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PELLETING PROCESS, REQUIRED EQUIPMENT AND BENEFITS OF USE

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Abstract: *Pelletizing, not to be confused with pelleting (extrusion), continues to see increasing use across industries for the many benefits it can offer to previously difficult-to-handle bulk solids and fines.*

Here's an inside look at the principles behind this process, the equipment used, and the many benefits producers can gain from pelletizing their material.

Key words: PELLETIZING, LIMESTONE, POTASH FERTILIZER, PELLETIZING EQUIPMENT

INTRODUCTION

What is pelletizing?

Pelletizing is a type of agglomeration, or particle size enlargement. While there are many types of agglomeration, pelletizing falls under the non-pressure category and is also commonly called wet granulation, tumble-growth agglomeration, or agitation agglomeration.

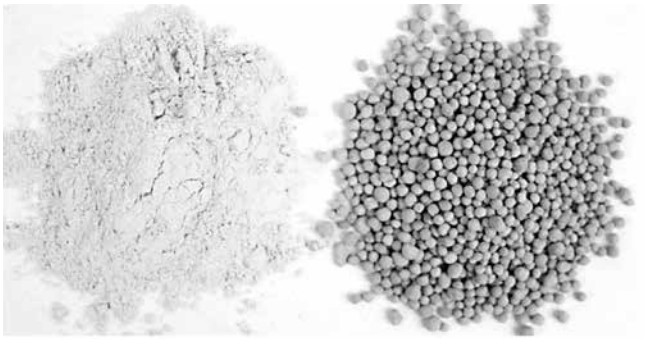
In contrast to pressure-agglomeration methods, which employ extreme pressure to press material into a desired form, pelletizing utilizes a liquid binder, along with agitation, to encourage granule formation (a process often likened to rolling a snowball). As a result, this type of agglomeration is considered a wet process and often requires a post-granulation drying step.

The result of this process, though it can vary slightly across equipment type and configuration, is rounded granules, considered a premium product for their uniformity and minimal attrition.

PELLETIZING APPLICATIONS

The pelletizing process can be applied to nearly any material in the form of powder or fines; with additional pretreatment, even slurries can be converted to a dry, granular product, though it's important to note that not all materials respond favorably to this technique. Some of the most common materials to which pelletizing is applied include:

- Soil Amendments (Limestone, Gypsum, Iron, etc.)
- Coal and Carbon Products
- Single Nutrients, Complex Fertilizers, and Micronutrients (potash, NPK, MAP, boron, etc.)
- Industrial Byproducts (fly ash, synthetic/FGD gypsum, EAF dust, etc.)
- Minerals & Ores (iron ore, nickel laterites, gold and copper ores, etc.)



Picture 1. Limestone soil amendment before and after pelletizing

Picture 2. Potash fertilizer before and after pelletizing

BENEFITS OF PELLETIZING BULK SOLIDS

The pelletizing process lends a number of advantages to both producers and the end product.

The flexibility and control behind the pelletizing process gives producers the ability to control a range of particle characteristics in the finished product. It also largely eliminates dust, which brings an array of additional benefits. When producers choose to pelletize their material, they can often gain the following benefits:

Improved product performance
Because pelletizing gives producers control over particle characteristics, they are able to hone-in on the characteristics important to their product's performance. For example, fertilizer and soil amendment producers often use particle properties such as bulk density, particle size distribution, and the like, to control more advanced qualities, such as solubility, nutrient release rate, and more.

Better handling & application
Since pellets are inherently more flowable and less dusty than fines, pelletizing material significantly improves its handling and application qualities. Material is easier to feed, less likely to clog equipment, and are nearly dust-free.

Again, the ability to control particle characteristics through the pelletizing process also means producers can target the characteristics important to them when it comes to handling and application qualities.

Less material & product loss
The mitigation of dust means that less material and product is lost in the form of dust during handling and application. In the case of soil amendments, for example, a pelletized product does not become windblown on application, so application results are reliable and the grower is able to realize the full value of the investment.

Less attrition and dust generation
Similarly, the rounded granules produced in the pelletizing process are significantly less dusty and less prone to attrition than granules produced via pressure agglomeration techniques.

This is because rounded granules do not have the jagged edges that can rub together and break away, generating dust (a phenomenon known as attrition), which makes product challenging and unpleasant to work with, while also creating housekeeping issues.

Faster product breakdown

Compared to granules produced via compaction, those produced via pelletizing are capable of breaking down faster; granules produced via pelletizing are strong and stable enough to hold up to handling and storage, but are still capable of breaking down as needed on application. This is because granules produced via pelletizing are not as dense, due to the fact that the particles have not been tightly pressed together.

Greater control over product formulation

The pelletizing process is inherently flexible, allowing the incorporation of multiple solid and liquid feed components. This allows producers to easily incorporate additional nutrients and beneficial additives. This is especially useful in specialty fertilizer and soil amendment production.

A more marketable product

For all of the reasons mentioned here, granules produced via the pelletizing process are highly marketable, often allowing producers to fetch a higher market value for their product.

PELLETIZING EQUIPMENT & PROCESS CONFIGURATION

Pelletizing can be carried out using various types and combinations of equipment. Perhaps the two most common devices used are the disc pelletizer (also known as a pan granulator) and rotary drum.

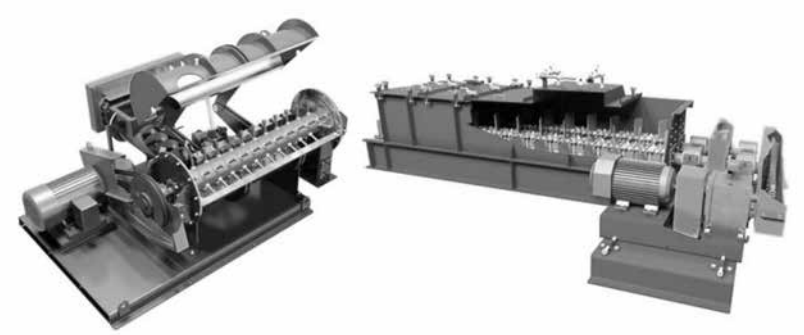
The disc pelletizer consists of a rotating disc mounted onto a stationary base. Material and binder are continuously fed onto the disc; the tumbling action, combined with the tackiness created by the binder, causes fines to gather together and refine into pellets as they continue moving around the disc.

The rotary drum works on similar principle, but granules are tumbled in a rotating drum instead.

Picture 3. 3D Models of a Disc Pelletizer (left) and Rotary Drum Agglomerator (right)

A pin mixer is also commonly used to pelletize material, but in this case the process is often referred to as micro pelletizing, for the small, dense pellets produced. The pin mixer is a horizontal mixer consisting of a single shaft fitted with rods ("pins") rotating inside a stationary trough. The mixer employs an intense spinning action to mix solid and liquid feed components and, if desired, form small granules.

A pugmill mixer, also known as a paddle mixer or pug mill, may also be used to pelletize material, but is less common as a stand-alone agglomeration device because of the rough agglomerates it yields. Also a horizontal mixer, the pugmill mixer uses dual counter-rotating shafts inside a stationary trough to produce a folding and kneading motion that thoroughly mixes material and produces rough agglomerates (when desired).



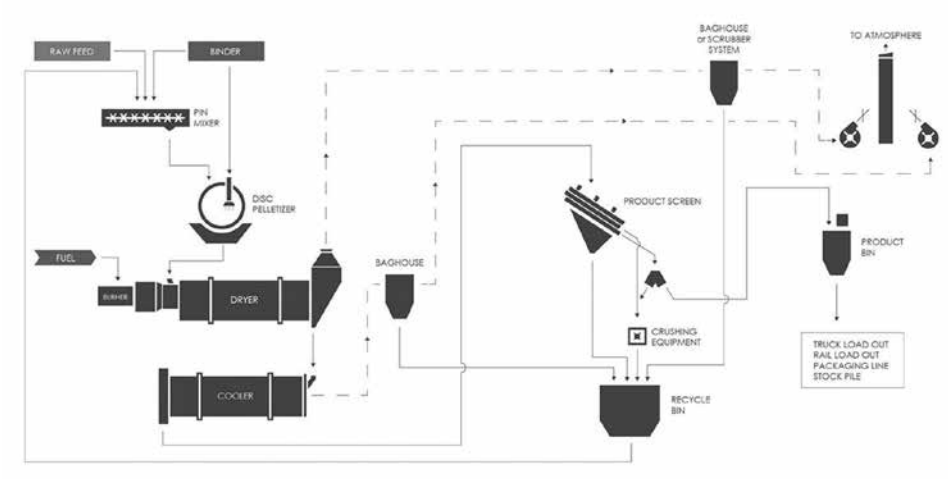
Picture 4. 3D Models of a Pin Mixer (left) and Pugmill Mixer (right)

Preconditioning material for pelletizing

Oftentimes, a pin mixer or pugmill mixer is used first as a preconditioning device in order to produce a more homogeneous mix of material for granulation

in the disc pelletizer or agglomeration drum. This helps to better combine the solid and liquid feed components prior to granulation, producing a more uniform product.

One of the most common setups for pelletizing is the use of a pin mixer and disc pelletizer in combination. A typical flow diagram utilizing this approach is illustrated in picture 5. below.



Picture 5. Simplified Pelletizing Process Flow Diagram

In this setup, a pin mixer homogeneously mixes the solid and liquid feed components and forms "seed pellets" or starting nuclei that can then continue growing through layering on the disc pelletizer.

Material is then fed onto the disc pelletizer where additional fines and binder are continuously added, causing the seed pellets to accumulate additional layers until they reach the desired particle size, at which point they are discharged from the disc.

Drying

Because a liquid binder is added, a drying step is necessary to bring down the moisture content of the final product. This is typically conducted in a rotary dryer; the tumbling motion continues to polish and refine granules as they move through the drum.

The role of process development in pelletizing

The diversity of applications, combined with the numerous process configurations, and the variation across materials, makes process development testing an essential aspect of developing a pelletizing process.

Testing such establishes critical process data and allows producers to understand how the specific qualities of their material source respond to the process.

Through agglomeration testing, numerous questions can be answered, including whether or not the material is capable of pelletizing properly, the most suitable equipment configuration, how the process can be optimized for product quality and efficiency, and so much more.

CONCLUSION

Pelletizing continues to gain traction as a way to manage and improve bulk solids handling and performance. This essential process can be used for everything from coal products to soil amendments, and everything in between. It may be carried out using various types and combinations of equipment, but the flexibility of the process, combined with the various responses of material to the process, often demands thorough process development testing to design a process that will consistently reach the desired results.

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