KEY CONSIDERATIONS:
Averting Powder & Bulk Solids Processing & Handling Issues.

This white paper outlines the keys to mitigating bulk solids processing and handling issues.

Overview

Powder and bulk solids processing and handling are essential components of almost every industry worldwide. From the clothes we wear, the products used to build our vehicles, the coffee and food we consume to the materials used to build our homes, processing and handling bulk solids affects the genetic code of just about everything that keeps the world moving.

No matter the classification, no two bulk solids are the same, presenting just one of many challenges when it comes to process operations. Other issues such as poor material flow, segregation, or particle degradation compound the challenge. When thorough lab testing is not considered before equipment selection, process engineers may be faced with a losing battle.

Since processing bulk solids plays such an essential role in getting so many products to market, process engineers must continue to look for ways to maximize operational efficiency. This paper explores the key considerations to averting issues that lead to delays in startup time, bottlenecks and stopgaps in the processing and handling of powders and bulk solids.

Key Considerations:

- Resources & Capabilities
- Material Characteristics
- Equipment & Application
- Equipment Design
- Lab Testing

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Discover the keys to avoiding process issues.

Resources & Capabilities

The first key to averting issues associated with processing challenges is developing a risk mitigation and reward strategy that includes the resources and capabilities needed to achieve the plan. There are no shortages of process equipment suppliers in today's market. Many manufacturers build reliable equipment and offer design and engineering expertise. However, finding a single resource that can provide design, manufacturing and most importantly, testing of materials through processing or handling steps can be challenging.

Testing in a competent and fully equipped lab can provide the advantage of being able to test several technological solutions to ascertain the best solution for economic value and product quality. Furthermore, testing delivers peace of mind because it mitigates surprises and provides assurance that the process will work as intended.

It's becoming increasingly important to consider addressing questions such as:

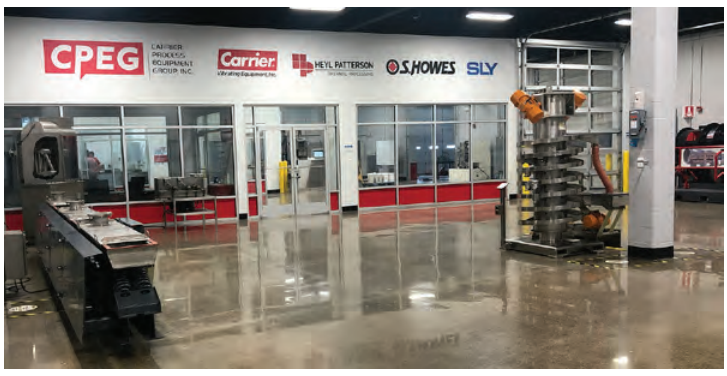
- What type of equipment does this manufacturer build?
- Do they have enough design and engineering experience to help?
- Do they provide lab testing and material analysis, and if not, who will perform the testing?
- Can they test multiple processing steps?
- Will testing in my equipment supplier's facility be representative of real-world conditions?
- Is there any type of guarantee associated with the lab testing?

Securing a partner with proven solutions to the questions above is a key factor in predicting successful outcomes in the design and operation of an efficient process system.

Partnering with a company that combines experience in equipment design, engineering, manufacturing and has the capability to test multiple process steps in a scaled, real-world environment increases the odds of overcoming potential processing challenges.

CPEG provides the following - all under one roof:

- Comprehensive line of process equipment
- 500+ years of combined experience in equipment design, engineering and manufacturing
- Extensive line of test equipment to simulate scaled field operation with multiple pieces of equipment for multistep and multistage testing needs
- Full analysis of material characteristics and measurements of material behavior in specific processing applications



More Brands. More Equipment. More Experience. More Testing Capabilities.

Material Characteristics

Understanding material characteristics including particle size distribution, bulk density, moisture content and other factors such as heat sensitivity, fragility, cohesiveness, etc., are often necessary parameters for designing an efficient process system. By performing a full analysis of material characteristics and measurements of material behavior in specific processing applications, operators are assured an efficient and reliable process solution. Having the materials analyzed will help identify operational parameters such as flowability of the materials through specific types of equipment.

Particle Size Distribution
Particle size distribution (PSD) contributes to many factors that affect the design of a process system. Analysis of PSD will help determine factors such as chemical conversion processes, the activity of catalysts, size reduction needs, and pretreatment requirements. Analysis of PSD will also influence the size of the equipment, maximum allowable capacity, flowability, and more.

Bulk Density
Determining a material's bulk density will have implications for sizing various system components in a process system. From drive design and horsepower requirements to feed design and feed rates, system components must be designed to accommodate a material's bulk density as the material works its way through a particular process. Understanding these factors will help determine appropriately sized components for a process system.

Moisture Content
Moisture content has widespread effects in all types of equipment, impacting how material flows, discharges, and generally acts. Factors such as energy, temperature and retention time requirements as well as the way a material carries its moisture content and flowability should be considered when designing a process system. Moisture content sensors and controls can be incorporated into the process system so that real-time adjustments can be made in the field.

Lab technicians at CPEG perform tapped and packed bulk density measurements. Moisture content analysis is performed prior to testing and measured throughout the entire testing process. Loss of Drying (LOD) and Loss of Ignition (LOI) measurements can be provided. An oven and a muffle furnace is available for applications such as evaporation, product age acceleration, part drying, baking, curing, polymerization, sterilization, and heat treatment.

Equipment & Application

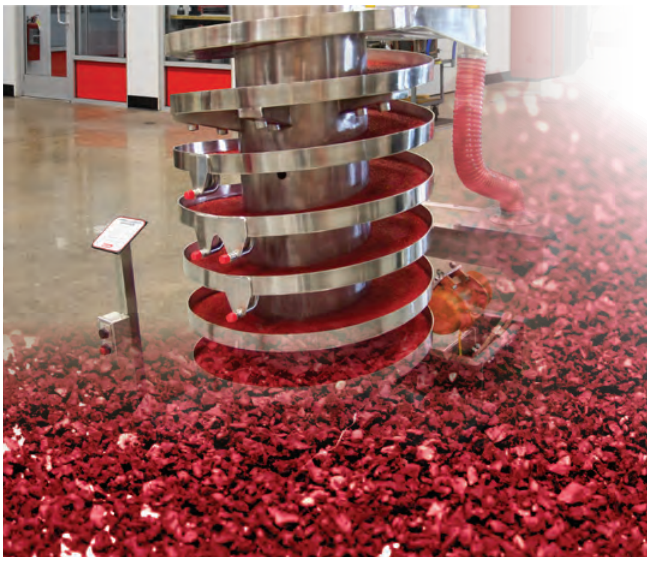
Process engineers are faced with a mountain of options when it comes to selecting suitable process equipment for various applications. Most pieces of process equipment are designed to perform specific, singular process steps or tasks (e.g., mixing, conveying, screening, drying, cooling, etc.). Some pieces of equipment are designed to be multi-functional, performing several steps such as conveying, heating, cooling, and screening. To complicate matters, equipment suppliers may offer multiple pieces of equipment that perform the same process step or task (e.g., fluid bed dryers, belt dryers, flash dryers, rotary dryers, etc., for a drying process).

With so many equipment options, determining which equipment is most suitable for specific materials and applications can be intimidating. Testing the equipment will disclose the advantages and disadvantages of each and provide the basis for the supplier to make equipment and process recommendations to handle specific materials and applications.

The primary consideration for testing with a supplier is obtaining a representative product sample of actual production conditions. When testing with a supplier, several factors come into play. Will the product behave differently if it is shipped for testing? If multiple pieces of equipment on a new processing line are being evaluated and tested, will the time lost and extra handling while transferring materials for testing build uncertainty in the results? Process engineers should work with the supplier to find ways to reduce uncertainty and eliminate inconsistencies.

Much of CPEG's diverse portfolio of equipment is available for testing materials and process variations through multiple processing steps, which help identify inefficiencies in process lines. When testing is considered as a component of a risk mitigation and reward strategy, this information can be leveraged to make equipment and process recommendations.

- Multiple dryer, cooler, screener, feeder, and conveying equipment options
- Wide range of additional processing equipment such as blenders, mixers, bulk material heat exchangers, lumpbreakers and agglomerators
- Expertise designing equipment to handle specific materials and applications
- Validation through lab testing



Equipment & Application Examples

ROTARY DRYERS

Rotary dryers process a broad range of material including powders, bulk solids and liquid sludges. They are specified according to starting and final moisture content, material temperature, drying air temperature, air velocity and retention time.

FLUID BED DRYERS

Fluid bed dryers are available in vibrating designs or static (conventional) designs and are custom-engineered for each application. They are ideal for drying non-uniform particle streams and process most granular or crystalline solids, filter cakes or powders.

FLASH & TORNESH DRYERS

Flash and tornesh dryers process wet solids ranging from 1 micron up to one-half inch diameter in a short time. They are ideal for quick drying of fine powders, food products, pharmaceuticals, plastic polymers and resins, solid chemicals and minerals and ores.

SPIRAL ELEVATORS

In addition to elevating difficult-to-handle products, spiral elevators can also dry, cool, heat or condition a wide range of materials including dry pellets such as rubber and plastic, catalyst, polymers, food and dairy products and pharmaceuticals.

ROTARY CALCINERS

Rotary calciners continuously process bulk materials at medium to high temperatures through an indirect heat source. Alternative fuels, chemicals, coals, fly ash, minerals, biomass, and waste conversion are common materials for rotary calciners.

FEEDERS & CONVEYORS

Feeders and conveyors move materials and can be designed to convey, feed, heat and cool, scalp, screen and more. They efficiently handle bulk solids like fragile materials or durable items in a wide variety of industries and applications.

MIXERS & BLENDERS

Mixers and blenders provide batch or continuous operation using a paddle or ribbon agitator. Paddle designs handle high viscous pastes or free flowing slurries, plastic pellets, cement, pigments and mud, while ribbon designs provide consistent mixing of powders, granules and some slurries.

BULK FLOW HEAT EXCHANGERS

Bulk flow heat transfer equipment provides efficient indirect heating and cooling due to intimate contact between solids and the unit's plate coils. Applications include explosion mitigation (inert atmosphere), drying very fine particles and temperature-sensitive materials that require long residence time.

Equipment & Application Examples - *continued*

BAGHOUSES / DUST COLLECTORS

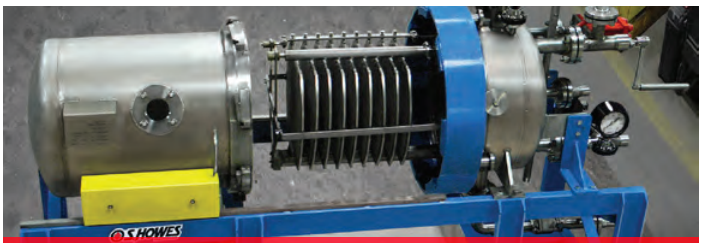
Baghouses are used in a wide variety of industries for air quality control, collecting dust and contaminants from process equipment such as boilers, furnaces, kilns, dryers, separators and mills. They are also utilized for controlling nuisance dust or particulate generated by material handling equipment.

WET SCRUBBERS

Wet scrubbers control harmful airborne pollutants and odors in process exhaust streams. They efficiently clean, cool and absorb vapors and gases from airstreams and collect particulates and can be designed for high temperature, highly corrosive applications.

SIZE REDUCTION

Lumpbreakers, knife cutters, agglomerators and granulators are used to improve downstream processing by breaking up large clumps of material into smaller, more uniform particles for better flow.



FILTRATION

Liquid-solid separation is performed by pressure leaf filters or tubular filters to produce wet or dry cakes. Filtration equipment is used in a number of applications for food, chemicals, minerals and more.

Through four separate process equipment companies, CPEG offers a comprehensive line of bulk solids and material handling equipment for a wide variety of materials and applications.

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Equipment Design

Designing reliable and efficient process systems that deliver required parameters is always the goal. Contributing factors include the actual process used, design attributes such as construction materials, temperature settings and variability, and equipment designed to achieve mass flow to promote uniformity and consistency while eliminating uncontrolled flooding, caking or product degradation.

Material Flow

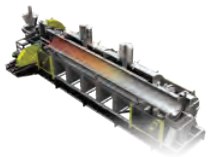
Material flow is likely the most critical factor in the design of any bulk solids handling or processing operation, regardless of the goal. Issues related to poor material flow run rampant and can result in bottlenecks. From segregation, particle degradation, cohesiveness and buildup to ratholing and bridging, flow issues can be averted prior to any equipment design with proper material analysis, testing of flow behaviors and equipment design. For example, feeders can be designed with variable feed rates for precise control of material flow.

Material Degradation

Material degradation issues are of major concern when designing process systems. Process engineering expertise combined with equipment that provides specific features should be leveraged to minimize material degradation. For example, food, dairy and pharma process engineers may opt to use mixers with paddle assemblies, producing a tumbling motion for less product shear compared to mixers with ribbon agitators.

Temperature

Temperature plays an important role in the design and selection of bulk solids handling equipment. For example, some materials flow better at low temperature and others may become burnt or melt if exposed to too hot of a temperature. Some materials may require exact temperatures to ensure quality and reduce defects. In some industries, material of relatively high temperatures can cause unwanted exothermic reactions between material and equipment, and therefore, must be designed with suitable construction materials.



Heating zones built into equipment can provide tight temperature control for uniform heating of materials.

Heat-resistant substrates & surfaces and protective heat shields & enclosures should be included in the design.

Immersed heat exchanger tubes can be built into a variety of equipment for indirect heat transfer.

Retention Time

Residence or retention time is the amount of time for which a material is processed in a given piece of equipment. In many applications, process engineers must be able to reach a specific retention time at a specific temperature to meet specific moisture requirements. Residence time can also be used to initiate or complete a chemical reaction, or form granules within the desired particle size distribution. Equipment with specialized drives that allow real-time adjustments to the angle of attack help control retention time.

Air Pollution Control

Most powder and bulk solids process systems create dust and contaminants which must be controlled to meet EPA standards for emissions from process industries. Dust and contaminants are generated from various process equipment and nuisance dust can be generated by material handling systems that move materials prone to dust. Baghouses and/or various wet scrubber equipment can be utilized for both process and nuisance air pollution control.

Lab Testing

As mentioned, bulk solids processing systems engineered without proper vetting through a qualified lab could cause delays and other inefficiencies or bottlenecks. When bulk solids systems are not properly engineered to handle the unique characteristics of the materials, start-up time can be significantly delayed, and design capacity may never be reached. Decisions made during the preliminary stages of a project are critically important to the success of an operation and should be included in the risk mitigation and reward strategy.

Comprehensive material and equipment testing in a qualified lab has proven to avert common issues associated with processing bulk solids material. Testing can also bring to light new challenges which can be circumvented before any problems may arise, validate new equipment designs and processes, and facilitate a quicker return on investment.

Validate Equipment Designs & Processes

Thorough testing can validate new equipment designs and processes against material and process parameters and improve existing process lines. Conducting tests with a variety of custom-engineered equipment, modern diagnostic tools, computerized data collection, and real-time information should always be considered.

Expedite ROI

The cost of testing material, equipment, or processes prior to commissioning is negligible when compared to calculating the cost of downtime resulting from equipment that was not properly vetted. With thorough risk analysis through lab testing, factors such as successful increases in capacity and energy efficiencies will be discovered, facilitating a quicker return on investment.

The testing facility at CPEG provides access to the most extensive testing capabilities in the industry with full analysis of material characteristics and measurement of material behavior in specific processing applications. Multiple processing steps can be tested in one location during a single visit. Modern diagnostic equipment is maintained and operated by extensively trained technicians and the entire testing process is supervised by engineers.

Moisture Content Analysis | Loss of Drying (LOD) | Loss of Ignition (LOI) | Sizing, Volume & Capacity Testing
Attrition Testing | Screen Testing | Convey Testing | Drying, Cooling & Curing Testing | Special Qualities Testing

High temperature testing is natural gas powered to generate electricity and produces useful thermal output. Includes a vertical vibrating machine that heats up to 450 - 1500° F.

Low temperature testing is also available and is operated with electric and includes a vertical vibrating machine that heats up to 450° F.

CPEG offers a process warranty on equipment built as a result of proven lab tests. Test fees are refundable against the total purchase of the new equipment.

CPEG's Lab Testing Process

The CPEG lab simulates operating conditions on a smaller scale to provide data and assurance that your process will be a success. The lab is equipped with modern diagnostic machinery and experienced engineers to analyze test results, provide recommendations, and solve powder and bulk solids processing and handling issues.

The lab is available all year and can be booked with less than a month's notice. Typical arrival is 8:30 A.M. EST, and the company's process engineers will be met at the door by a CPEG sales team member. They will guide members to a conference room adjacent to the lab to discuss requirements or desired outcomes.

Material characteristics and behavior are tracked and analyzed with the use of moisture analyzers, particle size analysis equipment, and computerized data collection.

During a 1-day test, company members will receive the results via email prior to arriving home. During a 2-day test, the first day's results will be printed and waiting for process engineers on a designated conference room table, while CPEG staff preps for the second round of testing.

Conference Room 1

Process engineers that are present during the testing have the ability to designate how often one of CPEG's trained technicians will monitor product material and testing equipment. And with 15,000 square foot of space and multiple conference rooms with large monitors and wifi connections, CPEG makes testing comfortable and safe while allowing members to catch up on day-to-day work during breaks in testing.

Rental Equipment Program

Field testing with rental equipment is available when lab testing would not effectively simulate process operating environments. CPEG offers an efficient and hassle-free rental process.

Data generated during the on-site test can be used to generate process guarantees on new equipment. CPEG rental equipment packages and utility requirements are identified and discussed. CPEG engineers are available to visit job sites and assist in setup, operation, or dismantlement of equipment needed for use.

CPEG's rental process takes into consideration the need to test at other facilities, locations, or environments, since materials or chemicals can change during shipment/transport to the CPEG lab. Other considerations for testing outside of the CPEG lab include shelf-life issues with materials and the fact that hazardous materials are not often shipped easily.

AVAILABLE TO RENT

- Baghouses
- Burners
- Continuous Pug Mill Mixer
- Conveyors
- Cyclones
- Delta-Phase Controls
- Exhaust Fans & Headers
- Feeders
- Fluid Bed Dryers & Coolers
- Heaters
- Lumpbreaker
- Mult-Disc Processor
- Paddle Blender
- Ribbon Blender
- Rotary Calciner
- Rotary Dryer
- Screening Decks
- Screw Conveyor
- Screw Feeder
- Standard & Expandable Hoods
- Variable Feed Drives

"When you visit our lab you will notice a few things, first how clean and inviting the space is, secondly, how much we care and attend to your product, goals, and general level of comfort."

—Josh Greene,
Lab Manager

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