recyclable PET uses purified terephthalic acid – more commonly known as PTA or TPA – as its main component. The resulting PET product is then sold to manufacturers for use in making plastic bottles for packaging drinking water, carbonated soft drinks, and other beverages.

The analysis of the optimal conveying method begins with understanding system and material variables such as; energy requirements, bulk density of material, purchasing and storage of material prior to use, conveying distance, space and location, and durability and maintenance. These are just a few of the many elements that must be considered in conveyor selection and design.

Pneumatic conveying is often a standard solution for processing facilities conveying dry bulk product. While pneumatic conveying has advantages in specific applications, a totally enclosed tubular drag conveyor can offer similar advantages, plus allows for:

- Custom engineered designs that meet specific plant layout requirements, inlet and discharge points and flow rate
- Gentle conveying of highly degradable materials, yet durable for mineral and mining material handling
- Minimal operator monitoring with patented air over-hydraulic auto tensioner that automatically maintains chain tension for reliable and consistent flow
- Variable frequency drives that mitigate energy usage spikes and reduce overall power requirements
- A fully enclosed conveying system that does not introduce air into the material stream, reducing the chance of igniting dust
- 100% discharge of conveyed product

PET Resin Manufacturer Saves Energy and Improves Production with Tubular Drag Technology

As an example of these benefits, Dhunseri Petrochem & Tea Ltd. (DPTL) had a goal to significantly reduce costs by replacing pneumatic conveyors with tubular drag technology. Located in Haldia, West Bengal, India, DPTL is a leading global manufacturer of bottle-grade PET (polyethylene terephthalate) resin. The lightweight and recyclable PET uses purified terephthalic acid – more commonly known as PTA or TPA – as its main component. The resulting PET product is then sold to manufacturers for use in making plastic bottles for packaging drinking water, carbonated soft drinks, and other beverages.
The DPTL facility produces 600 metric tons of PET resin per day, and runs the pneumatic conveyors nonstop year round transporting PTA from massive 15-ton hoppers to a staging silo 115 feet above ground at a rate of 883 cubic feet per hour. However, the pneumatic conveying system’s nitrogen compressors consumed enormous amounts of both energy and nitrogen during operation.

Charged with improving efficiencies and decreasing costs, DPTL executives researched a more economical solution to pneumatic conveying. The results of their research lead them to tubular drag conveying technology. This rugged, low velocity conveying method required virtually no maintenance, reduced noise levels in the plant, and consumed little power.

By replacing the 167.5 kW pneumatic conveyors with 33.5 kW tubular drag technology, DPTL reduced energy consumption by 134 kW, and nitrogen consumption by 2,500 Nm3 per day.

**Tubular Drag Conveyor Technology**

The tubular drag conveyor consists of a stationary outer housing, usually round in shape, through which a chain is pulled by a sprocket drive arrangement. Flights are attached to the chain at regular intervals. As shown in Figure 3, the looped chain and flight assembly moves through the stationary housing, bulk material is pulled from the in feed points to the discharge ports.

Conveying capacity is established by varying the housing size, distance between flights, and the chain speed. The stationary outer housing, or casing, is manufactured of carbon steel or stainless pipe in sizes ranging from 3 inches in diameter up to 12 inches in diameter. Figure 5 represents the intersection of optimal size and flow for effective movement of material. Casing sections are supplied in lengths as required by the predetermined conveyor path. To provide for a change in direction, the casing is formed into a sweep elbow. (Figure 4)

All sections are constructed with bolted and gasketed flanged ends to allow for easy field installation while assuring a tightly sealed system. Solid circular flights are available in polyurethane, cast iron, ductile iron, nylon, stainless steel or other material as required including ultrahigh molecular weight polyethylene. Link and pin type chains are less prone to fatigue, wear and stretch than steel cables or ball and-sprocket bar type chains. Round-link, rivet less and seal-pin chains are the most common types. The tubular drag chain and flight configurations are selected based on specific application data for optimal performance.
Product discharge points are engineered where needed in the conveyor layout. The discharge gates, like the chain and flight assembly configurations, are important conveyor design considerations. Traditional knife or slide gate valves are sometimes used in tubular drag designs but are not the most effective design for the application.

A conveyor discharge designed with a traditional gate valve requires a flat surface to seal against a cylindrical surface, resulting in an internal gap. This gap will cause several undesired issues during operation. As material moves over the discharge port, it accumulates in the space left by the shape difference between the two surfaces. This characteristic is true when the valve is in the open or closed position; product will never completely discharge from the gap.

If the material is friable, a sheering affect begins to take place causing product degradation. Conveying applications such as mining and mineral processing will have failure issues related to the conveyed material characteristics. The large size and hard particle material moved in these applications, combine with the lack of full product discharge, will cause the gate valve to periodically fail open because the carry over will become lodged in the valve path. Furthermore, in batch applications, the carry-over will cause cross-contamination of product. For these reasons, a discharge gate specifically engineered for tubular drag conveying is highly recommended. (Figure 7).
Tubular Drag Conveyor Layout
By virtue of the flexible chain and the custom made conveying sections and casing bends, virtually unlimited variations of conveyor layouts are possible. An example of customized design configurations is shown in Figure 8. This type of conveyor can be installed in existing facilities, bypassing obstacles that would interfere with the path of other types of conveyors.

Many variations of these circuits are possible. Numerous inlet or discharge hoppers can be incorporated into a single conveyor design. In addition to the limitless design flexibility of these cost-effective conveyors, they also integrate well with new or existing process equipment, such as bulk bag unloaders and solid and liquid blending (Figure 10).

For sluggish or sticky materials, a special chain vibrator is used. This mechanism consists of a fractional horsepower motor driving through a V-belt to a set of adjustable eccentric weights mounted on a shaft. The assembly is mounted to a spring plate connected to a shoe positioned slightly above the conveyor flights. A controlled, low
frequency, vibration causes the shoe to “tap” against the conveyor flights further inducing the product to flow from the conveyor (Figure 9).

Enclosed, Sealed Conveying Method
An important feature of this conveyor is the enclosed construction. This design effectively protects the product being conveyed from contamination from the outside atmosphere and/or protects the atmosphere and the worker from the product. If required, material can be conveyed under a slight negative or positive pressure or under a purge blanket of inert gas. The slow moving, positive displacement action of the conveyor chain assembly makes the system ideal for handling blended materials without separation and assures gentle product handling with an absolute minimum amount of product degradation. This slow movement also assures long conveyor life, dependable service and operation at minimum noise levels. This system is designed to operate 24 hours a day, seven days a week under various loads.

The Tubular Drag Conveyor System Integration
The tubular drag conveyor flexibility provides plant and process engineers the ability to configure the conveyor layout as part of a complete material handling system. Figure 10 represents a lime milling and blending system used in many chemical processing plants. In this application, several dry products are unloaded from bulk bags while a third product is conveyed from a storage silo. The raw material is brought to a loss-in-weigh blending station which uses a metered feeder to accurately blend the mixture in preset ratios. The blended product is then discharged into a grinding mill for particle reduction and final blending. A tubular drag conveyor on the discharge of the mill delivers the final product to a truck loading station where it is hauled away for packaging or bulk sale.

A Better Technology Choice
The tubular drag conveyor is a viable alternative to pneumatic conveying offering many benefits in a wide range of applications. The core operating components of the conveyor allow for optimal conveying based on material and application factors. Particle size, bulk density, intermittent or continuous operation, volume of flow, number of unique materials to be conveyed, and obstacles or barriers the layout must overcome are all important design data used in the layout and engineering of a tubular drag conveyor. This technology is also very energy efficient in comparison to pneumatic conveying, especially when the motive is an expensive utility, such as Nitrogen. Chain and flight configurations, materials of construction, and number and placement of inlet(s) and discharge points, are customized conveyor elements selected based upon application data. The tubular drag conveyor is typically shipped in sections with flanged ends for manageable in-plant installation. The design options with the tubular drag conveyor allow for integration into a new or existing material handling system and provide for long, reliable conveying operation.

ABOUT THE AUTHOR
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