability - Everything You Need to Know - in 45 Minutes*.

February 6-8, 2006 Las Vegas, NV

April 17-19, 2006 Chicago, IL

May 24-26, Vancouver, Canada

J&J engineers will present the following ASME/AIChE courses[†]: *Flow of Solids in Bins, Hoppers, Chutes, and Feeders; and Pneumatic Conveying of Bulk Solids*

[†]For more information, please visit www.asme.org.

February 16, 2006 San Juan, Puerto Rico

Interphex Puerto Rico - J&J senior project engineer Roger Barnum will deliver a presentation titled, *Interstitial Air Effects on Powder*.

February 21-22, 2006 Zürich, Switzerland

Polyethylene 2006, 8th World Congress, Global Technology & Business Forum. J&J senior consultant Brian Pittenger will deliver a presentation titled, *Predicting and Improving Solids Flow Through Flow Visualization Modeling*.

March 21-23, 2006 New York, NY

InterPhex. Come see us at booth #974.

April 6-7, 2006 São Paulo, Brazil

J&J senior consultant Jim Prescott will present the two-day course^{††}, *Flow of Solids in Pharmaceutical Applications*.

^{††}To register, please contact Gregory Hoyl, (55-11) 41545691, or by e-mail to gregory.h.hoyl@attglobal.net

April 9-14, 2006, Phoenix, AZ

48th Cement Industry Technical Conference. J&J senior project engineer Eric Maynard will present a one-day tutorial, *Bulk Solids Handling and Pneumatic Conveying Principles for the Cement Industry*.

April 23-27, 2006 Orlando, FL

WCPT5 - Fifth World Congress on Particle Technology. J&J engineers will be discussing:

- *Predicting Flow Behavior of a Solid after Fifty Years of Storage Using Sampling and Flowability Studies*.

- *Modeling and Scale-up of Tumble Blenders for Highly Segregating Materials*
- *Particle Segregation*

April 23-28, 2006 Princeton, NJ

Formulation & Process Development for Oral Dosage Forms. J&J senior consultant Jim Prescott will deliver a presentation titled, *Powder Flow, Blending, and Segregation: Tying It All Together*.

May 1-3, Hershey, PA

PMCA's 60th Annual Production Conference. J&J senior project engineer Scott Clement will be presenting a paper titled, *Critical Tips for Handling Dry Bulk Ingredients in Confectionary Processes*.

May 8-10, Las Vegas, NV

Advanced Practices in Pharmaceutical Tablet and Capsule Technology. J&J senior consultant Jim Prescott will be speaking on segregation testers.

May 8-11, Rosemont, IL

International Powder & Bulk Solids Conference/Exhibition. Come see us at booth #1639. J&J engineers will also present the following sessions:

- *Fundamentals of Effective Bin, Hopper, and Feeder Design*

- *Blending and Segregation of Bulk Solids and their Effects on Product Quality*
- *Proper Selection, Design, and Operation of Screw, Belt, and Rotary Valve Feeders*
- *Design of Transfer Chutes to Prevent Plugging, Buildup, Abrasive Wear, and Dust Generation*

More complete course information is available at www.jenike.com/pages/education/dates.html

Hot Off the Press

Preventing Degradation of PRB Coal During Storage and Handling

by R. J. Hossfeld and R. Hatt

Prevent Caking During Solids Handling

by H. Purutyan, B. H. Pittenger, and G. I. Tardos

Blending, Segregation, and Sampling

by S. A. Clement and J. K. Prescott

Segregation During Batching

by R. A. Barnum and S. A. Clement

In Safe Hands (discussing limestone and clay handling)

by E. P. Maynard

Customizing Silo Storage and Feeding for Sodium Bicarbonate Using Bulk Solids Flow Principles

by D. A. Craig and N. A. Mayberry

Troubleshooting Problems with Three Common Feeders

by J. W. Carson

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