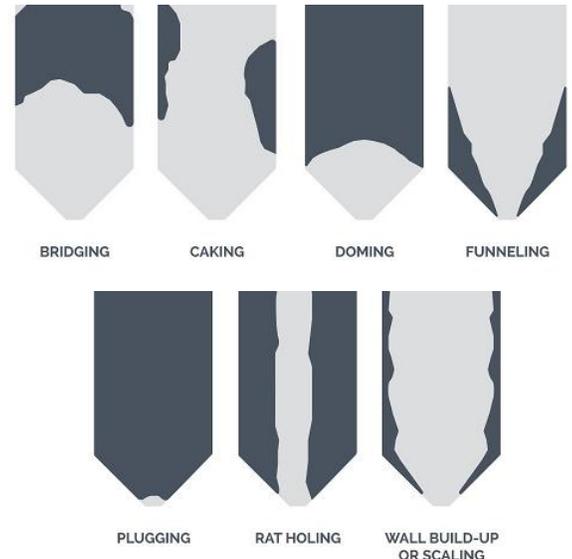


Conglomerations of fine particle solids, along with the gaseous space between them and to a lesser extent the encompassed moisture, make up what is simply known as “powder”. This three-phasic system of matter is anything but simple.

Powder is used in nearly every industry where products are made, if not as the final product, then as raw material or an intermediate part of the manufacturing process. *In all cases, powder must be handled efficiently and effectively to keep the process running smoothly and ensure a quality product.* Without properly considering the multitude of powder characteristics, manufacturing process parameters, and environmental variables, the outcome will most likely be just the opposite. A few of the common issues with powder processing and handling are shown in the image to the right. Applying *powder rheology* will prevent these problems from occurring and can be used to fix issues already present. But what is *powder rheology*?



Powder & Bulk Solids: 2018

Powder rheology is a phenomenological approach which considers internal and external influences to characterize powder behavior in specific applications. Here is a break down of the definition to better grasp how *powder rheology* is applied in understanding how powder acts in different situations.

Phenomenological Approach: This scientific method of study starts with the fact that powder exhibits various behaviors and seeks to determine their explanation. Qualitative research is used to examine how different powders perform similarly. By discovering common attributes between these powders, they can then be used to further predict behavior.

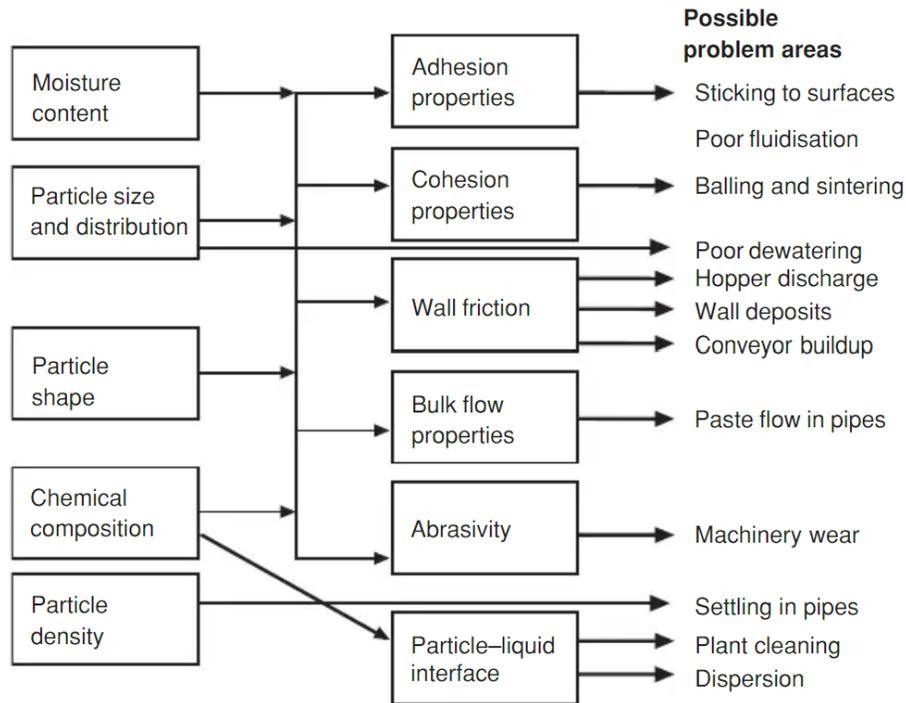
Internal and External Influences: Internal influences are properties such as particle size and distribution, shape, surface characteristics, density, packing property, moisture content, and chemical composition. External influences are environmental conditions such as humidity, temperature, pressure, gas flow rate through the powder, and applied consolidation.

Powder Behavior Characteristics: Powder behavior is commonly described by its compressibility, flowability, and fluidizability. Multiple rheological tests can be performed on samples to categorize the powder according to the Carr index and Hausner ratio, Jenike flow function, and Geldart classification.

Carr Index (%)	Flowability	Cohesion Index	Flow Behavior
0-10	Excellent	11	Free Flowing
11-15	Good	11-4	Easy Flowing
16-20	Fair	14-16	Cohesive
21-25	Passable	16-19	Very Cohesive
26-31	Poor	>19	Hardened, Extremely Cohesive
32-37	Very Poor		
>38	Extremely Poor		

Specific Applications: This phrase highlights the importance of understanding the parameters of the processing and handling methods. There are certain variables associated with filling and dumping, dosing and feeding, blending and sifting, pneumatic conveying, etc. that can have enormous impacts on the flowability of powder through the system.

Powder rheology is truly multi-faceted. It isn't enough to just understand the powder properties or to control the environment or to specify the equipment correctly and adjust the process parameters. All these factors must be considered in order to design a system that will work well.



Bulk Solids Handling: Equipment Selection and Operation (2008)

Typically, what works for one powder in a manufacturing process under one set of parameters won't work for another. Every application is unique. The science of *powder rheology* can expose the perplexities that are causing setbacks in an operation. Common powder handling issues that arise from not assembling the requisite information can be avoided by applying *powder rheology*. It is essential to have experts to guide the design and implementation of powder handling solutions.

References

Stanley-Wood, N. (2008). 'Bulk Powder Properties: Instrumentation and Techniques', in *Bulk Solids Handling: Equipment Selection and Operation*. Blackwell Publishing, pp 1-62.

Powder Rheology. (n.d.). Retrieved April 10, 2020, from <https://wiki.anton-paar.com/us-en/powder-rheology/>