AVOID THE HIGH COSTS & LOSSES ASSOCIATED WITH SCREW CONVEYOR DOWNTIME

Without a guaranteed one-size-fits-all solution available, many screw conveyors need custom alterations to maximize efficiency and ROI.

By Andrew Parker, President, CDM Systems, Inc.

This whitepaper will provide:

- History & uses for screw conveyors
- Insights on misapplications
- Solutions for efficient screw conveyor use

INTRODUCTION

The screw conveyor is the oldest type of conveyor in recorded history, utilizing the oldest mechanical device employed by mankind: an inclined plane with a helix wrapped around the core[1]. Archimedes' design for the first screw conveyor in the third century B.C. remains incredibly similar to today's versions, though the materials that comprise the conveyor makeup, the applications a screw conveyor serves and the many kinds of bulk materials it conveys have expanded over thousands of years

Although the modern screw conveyor is a direct descendant of the Archimedes screw, there are some slight differences that have evolved over time. While the Archimedes screw was designed to lift fluids trapped within cavities formed by its inclined blades, the screw conveyor propels dry bulk materials (powders, pellets, flakes, crystals, granules, grains, etc.) through the pushing action of its rotating blades. Also, most screw conveyors in use today have a single blade, while Archimedes screws typically had two or three blades[2].

One of the screw conveyor's most attractive features is its simplicity coupled with its versatility. Whether it is moving dry ingredients, free-flowing materials such as Portland cement, or possibly wet and heavy masses such as dewatered bio solids, the screw conveyor is one of the most reliable and cost-effective ways for conveying bulk materials.

Today, the screw conveyor is the most common form of conveyor. Its widely accepted use is based on centuries of reliability. The key benefits of the screw conveyor are its simple design, proven results, application versatility, and short-run effectiveness.

Many industries utilize the screw conveyor as part of their overall operations, including:

- Biomass
- Cement
- Fertilizer
- Minerals & Mining
- Ports & Terminals
- Potash
- Power
- Pulp & Paper

When considering a screw conveyor for an application process, it is important to also understand the screw conveyor is not a one-size-fits-all solution. A screw conveyor, for all its simplicity and effectiveness, is not the perfect solution for every conveying job. It has shortcomings that can result in operational malfunctions, loss of productivity, and inefficiency. Like any other conveyor system, the screw conveyor, if misapplied, will experience breakdowns that result in lost revenues from production downtime.

THE CHALLENGE

In any manufacturing or production operation, one of the biggest variables in calculating reliable profit projections is the constant reality of downtime. The financial cost of downtime can be a significant component in determining whether an operation is extremely profitable or bleeding money.

In the industrial sector, machine downtime and asset failure can be some of the biggest costs that companies incur. Downtime is already a multi-

billion-dollar problem that will only continue to grow as companies strive to optimize their operations in the pursuit of better margins and greater efficiency. While the magic number changes from business to business and industry to industry, one study conducted by the International Society of Automation estimates that downtime costs the manufacturing industry nearly $650 billion every year[3].

No matter how experienced management personnel may be, they understand that downtime is a part of doing business in an imperfect world where hundreds of variables are outside of their control. Ignoring the financial cost of downtime isn't an option; it must be addressed directly in order to understand how it is impacting an organization's profitability and ability to attain future growth.

DOWNTIME CAN IMPACT KEY AREAS OF THE BUSINESS, RESULTING IN:

Lost Production: This is the most direct impact felt throughout the entire business.

Depleted Inventory: Many businesses require a minimum warehouse supply to operate smoothly.

Wasted Labor: When the equipment goes down, paid employees become inactive until the situation is rectified.

Lack of Innovation: When a company's focus is on fixing equipment and solving recurring problems, there are no resources remaining for innovation[4].

Results of Misapplication

Misapplication is the number one challenge impacting downtime for a screw conveyor. While the application flexibility of the screw conveyor design may be impressive, the equipment's reliability can be negatively impacted if variables such as bulk material characteristics, volume capacity, temperature, and length of run are not taken into consideration.

Misapplications often start with a screw conveyor's length. Standard screw conveyors are available "off the shelf" with the trough and the screw in a nominal 10-12 foot length. When a customer's required distance of travel exceeds the standard length, those nominal lengths must be joined together with additional screw sections, along with the addition of coupling shafts and the installation of a hanger bearing. The process must be repeated for every additional flight added to the overall run.

Often made of plastic, hanger bearings are required whenever several lengths of conveyor must be connected. The hanger bearing is a clear point of vulnerability in any screw conveyor operation. Whenever a screw conveyor is misapplied, in addition to the hanger bearing vulnerability, additional components can deteriorate and break down.

While the off-the-shelf solution may be convenient, the impact of misapplication starts when the standard screw conveyor—which is built with distinct specification guidelines in mind (i.e. rpm, capacity, flowability[5], etc.)—starts to encounter material or operating variables outside of its general specifications.

Materials & Misapplication

An off-the-shelf screw conveyor that is designed for a low-caustic material exhibiting high flowability becomes misapplied when it is required to handle a sluggish, abrasive material, or anything outside the specifications for optimal operation. This is a crisis waiting to happen. Misapplied screw conveyors can go down in just weeks if overloaded beyond design specifications.

Screw conveyors can handle a great variety of materials which have good flowability. This characteristic is important in screw conveyor operation, as the screw conveyor components/ makeup must be adjusted to the characteristics of the materials being transported. The more free-flowing a material is, the less horsepower required to transport it. It's easy to see how less flowability can increase friction, cause higher temperatures, and create more potential for downtime.

Helix Design

Another source of maintenance woes on a screw conveyor involves the engineering, materials and design of the helix. When it comes to moving heavy, aggressive materials in a screw conveyor, the basic helicoid screw, if misapplied, will not hold up to the wear and tear caused by these materials.

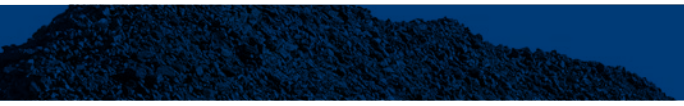
The thinner helicoid screw construction performs well with materials exhibiting high flowability. However, it cannot hold up to the punishment of more abrasive or caustic materials that are often found in a 24/7/365 production process.

Heavy-duty applications require a heavy-duty screw that features individual, highly durable sections fastened to form the screw flight. Without such custom modifications to a conveyor's design, breakdowns are inevitable. production process.

Grinding to a Halt

When a modern production process that relies on output grinds to a halt, the pressure impacts everyone until the situation is remedied. When conveyors need to be shut down, their inactivity means no material is being fed to the processing equipment, also resulting in those machines becoming inactive.

Frequently, when production problems originate with the conveyor—a piece of equipment that often isn't highly valued until production is compromised—the response is often a short-term fix. These temporary solutions promise one thing: they inevitably will lead to another, often predictable, failure. Only after replacing a common culprit, usually a hanger bearing or an entire helicoid screw, can the operation get back in business. This short-term relief creates additional stresses, as everyone understands another shutdown is looming in the near future.



THE SOLUTION

There is no one-size-fits-all solution for a screw conveyor. Balancing all of the processing and material demands with the appropriate conveyor design, components, and features is important for achieving optimal operating efficiency and maximum ROI.

When you talk about effective screw conveyors, you must also look at the variables offered by screws, troughs, and the conveyor's materials of construction. Each of these distinct choices have the potential to impact the effectiveness of the screw conveyor, an operation's production, and profits.

Screw design features that make a difference:

- Ribbon
- Sectional
- Shaftless
- Variable Pitches
- Cone
- Cut Flighting

Based on the job at hand, choose the trough configuration:

- Tubular
- Beveled
- Square
- U-Trough
- Flared

For durability, match the job to the conveyor's construction materials:

- Carbon Steel
- Stainless Steel
- Special Abrasion-Resistant Alloys

When misapplication of a screw conveyor occurs, the immediate reaction is to get production back up as soon as possible. While understandable, it is simply a short-term fix, not a solution. A longer-term plan to eliminate costly downtime is critical to success.

There are three ways to address the misapplication of a screw conveyor:

1. **Design it from scratch** to custom fit your operations' needs.
2. **Replace or retrofit** existing misapplied parts as part of standard maintenance.
3. **Redesign** the system to incorporate alternative conveying methods.

Custom Design

Designing a screw conveyor system from scratch to custom fit an operation's needs is the best long-term approach. Custom-engineering based on the operating environment, available space, volume targets, materials, heavy-duty considerations, and other variables may be a more costly approach initially, but the financial impact of downtime easily makes it economically beneficial in the larger scope of long-term efficiency, reliability and profitability.

Retrofit

Retrofitting or replacing the existing screw conveyor parts impacted by the initial misapplication is another approach. The frequency of downtime is highest under this scenario because the screw conveyor is still being misapplied, though the retrofitting can overcome some of the negative results. This approach involves identifying the key components impacted by the misapplication and engineering a custom fit for the process. Whether that involves changing out a vulnerable helicoid screw for a more heavy-duty version or changing the trough to better accommodate the speed and capacity production targets, retrofit solutions can improve reliability and address unplanned downtime.

System Review

Yet another option for solving the problem created by a misapplied screw conveyor involves a review of the entire conveying system. In many cases, a screw conveyor may have been the most convenient or affordable initial option. After breakdowns and costly downtime, it became clear that other conveying methods were better suited to reliably get the job done. Reevaluating the entire system allows for the substitution of misapplied screw conveyors with more specialized, efficient methods such as en-masse conveyors.

Solutions require honest evaluation and expert insights. There are always going to be viable solutions for conveying challenges. Recognizing the pain points associated with downtime and the financial impact of those inactive periods on the bottom line make it imperative that management consider the total cost of ownership—not just the initial start-up costs.

CONCLUSION

Screw conveyors are the most widely utilized conveyors in the world. They are proven, tried-and-true options for many conveying challenges, but they do have limitations, which can be overcome with specific alterations to the existing screw conveyor system.

While there is no single conveyor for every production process, an experienced conveyor manufacturer is capable of engineering the most effective and efficient system to positively impact profit margins. Looking at the costs of a conveyor system must include calculations for reliability and honest assessments of maintenance and downtime expenses to accurately make a decision on the best possible conveyor choice.

ABOUT THE AUTHOR

Andrew Parker is President for CDM Systems, Inc. He has more than 20 years of experience in the bulk material handling industry. He oversees operations including conveyor design and development.

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