

# THE GYPSUM PROCESSING

HANDBOOK



FROM THE FEECO  
**MATERIAL PROCESSING SERIES**

**FEECO**  
INTERNATIONAL

TOMORROW'S PROCESSES, **TODAY.**

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## Introduction

FEECO International was founded in 1951 as an engineering and manufacturing company. We quickly became known as the material experts, able to solve all sorts of material processing and handling problems, and now serve nearly every industry, from energy and agriculture, to mining and minerals.

As experts in the fields of particle size enlargement and thermal processing, FEECO has been an expert in gypsum processing since the 1950s. We've helped our customers process hundreds of materials into value-added products, eliminating handling and transportation problems, improving product characteristics, and creating marketable products.

For further information on our gypsum processing capabilities, [contact a FEECO expert](#) today.

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# An Overview of **GYPSUM**

INTRO | SYNTHETIC GYPSUM | GYPSUM RECYCLING



Synthetic Gypsum pellets created in  
the FEECO Innovation Center

## AN INTRO TO GYPSUM

Gypsum is a naturally occurring mineral found in deposits throughout the world. Composed of calcium sulfate dihydrate, gypsum offers a variety of useful characteristics that lend it to a multitude of products.

Gypsum is most widely found in the construction industry as gypsum wallboard, as well as other construction materials that rely on gypsum's ability to harden into a cement-like form. Gypsum is also commonly found in the agriculture industry as a soil conditioner or amendment, where it provides sulfur and calcium for plants, and acts as a natural aerator, coagulating soil particles and loosening compacted soils. Additional applications include uses in concrete, cosmetic products, medical products, and even food products.

While gypsum's characteristics make it ideal for use in so many applications, these same characteristics can present challenges during processing. The following takes a look at the various available gypsum processing techniques, the challenges they present, as well as common processing issues and specialty applications. First, it's important to take a look at alternative sources to natural, mined gypsum.

### **SYNTHETIC GYPSUM: A SUSTAINABLE ALTERNATIVE**

Although mined gypsum has traditionally served as the raw material for products such as soil amendments and wallboard, a manufactured form of gypsum, commonly called, 'Synthetic Gypsum,' has been garnering attention and making its way into all sorts of products as of late.

While natural gypsum has been mined and manufactured for centuries, the process of manufacturing synthetic gypsum has only been available for the last few decades.

When the Acid Rain Program was introduced under the Clean Air Act, fossil fuel power plants were required to fit their stacks with scrubbers to remove sulfur before it could escape into the atmosphere, causing air pollution and acid rain.

Called Flue Gas Desulfurization (FGD), this process resulted in a by-product that people soon discovered could be manufactured into a pure, synthetic form of gypsum. Today, synthetic gypsum has replaced natural gypsum in many applications. Listed below are the basics on this incredible material.

### **SYNTHETIC GYPSUM IS A UNIQUE BY-PRODUCT**

Synthetic gypsum is created as a by-product of industrial processing. It is composed of calcium sulfate dihydrate, has the same characteristics as natural gypsum, and is a high-quality and environmentally friendly product.

### **SYNTHETIC GYPSUM COMES IN MANY FORMS**

Synthetic gypsum is the name used to classify a variety of gypsum by-products. The most common gypsum by-product is FGD gypsum. When referencing synthetic gypsum, most people are likely referring to FGD gypsum. However, there are small quantities of synthetic gypsum created through various acid-neutralizing industrial processes.





These additional types of synthetic gypsum include:<sup>1</sup>

- *Citrogypsum*, a by-product of citric acid manufacturing
- *Fluorogypsum*, a by-product of hydrofluoric acid manufacturing
- *Phosphogypsum*, a by-product of phosphoric acid manufacturing
- *Titanogypsum*, a by-product of titanium dioxide manufacturing

### **FGD GYPSUM IS CREATED AT POWER PLANTS**

FGD gypsum is formed when fossil-fueled power plants utilize flue gas desulfurization systems to remove sulfur dioxide from gas pollutants. Using a process referred to as 'scrubbing,' gas pollutants are fed through calcium carbonate to eliminate impurities and environmental concerns. When the sulfur dioxide is removed, the gypsum by-product is formed.

### **COMMON USES FOR SYNTHETIC GYPSUM**

Synthetic gypsum is used interchangeably with natural

gypsum in a number of applications. Examples of products that utilize synthetic gypsum include:

- Cement
- Drywall
- Glass Manufacturing
- Plaster
- Soil Amendments

### **BENEFITS TO USING SYNTHETIC GYPSUM**

Manufacturing synthetic gypsum creates many positive economic and environmental benefits. Economically, manufacturing synthetic gypsum creates revenue from a product that otherwise incurred waste management costs. And by creating a valuable product from waste, material is kept out of landfills and environmental pollution is reduced. Furthermore, increased use of synthetic gypsum conserves natural gypsum and reduces the need to mine finite resources. Synthetic gypsum products even have benefits over natural gypsum products in terms of costs and environmental impacts.

1. "Gypsum," Donald W. Olson, U.S. Geological Survey: <http://minerals.usgs.gov/minerals/pubs/commodity/gypsum/gypsmby01.pdf>

## GYPSUM IS 'GREEN'

In addition to the infrequent occurrence of tinted green natural gypsum, all gypsum products (natural and synthetic) are also figuratively considered 'green' in terms of their recycling capabilities. This is due to the fact that gypsum is eternally recyclable—a major advantage when manufacturing gypsum into a commercial product. Gypsum is a rare example of closed loop recycling, i.e., the ability to use product waste to make the same product over and over.

## A LOOK AT RECYCLING GYPSUM

Each year, more and more gypsum manufacturers are discovering the benefits of gypsum recycling. Not only is gypsum fully recyclable, but it is also sustainable throughout its entire life cycle. Gypsum recycling results in emission reductions, processing waste decreases, and lowered transportation-related costs. Considering today's increasing environmental concerns and regulations, it goes without saying that there is immense value in the opportunities provided through processing recycled gypsum.

## WHY RECYCLE GYPSUM

Gypsum wallboard is an extremely prevalent waste. Even though the option to recycle gypsum board is widely available, most gypsum wallboard is disposed of in landfills. This is problematic because the anaerobic decomposition of gypsum can produce harmful gasses such as hydrogen sulfide. Additionally, the gypsum found in drywall is capable of breaking down clay liners that waste management companies use to prevent toxins from seeping into surrounding water systems.

Gypsum recycling is an excellent solution to circumvent

disposal issues. By recycling gypsum, waste is reduced at its source, thus turning an environmental problem into a business opportunity. In addition, using recycled gypsum versus mined gypsum promotes sustainable manufacturing practices. Gypsum recycling not only provides manufacturers with emission reductions, but less energy is also spent on processing when using recycled gypsum versus raw gypsum. In addition, because less raw, mined gypsum is required, transportation energy emissions are also reduced.

## SOURCES OF GYPSUM WASTE

Because gypsum board is such a large industry, most gypsum waste originates from gypsum board-related products and manufacturing. Plaster and gypsum blocks also contribute to gypsum waste, but to a much lesser degree. According to the EPA,<sup>2</sup> sources of gypsum board waste (and their associated total percentage) include:

### GYPSUM BUILDING CONSTRUCTION WASTE (64%):

The greatest amount of gypsum recycling comes from uninstalled gypsum board scraps from building construction sites. This is considered a clean waste, free of contamination.

### GYPSUM POST-CONSUMER WASTE: DEMOLITION (14%) AND RENOVATION (10%):

Gypsum post-consumer waste occurs when installed ceiling and wallboards are removed during a building's demolition or renovation. While not as prevalent as processing recycled gypsum from new construction waste, there are a number of U.S. recyclers who accept post-consumer gypsum board waste. The lack of recycling in this category is often due to contamination issues; nails, wall coverings, and so forth, must all be separated from the gypsum.

2. EPA, WARM Version 13: <http://epa.gov/epawaste/conserve/tools/warm/pdfs/Drywall.pdf>



Agglomerated gypsum wallboard waste created in the FEECO Innovation Center

Additionally, lead and asbestos contamination concerns associated with older buildings are also a recycling issue.

**GYPSUM MANUFACTURING WASTE (12%):** Gypsum manufacturing waste is a result of rejected material created during the manufacture of gypsum products. Most gypsum manufacturing plants recycle this waste stream as part of their waste avoidance protocol.

## PROCESSING GYPSUM WASTE

Closed-loop gypsum board recycling begins when construction site waste is brought to a recycling center for processing. The recycling center separates the paper from the gypsum and breaks down the gypsum into a fine powder. The gypsum powder is then ready to be used in recycled gypsum products. Additionally, the screened paper is sorted and processed based on its intended use.

## RECYCLED GYPSUM PRODUCTS

There are a number of different products for which recycled gypsum material is valued:

**AGRICULTURAL PRODUCTS:** Recycled gypsum is an

excellent fertilizer and soil amendment. Not only does gypsum loosen compacted soils, but it also increases water filtration and adds nutrients such as calcium and sulfur back into the soil, making it essential when promoting sustainability in irrigated soils.

**NEW DRYWALL:** Many gypsum manufacturers utilize gypsum recycling as a material source for new boards. Because of gypsum's sustainable qualities, new products containing recycled gypsum are of the same quality as gypsum boards produced using only raw materials.

**CEMENT:** Gypsum is used as an ingredient in cement manufacturing, providing benefits such as reduced setting time.

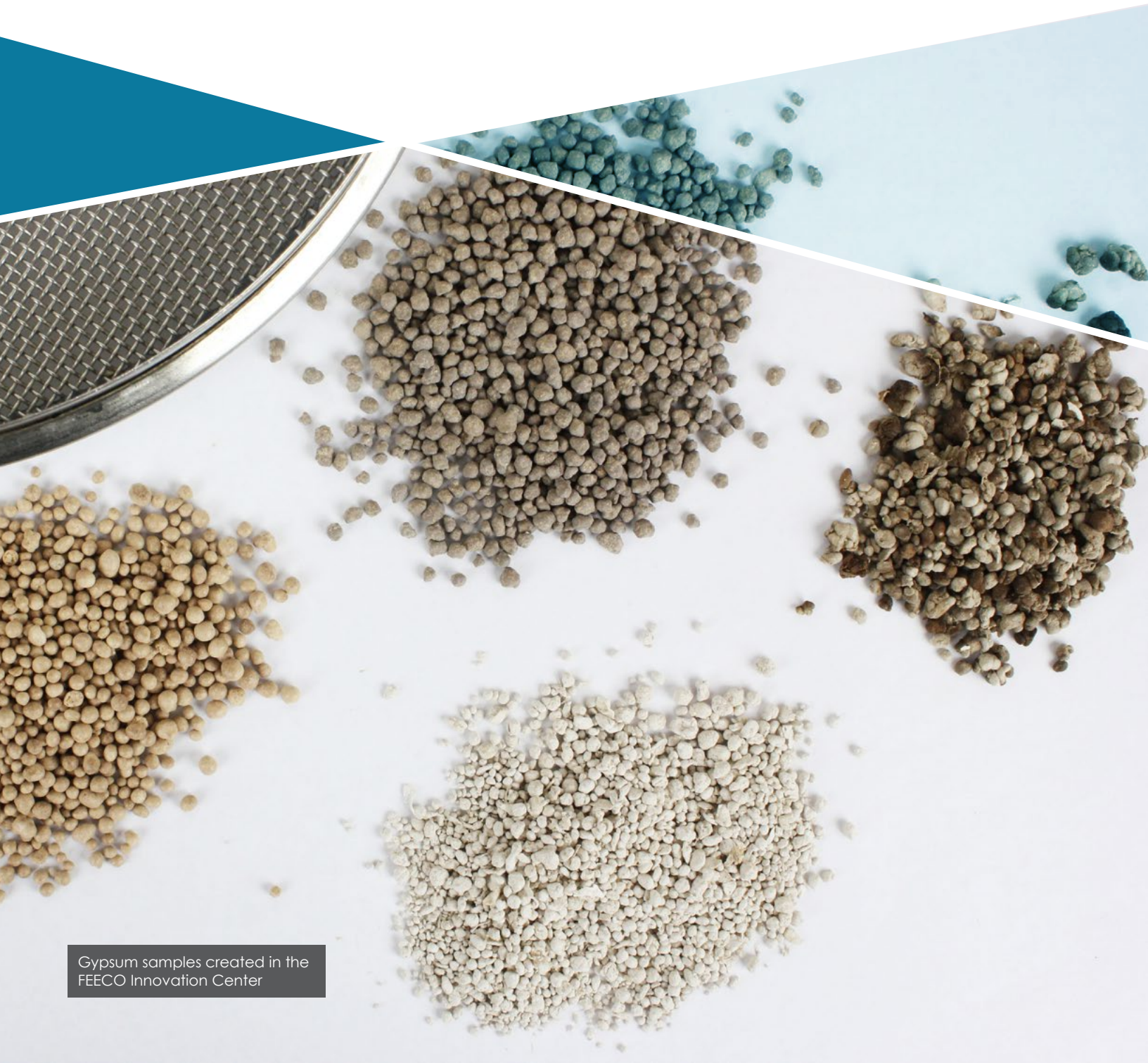
**PAPER PRODUCTS:** Recycled paper waste from gypsum boards can be used in agriculture, animal bedding, and even ceiling tiles.

**COMPOSTING:** Gypsum board is used as an additive to compost. It is added after the compost is created in order to supply plants with the important nutrients found in gypsum.



# GYPSUM PROCESSING

CHARACTERISTICS | PELLETIZING | DRYING | PIN MIXER PROCESSING



Gypsum samples created in the  
FECCO Innovation Center



## GYPSUM MATERIAL CHARACTERISTICS

Whether raw, natural, synthetic, or even recycled, it is often desirable to further process gypsum before use, particularly in the case of agricultural applications.

When processing any material, it is important to recognize key characteristics that will affect manufacturing operations and the final product generated. Even commonly processed minerals such as gypsum require testing on a case-by-case basis to ensure quality results. The following list outlines key material characteristics that often have an effect on gypsum processing.

### ABRASIVENESS

Mined gypsum is a somewhat abrasive material. As a result, robust equipment must be used when processing gypsum. Rotary dryers are an ideal solution for many types of ore, as they are especially heavy-duty. Customizations can be made to other processing equipment as well, in order to protect against abrasion, and prolong equipment life. No matter what the equipment, keeping gypsum's abrasive nature in mind during design is a must.

### DUST AND CLUMPS

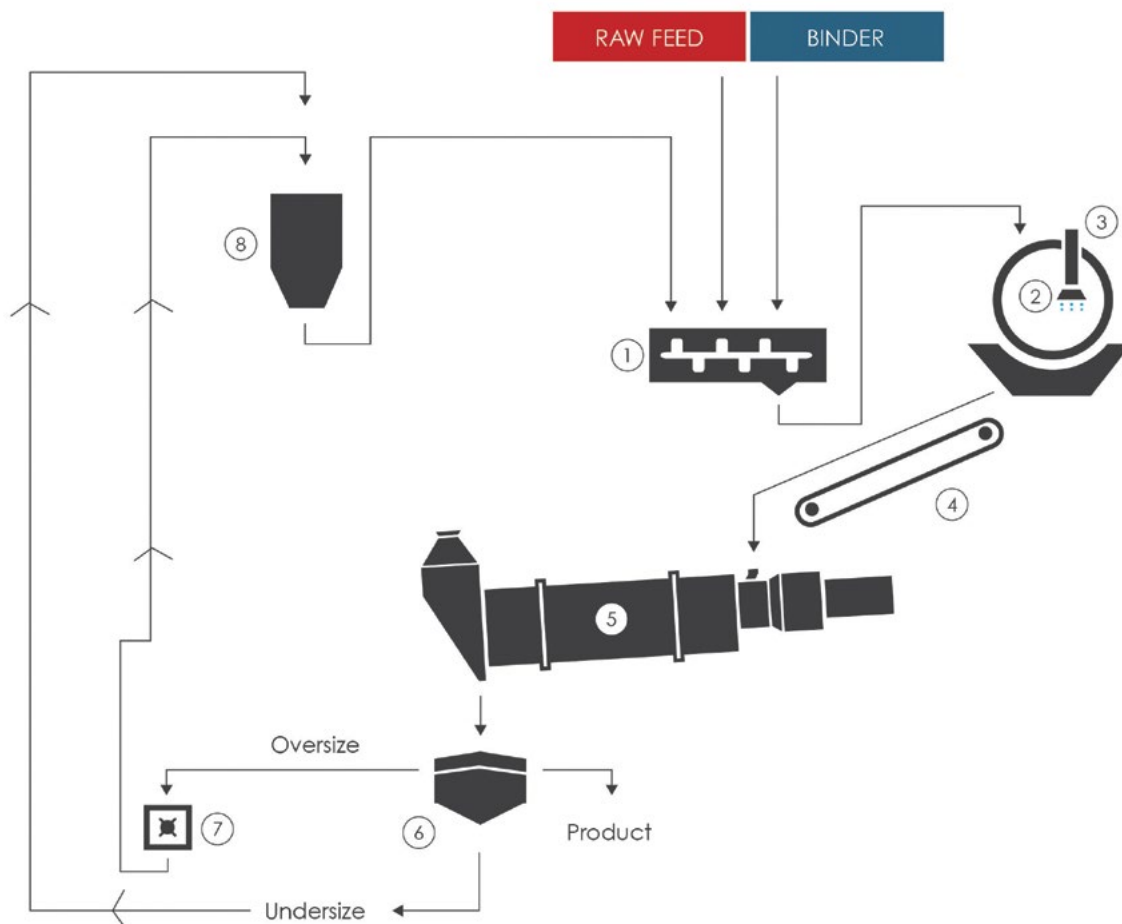
When granulated properly, pelletized gypsum is much easier to handle than its raw, powdered counterpart. However, clumping and dusting issues may occur when drying and pelletizing powdered gypsum. In order to avoid such problems, processing equipment should be customized to accommodate this characteristic.

### VARIABILITY

The make-up of naturally occurring gypsum may vary based on the region or deposit from which it was mined. Because of this variation, different types of gypsum may require more processing time or additional binder. [Testing](#) is always recommended to confirm that the suggested gypsum processing methods will deliver the necessary results. This is true of synthetic gypsum as well. Even more so than natural gypsum, synthetic gypsum requires testing to determine the best processing methods for this unique by-product material.



## FLOW DIAGRAM OF TYPICAL GYPSUM PELLETIZING PROCESS



## GYPSUM PELLETIZING

Whether natural or synthetic, gypsum is commonly pelletized for improved handling and use. While not typically pelletized for use in the construction industry, gypsum is almost always pelletized for agricultural applications, as well as for some others too.

### PELLETIZING GYPSUM FOR USE AS A SOIL CONDITIONER

Gypsum is an ideal agricultural resource because it improves the properties of soil and promotes optimal crop growth. In addition to the benefits created from [pelletizing gypsum](#), there are many advantages to regularly using gypsum for agricultural purposes:

#### DIAGRAM KEY:

1. Pin Mixer
2. Disc Pelletizer
3. Liquid Spray System
4. Transfer Conveyor
5. Rotary Dryer
6. Vibrating Screen
7. Oversize Mill
8. Surge Hopper





FEECO Disc Pelletizer

**1. INCREASED PLANT NUTRITION:** Gypsum is composed of calcium sulfate. When applied to a field, gypsum supplies calcium and sulfur, two essential nutrients that increase crop yield and stimulate root growth.

**2. WATER INFILTRATION:** Gypsum applications improve a soil's ability to drain and move water efficiently.

**3. IMPROVED SOIL STRUCTURE:** By reducing soil aluminum toxicity, gypsum can improve acid soils and allow for increased root growth in crops. Gypsum applications also loosen compacted soil and clay, improve soil aggregation, and increase the overall permeability of the soil.

**4. EROSION RELIEF:** Gypsum helps to prevent the runoff of phosphorus and other nutrients from fields, making it an economical way to reduce non-point runoff pollution.

## BENEFITS OF PELLETIZING GYPSUM

The value of gypsum pellets as part of an integrated systems approach to soil management has received increased attention and recognition over the last few decades. As a result, more and more questions have come up regarding gypsum processing equipment and how to effectively manufacture quality gypsum pellets.

Although it's been used as a supplement in agricultural practices for centuries, gypsum has not always been easy to apply, handle, or store. The process of pelletizing gypsum has greatly improved its usability, particularly in the agriculture industry.

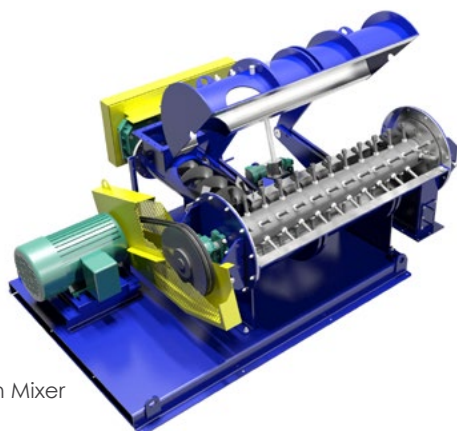
Pelletizing offers the following benefits:

- Dust-free product handling
- Improved product formulations

- Simplified transportation
- More accurate and easier application
- Mitigation of product lost as dust

## THE BASICS OF PELLETIZING GYPSUM

Gypsum pelletizing, a type of tumble growth agglomeration, forms a strong pellet capable of breaking down quickly in standard field conditions. This non-pressure process relies on three critical pieces of equipment to create quality gypsum pellets: a pin mixer, disc pelletizer, and rotary dryer.



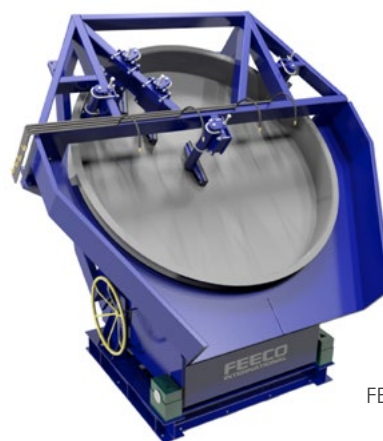
FEECO Pin Mixer

The [pin mixer](#) works as a primary feed conditioner to the gypsum pelletizing process, mixing the powdered gypsum with a liquid binder solution. The rotational motion of the pins imparts a spinning action to the gypsum mixture, reducing air and water volume between particles. The intense motion also results in densification many times that of a disc pelletizer. This step conditions gypsum, priming it for ideal pellet formation on the disc pelletizer.

While pin mixers are not always used, systems that employ a pin mixer will enjoy a higher throughput, use less binder, and yield more on-size pellets. In processes where this preconditioning step is not utilized, crushed gypsum is fed directly onto a disc pelletizer and binder is applied.

## FEECO PIN MIXERS AT A GLANCE

<b>SIZE</b>	10" - 50" (254 - 1,270mm)
<b>CAPACITY</b>	200 lb/hr - 70 TPH
<b>CUSTOMIZABLE?</b>	Yes



FEECO Disc Pelletizer

**THE DISC PELLETIZER**, or [gypsum pelletizer](#), creates spherical gypsum pellets by growing and tumbling the now-tacky material against itself. The rotating motion of the disc allows particles to gradually build (or 'snowball') to the desired pellet size. Additional liquid binder and mixed gypsum material are continually fed onto the rotating pan of the disc pelletizer, making this a continuous process.

## FEECO DISC PELLETIZERS AT A GLANCE

<b>SIZE</b>	24" - 25' (0.6 - 7.5m)
<b>CAPACITY</b>	100 lb/hr - 100 TPH
<b>CUSTOMIZABLE?</b>	Yes



FEECO Rotary Dryer

Synthetic gypsum pellets created in the FEECO Innovation Center

The [rotary dryer](#), or gypsum dryer, accomplishes the final treatment of the gypsum pellets, drawing moisture out of the material, while producing a uniform, high-quality product. The rotating motion and lifting flights of the drum are designed to shower gypsum pellets through the air stream, ensuring all of the pellets are properly dried.

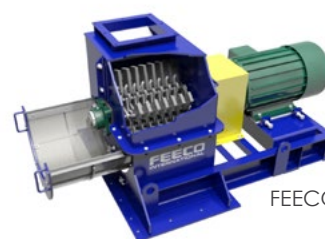
#### FEECO ROTARY DRYERS AT A GLANCE

<b>DIAMETER</b>	3' - 15' (1 - 4.6m)
<b>CAPACITY</b>	1 TPH - 200 TPH+ (1 MTPH - 181 MTPH)
<b>CUSTOMIZABLE?</b>	Yes

One important thing to note is that while drying and pelletization processes are used to counteract dusting and clumping issues, the equipment itself must also be designed to avoid these problems during processing as well. Choosing a manufacturer that is familiar with gypsum processing and can tailor equipment specifications to meet such material characteristics will offer the best result. A one-size-fits-all approach will not be effective when working with gypsum.

Once the material is dried, the gypsum pellets are

screened by size. Under-size pellets go back into the process as feedstock, while over-size pellets are crushed and added back into the process as recycle. Optimally sized gypsum moves on to bagging, storage, or transport. A [hammer mill](#)—a size reduction device—is frequently used for crushing over-size granules so they can be worked back into the process as recycle.



FEECO Hammer Mill

#### IMPORTANT GYPSUM PELLETIZING ELEMENTS

While there are a number of factors that can have an effect on the success of a gypsum pelletizing operation, perhaps the two most influential factors are binder and equipment.

##### BINDER

Gypsum pelletizing requires a binder in order to





FEECO Rotary Dryer

achieve proper pellet strength. A binder assists in pellet formation, and also helps to create an end product with the desired crush strength. When it comes to pelletizing gypsum, lignosulfonate is the most commonly used binding agent. If only water were to be used as a binder, the resulting pellets would be weak.

### EQUIPMENT

Quality equipment is a must in order to produce the best pelletized gypsum product. Equipment designed around the unique processing requirements of gypsum, instead of a one-size-fits-all approach, will produce the best results. Additionally, modifications to accommodate the rigors of gypsum processing are often necessary—for example, abrasion-resistant pins to prevent accelerated wear on the pin mixer. Choosing quality equipment will not only aid in process efficiency, but will also result in less maintenance and downtime, as well as prolonged equipment life.

## DRYING GYPSUM

Drying is a critical process step, both in mining gypsum ore, and pelletizing gypsum. While these two steps involve considerably different processing techniques,

in both cases, drying helps to create a uniform, premium product.

### DRYING MINED GYPSUM

After gypsum ore is extracted from mines or quarries, it is crushed and stockpiled as needed. If the gypsum ore does not meet specified moisture levels, it must be dried. A gypsum dryer, commonly known as a rotary dryer, is used to reduce the moisture content of the ore to the necessary level. The heavy-duty, high-volume functionality of a rotary dryer makes it an ideal drying solution for gypsum. In addition, the lifting flights within the rotating drum shower the gypsum through a heated air stream, uniformly drying the material as it travels through the dryer, as well as increasing efficiency.

### BENEFITS TO DRYING GYPSUM ORE

**GYPSUM PROCESSING IMPROVEMENTS:** Gypsum ore with a higher moisture content is problematic for grinding equipment. By adding the drying step, a rotary dryer removes moisture from the material to help avoid congesting equipment in later steps.

## BENEFICIATION

Drying is also a technique used as part of the gypsum beneficiation process. In mineral processing, beneficiation separates the wanted mineral from the unwanted gangue material using a variety of processes. Gypsum dryers remove moisture and prepare the mineral for subsequent steps in the beneficiation process.

Once crushed and dried, gypsum is ready to move on to subsequent processing based on its intended use.

## DRYING GYPSUM FOR USE IN WALLBOARD

Drying is of particular importance when gypsum will be processed into wallboard as well. Throughout various stages of a gypsum wallboard processing system, drying can be attributed as a leading factor in the overall quality of the final gypsum product. The material refining stages set a precedent for the quality of the final product, with moisture levels and drying playing a key role in manufacturing gypsum into wallboard.

## BENEFITS TO DRYING PELLETIZED GYPSUM

Drying gypsum pellets is a critical step in the processing of a high-quality pellet product. Because moisture is added during the conditioning and pelletizing steps, the moisture must be drawn out to cure the pellet into its final, dry form. As previously mentioned, this is most commonly carried out using a rotary dryer. Benefits include:

### IMPROVED PRODUCT HANDLING

The drying process reduces material handling issues such as clumping. Drying also forms a strong pellet

that is able to withstand handling and transportation, but is still capable of breaking down quickly, offering fast nutrient delivery.

### PRODUCT CONSISTENCY

The tumbling action within the gypsum dryer rounds and polishes the pellets, creating a uniform product.

## ROTARY DRYER CUSTOMIZATION

There are many customizations available for rotary dryers, all of which aim to maximize efficiency during gypsum processing, as well as prolong the life of the equipment. Among them:

- Abrasion-resistant internal flights
- Heavy-duty linings to protect against abrasion
- Special burners to limit pollutants such as NO<sub>x</sub> and CO
- Knocking systems to reduce and prevent buildup



## THE BENEFITS OF ADDING A PIN MIXER TO A GYPSUM PELLETIZING SYSTEM

As mentioned, the use of a pin mixer in a gypsum pelletizing process is not required, but the addition of a pin mixer to the process does offer a wealth of benefits. The major advantages that this approach yields are summarized here. In general, pin mixers help to produce the best final gypsum product, while also improving processing productivity.

### HOW IT WORKS

A pin mixer is composed of a central rotor shaft housed in a stationary shell. The shaft extends the entire length of the mixer, with multiple pins extending outward. Using a constant speed motor, the shaft is spun at a high velocity exceeding several hundred RPMs. The rotational speed is pivotal to how a pin mixer works, because this motion imparts agitation forces on the gypsum and binder material. As mentioned, the intense spinning action reduces air and water volume between material particles, and results in material densification greater than what can be achieved with a disc pelletizer alone. Adding a pin mixer to a gypsum processing system is beneficial for many reasons:

#### IMPROVED BLENDING

Because a disc pelletizer is not intended to mix materials on the pan, often the distribution of binder throughout the material can be uneven. Adding a pin mixer prior to the pelletizer allows for thorough mixing of the binder with the material, resulting in more uniform pellets. This is particularly noted in final crush strength; relying on the pan pelletizer to mix the binder can yield varying crush strengths due to uneven

distribution of binder. When material and binder are pre-blended in a pin mixer, end crush strength is much more uniform.

#### DE-DUSTING

Disc pelletizers are referred to as an “open system,” meaning that the gypsum is not contained and is free to escape into the air.

The introduction of a pin mixer allows the gypsum powder to be de-dusted prior to entering the pelletizer by pre-blending the material with a majority of the required moisture/binder before the pelletizer. By using a pin mixer to blend powdered gypsum with a binder, the resulting mixture becomes nearly dust free, easier to handle, and optimally preconditioned for pelletization on a disc pelletizer.

#### IMPROVED PRODUCTIVITY

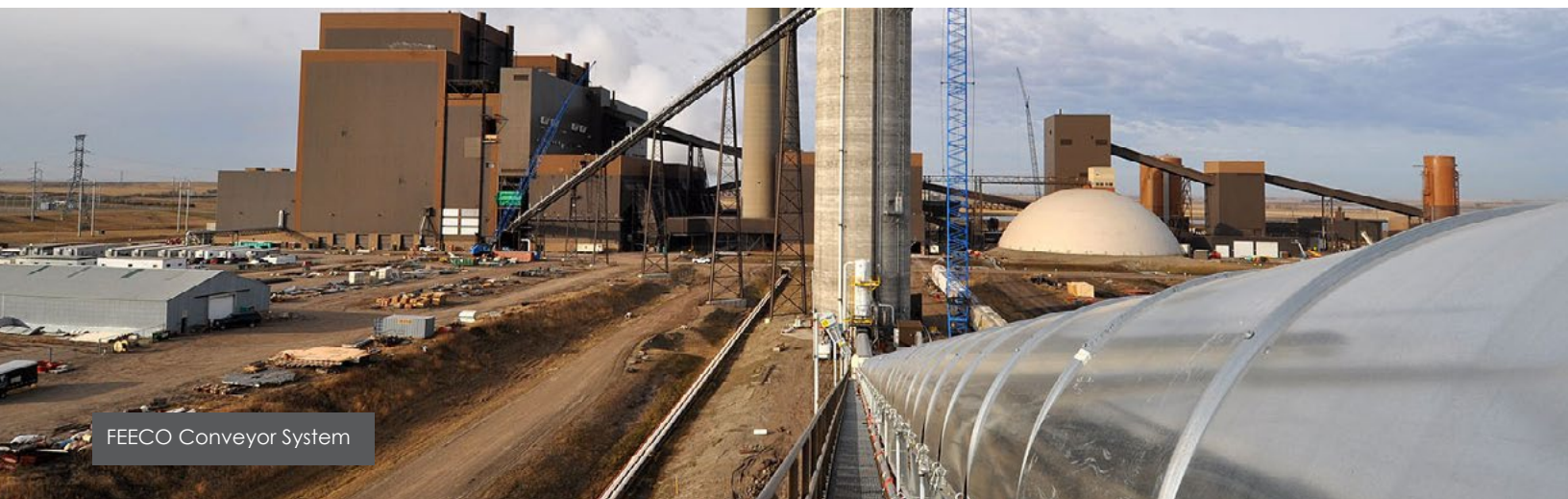
The pin mixer also often results in increased production. Without a pin mixer, the required amount of moisture must be gradually added during processing on the disc pelletizer, a process which can be lengthy. When a pin mixer is introduced, however, the majority of the moisture can be added before material enters the disc, resulting in an opportunity for increased production.

#### REDUCED BINDER USAGE

Because pin mixers use motion to create densification instead of binder, less binder is often required, translating into reduced binder costs.

Pin mixers are also ideal components in an automated system, offering precise quality control and accurate production rates.





FEECO Conveyor System

## GYPSUM HANDLING SYSTEMS

In addition to the major pieces of equipment in a gypsum processing system, attention should also be paid to the handling portion of the process. The primary role of a [gypsum handling system](#) is to transfer material safely and efficiently from one location to another, typically around the processing facility, as well as to shipping, storage, and transport. While this functionality is universal regardless of industry or material, the equipment is not considered to be an all-purpose, one-size-fits-all solution. Gypsum is a prime example of this, due to the fact that it varies based on its source and processing stage in the manufacturing cycle. As a result, even straightforward equipment such as gypsum conveyors should be examined to ensure a reliable, value-added solution is being utilized to enhance individual manufacturing systems.

When it comes to designing a system to best handle the characteristics of gypsum, the biggest concern is material buildup. Gypsum is not a free-flowing material; it tends to be sticky, and as a result, requires additional maintenance and cleaning. The best way to avoid buildup and maintenance issues is

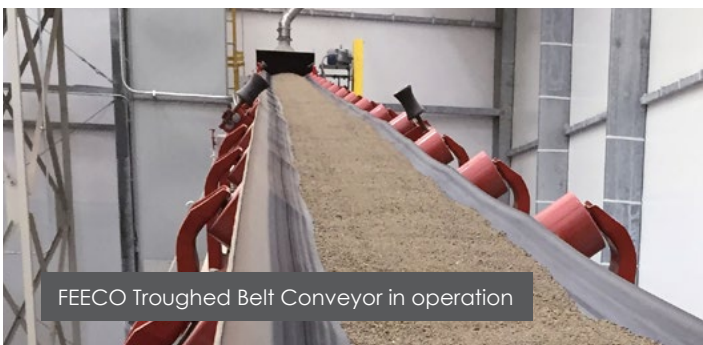
through consistent equipment cleaning as part of the equipment's regular maintenance routine.

## TYPICAL GYPSUM HANDLING EQUIPMENT

Gypsum manufacturing facilities most often utilize the following gypsum handling equipment:

### BELT CONVEYORS

[Belt conveyors](#) are commonly used to transport material via a continuously moving belt surface. The reliability and versatility of this piece of material handling equipment lends itself to a wide range of handling systems, with synthetic gypsum and naturally occurring gypsum being two common applications. Add-ons for enhancing efficiency, such as belt trippers and belt cleaning systems, are widely available.



FEECO Troughed Belt Conveyor in operation

### BELT TRIPPERS

A tripper, also known as a [traveling belt tripper](#), complements belt conveyor systems by transporting and discharging material from any location on the belt of a conveying system. While belt conveyors move material from the initial starting point to the end of the belt, the addition of a tripper provides the ability to create a pile anywhere along the length of the belt, or unload inventory in a long, continuous pile. As an added benefit, employing long form pile management assists in maintaining desired gypsum moisture levels, making a tripper a commonly preferred handling solution for many indoor and outdoor gypsum storage applications.

### BUCKET ELEVATORS

A [bucket elevator](#) may also be used in facilities that process mined gypsum. For applications such as gypsum, a continuous bucket elevator with a single or double chain is recommended in order to handle the high capacity of material that typically needs to be conveyed in this setting. The bucket elevator transports material vertically at a low speed, and can be customized to meet a wide range of height requirements.

Conveying gypsum in a manufacturing facility can be an invaluable part of the overall process, adding flexibility, efficiency, and automation to an otherwise difficult task. In order to meet performance expectations, maintain reliable machinery, and extend the life of gypsum handling equipment, it is important to plan for gypsum's unique material characteristics as equipment is being designed and fabricated.

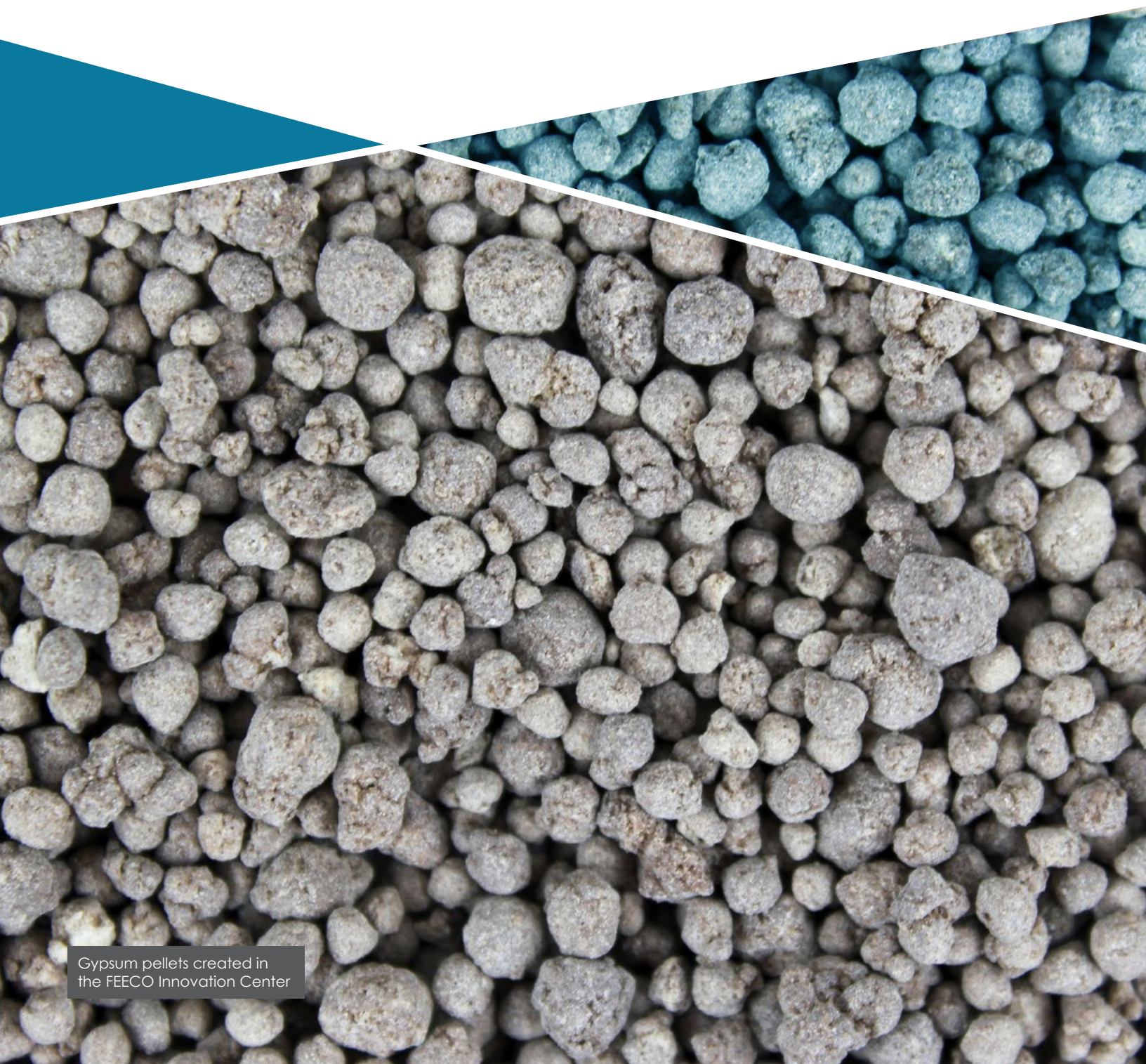


FEECO Bucket Elevator



# CONSIDERATIONS

CHALLENGES | MATERIAL TESTING



Gypsum pellets created in  
the FEECO Innovation Center



Pellets under a microscope in the FEECO Innovation Center

## CHALLENGES IN PROCESSING GYPSUM

While processing gypsum is relatively straightforward, the unique characteristics of gypsum can present challenges. The following list highlights typical challenges associated with gypsum processing.

### BUILDUP

Gypsum's natural ability to harden and cake into a cement-like form makes it difficult to remove from equipment. This can be accentuated if gypsum is dried at too high of a temperature, where molecular moisture is being removed, resulting in an undesirable form of gypsum, and then re-exposed to moisture. This can quickly cause buildup issues.

Gypsum buildup, if left untreated, will eventually wear down moving parts and result in maintenance issues for processing and material handling equipment. Consistent removal of material buildup is recommended in order to counteract this issue.

### CLUMPING

Gypsum's ability to harden into a cement-like form also makes it prone to clumping during drying or

storage. As a result, preventative measures are recommended to combat this issue.

*Drying:* Adding a drying step prevents clumping in a number of ways. For example, the tumbling action within a rotary dryer polishes gypsum pellets and showers material through a heated stream of air. As a result, a conformal level of drying is applied, clumping is minimized, and the resulting product is easier to handle and store. In addition, rotary dryers can be customized with knocking systems that work to further reduce lumps within the material while dislodging any gypsum that would otherwise build up inside the dryer.

*Screw Conveyors:* The feed trajectory of the screw conveyor is an efficient solution against material clumping. Lumps are naturally broken apart using a flinging motion that transfers the gypsum into subsequent processing equipment.

### VARIABILITY

The composition of gypsum can vary significantly from source to source. As a result, gypsum processing problems may differ and solutions will consequently

vary. The best way to determine and confirm gypsum processing methods is through testing. Subtle changes to binders or processing times may be the key to delivering optimal results. Therefore, testing, such as that which can be carried out in the FEECO Innovation Center, is always recommended to confirm best practices for the unique gypsum sample at hand.

## GYPSUM PROCESS AND PRODUCT DEVELOPMENT

The unique challenges that gypsum can present often require material testing in order to achieve success in gypsum processing. Whether you are looking to design a new process, improve on an existing one, or even enhance product characteristics, testing offers the opportunity to confirm the viability of your intended process, as well as to work out process variables and other unknown data points. This allows you to develop a recipe for success, reducing the opportunity for unforeseen issues after scale-up.

The FEECO Innovation Center offers customized testing solutions around each customer's unique project goals. For all types of testing, depending on what information the customer already knows and is looking to gather, the testing process typically starts at batch scale, where small samples of material are tested to gather initial data and determine feasibility of the intended goal.

Once batch testing has been successful, continuous pilot-scale testing can be conducted. This is a much larger scale test, where the process is tested as a continuous process loop.

The Innovation Center is capable of measuring and adjusting a variety of particle characteristics during the testing process. This includes:

- Attrition
- Bulk Density
- Compression
- Crush Strength
- Flowability
- Green/Wet Strength
- Moisture Content
- Particle Size Analysis
- Physical Characteristics
- Solubility
- Temperature

## AUTOMATION

FEECO is a Rockwell Automation partner, providing integrated process control solutions, both as a service in the Innovation Center, and as part of a system purchase. FEECO and Rockwell Automation process control solutions are provided with current technology, motor control centers, programmable logic controllers, and data collection systems with advanced technologies for reporting.

## ADDITIONAL RESOURCES

For further information or reading on gypsum, we have provided some additional resources below. Please note that the inclusion of any resource or company is not an endorsement and the views of that resource do not reflect those of FEECO International.

### ASSOCIATIONS & PUBLICATIONS

Gypsum Association

[www.gypsum.org/](http://www.gypsum.org/)

Global Gypsum

[www.globalgypsum.com/](http://www.globalgypsum.com/)



## ABOUT FEECO

FEECO International, Inc. was founded in 1951 as an engineering and equipment manufacturer. We are recognized globally as an expert in industry-leading process design, engineering capabilities (including everything from process development and sample generation, to feasibility studies and detailed plant engineering), custom equipment manufacturing, and parts and service. We serve a range of industries, including fertilizer and agriculture, mining and minerals, power/utility, paper, chemical processing, forest products, and more. As the leading manufacturer of processing and handling equipment in North America, no company in the world can move or enhance a concept from process development to production like FEECO International, Inc.

The choice to work with FEECO means a well-rounded commitment to quality. From initial feasibility testing, to engineering, manufacturing, and parts and service, we bring our passion for quality into everything we do.







For more information on gypsum processing, material testing, custom equipment, or for help with your gypsum operation, contact FEECO International today!

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[FEECO.com/contact](https://www.feeeco.com/contact)