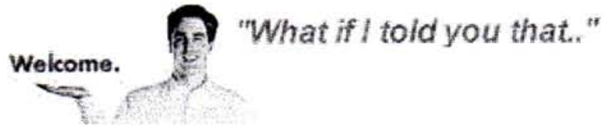

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How to Design a Volumetric Screw Feeder (Part 1)

by Joseph Marinelli

When using a hopper with a slotted outlet configuration, you are pretty much limited to using a screw feeder or belt feeder to withdraw your product. Screws and belts can be designed as volumetric devices, since they discharge a particular volume of material per unit time. This is done by control of belt speed or screw rpm.

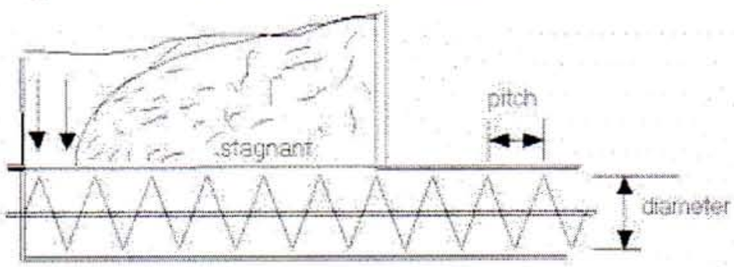
A screw is preferable to a belt when handling certain bulk solids and you would typically use a screw feeder when:

- Require an enclosed device
- Headroom is restricted
- Handling dusty or toxic materials

Also, consider that if your product is friable, a screw may cause particle breakage.

Assuming that your hopper is designed to give you reliable mass flow, the screw feeder must be capable of maintaining the mass flow pattern and withdraw material uniformly over the entire outlet cross-sectional area. The key to this approach is to ensure that the feeder increases in capacity in the discharge direction. This is an extremely important statement that will be made several times during our discussion.

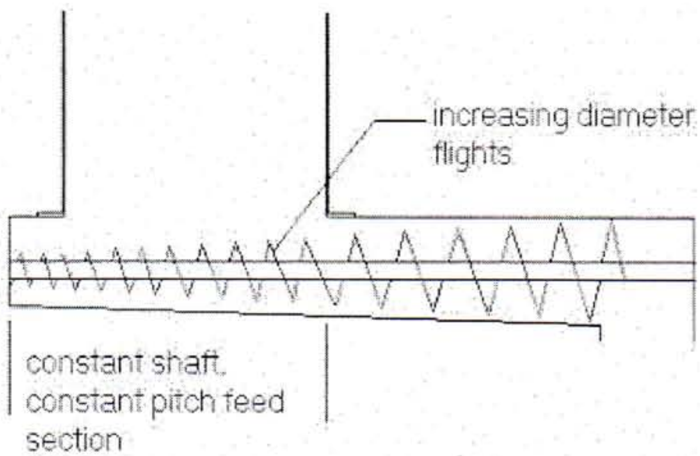
Figure 1. Constant Pitch Screw Feeder



In this week's article we will discuss the wrong way to design screw feeders. Take, for example, the constant pitch, constant diameter screw shown in Figure 1. Notice that the material is withdrawn preferentially from the back of the screw. The constant pitch flights do not allow any increase in capacity in the direction of feed. Therefore, the last flight fills with material and there is no more capacity to take material over the entire outlet length.

Any modifications that you made to your hopper to ensure mass flow are now rendered useless. The improperly designed screw feeder creates a preferential flow channel that enforces a funnel flow pattern with its resulting problems of ratholing, erratic flow, flooding, segregation, etc.

Figure 2. Increasing Diameter Screw Feeder



Remember the statement above, ensure that the feeder increases in capacity in the discharge direction. One way to provide this increase is to provide an increasing diameter screw flight, as shown in Figure 2. Notice that the screw flights increase in diameter from back to front.

You will also notice that the capacity of each flight increases in the discharge direction. We therefore have satisfied our increasing capacity requirement. Our screw should promote mass flow---WRONG! Consider that our solid may require a 12" wide slotted outlet to prevent arching. The small diameter section of a 12" screw is likely about 4" in diameter. The active flow channel through which material flows over a screw is approximately the screw diameter. It is highly likely that your material will arch over most of the feed section, because of its narrow diameter.

Another important consideration is that an increasing diameter screw and trough will be difficult to interface with your hopper outlet. The taper may impede flow along the hopper walls destroying the mass flow pattern required for your material.

There are ways to design a screw feeder to provide uniform flow along an outlet by increasing flight capacity over the entire feed section. We will discuss these approaches in our next article.

Help others by posting your comments, suggestions and experiences with bulk solids feeding or any other materials handling concerns you may have on our **On-Line Help Forum**. For past Ask Joe ! Articles, visit the **Ask Joe! Archived Articles**.

Guest articles for the Ask Joe! Column are always welcome, for more information please contact Joe Marinelli directly at his email address: shtech@fmtc.net.

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How to Design a Volumetric Screw Feeder (Part 2)

by Joseph Marinelli

In our previous article, we discussed the WRONG way to design a mass flow screw feeder. This article will discuss three possible approaches to providing uniform discharge with a mass flow screw feeder that will maintain mass flow from our bin.

If you will remember from our last article, the key to successful mass flow screw feeder design was to increase the screw's capacity in the discharge direction. We showed how not to do it! Here is the proper way to provide increased screw capacity to ensure uniform withdrawal.

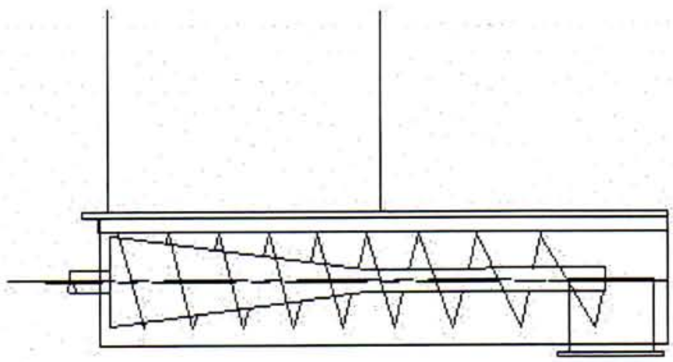

Figure 1. Tapered Shaft, Mass-Flow, Screw Feeder

Fig. 1 shows a tapered shaft mass flow screw feeder. This conical shaft is either wound in between the ½ pitch flights or formed and the flights fitted around the shaft. This approach will provide increased flight capacity; however, the length of outlet over which you can use this is limited to three (3) times the screw diameter. In other words, a 12" screw with a conical shaft can be used with a 36" long outlet. The reason for this limit is simply fabrication tolerances. The screw feeder fabricator can only maintain the flight tolerances over this particular diameter and length of screw.

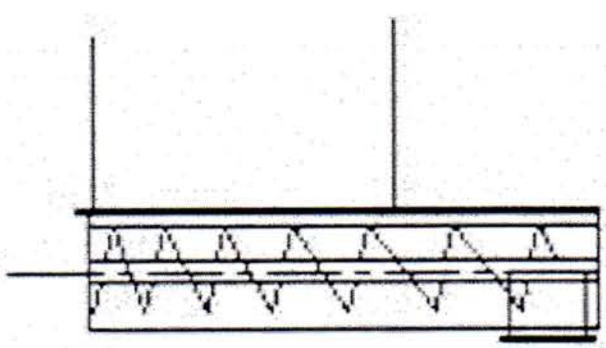

Figure 2. Increasing Pitch, Mass-Flow, Screw Feeder

Fig. 2 shows an increasing pitch mass flow screw feeder. Notice that the flights increase from ½ pitch to full pitch over the length of the screw. This approach will as well, provide increased flight capacity; however, the length of outlet over which you can use this is also limited to three (3) times the screw diameter.

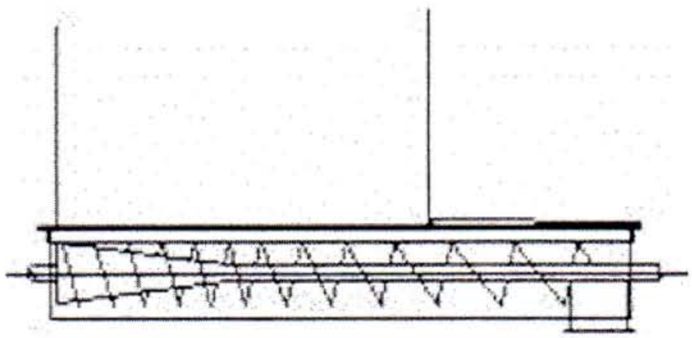

Figure 3. Recommended Mass-Flow, Screw Feeder

Fig. 3 shows a combination of conical shaft and increasing pitch to maintain mass flow. The two approaches stated previously are joined together to provide a longer screw. Instead of being limited by a 3 to 1 outlet length to screw diameter ratio, we can use a 6 to 1ratio. This allows us to use larger screw lengths to accommodate larger slot openings and/or more cohesive materials.

Notice the following:

1. There is U-shaped trough to contain the screw. vee-shaped troughs will not work because material usually only feeds directly above the screw diameter. A vee-shaped trough will create stagnant material and destroy our mass flow pattern.
2. There no hanger bearings to support the screw; therefore, the screw shaft has to be sized to withstand deflection. Hanger bearings will interfere with the full capacity screw trough. Material will back up into the hopper, effecting flow. Your hanger bearings will also wear out quickly.
3. The screw flights should be smooth while the screw trough (walls) should be rough. If they are both smooth, the material will simply spin in the trough and not convey.
4. The screw speed should be kept between 3 and 40 rpm. Three on the low side to minimize motor reducer size and 40 on the high side to maintain screw efficiency.
5. There is ½" clearance between the screw and screw trough.

In upcoming articles we will discuss other volumetric feeder designs. See you at the Powders Show in Chicago !!!

Help others by posting your comments, suggestions and experiences with bulk solids feeding or any other materials handling concerns you may have on our **On-Line Help Forum**. For past Ask Joe ! Articles, visit the **Ask Joe! Archived Articles**.

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