Flow of Solids

JENIKE & JOHANSON INCORPORATED

Bulk Solids: Science / Engineering / Design

The Newsletter of Jenike & Johanson, Inc.

Winter 2008

P.J. Noyes Co.: A Long History from Heroin to Space Monkeys to Fish Food to High Quality Pharmaceutical and Nutritional Products

When engineers at Jenike & Johanson were contacted by P.J. Noyes to assist in a process review and product quality enhancement project, we were surprised by the long and colorful history of the company.

The company was founded in 1868 by pharmacist Parker J. Noyes (shown at bottom). The firm invented some of the first automated tablet manufacturing and coating machinery in the United States. See their Tablet-Making Room, circa 1901, shown to the right.

At the turn of the century (1900's), P.J. Noyes company was one of the largest drug manufacturers in the country, even publishing and promoting its own magazine. According to their 1902 catalog, "Noyes Pectoral Syrup with heroin should be placed at the head of cough remedies, as its sales far exceed all others combined."

One of the many products of interest over the company's history include a fortified nutritional food tablet for NASA. Monkeys were to work while in space and these food tablets would provide not only much needed nutrition, but also a reward for accomplishing tasks. For more on this interesting history, see www.pjnoyes.com/history.html.

In business in Lancaster, NH for nearly 140 years, the company has manufactured a variety of products predominantly for the health care industry. In 1985, David and Sarah Hill and family purchased the company and reinvigorated the laboratory animal food business, while strengthening the company's contract manufacturing capabilities.

The Hills saw a need among companies in the pharmaceutical and nutritional industries for high quality, small scale, contract manufacturing services, and decided to focus the company's resources on fulfilling that need. The laboratory animal food business was sold in 2001, and today the company is solely dedicated to serving its contract manufacturing customers. Products made at P.J. Noyes Company can now be found in all major domestic retail outlets, and on many shelves around the world. For more on this company, see their website www.pjnoyes.com.

P.J. Noyes' tablet manufacturing operations provide versatile equipment in a modern FDA inspected, EPA and ATF registered facility. Their focus on providing a cGMP facility to support tablets, as well as compressed small and large chewables (20 mg to 8 grams), has enabled a number of Fortune 500 companies to have a turnkey solution for immediate production and distribution of a variety of major brand products.

As part of their goal to provide quality, service and a resource for product line growth, P.J. Noyes continually assess their processes and equipment. In a recent product quality enhancement initiative, the firm contacted Jenike & Johanson to work with the management, quality, operations, and production staff to identify root sources of

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President's Message

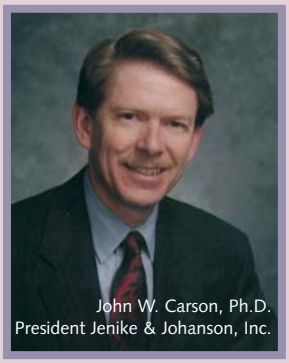
At the recent AIChE Annual Meeting in Salt Lake City I was proud to accept on behalf of the Jenike family the British Materials Handling Board's award recognizing Andrew Jenike as the leading Bulk Technology Pioneer of the Twentieth Century.

I first worked with Dr. Jenike in 1967 as a summer employee between undergrad and grad school. Jenike & Johanson, Inc., which had just been formed, was located in the basement of his house. After grad school I worked with him full time from 1970 until he retired in 1979. He continued with research for about eight years until a serious automobile accident in 1987 prevented him from working further, and he passed away in 2003.

I'm proud to have known Andy Jenike as a mentor and a friend. In addition to his impressive technical accomplishments, he set the guiding principles for our firm that have allowed us to grow and prosper for over 40 years – and we continue to improve our ability to serve you, our clients.

We have added considerably to our staff over the past year. Dr. Jayant Khambekar is a mechanical engineer who recently obtained his Ph.D. from the Worcester Polytechnic Institute. His thesis involved characterization of transport of bulk solids on vibrating surfaces. Jayant joins two other relatively new employees, Dr. Jesus Chavez and Dr. Greg Mehos, in our Tyngsboro office.

In addition, we have added several new technicians and designers in both our U.S. and international offices to handle our growing workload.



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

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P.J. Noyes Co.: A Long History from Heroin to Space Monkeys to Fish Food to High Quality Pharmaceutical and Nutritional Products

powder flow variation, improve tableting efficiencies, and to understand the flowability of raw and in-process materials.

P.J. Noyes' process is not unlike many pharmaceutical operations, wherein raw materials are received, quality audits are performed, orders are placed, batch records are released for production, accurate metering of constituents is performed, in-process checks are made, blending and mixing are carried out, (blending shown to right) and, after final product quality is confirmed, proper pellets, tablets, wafers, compacts are produced, checked and packaged.

As Lawrence (Larry) Vars, Tableting Technology and Process Support for P.J. Noyes emphasized, "It is critical for us to not only identify underlying flow variations, but then to eliminate these variations through process improvements and equipment modifications. Jenike & Johanson played a key role in assisting us with understanding our materials and processes and enabled us to focus in on specific areas for process improvement. We appreciate our on-going working relationship with them."

Jenike & Johanson was provided with samples of the raw materials and blends on a major product line. Part of the goal of the flowability investigation was to identify flow testing methods that would function as effective incoming raw material quality checks. Not only did this testing provide new insights into the material flow behavior, it also enabled specific equipment changes to be identified that would have a noticeable improvement to productivity. It also laid the groundwork for justification of additional capital investments.

Classic Tableting Press Technology

As Larry further points out, "High dosages of natural ingredients can present complexities during processing, especially when very consistent tablets are to be produced at high rates. The experience and knowledge Jenike & Johanson immediately brought to the table, helped our team focus in on key aspects of our material and process. For example, part of our problem has been the original design of the older model presses still in use today. Two of our presses were made in 2000, but the design is dated. The funnel flow pattern of the material in the press feed hopper was certainly one area for improvement. Understanding the importance of key dimensions as well as how it interfaces with the press was vital to our understanding of die filling. The weight of a tablet is regulated by fill volume and the bulk density of the blend (as well as its blend components).

This can be greatly impacted by the feed and flow of the material through the process (blenders, transfers, bins, feed hoppers, and feed frame). It is interesting how minor details can influence this behavior. We are pleased with the results we have achieved with our work with Jenike & Johanson."

As Dr. John Carson, President of Jenike & Johanson, put it, "We are excited about our involvement and P.J. Noyes' use of our particle handling and processing expertise, as well as our laboratory services. Our engineering support throughout the optimization of the tableting process has been and continues to be an exciting challenge and an on-going source of mutual growth in process capabilities with our clients. We look forward to future challenges where processes and equipment continue to be pushed into new processing areas and new processing capabilities."

Behind the Scenes: Meet TRACY HOLMES

Title: Sr. Project Engineer
Joined J&J: 1994
Job Description: Tracy specializes in the design, development, and evaluation of bulk solids handling systems. Over her 14 years with J&J, she has provided consulting services to a broad spectrum of clients in Canada and overseas, organized and presented more than 25 seminars, and co-authored several technical papers in the areas of silo design, silo failure, equipment selection, and pneumatic conveying.

Of note: Tracy received her Bachelor of Applied Science in Civil Engineering at the University of Waterloo. She is a registered Professional Engineer in Ontario.
Tracy spent her first two years with J&J in the testing laboratory. This hands-on experience has given her an in-depth knowledge of bulk solids and flow property testing.
"For me, the best part about working for J&J is the diversity of both the clientele and the problems I am asked to help solve. Nothing beats the feeling I get when, as I'm touring a plant and the client points out a piece of equipment that I've designed and says "It works perfectly"."

Andrew Jenike - Man of the Century

The 2007 Annual Meeting of the American Institute of Chemical Engineers (AIChE) was held in Salt Lake City, Utah in November. This meeting coincided with the 100th anniversary of the founding of the University of Utah. It also roughly corresponded to the 50th anniversary of the start of Dr. Andrew Jenike's pioneering work at that university in understanding the gravity flow of bulk solids. AIChE's Particle Technology Forum sponsored two sessions at this meeting commemorating this event. One was a Jenike memorial session, and the other a panel discussion concerning Jenike's legacy.


Andrew Jenike

In recognition of this occasion, the British Materials Handling Board created a special award. We have all heard of Man of the Year awards, but this one is different. Because of his outstanding contribution that transformed the storage and handling of bulk solids from an empirical industry to a science, the BMHB decided to honor Andrew Jenike as the one person who made the greatest contribution of the 20th century.

Lyn Bates, Director of BMHB, prepared the following tribute that was read by Emeritus Professor Alan Roberts of the University of Newcastle, Australia:

"There are many examples within chemical engineering where a single person has made an important discovery or developed a key theory that allows great strides to be made in the technology. Collectively, these combine to transform the subject from an empirical approach to a science. Some advances are made by serendipity, but the more radical improvements usually come about by dedicated study, based upon insight and a fundamental analysis of the underlying factors.

The contributions of Andrew Jenike to fill the void in our understanding of the rheology of particulate solids in gravity flow were thorough and comprehensive. His first important step was to recognise that the inability to predict the design requirements for bulk storage containers that would discharge reliably was a handicap of immense importance to all industries that handled loose solids. Applying himself to this task he produced a theory of converging flow that represented the key parameters and process conditions. He then developed an instrument with which to quantify the relevant factors of a given product and finally, in this tour-d-force, constructed a design methodology to interpret these values and produce a geometry for a bulk storage vessel that would guarantee to flow and discharge the contents reliably. His pioneering work, published in Bulleting 123 of the Utah Experimental Station in 1964, remains the most quoted reference of all papers that are published in the field of bulk technology.

The result of Jenike's outstanding work was to change the design of bulk storage hoppers, silos, and other storage and processing vessels from an empirical technique to a formal engineering procedure with a predictable outcome.

The British Materials Handling Board was set up by the UK government in the 1960s to coordinate research and technology in all bulk solids handling applications. It quickly recognized, as did the Rand organization in the US in some well documented reports, that bulk handling was a massive source of industrial inefficiency, largely because of storage problems and other difficulties associated with the lack of predictability of bulk material behavior. Through publications, sponsored research and the organization of co-operative projects between industries with common objectives, the BMHB has promoted this technology.

Acknowledging the significance of the major advance in technology made by Andrew Jenike is a small step in the direction of developing widespread industrial awareness in this subject of immense practical importance. It is with great pleasure that The British Materials Handling Board recognizes Andrew Jenike as the leading Bulk Technology Pioneer of the Twentieth Century."

(ed. note: Chemical Engineering magazine ran an editorial about this award in their October 2007 edition).


Dr. Carson receiving award from Professor Roberts

In early 2007 our Canadian office began planning a move. After considering our current and projected needs, we designed a facility with 25% more engineering offices and 50% more laboratory area. Our efforts have culminated in an attractive, modern space in the Airway Centre in Mississauga, just north of Pearson International Airport.

We moved in to our new location in August 2007 and are settling in nicely. Please stop by and visit when you're in the area.

Flow-of-Solids Industry Calendar

Congratulations

At this year's annual business meeting in Nürnberg Germany, the Working Party on the Mechanics of Particulate Solids (WPMPS), part of the European Federation for Chemical Engineering, elected Dr. John Carson, President of Jenike & Johanson, Inc. to become a Permanently Invited Guest. In addition to Dr. Andrew Jenike who served in this capacity for many years in the 1970s and 1980s, Dr. Carson is the only other person from North or South America to ever receive this distinguished honor.

The goal of the WPMPS is to promote science, education, and technology transfer in bulk solids handling and transportation, especially between industry and academia.

The next annual meeting of this Working Party will be held on June 9th, 2008 in Tromso, Norway.

Flow of Solids Industry Calendar

February 24-27, 2008 Salt Lake City, UT
Society of Mining, Metallurgy and Exploration Bulk Materials Handling Symposium/Annual Meeting and Exhibition.
Dr. John Carson, President of J&J, will present a paper titled Interfacing Belt Feeders and Hoppers to Achieve Reliable Operation

March 26, 2008 Philadelphia, PA
Interphex 2008
Roger Barnum, Senior Consultant, will present the following course:
- B-2: Understanding Powder Flow for Formulation Development and Production Process Design

June 10-12, 2008 San Francisco, CA
J&J engineers will present the following ASME/AIChE courses*:
- Flow of Solids in Bins, Hoppers, Chutes, and Feeders
- Pneumatic Conveying of Bulk Solids

*For more information, please visit www.asme.org.

May 5-8, 2008 Rosemont, IL
International Powder and Bulk Solids Conference/Exhibition (PTXI International)*
J&J will be exhibiting and J&J engineers will present courses.
*For more information, please call 310-445-4200.

June 8-12, 2008 Washington, D.C.
World Congress PM 2008*.
Brian Pittenger, Senior Consultant, will be chairing a session on modeling.
*For more information, please visit www.mpif.org

June 10-12, 2008 Tromsø, Norway
International Symposium, Reliable Flow of Particulate Solids IV*.
Dr. John Carson, President of J&J, will be a speaker.
*For more information, please visit www.relpowflo.no/eng.

June 30 - July 2, 2008 Edinburgh, Scotland
Structures and Granular Solids, Int'l. Conference at the Royal Society of Edinburgh*.
Dr. John Carson, President of J&J, will be a speaker.
*For more information, please visit www.royalsoced.org.uk.

Off the Press

Proven Techniques for Air-Assisted Handling of Powders in Bins and Hoppers
by T. G. Troxel, J. W. Carson, and K. E. Bengtson

A Valuable New Tool for Inventory Analysis of Bulk Solids Storage Vessels Operating with a Funnel Flow Pattern
by T. A. Royal, J. W. Carson, and B. H. Pittenger

Predicting Flow Behavior of Solids After Fifty Years Storage Using Sampling and Flowability Studies
by J. W. Carson, B. H. Pittenger, and M. Griffin (Fluor Fernald)

Modeling and Scale-up of Tumble Blenders for Highly Segregating Materials
by T. G. Troxel

Development of an International Standard for Shear Testing
by J. W. Carson and H. Wilms (Zeppelin Silos & Systems GmbH)

Erratic Flow Behavior of Bulk Solids and Its Effects on Safety
by G. Mehos and E. Maynard

Development of an Improved Fluidization Segregation Tester for Use with Pharmaceutical Powders
by J. Prescott, M. McCall, S. Clement (J&J) and D. B. Hedden, D. Brone, A. Olosofsky, P. J. Patel, and B. C. Hancock (Pfizer)

Predicting, Diagnosing, and Solving Mixture Segregation Problems
by J. Carson and H. Purutyan

Recent Developments in Pneumatic Conveying at the Universidad Tecnica Federico Santa Maria
by F. Cabrejos

Manejo y Almacenamiento de Cal Viva en Plantas Mineras mediante Silos con Descargadores Aeroasistidos
by F. Cabrejos, A. del Campo, and J. Concha

Preventive Medicine: Keys to Avoiding Powder Flow Problems
by T. Baxter

The Effect of Particle Size Distribution upon Adverse Two-Phase Flow
by T. Baxter, J. K. Prescott, and R. Barnum

A Retrospective of Mixing and Blending over the Past 25 Years
by E. P. Maynard

Preventing Solids Flow and Segregation Problems during Precision Material Manufacturing Operations
by R. Barnum

Waste Coal: How to Avoid Flow Stoppages during Storage and Handling
by R. J. Hossfeld and R. A. Barnum

Using Bins and Silos to Heat or Cool Bulk Solids
by G. Mehos and B. Pittenger

Using Flow Properties to Solve Flow Problems with Hard-to-Handle Powders in the Ceramics Industry
H. Purutyan, A. del Campo, and R. A. Barnum

Copper Roast Segregation Process: A Promise to be Fulfilled and a Challenge for Material Handling Technology
by A. del Campo and F. Cabrejos

Diseño y Operación de Stockpiles en Faenas Mineras
by F. Cabrejos and A. Del Campo

Method and Apparatus for Segregation Testing of Particulate Solids
by J. Prescott et al. (U. S. Patent No. 7,240,575 B2, July 10, 2007)

Interfacing Belt Feeders and Hoppers to Achieve Reliable Operation
by J. Carson, F. Cabrejos, and M. Rulff

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