Institute for Briquetting and Agglomeration Newsletter Q1 2022

Monday, January 17th, 2022

Good Day to all of our Membership:

The Bi-Annual IBA Conference will be held in Denver, CO, September 18th - 21st, 2022. The host hotel is the Oxford; Backup hotel is the Crawford. Make your reservations as soon as you can. See phone numbers and links below.

The Crawford Hotel: (844) 432-9374 or https://be.synxis.com/?Hotel=61147&Chain=6052&arrive=9/18/2022&depart=9/21/2022&adult=1&child=0&group=331220915IBA

The Oxford Hotel: (800) 228-5838 or https://gc.synxis.com/rez.aspx?Hotel=239&Chain=6052&arrive=9/18/2022&depart=9/21/2022&adult=1&child=0&group=252220917IBA

Membership:
Membership dues are due now for the 2021/2022 time period at $300.00 for Individuals and $400.00 for consultants. Please pay by check, wire or Paypal. See the website for details. If I can be of any help please reach out!

WELCOME NEW MEMBERS as of this printing: Thanks for being part of the IBA!

Lauren Petraglia	LCI Corp.	Charlotte, NC	USA
Abby Smith	Borregaard	Rothschild, WI	USA

Highlighted Technical Paper from the 2019 IBA Conference in Charleston, S.C.:

Author: *Greg Mehos, Ph.D., P.E., AIChE Fellow; Consultant*

Gravimetric Feeders - The Achilles' Heel of Continuous Manufacturing

Gravimetric feeders are frequently used in continuous manufacturing processes. A gravimetric feeder relies on a control system that adjusts the speed of the feeder based on loss-in-weight measurements. Since the controller is unable to discern the discharge rate when its hopper is being filled with new material, two hoppers arranged in series are typically used. The lower hopper is frequently asymmetric with at least one steeply sloped wall to reduce the likelihood of flow obstructions. Such geometries often result in a highly variable solids velocity distribution, which can exacerbate segregation. In some hoppers, an agitator is used to ensure that it has a "live bottom" and no dead zones. During the fill cycle, the downstream feeder is operated in a volumetric mode (i.e., at a constant speed). The feeder then operates in gravimetric mode (i.e., its speed is controlled by measuring the loss in weight of material inside the hopper) after the downstream hopper has been filled. A schematic of a gravimetric feeder is given in Figure 1:

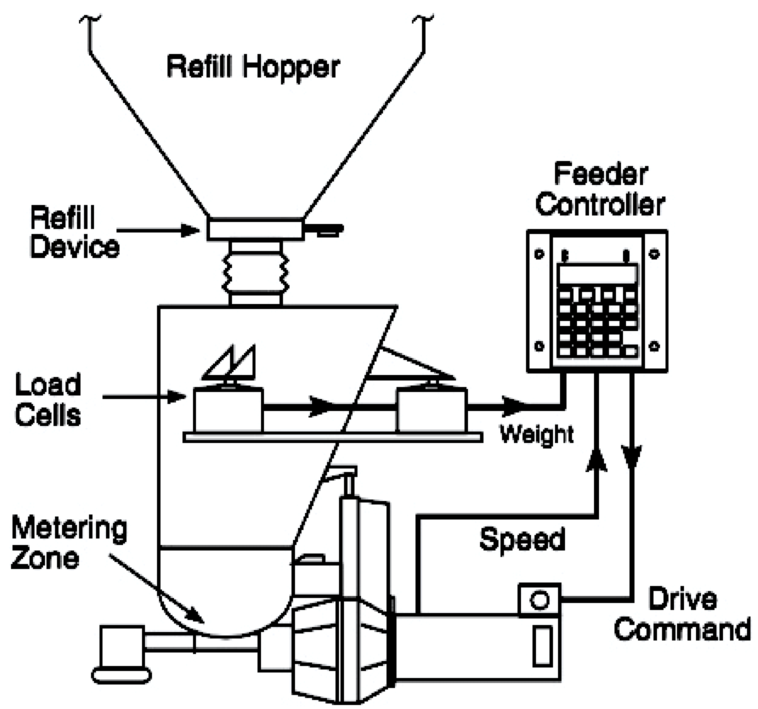

Figure 1. Loss-in-weight feeder.

Most powders are compressible. The bulk density of a powder increases with increasing consolidation stress, varying rapidly at low stresses and less dramatically at high stresses. A typical compressibility curve is shown in Figure 2, where the bulk density is plotted against major principle stress. The major principle stress is the stress that would be measured on a plane that gives the stress its maximum value.

Because of the hopper's odd geometry, the powder will remain in what is called an active state of stress. When in an active state, the direction of maximum stress is downward. If an additional stress were applied to the powder, for example, if a slug of powder were dropped from the upper hopper into the lower hopper, the stress would be transmitted vertically toward the powder and, being compressible, its bulk density would increase. The feeder would be unable to compensate for the change in bulk density because it was in volumetric mode during the fill cycle. Because the bulk density of the powder had increased during filling, the discharge rate during the fill cycle and the begging of the emptying cycle can be higher than before. This is illustrated in Figure 3, where the discharge rate is calculated by measuring the gain in weight in a container filled by the feeder.

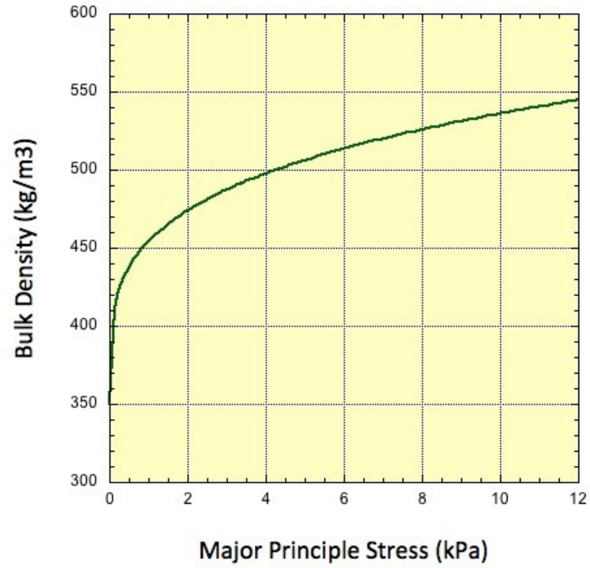

Figure 2. Compressibility of bulk solid.

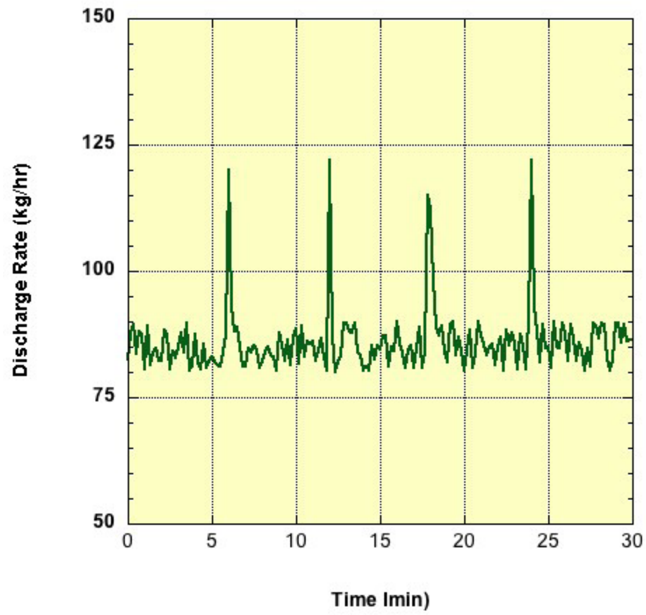

Figure 3. Discharge rate from lower hopper, active state of stress in cylinder section.

When the lower hopper is emptying and the feeder is operating in gravimetric mode, the discharge rate is very steady. The bulk density of the powder is not necessarily constant, but the control system compensates by reducing the feeder speed if the density increases and vice versa. Unfortunately, during the fill cycle, the impact of fresh material compresses the powder in the heel of the contents of the hopper. This means as the bulk density increases, the controller does not adjust the speed due to being in volumetric mode.

There are methods to dampen the variability. For example, fresh powder can be added more frequently so that less of a load will be imparted during the fill cycle and the time the feeder must remain in volumetric mode is shortened. Also, modern controllers are more predictive: they can estimate the higher bulk density that accompanies the fill step, which provides an estimate of the feeder speed required when the feeder returns to gravimetric mode.

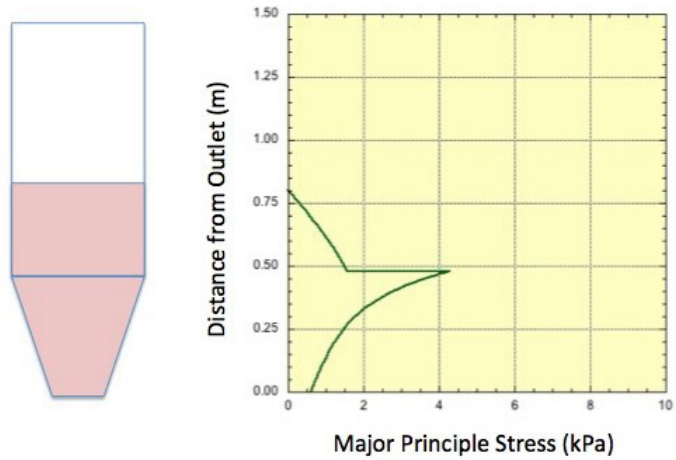

Figure 4. Solids stress profile – mass flow.

Variability can also be reduced by modifying the converging section of the lower hopper for mass flow. Mass flow occurs when the hopper walls are steep enough and low enough in friction to ensure flow along them. With mass flow, a passive state of stress will develop when the powder is discharged from the bin, and this passive state of stress will remain during refill. The powder is compressed laterally and expands vertically, and as a result, the major principal stresses act horizontally instead of vertically. A typical major principle stress profile is shown in Figure 4.

Figure 5 shows the solids stress profile at the end of the emptying cycle and the start and end of the fill cycle. At the start of the refill step, an additional load is applied to the powder as a result of impact of the new material. Because the lower hopper is a mass flow hopper, a passive state of stress exists. As a result, the solids stress at the hopper outlet is nearly constant. Consequently, the bulk density of the powder, which is related to major principle stress by its compressibility curve, also does not change.

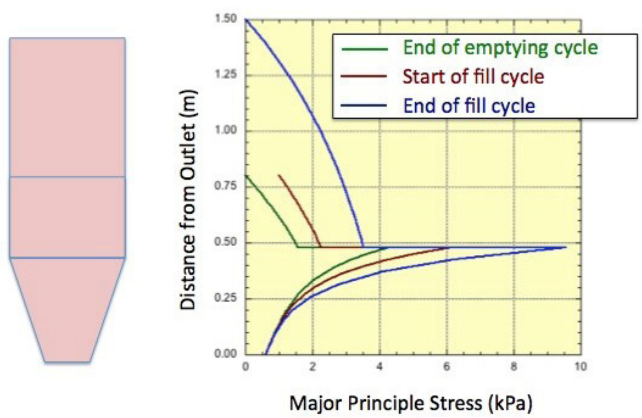

Figure 5. Solids stress profiles at end of emptying cycle, start of fill cycle, and end of fill cycle.

Figure 6 shows the discharge rate of powder from the lower hopper designed or modified for mass flow. Note that there is no significant change in the discharge rate when the feeder operates in volumetric mode.

Continuous manufacturing requires steady feeds. The likelihood of having a reliable gravimetric feeder is greatly improved if its lower hopper is designed for mass flow. Wall friction testing is required to determine the recommended mass flow hopper angle.

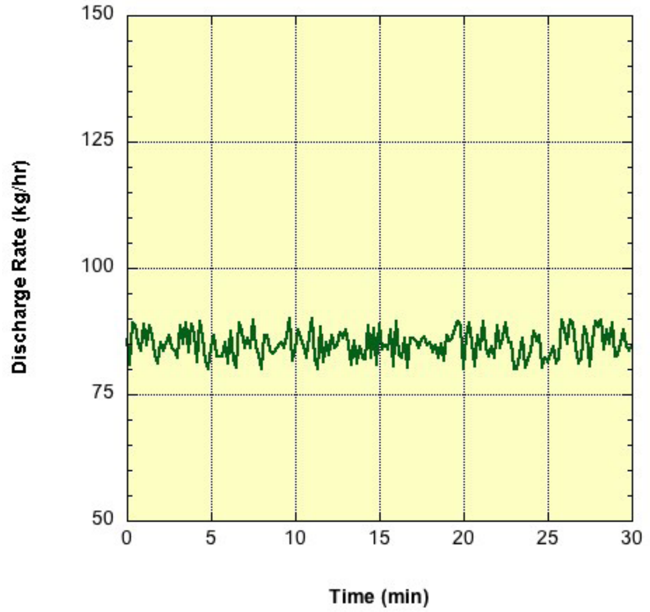

Figure 6. Discharge rate from lower hopper, passive state of stress in cylinder section.

NEAL RICE AWARD

Established in 1979 honoring Neal Rice, a founder of the IBA and its Secretary / Treasurer from 1949 to 1977, this award is given to the author of the paper judged to have the most excellent technical content and presentation at each biennial conference.

Shi-kyung Yoon with Richard Komarek as the presenter.

Previous Neal Rice Award Winners

2017: N.M. Morales and P.Bonadia of Magnesita S.A., for “Effect of Different Roll Speed on a Briquetting Machine For Simultaneous Grinding and Densification of Caustic Magnesia.”

2015: Hyun-Soo Kim, Shi-kyung Yoon, and Min-Young Cho all of POSCO, for “Influence of Composition of Partially Reduced Iron Ores on Consolidation and Strength of Hot Compacted Iron.”

2013: Darrell Taulbee, University of Kentucky, for “Drying and Agglomerating of High Moisture Coal and Coal Fines.”

2011: Greg Mehos, Cabot Corporation, for “Improving the Flowability of Solids by Agglomeration” 32nd IBA Biennial Conference, New Orleans, LA, 2011.

2007: Dr. Seiichi Yamamoto, Kobe Steel Ltd, for “Development of Upgraded Brown Coal Process”, 30th IBA Biennial Conference, Savannah, Georgia, 2007

2005: Bill Callaghan, Continental Products Corporation, for “Exploring the Versatility of “Free-Fall Processing””, 29th IBA Biennial Conference, Clearwater Beach, Florida, 2005.

2003: Antonios Zavaliangos, Drexel University, for “Multiparticle Simulation of Powder Compaction with Finite Element Discretization at the Particle Level,” 28th IBA Biennial Conference, Santa Fe, New Mexico, 2003

2001: Carolyn Sturgess, Ph.D., Alberta Research Council, for “ The Development of Agglomerated Elemental Sulphur Fertilizers,” 27th IBA Biennial Conference, Providence, Rhode Island, 2001

2001: Dr. Ing. C. Pretorius and Peter M. Koenig, Hosokawa Bepex, for “Low Pressure Extrusion and Spheronization,” 26th IBA Biennial Conference, San Diego, California, 1999

1999: Paul Language, Billiton Process Research, for “A Method of Producing Sodium Silicate in situ, for Bonding Chromite Briquettes,” 25th IBA Biennial Conference, Charleston, South Carolina, 1997

1997: Dr. Ronald W. Miller, Bristol-Myers Squibb, for "Vacuum Deaeration Advances Pharmaceutical Roller Compaction Technology," 24th IBA Biennial Conference, Philadelphia, Pennsylvania, 1995

1995: Dr. Harald Gunter, Brennstoffinstitut Freiberg, for "The Application of Waster Paper as a Binder in Pressure Agglomeration," 23rd IBA Biennial Conference, Seattle, Washington, 1993

1993: David Bigio, M.D. Applebaum, William Baim and Kai Wang, Polymer Processing Laboratory, University of Maryland, for "Specific Throughputs as an Operating Parameter for Mixing," 22nd IBA Biennial Conference, San Antonio, Texas, 1991

1991: Dr. Roman Dec and Richard Komarek, K.R. Komarek Briquetting Research, Inc., for "Computer Aided Design of Roll Type Briquetters and Compactors," 21st IBA Biennial Conference, New Orleans, Louisiana, 1989

1989: Dr. J.R. Johanson and Brian D. Cox, Johanson Inc., for "Fluid Entrainment Effects in Roll Pressing Compaction, " 20th IBA Biennial Conference, Orlando, Florida, 1987

1987: Derek R. Augood, Kaiser Aluminum and Chemical Corporation, Pleasanton, California for "An Agglomeration Exercise," 19th IBA Biennial Conference, Baltimore, Maryland, 1985

1985: Eric W. Blaustein for "Development of a Workable Lignite Pelletizing Process," 18th IBA Biennial Conference, Colorado Springs, Colorado, 1983

1983: R. K. Oberlander for "The Extrusion of High Surface Area Aluminas for Use as Catalysts," 17th IBA Biennial Conference, Reno, Nevada, 1981

1981: M. Adnan Goksel and Laszlo Valentyik for "Production and Evaluation of Lignite Pellets," 16th IBA Biennial Conference, San Diego, California, 1979

1979: Robert M. Koerner and Arthur E. Lord for "Strength Behavior of Briquets as Determined by Acoustic Emission," 15th IBA Biennial Conference, Montreal, Canada, 1977

Upcoming Conferences

- **AISTech Conference:** May 16th - 19th 2022. Pittsburgh, PA.
- **Scrap Expo:** September 13th - 14th, 2022. Kentucky Exposition Center, Louisville, KY
- **CONEXPO-CON/AGG:** March 14th - 18th, 2023. Las Vegas, Nevada

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Important Source Links:
There are 5 member links on our website, by equipment manufacturers, processors, additive suppliers, and research groups. We thank our advertisers. Please visit our website for details. Please add your company name to the list with a $200.00 fee for 2 years 2021/2022. You can do this on the website through PayPal.

www.agglomeration.org
https://www.linkedin.com/groups/8494240/
https://www.powderandbulkshow.com/en/home.html
www.aist.org/conference-expositions/aistech

36th Bi-Annual IBA Conference 2019, Charleston, SC Proceedings:
At long last the IBA – 2019 Proceedings have been completed and will go out to members and attendees. Keep an eye out for the package in your mail.

It's not too early to submit an abstract for the 37th Bi-Annual IBA Conference for the Fall of 2022 in Denver, CO. The sooner the better: That way we can advertise and drive our membership and attendance at the next conference! Please commit to a paper and also get your colleagues to submit a paper!

Companies / Technical Consultants that have committed to giving papers in 2022 are:

- Greg Mehos, Ph.D., P.E., AIChE Fellow
- Nick Slater, Freund-Vector
- Jesper Madsen, C.F. Nielsen
- Colorado School of Mines – Corby Anderson
- J.C. Steel, Mac Steele
- Direxa – Clement Cardier
- BASF – Willy Cilengi
- Jenike & Johanson – Kurt Naugler
- NU-Rock – Mahroun Rahme

The IBA wishes all a very happy, healthy and prosperous New Year! See you in Denver!

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Please, if you have not paid your dues and or you want to become a member, please go to the site, www.agglomeration.org to do so! We look forward to your membership!

Stay tuned for the spring newsletter! Be safe, stay healthy!

Institute for
Briquetting and
Agglomeration