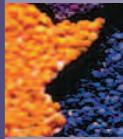


Flow of Solids

Bulk Solids: Science / Engineering / Design

The Newsletter of Jenike & Johanson, Inc.

Spring 2003



The Inside View

Meeting the Challenges of Unusual Materials: The Light Stuff

Background

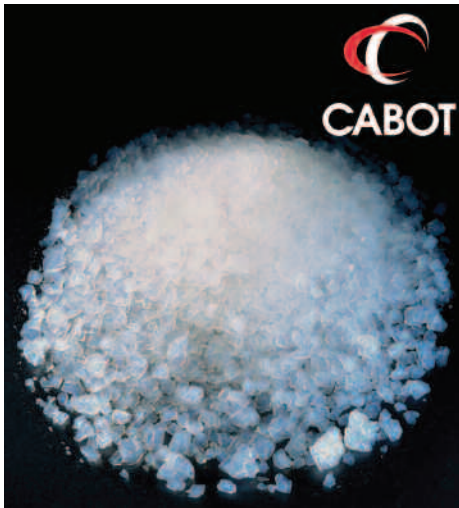
It's been hailed as the world's lightest solid, and a near-magical material. Yet for more than 70 years after chemists first discovered the extraordinary form of matter called "aerogels", it's been used almost exclusively by space researchers.

Aerogels are described by scientists as the lightest form of solid matter that exists, the residue left when silicon dioxide compounds are turned into a gel-like substance and then all the water is removed. In May of 2002, the Guinness Book of World Records gave the "world's lightest solid" prize to one version of aerogel.

Aerogels have been used in NASA projects, such as the Mars 2000 Pathfinder Mission, Mars exploration vehicles, the space shuttle, and a space probe capturing comet-tail dust. Aerogels are made up of both nano-sized particles and nano-sized pores. They are typically more than 95% porous (air) and less than 5% solids.

Aerogels were widely touted in the energy-conscious 70's as a breakthrough technology for insulation and light transmission. The staggering cost due to the high temperature and pressure requirements of the process, as well as the inherent complexity and safety hazards, made producing even small quantities of aerogels uneconomical. As a result, it prevented any kind of large-scale commercial application from developing.

Now, Cabot Corporation (www.cabot-corp.com) is rolling out the first major continuous process that can produce aerogels in bulk. Cabot Corporation is a global specialty chemicals and materials company, headquartered in Boston, MA.



Commercial applications of the silicon-based material are lining up. The first major commercial application is in window and skylight panels that use aerogels for heat and sound insulation while allowing light to pass through (think superdomes, shopping malls, pool enclosures, and a host of other structures where energy efficiency as a result of light transmission and thermal insulation are necessary).

Cabot's product is known as Nanogel®. The Nanogel process does not require the extremes in pressure and temperature that previous process approaches required. The new process, with the first facility in Frankfurt, Germany, is now producing bulk quantities of Nanogel.

Sidney Perkowitz, an Emory University professor who wrote extensively about aerogels in his book "Universal Foam: From Cappuccino to the Cosmos," said that using aerogels as heat and sound insulation in buildings "is a fantastic idea. The potential is very, very good." Insulation is not the sexiest application, but it is a huge market.

Nanogel is now being considered in applications as diverse as cryogenics to construction, and automobiles to apparel. Whether translucent or opaque form, it is finding use as an additive to improve coatings, sealants, adhesives, and industrial rubber. The process can deliver product from a fine powder to spheres, to granules of various sizes, shapes, porosities and chemistries, depending on the requirements of the application.

The Process

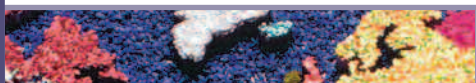
Cabot's process begins by forming a hydrogel from sodium silicate (waterglass) at precise conditions. The solidified hydrogel looks similar to, and can fracture like, ice, but it can also be

continued on page 2

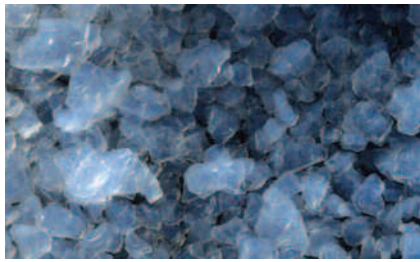
This issue highlights recent work with Cabot Corp., in the development of a unique material called "Nanogel." This project is an excellent example of our ability to assist companies who are at the forefront in the development of advanced processes and materials.

I am proud of the capabilities of our staff and our extensive resources that allow us to tackle challenging projects like this. Whether you are developing a new process or struggling to debug an old one, I encourage you to give us a call. I'm sure you'll be impressed with our capabilities, quick response, and knowledgeable staff.

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



Meeting the Challenges of Unusual Materials: The Light Stuff



mashed depending on the types of shear and impact forces that are applied.

The hydrogel is then surface modified using a patented silylating process to form a highly elastic, hydrophobic granular stream. The saturated granular stream is then dried and a tightly size-distributed range of extremely light-weight, elastic, particles is produced. A cubic foot of the compound can weigh less than seven pounds. This material is ultimately used in a host of developing applications, one of which is building panels (see below).

Our Role

Jenike & Johanson was asked to join the process design team to assist in optimizing product flow and handling through the process as well as customer applications. Nanogel is an amazing granular material with unique flow behaviors. The process require-



ments, from particle size control to process flow reliability to consistency of properties, give plenty of room for particle mechanics to assist in process optimization. Cabot's goal is a highly flexible, well-controlled, continuous process. Therefore factors such as particle attrition, segregation, particle process residence times, flow consistency and process efficiency all come into consideration.

The full range of Jenike & Johanson's services and capabilities are well utilized for this kind of process

and project. Dr. Jim Wilson, Cabot's Business Quality Manager, Nanogel Business Group, describes Jenike & Johanson as, "an integral part of our process optimization team. Their services, talents, and personnel are easily introduced to complex processes and quickly provide critical insights into root causes and approaches for ensuring both short and long-term improvements. I would highly recommend Jenike & Johanson's services to anyone working with difficult behaving powders and bulk solids or poorly controlled processes."

Jenike & Johanson is excited about our client's new product and Cabot's utilization of our particle handling and processing expertise, as well as our laboratory facilities. Our engineering support throughout the optimization of their new process has been an exciting challenge and an on-going source of mutual growth with the highly talented Cabot Nanogel team.

Jenike & Johanson is accustomed to working with unusual applications and materials. While we do not invent or produce new materials, we do use our proven technology and hands-on experience to engineer efficient, reliable, and safe solids handling and processing systems to improve the bottom line of newly developed processes or materials.

Behind the Scenes: Meet Brian Pittenger

Title: Sr. Consultant

Joined J&J: 1993

Job Description: Brian's industry focus is powdered metals and plastics, although he works with all industries, taking him to various countries such as Argentina, Austria, Czech Republic, France, Germany, Guinea, Mexico, and Turkey. Past projects include Six Sigma investigations of automotive

powdered metal parts variability, and plant efficiency studies with respect to polymer handling.

Of note: Brian received his Bachelor's degree in mechanical engineering ('89) from Rensselaer Polytechnic Institute and a Master's degree in Mechanical



Engineering ('97) from Worcester Polytechnic Institute. Before joining J&J, Brian worked for General Electric. Brian also lectures regularly for many professional societies, including AIChE, MPIF, SPE, and ASM.

"As detailed in the Nanogel article, I am enthused by the continually increasing role that J&J is playing, in working with clients who are developing new processes and materials. The need to fix existing bulk solids handling and processing problems is an obvious and continuing part of our work, but being involved early in a project allows us to efficiently merge process and solids handling equipment in innovative ways, while at the same time ensuring that problems don't develop."



In their first commercial installation, Cabot is working with Kalwall Corporation (www.kalwall.com) to incorporate translucent insulating Nanogel into its building panels. Kalwall Corporation is the leader in the field of translucent building panel systems, having invented translucent, structural building panels.

Bruce Keller, Kalwall's Vice President of Marketing says, "Nanogel is a giant step in technology for us. It's the magic insulation material." Kalwall replaced a 1,000 sq. ft. swimming pool pitched roof at a Comfort Inn in Manchester, NH with translucent Nanogel panels. There's enough daylight to naturally light the pool area and, more importantly, the room is no longer losing much heat. It was 85°F in the pool room, but there was no thawing of the ice on the panels, when the roof was inspected from the outside.

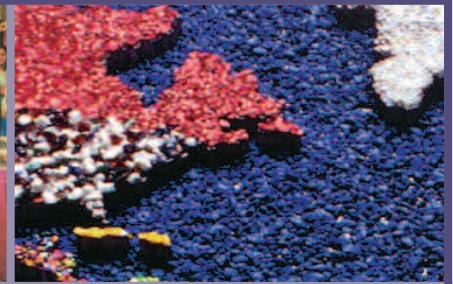
Fred Bailey, owner of the Comfort Inn describes it as astounding and has coined the phrase "frozen smoke" to describe the material.

A Kalwall construction panel, 2 3/4 in thick, insulated with Nanogel can have the same "R-20" insulation value as a house or building wall, while allowing outside daylight through. This is one of the most amazing features of Nanogel – how well it insulates while transmitting (diffused) light. The excellence in insulation and light transmission is compounded by the numerous environmental advantages, including the lack of ozone-depleting substances found in most high-R-value foam insulation materials, as well as its natural hydrophobic tendency which eliminates moisture buildup and mold and mildew concerns.



Congratulations, Eric Maynard!

We would like to congratulate Eric Maynard, project engineer and education coordinator for J&J, for receiving a prize for the best presentation at the North and South American Cement Conference, 2002. Eric presented a paper on environmental compliance in the cement industry, through correct design of transfer chutes. (Eric is to the left in the photo.)



Quantify Segregation Potential with Two New Testers

Fluidization Segregation Tester

Fluidization can cause vertical segregation, i.e., horizontal layers of fines and coarse, during bulk solids handling. Fine particles generally have a lower permeability than coarse particles and therefore tend to retain air longer. Thus on filling a hopper, the coarse particles are driven into the bed while the fine particles remain fluidized near the top surface. This can also occur after tumble blending if the material is fluidized during blending. Air entrainment often develops in materials that contain a significant percentage of particles below 100 microns in size. Fluidization segregation is likely to occur when fine materials are pneumatically conveyed, filled or discharged at high rates, or if gas counterflow is present.



The Jenike Sifting Segregation Tester measures the tendency of powders or other bulk solids to segregate by the sifting segregation mechanism.

- Simulates the side-to-side segregation effects of a free-flowing material discharging from a hopper
- Provides a trend through a fill/discharge cycle
- Allows comparison of one material to another
- Allows multiple fill/discharge cycles
- Typically provides both mass flow and funnel flow discharge patterns

Related Services

Our test equipment is invaluable if your company handles numerous materials in various applications, needs data for quality control purposes, or if you continuously develop new materials. However, if you need to analyze a limited number of materials or solve a specific handling problem, but do not have the time or budget to develop your own lab capabilities, we can still help.



Jenike & Johanson is a specialized engineering firm whose primary focus is to provide a means for companies to obtain reliable bulk solids handling. We offer a range of services in the area of bulk solids flow technology, including consulting, testing, engineering design, and equipment supply.

Additional Information

For additional information or pricing, contact Don Ploof, Test Equipment Sales, at (978) 392-0300, or by fax at (978) 392-9980, or by e-mail to daploof@jenike.com.

The Jenike Fluidization Segregation Tester measures the tendency of powders or other bulk solids to segregate by the fluidization segregation mechanism.

- Simulates the top-to-bottom segregation effects of gas flow through a bulk material, e.g., upon filling a bin, rapid blending, or pneumatic conveying
- Allows comparison of one material to another
- Provides computer controlled gas flow rate for repeatable, operator independent testing

Sifting Segregation Tester

Sifting, which is a process by which smaller particles move through a matrix of larger ones, is the most common method of segregation. This mechanism is most likely to occur when handling particles with different particle size and when there is interparticle motion, such as during filling, transfer, etc.

Q&A with

Q Your course was excellent. Now can you recommend someone who can provide the services you describe, to solve my solids processing problems?



A Absolutely. Jenike & Johanson provides the consulting, testing, and specialized engineering services discussed in our courses and presentations. This point is often overlooked by our course attendees, because we prefer to "err" on the side of presenting useful information, rather than a biased sales pitch. Although we provide a significant amount of educational services, our main focus as a company is to use our proven technology and hands-on experience to engineer efficient, reliable, and safe solids handling and processing systems to improve your bottom line.

If you have any bulk solids handling questions, or if you have suggestions for future articles, please contact:

Flow of Solids® Newsletter
Jenike & Johanson, Inc.
One Technology Park Drive
Westford, MA 01886-3189
E-mail: newsletter@jenike.com
Voice: 978-392-0300
Fax: 978-392-9980

Did you know?

Jenike & Johanson opened an office in Chile in 1994 to better serve markets in South America. Almost a decade ahead of the announced free-trade agreement between the U.S. and Chile, we have been actively involved in most of the new mining projects - particularly the design of stockpiles to handle copper ores, and the design of bins for handling wet and dry concentrates. The office is located in Viña del Mar and has a fully equipped lab for flow property testing. For more details, please visit our web page:

www.jenike.com/pages/company/offices/office_chile.html

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

May 4-8, 2003, Nashville, TN

ANTEC 2003. Brian Pittenger, Jenike & Johanson senior consultant will present, *Improvements in the Degassing of Polyolefins Using Gravity Bed Purge Columns*.



May 5-8, 2003, St. Charles, IL

International Powder and Bulk Solids Technology Forum. Presentations by Jenike & Johanson personnel will include the following[†]:



- Storage and Handling Fundamentals - Flow Problems and Patterns
- Blending and Mixing Fundamentals - Characteristics, Equipment, and Pitfalls
- Proven Techniques for Solving Flow Problems in Bins and Hoppers
- Design of Transfer Chutes to Minimize Buildup, Abrasive Wear, and Dust Generation
- Fine Powders: Reliably Handling Bulk Solids that Can Behave like Fluids
- How to Select or Troubleshoot Volumetric and Gravimetric Feeders to Ensure Reliable Flow
- How to Prevent Silo Failures
- Using Particle Technology to Prevent Particle Caking and Attrition
- Troubleshooting Blend and Product Uniformity Problems
- How to Select a Blender for your Industrial Mixing Application
- Understanding and Preventing Segregation of Granules
- Understanding and Preventing Segregation of Fine Powders and Their Blends

May 27-30, 2003, Budapest, Hungary

4th International Conference for Conveying and Handling of Particulate Solids. John Carson, president of Jenike & Johanson, will be presenting two papers titled:

- How to Avoid Common Shear Testing Mistakes
- The Dangers of Relying on Wall Friction Values in Codes.

June 8-12, 2003, Las Vegas, NV

2003 International Conference on Powder Metallurgy & Particulate Materials. Design & Modeling session chaired by Brian Pittenger, Jenike & Johanson senior consultant.



June 11-12, 2003, Philadelphia, PA

AICHE course, *Flow of Solids in Bins, Hoppers, Chutes, and Feeders*^{††}.



June 13, 2003, Philadelphia, PA

AICHE course, *Pneumatic Conveying of Bulk Solids*^{††}.



October 29-30, 2003, Houston, TX

AICHE course, *Flow of Solids in Bins, Hoppers, Chutes, and Feeders*^{††}.



October 31, 2003, Houston, TX

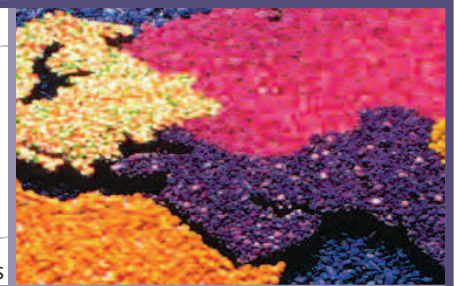
AICHE course, *Pneumatic Conveying of Bulk Solids*^{††}.



[†]To register, contact Reed Exposition Companies, (203) 840-5848, or visit www.reedexpo.com.

^{††}To register, contact AIChE, (800) 242-4363, or visit www.aiche.org.

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



Hot Off the Press

Keep Coal Flowing

by D.A. Craig and R.J. Hossfeld

The Evolution of Bulk Solids Technology Since 1982

by J.W. Carson and H. J. Feise

How to Achieve Reliable Coal Flow and Maintain Plant Availability

by R.J. Hossfeld and others

Improving Fuel Handling with PRB Coal by Converting a Bunker from Funnel Flow to Mass Flow

by R.J. Hossfeld, K. L. McAtee, and B. Dantoin

Bulk Properties of P/M Powders, Part 1: Cohesive Strength, Internal and Wall Friction

by B.H. Pittenger

Bulk Properties of P/M Powders, Part 2: Bulk Density and Compressibility

by B.H. Pittenger

To order any of these free papers, write on your company letterhead to:

Librarian, Jenike & Johanson, Inc.
One Technology Park Drive
Westford, MA 01886-3189 USA
or fax us at (978) 392-9980.

Web Site: <http://www.jenike.com>

Email: newsletter@jenike.com

East Coast, USA

Jenike & Johanson, Inc.
One Technology Park Drive
Westford, MA
01886-3189 USA
Voice: (978) 392-0300
Fax: (978) 392-9980

West Coast, USA

Jenike & Johanson, Inc.
3485 Empresa Drive
San Luis Obispo, CA
93401-7328 USA
Voice: (805) 541-0901
Fax: (805) 541-4680

Canada

Jenike & Johanson, Ltd.
400 Carlingview Drive
Toronto, Ontario
M9W 5X9 Canada
Voice: (416) 674-8595
Fax: (416) 674-8520

South America

Jenike & Johanson, Chile S.A.
Av. Libertad 798, Of. 701
Viña del Mar, Chile
Voice: (+56) 32 690 596
Fax: (+56) 32 690 596