Screw conveyors

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Device for moving loose materials, consisting of a shaft with a broad, helically wound blade rotating in a tube or trough
Screw tube conveyors
Przenośnik śrubowy rurowy

1. Feed inlet
2. Feed screw
3. Feed inlet (alternative)
4. Lifting screw
5. Tubular casing
6. Drive unit
7. Outlet
8. Fixed base

Kosz zasypowy
Śruba pociągowa
Dodatkowy kosz zasypowy
Śruba podnosząca
Obudowa rurowa
Napęd
Wylot
Podstawa stała

A - Screw Conveyor
B - Components (Job)
C - Hangers and Bearings
D - Trough Ends
E - Troughs, Covers, Clamps, Shrouds
F - Flange
G - Drive Spool
H - Supporting J ust and Saddles
Screw Conveyors

History

The screw conveyor has been around since 267 BC when Archimedes came up with the brilliant idea to use a spiral incline plane to pump water for irrigation purposes.

Comparison of Shafted to Shaftless Conveyors
Characteristics of Screw Type Conveyors

Advantages (Pros)

+ Screw Conveyors can be employed in horizontal, inclined and vertical installations.
+ They can be outfitted with multiple inlet and discharge points offering greater system design flexibility.
+ They can be set up as Screw Feeders to control the flow of material in processing operations which depend upon accurate batching.
+ A Screw Conveyor can be used as a mixer or agitator to blend dry or fluid ingredients.
+ They are compact and easily adapted to congested locations - the requirement of space is low.
+ Screw Conveyors can be sealed for dust free and vapor tight requirements.
+ A Screw Conveyor can be used for heating and cooling products by utilizing jacketed housings and/or hollow flight screws.
+ Screw Conveyors can be made out of a variety of materials to make them corrosion resistant, abrasion resistant or heat resistant depending upon the product being conveyed.
Disadvantages (Cons)

- Because the principle is based on friction in most cases a part of the particles would be crushed or chipped within the conveying process,
- Abrasion of the conveyor tube, this problem increases with the speed of the screw,
- The power requirement is higher than with other conveying principles, because the principle is based on friction,
- The possible mass flow and the power requirement strongly depends on the characteristics of the conveyed material.
- When the angle of inclination increases, the allowable capacity of a given unit rapidly decreases.
Screw feeders
Podajniki śrubowe

Applications: Screw Feeders & Live Bottoms
### Vertical Screw Conveyors

- They convey a wide variety of materials very efficiently
- Vertical Screw Conveyors occupy a very small footprint
- They have very few moving parts so reliability is high
- Heights up to 45 feet
- Construction is available in many materials including stainless steel and various types of corrosion resistant alloys as well as carbon steel and abrasion resistant materials
- Shaftless Vertical Screw Conveyors are available for sticky materials
- Vertical Screw Conveyors are a good fit for many industries including Chemical, Grain, Food, Mining, Pulp & Paper, etc.
- The housings are fully enclosed keeping contamination potential very low. Fully dust and vapor tight designs are available
### Screw conveyors

**Przenośniki śrubowe**

1. **Feed hopper**  
   Kosz zasypowy, zasobnik
2. **U trough**  
   Rynna U
3. **Close bladed screw**  
   Śruba z łopatkami pełnymi, ślimak pełny
4. **Ribbon spiral**  
   Śruba wstęgowa, ślimak wstęgowy
5. **Close bladed screw with mixing paddles**  
   Śruba z mieszalnikami, ślimak łopatkowy
6. **Trough end bearing**  
   Łożysko krańcowe
7. **Drive unit**  
   Napęd
8. **Hanger bearing**  
   Łożysko podwieszane
9. **Cover plate**  
   Pokrywa
10. **Outlet**  
   Wylot
11. **Pitch**  
   Skok śruby

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### Ribbon spiral

**Przenośnik wstęgowy**

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Screw conveyor segments are manufactured to your specifications. They are available with an outer diameter between 30 mm and 3.000 mm; the material thickness is between 2 and 40 mm.

Right pitch

Shaftless spiral

Endless spiral
Adjustable hanging bearings

Basic Calculations for Screw conveyors

Calculations for screw conveyors

**Belt speed in m per sec**

\[
v = \frac{\text{Screw diameter (in meters)} \times 3.14 \times \text{Rotations per minute}}{60}
\]

\[
v = \text{speed in m per sec}
\]

**Capacity in kg per hour (Q)**

\[
Q = \frac{3.14 \times D^2}{4} \times s \times n \times s_g \times i \times 60
\]

**Power in Kw (P)**

\[
P = \frac{Q \times L \times K}{407}
\]

\[
P = \text{power in Kw}
\]

\[
Q = \text{capacity in 1000 kg per hour}
\]

\[
L = \text{conveyor screw length}
\]

\[
K = \text{friction coefficient}
\]

\[
s = \text{pitch in dm}
\]

\[
D = \text{screw diameter in dm}
\]

\[
n = \text{rotations per minute}
\]

\[
S_g = \text{specific weight of the material (see table)}
\]

\[
i = \text{degree of trough filling}
\]

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Capacity of Screw Conveyor

The capacity of a screw conveyor depends on the screw diameter, screw pitch, speed of the screw and the loading efficiency of the cross sectional area of the screw. The capacity of a screw conveyor with a continuous screw:

\[ Q = V \times \rho \]

\[ Q = 60 \times \left(\frac{\pi}{4}\right) \times D^2 \times S \times n \times \psi \times \rho \times C \]

Where,

- \( Q \) = capacity of a screw conveyor
- \( V \) = Volumetric capacity in m³/Hr
- \( \rho \) = Bulk density of the material, kg/m³
- \( D \) = Nominal diameter of Screw in m
- \( S \) = Screw pitch in m
- \( N \) = RPM of screw
- \( \psi \) = Loading efficiency of the screw
- \( C \) = Factor to take into account the inclination of the conveyor

Parameters

Screw Pitch:

Commonly the screw pitch is taken equal to the diameter of the screw \( D \). However it may range 0.75 – 1.0 times the diameter of the screw.

RPM of Screw:

The usual range of RPM of screw is 10 to 165. It depends on the diameter of screw and the type of material (Max RPM of screw conveyor is 165)

Loading efficiency:

The value of loading efficiency should be taken large for materials which are free flowing and non abrasive, while for materials which are not free flowing and or abrasive in nature, the value should be taken low:

- \( \psi = 0.12 \) to 0.15 for abrasive material
- \( \psi = 0.25 \) to 0.3 for mildly abrasive material
- \( \psi = 0.4 \) to 0.45 for non abrasive free flowing materials

Inclination Factor:

The inclination factor \( C \) is determined by the angle of screw conveyor with the horizontal.

<table>
<thead>
<tr>
<th>Angle of screw with the horizontal</th>
<th>Value of factor C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>1.0</td>
</tr>
<tr>
<td>5°</td>
<td>0.9</td>
</tr>
<tr>
<td>10°</td>
<td>0.8</td>
</tr>
<tr>
<td>15°</td>
<td>0.7</td>
</tr>
<tr>
<td>20°</td>
<td>0.65</td>
</tr>
</tbody>
</table>
Power requirement of Screw Conveyors

The driving power of the loaded screw conveyor is given by:

\[ P = P_H + P_N + P_{st} \]

Where,
- \( P_H \) = Power necessary for the progress of the material
- \( P_N \) = Driving power of the screw conveyor at no load
- \( P_{st} \) = Power requirement for the inclination of the conveyor

Power necessary for the progress of the material \( P_H \)

For a length \( L \) of the screw conveyor (feeder), the power \( P_H \) in kilowatts is the product of the mass flow rate of the material by the length \( L \) and an artificial friction coefficient \( \lambda \), also called the progress resistance coefficient.

\[ P_H = I_m \times L \times \lambda \times g / 3600 \text{ (kilowatt)} = I_m \times L \times \lambda / 367 \text{ (kilowatt)} \]

Where,
- \( I_m \) = Mass flow rate in t/hr
- \( \lambda \) = Progress resistance coefficient

Each material has its own coefficient \( \lambda \). It is generally of the order of 2 to 4. For materials like rock salt etc, the mean value of \( \lambda \) is 2.5. For gypsum, lumpy or dry fine clay, foundry sand, cement, ash, lime, large grain ordinary sand, the mean value of \( \lambda \) is 4.0.

In this connection it should be noted that the sliding of the material particles against each other gives rise to internal friction. Other resistance due to grading or shape of the output discharge pattern contributes to the resistance factor. That is why the parameter \( \lambda \) is always higher than that due to pure friction.
Drive power of the screw conveyor at no load, \( P_N \)

This power requirement is very low and is proportional to the nominal diameter and length of the screw.

\[ P_N = \frac{D \times L}{20} \text{ (Kilowatt)} \]

Where,
- \( D \) = Nominal diameter of screw in meter
- \( L \) = Length of screw conveyor in meter

Power due to inclination: \( P_{st} \)

This power requirement will be the product of the mass flow rate by the height \( H \) and the acceleration due to gravity \( g \).

\[ P_{st} = I_m \times H \times g / 3600 = I_m \times H / 367 \]

Total power requirement

\[ P = (I_m (\lambda \times L + H) / 367) + (D \times L / 20) \text{ (Kilowatt)} \]

Where,
- \( I_m \) = Mass flow rate in t/hr
- \( \lambda \) = Progress resistance coefficient
- \( D \) = Nominal diameter of screw in meter
- \( L \) = Length of screw conveyor in meter
- \( H \) = Height in meter
Screw conveyors

- Primarily run on a continuous motor that is simply on or off
- Costs range from $500-30,000
- Sizes up to 48" diameter tubing and can stack as high as 50 ft
- Used in the pharmaceutical, food, and manufacturing industries
- Useful for accumulation, drying, or moving vertically in a small space

Bibliography

- Continuous handling equipment – Nomenclature, ISO 2148-1974
- http://www.bechtel-wuppertal.com/