

Available online at www.sciencedirect.com**ScienceDirect**

Procedia Engineering 102 (2015) 657 – 660

**Procedia
Engineering**www.elsevier.com/locate/procedia

The 7th World Congress on Particle Technology (WCPT7)

Andrew Jenike: A True Visionary in Particle Technology

John Carson*

Jenike & Johanson, Inc., 400 Business Park Drive, Tyngsboro, MA 01879 USA

Abstract

This year marks the centennial of the birth of Andrew Jenike. At the age of 39 he made a momentous decision -- one that influenced and affected his life and indeed thousands of people around the world. His decision was to devote his life to the study of the design of bins and hoppers for storage and flow of bulk solids. Jenike was truly a visionary. He developed a theory to fulfil a practical need, and he approached his work with enthusiasm and focus not unlike famous inventors like Thomas Edison. Indeed he changed the way we design and build storage vessels for solids in a very revolutionary way. As Reg Davies once said, "As scientists and engineers, rarely do we accomplish something that changes the way people think and behave to such a degree that our name becomes synonymous with its application. That's Jenike".

© 2015 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Selection and peer-review under responsibility of Chinese Society of Particuology, Institute of Process Engineering, Chinese Academy of Sciences (CAS)

- *Keywords:* Jenike; silo design; mass flow

April 16, 1953 -- 3:15 in the afternoon. Andrew Jenike, a 39 year-old mechanical and structural engineer, is celebrating his birthday in Salt Lake City, Utah. Facing a mid-life crisis, he has just made a momentous decision -- one that will influence and affect his life, and indeed thousands of people around the world.

Jenike was born in Poland in 1914 and graduated from Warsaw Polytechnic Institute with a B.S. in Mechanical Engineering in 1939. Upon graduation he entered the Polish Army where he served with distinction as an officer in

* Corresponding author. Tel.: +1-978-649-3300; fax: +1-978-649-3399.

E-mail address: jwcarson@jenike.com

the Second World War. Soon after entering the army, the country of Poland was being overrun by the Nazis and the Russians. One day, as he relayed this story to me in one of our numerous conversations, he found himself at the top of a hill. Advancing on one side of the hill were the Nazis, advancing on the other side of the hill were the Russians. His unit commander said it was time to leave, so he fled on foot through Eastern Europe and eventually ended up in England. He found employment there and attended the University of London where in 1949 he received his Ph.D. in Structural Engineering. While in England he also met and married a lovely British girl with the delightful name of Una. They immigrated to Canada and then to the United States, eventually settling in Salt Lake City. Along the way he worked for several engineering design firms as a mechanical and structural engineer. Two sons, Michael and Ian, were born.

As Jenike approached his mid- to late-30's he began getting restless. He wanted to do something unique, something that would set himself apart, something that would be worthwhile. He started by reading and collecting articles on every conceivable subject, going to the library every night and every weekend. He put the information he collected into a series of folders arranged by topic. Eventually he had identified about 40 different topics. He constantly poured over these folders, trying to decide which topic would be the right one for him. Where could he make a significant contribution?

Finally, on April 16, 1953 at 3:15 in the afternoon -- his 39th birthday -- he made his decision. The topic he chose was the design of bins and hoppers for storage and flow of bulk solids. Up to that time, design of this equipment was mostly a black art. Most hoppers were either 45° or 60° , because those were the common triangles that all engineers carried around with them. No one gave much thought to the material being stored. After all, it's "just a bin."

Once he made his decision, he promptly went out to the garbage container at the apartment building where he and his wife were living and threw away box after box he had collected on every other topic that he considered. He wanted nothing to interfere with his decision, no looking back.

He approached the National Science Foundation and other groups for funding. They told him that while they thought his work was a worthwhile area of research, he would have to have some affiliation with a college or university before they could fund him. Since he was living in Salt Lake City, he went to the University of Utah with the following proposal: If you will put me on your staff, I will get all of the funding. It won't cost you a penny. They accepted the deal, and he spent seven years there developing basic theories and test equipment. He set forth design procedures in two famous University of Utah Engineering Experiment Station Bulletins 108 and 123, the latter probably the most cited work in the field today.

One key contributor to Andy's success in developing the basic theories of solids flow came from an unlikely source. While on a trip back to his native Poland, he came across a Polish translation of Sokolovskii's now famous book, *Statics of Soil Media*. At the time this book had just been published in Russian and had not been translated into English. Jenike immediately recognized that Sokolovskii's concept that soil stress could vary directly proportional to the distance from a point fit nicely with some crude bin pressure measurements that he had conducted using water-filled diaphragms. This gave rise to his Radial Stress Field concept.

During his period at Utah, Jenike had a number of graduate students working for him. The key one among them undoubtedly was Jerry Johanson. In 1962 Jerry finished his Ph.D. and went to U.S. Steel Research. Andy decided that the time had come to enter full time consulting, so he moved his family to Winchester, Massachusetts. Four years later Jerry joined him and formed the company, Jenike & Johanson.

I was fortunate to start working for Andy the summer between my undergraduate and graduate programs. The company was still headquartered in the basement of Andy's house. After grad school I joined the company full time, and 44 years later I'm still there.

Andy let nothing stand in his way when he set his mind to it. He was a first class engineer and mathematician, spending years studying such subjects as continuum mechanics and advanced plasticity concepts with people like Dick Shield at Brown. Andy was a very hard worker, working late into every night and most weekends to achieve his goal. He was also a frugal individual, but very compassionate with his employees. For relaxation he enjoyed jogging and mountain climbing.

Jenike lectured extensively around the world, authored or co-authored over 50 publications, and worked as a consultant for 25 years. Almost every significant technical paper written in the past 50 years having to do with bulk

solids flow references one or more of his publications. It is impossible to estimate the number of bins, hoppers, and feeders that have been built based on the sound principles and design guidelines he developed.

To judge Jenike only on his technical achievements would really miss a very important contribution that he gave to society. That contribution would be the people. Many of those engaged in the field today owe their starts to Jenike -- Schwedes in Germany, Enstad in Norway, and Roberts in Australia and many more all had discussions with Jenike about solids flow principles. Schwedes wrote to Jenike when Jenike won the IMechE award that “besides Hans Rumpf...nobody has influenced my scientific and professional career in a comparable way you did.”

Jenike received an honorary doctorate from Bradford University in 1975. This was arranged by his good friend, Prof. John Williams. Interestingly, in light of my quote from Schwedes, Williams also arranged the same honor to be bestowed at the same ceremony to another giant in this field – Hans Rumpf. Jenike received the Humboldt Scholarship in 1976; in 1989 he was elected Fellow of the ASME; in 1993 received the Solids Handling Award from the Institution of Mechanical Engineers, the first non-U.K. person to do so; and in 1998 he was awarded the Particle Technology Award from AIChE.

In addition to being a first class engineer and mathematician, Jenike had an excellent business sense. Perhaps one reflection of this is that the company that he and Jerry Johanson founded is still going strong for nearly 50 years. This is in no small part the result of Jenike’s keen sense of what clients need and how best to provide that service. He insisted on quality in everything he did, and this rubbed off on everyone around him.

Jenike had high ethical standards. He recognized that in order to maintain the confidence of clients it was essential that the advice offered be completely unbiased. I recall an instance when we had recommended that a client go to a certain equipment supplier for some custom-built equipment. The supplier was so appreciative that he sent us a check as a finder’s fee. Even though our client was unaware of this payment, Jenike returned it because he didn’t want even the perception that his recommendations might be biased.

Finding and retaining quality employees is important for any business, but Jenike’s approach as president of a small company was unique. He recognized that we were competing against major firms in the field, not just small, local engineering companies, so in order to attract and retain employees he insisted that we provide benefits comparable to large firms. Furthermore he wanted those benefits to provide protection to employees and their families to the full extent allowed by the IRS, so employees didn’t have to worry about paying their bills if something unexpected happened. We have retained these policies even today.

As a result of policies such as these, we have an enviable record of employee retention. Many have been with the company all of their career, while many others who have not yet retired have in excess of 25 years with the company.

Although Jenike was generous with his employees, he was a frugal man. He would use an eraser until it was worn down such that he could barely hold it between his fingers.

Jenike was a very down-to-earth man. In spite of his imposing stature and European charm, he insisted on being called “Andy”. No job was beneath him. As is typical in a small company, our employees were asked to wear many hats, and Jenike did his share as well. I recall him going out with a pair of scissors to cut a small grass strip in front of our office before a client showed up. His attitude of not putting himself above any job that needed to get done helped foster the idea that everyone had a stake in the company and had an equal share in its success. He insisted on limiting stock ownership to employees, with no outside investors.

Jenike was a pioneer in not only technical matters but also in business. We established a no-smoking policy in the early 1970s, well before it became fashionable. Jenike had wanted to do this for some time, but a few employees were smokers and found it hard to quit. Changing the policy became easier to implement when he found one of our lab technicians with a lit cigarette while running a shear test in our high temperature oven with hydrogen gas being fed in.

Jenike was a very organized, rational individual. When he found that the time was ripe for him to go into private consulting practice after having spent nearly a decade here in Salt Lake City, he decided on certain criteria for where he should move. He wanted to be near a major airport so as to facilitate flying to clients, and he wanted to be on the east coast since both he and his wife were from Europe and this would make getting back home that much easier. Finally he wanted to be near mountains and the ocean since he loved the outdoors. Putting those all together the logical choice was Boston. He told his wife he was going there to find a home for her and their two sons, and once

he found it he called them to join him. I doubt that any of us could get way with this today! I'm sure that his supportive wife Una realized that what he was doing was best for their family.

Even though his native tongue was not English, Jenike worked hard to perfect his command of the English language. Pick up and read again a few paragraphs of Bul. 123 and you'll see not only the clarity of his writing but how he packed as much as possible into every sentence. In addition to his writing he was also insistent on speaking as clearly as possible and without an accent. While he was learning English he would sit at the kitchen table and read aloud the newspaper to his wife whose native tongue was English.

Jenike was concerned about physical fitness before it became popular. He jogged regularly as well as climbed mountains frequently. I remember our company outing one year at Mt. Monadnock in southern New Hampshire. With an elevation of about 3,200 ft., this is a popular hike for novices. We all gathered with our families in the parking lot at the assigned hour, but Jenike didn't arrive. After waiting awhile we decided to start the climb, figuring that he would catch up to us. We got all the way to the top only to find that he was there waiting for us. He had bushwacked his way to the top, since he found that more interesting and challenging than taking the marked trail.

Jenike's interest in running rubbed off on many of our employees. He amazed us when, running road races in his 60s, he could soundly defeat employees in their 20s.

Jenike was firmly of the opinion that experiments are best used to verify or modify a theory, and that experiments without a theory have very limited use. One of his favorite expressions was, "Whenever you have an urge to run an experiment, lay down and take a nap. Usually the urge will go away." What he meant was that one's time is better spent coming up with a comprehensive theoretical model.

Jenike pushed himself relentlessly to further advance the field, and, even in retirement, he was always looking for opportunities to train others. One of our now senior engineers tells the story of his interaction with Jenike when working as a summer student during college. The two worked together on a simplified "triaxial" tester. Jenike had great common sense and hands-on experience combined with obvious command of the theoretical and mathematical side of things, and he took great care in getting this student up to speed and explaining what they were doing on the project -- not only the science behind it but the history and the players in the field. After each test he took time to fully explain what they had witnessed and what could be done to improve on the design. He did this for a summer student who could have just as easily been told, "Just do this". Not too many people who accomplished as much in life as he did would do that eight years into retirement.

Jenike was truly a visionary. He developed a theory to fulfill a practical need, and he approached his work with enthusiasm and focus not unlike famous inventors like Thomas Edison. He changed the way we design and build storage vessels for solids in a very revolutionary way. As Reg Davies once said, "As scientists and engineers, rarely do we accomplish something that changes the way people think and behave to such a degree that our name becomes synonymous with its application. That's Jenike".

Andy was president of our firm until he retired in 1979. After that time he conducted research for about eight years until a serious automobile accident in 1987 prevented him from working further. He passed away on August 8, 2003.

I'm proud to have known Andy Jenike as a mentor and a friend.



Fig. 1. Andrew Jenike 1914-2003