Mechanical Engineering Department
Carlos III University

BELT CONVEYORS

TRANSPORTATION

INTRODUCTION

A belt conveyor is rubber or textile structure with a belt shape closed ring, with a vulcanized or metallic joint, used for material transportation.

• Belt conveyors are the most used for transport of solid objects and bulk materials at great speed, covering great distances (up to 30 km)
**COMPONENTS**

- Driving pulley
- Belt
- Carrying idlers
- Bin or hopper
- Tail pulley
- Unloading
- Structural support
- Return idler
- Scraper
- Snub pulley
- Work run
- Take up weight
- Free/return run

**BELT**

**Textile belts or smooth textiles**

- **Definition (UNE 18 025):**
  - The width, expressed in mm.
  - The quality of the cover (standard UNE 18 052).
  - The number of plies.
  - The quality of the fabric (standard UNE 18 052).
  - The thickness of the top cover (tenths of mm).
  - The thickness of the bottom cover (tenths of mm).
  - The length of the belt (metres).

- Width of the belt (mm): 500
- Thickness of the top cover (tenth mm): 4
- Length (m): 15
- Thickness of the bottom cover (tenth mm): 35
- Consists of 4 light plies (L type)
BELT CONVEYORS II

BELT

Textile belts or smooth textiles

• Quality of the covers (UNE 18 052)

<table>
<thead>
<tr>
<th>Quality of the cover</th>
<th>Tensile strength (g/mm²)</th>
<th>Elongation at rupture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2500</td>
<td>550</td>
</tr>
<tr>
<td>B</td>
<td>2000</td>
<td>500</td>
</tr>
<tr>
<td>C</td>
<td>1050</td>
<td>350</td>
</tr>
</tbody>
</table>

• Quality of the fabric (UNE 18 052)

<table>
<thead>
<tr>
<th>Quality of the fabric</th>
<th>Warp Tensile strength (kgf/cm)</th>
<th>Elongation at rupture (%)</th>
<th>Weft Tensile strength (kgf/cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>60</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>LS</td>
<td>70</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>P</td>
<td>75</td>
<td>20</td>
<td>35</td>
</tr>
</tbody>
</table>

• Number of plies:

- It depends on the time the belt finishes its travel, which depends on:
  - The number of flexures on the pulleys.
  - The load impacts.
- If time travel is above 5 minutes ⇒ 2 plies

\[
z = \frac{S \cdot T \cdot R}{100 \cdot B \cdot R}
\]

Safety Factors for textile Carcass Belts (DIN 22101 standard)

<table>
<thead>
<tr>
<th>Number of plies (z)</th>
<th>from 3 to 5</th>
<th>from 6 to 9</th>
<th>More than 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety factor (S)</td>
<td>11</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>
**BELT**

**Belt conveyors for vertical or inclined transport**

- **Drawback of smooth textile belt:**
  - Grade limit: 18° - 20°

- **Different solutions:**
  - Profile belts:
    - Herringbone profile.
    - Nasta, Nappula, Ripa and Pyramid profile.
    - Grip Top profile.
    - Ripro profile.
  - U-cleats and V-cleats profiles.
  - Corrugated edge belt.

**PULLEYS**

**Driving pulley**

- **Entrusted of transmitting movement by means of the motor-speed reducer.**

- **Guarantee maximum adherence → Low slip.**

- **Bigger angle → Bigger force transmitted**
  - Simple pulley
    - \( \varphi = 180^\circ \)
  - Simple pulley with snub pulley
    - \( 210^\circ \leq \varphi \leq 230^\circ \)
  - Tandem motor
    - \( 350^\circ \leq \varphi \leq 480^\circ \)
**TENSION**

- The tension varies along the belt length.
- Depends on:
  - Belt conveyor arrangement.
  - The number and arrangement of the drive pulleys.
  - The drive and brake features.
  - The type and tension devices arrangement.
  - Operation phase (start-up, normal operation, braking, etc.).

**One drive pulley**

- Most common situation.
- Operation conditions:
  - Peripheral forces applied to the drive pulley have to be transmitted to the belt by friction without slippage.
  - The applied tension to the belt has to be adequate to avoid an important sag (between two pulleys).
BELT CONVEYORS II

TENSION

One drive pulley

- Euler-Eytelwein (without slip) equation:

\[
\frac{T_1}{T_2} = e^{\mu \phi}
\]

\[
T_1 = T_2 + F_u
\]

\[
\frac{T_1 - T_2}{T_2} = e^{\mu \phi} - 1
\]

\[
\frac{T_1 - T_2}{T_2} = e^{\mu \phi} - 1
\]

\[
T_1 = \frac{e^{\mu \phi}}{e^{\mu \phi} - 1} \cdot F_u = C_{TS} \cdot F_u
\]

\[
T_2 = \frac{1}{(e^{\mu \phi} - 1)} \cdot F_u = C_{T1} \cdot F_u
\]

BELT CONVEYORS II

PULLEYS

Pulley diameter

- Minimum driving pulley diameter proposed for fabric belts (m):

\[
D_{\text{min}} = 360 \cdot F
\]

- Action force (kg)

- Belt width (m)

- Transmission capacity pulley/belt:

1.600–2.000 Kg/m²

In underground, up to 3.500 kg/m²

<table>
<thead>
<tr>
<th>Standard pulley diameter w/DIN 22101</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
</tr>
</tbody>
</table>

\[
D_{\text{tail pulley}} = D_{\text{tensioning pulley}} = 0.8D_{\text{driving pulley}}
\]

\[
D_{\text{snub pulley}} = 0.65D_{\text{driving pulley}}
\]
MOBILE COMPONENT WEIGHT

Mobile component weight (kg):

\[ M_f (kg) = M_b + M_p + M_i \]

Belt weight (kg):

Idler roller weight (kg):

Pulley weight (kg):

Mobile component weight per unit length (kg/m):

\[ P_f = \frac{M_f}{L} \]

Belt length (m)

<table>
<thead>
<tr>
<th>Belt width (mm)</th>
<th>Mobile component weight per unit length (kg/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lightweight belt Rollers 102 mm</td>
</tr>
<tr>
<td>450</td>
<td>23</td>
</tr>
<tr>
<td>600</td>
<td>29</td>
</tr>
<tr>
<td>750</td>
<td>37</td>
</tr>
<tr>
<td>900</td>
<td>45</td>
</tr>
<tr>
<td>1050</td>
<td>52</td>
</tr>
<tr>
<td>1200</td>
<td>63</td>
</tr>
<tr>
<td>1350</td>
<td>70</td>
</tr>
<tr>
<td>1500</td>
<td>91</td>
</tr>
<tr>
<td>1650</td>
<td>100</td>
</tr>
<tr>
<td>1800</td>
<td>144</td>
</tr>
<tr>
<td>2100</td>
<td>168</td>
</tr>
<tr>
<td>2200</td>
<td>177</td>
</tr>
</tbody>
</table>
MOBILE COMPONENT WEIGHT PER UNIT LENGTH

Belt capacity (t/h)

\[ q_G = \frac{Q}{3.6 \cdot v} = 0.278 \cdot \frac{Q}{v} \text{ [kg/m]} \]

Belt speed (m/s)

RESISTANCE TO MOVEMENT

• Classification (UNE 58-204-92):
  1. Principal resistances, \( F_H \)
  2. Secondary resistances, \( F_N \)
  3. Special principal resistances, \( F_{S1} \)
  4. Special secondary resistances, \( F_{S2} \)
  5. Resistances due to inclination, \( F_{St} \)

\[ F_a = F_H + F_N + F_{S1} + F_{S2} + F_{St} \]

In every installation (1) y (2)
In some installations (3) y (4)
Act in all the belt length (1) y (3)
Act in certain regions (2) y (4)
RESISTANCE TO MOVEMENT

Principal resistance

• Turning resistance due to the load idlers rollers, due to friction in the bearings and joints in rollers.
• Belt friction resistance due to the rolling of the belt over the idlers rollers.

\[
F_H = f \cdot L \cdot g \cdot \left[ q_{RO} + q_{RU} + (2 \cdot q_f + q_G) \cdot \cos \delta \right]
\]

Return rollers weight per unit length (kg/m)
Belt weight per unit length (kg/m)
Load weight per unit length (kg/m)
Work run roller weight per unit length (kg/m)

Friction coefficient

<table>
<thead>
<tr>
<th>Type of bearing</th>
<th>State</th>
<th>( f )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller Bearing</td>
<td>Favourable</td>
<td>0.018</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>0.020</td>
</tr>
<tr>
<td></td>
<td>Unfavourable</td>
<td>0.023 - 0.030</td>
</tr>
<tr>
<td>Friction</td>
<td></td>
<td>0.008</td>
</tr>
</tbody>
</table>

Angle of the incline

Secondary resistances

• Inertia resistance and friction due to material acceleration in the loading point:

\[
F_{inertia} = \int \rho \cdot (v - v_0) \, dv
\]

Material flux (m³/s)
Material density (kg/m³)
Belt speed (m/s)

• Resistance due to material friction with feed-in chute sidewalls.
RESISTANCE TO MOVEMENT

Secondary resistances

- Resistance of pulley bearings safe drive pulleys:
  - For fabric belts:
    
    \[ F_i = 9 \cdot B \cdot (140 + 0.01 \cdot \frac{F}{B}) \cdot \frac{d}{D} \]

  - For metallic belts:
    
    \[ F_i = 12 \cdot B \cdot (200 + 0.01 \cdot \frac{F}{B}) \cdot \frac{d}{D} \]

- Resistance due to rolling belt effect over the pulleys:
  
  \[ F_i = 0.005 \cdot \frac{d}{D} \cdot \frac{F}{F_1} \]

- When \( L > 80 \ m \) \( \Rightarrow F_N \ < \ F_h \):

  \[ F_{f} + F_{N} = f \cdot C_{t} \cdot L \cdot g \cdot \left[ q_{RO} + q_{RU} + (2 \cdot q_{B} + q_{G}) \cdot \cos \delta \right] = f \cdot L_{c} \cdot g \cdot \left[ q_{RO} + q_{RU} + (2 \cdot q_{B} + q_{G}) \cdot \cos \delta \right] \]
LENGTH CORRECTION FACTOR

Shorter belts need more power to overcome friction resistances than longer belt conveyors.

**Corrected belt length (m):**

\[ L_c = C_L \cdot L \]

<table>
<thead>
<tr>
<th>Belt length (m)</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>13</th>
<th>16</th>
<th>20</th>
<th>25</th>
<th>32</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_L )</td>
<td>9.0</td>
<td>5.6</td>
<td>6.6</td>
<td>5.9</td>
<td>5.1</td>
<td>4.5</td>
<td>4.0</td>
<td>3.6</td>
<td>3.2</td>
<td>2.9</td>
<td>2.6</td>
<td>2.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Belt length(m)</th>
<th>50</th>
<th>63</th>
<th>80</th>
<th>100</th>
<th>125</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>320</th>
<th>400</th>
<th>500</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_L )</td>
<td>2.2</td>
<td>2.0</td>
<td>1.8</td>
<td>1.7</td>
<td>1.6</td>
<td>1.5</td>
<td>1.4</td>
<td>1.3</td>
<td>1.2</td>
<td>1.1</td>
<td>1.05</td>
</tr>
</tbody>
</table>

RESISTANCE TO MOVEMENT

**Special principal resistance**

- Toe resistance due to oblique belt position because of the loading rollers:
  - 3 roller picking idler of the same length in the work run:

\[ F_e = C_e \cdot \mu_o \cdot L_e \cdot \left( q_B + q_G \right) \cdot g \cdot \cos \delta \cdot \sin \varepsilon \]

Value:
- 0.4 for an angle of 30°
- 0.5 for an angle of 45°

Friction coefficient between the belt and the idler rollers: 0.3 – 0.4

- 2 roller picking idler for the return run:

\[ F_e = \mu_o \cdot L_e \cdot q_B \cdot g \cdot \cos \lambda \cdot \cos \delta \cdot \sin \varepsilon \]
RESISTANCE TO MOVEMENT

Special principal resistance

- Resistance due to friction with feed-in chute sidewalls, or with the longitudinal guide rails, when they take place along the total belt length:

\[ F_{\text{fl}} = \frac{\mu_{e} \cdot I_{e} \cdot e \cdot g \cdot l}{V^{2} \cdot B_{l}^{2}} \]

- Friction coefficient between the material and the guides: 0.5 – 0.7

- Transported flux (m³/s)

- Weight volume not tared (kg/m³)

- Transport length between guide rails (m)

- Belt width between guide rails (m)

RESISTANCE TO MOVEMENT

Special secondary resistances

- Resistance due to friction between the cleaning systems and the belt:

\[ F_{c} = A \cdot P \cdot \mu_{c} \]

- Friction coefficient between the cleaning system and the belt

- Contact surface between the belt and the cleaning system (m²)

- Pressure between the cleaning system and the belt (N/m²)

- Resistance due to the friction between the chute sidewalls or with guide rails when they only take place over a limited belt length:

\[ F_{c} = B \cdot k_{a} \]

- Belt width (m)

- Scraping factor = 1500 N/m
RESISTANCE TO MOVEMENT

Resistance due to slopes

\[ F_{Sl} = q_G \cdot H \cdot g \]

- Load weight per unit length (kg/m)
- Installation height (m)

POWER OF THE DRIVE PULLEY

\[ P_d = F_v \cdot v \]

- Force opposed to movement (N)
- Belt speed (m/s)

- For powered belts:

\[ P_{in} = \frac{P_d}{\eta_i} \]
TRANSPORT CAPACITY

\[ Q = 3600 \cdot V \cdot A \cdot \gamma \cdot k \]

- Speed (m/s)
- Material specific weight (t/m³)
- Cross section of material over the belt (m²)
- Reduction capacity coefficient due to incline

<table>
<thead>
<tr>
<th>Incline (degrees)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>k</td>
<td>1.0</td>
<td>0.99</td>
<td>0.98</td>
<td>0.97</td>
<td>0.96</td>
<td>0.93</td>
<td>0.91</td>
<td>0.89</td>
<td>0.86</td>
<td>0.81</td>
</tr>
</tbody>
</table>

- Cross section of the material over the belt depends on:
  - Effective width (b) of the belt is function of the real width B:
    - \( b = 0.9 \cdot B - 0.05 \) for \( B \leq 2 \text{ m} \)
    - \( b = B - 0.2 \) for \( B > 2 \text{ m} \)
  - The number, arrangement and dimensions of the rollers.
  - The dynamic built-in shape of the material over the belt is limited by a parabolic curve, characterised by a dynamic slope angle \( \theta \).

\[
S = S_1 + S_2 = \left\{ \begin{array}{ll}
S_1 = \left( l_1 + (b - l_1) \cdot \cos \lambda \right) \cdot \frac{tg \theta}{6} \\
S_2 = \left( l_1 + \frac{(b - l_1)}{2} \cdot \frac{1}{\cos \lambda} \right) \left( \frac{(b - l_1)}{2} \cdot \sin \lambda \right)
\end{array} \right.
\]

- Picking angle

Dependencies on:
- Material fluidity
- Transport conditions
**TRANSPORT CAPACITY**

- Uniform material size (cereals, granules or milled stones) do not influence belt width.
- Non-classified materials (materials obtained in quarries or mines) influence on belt width:
  - Maximum material size.
  - Fine and coarse-grain percentage.
- It may occur that for little capacities the belt width is big ⇒ not economic
- Belt width as a function of the maximum grain size:

<table>
<thead>
<tr>
<th>Dynamic slope angle</th>
<th>10 % coarse, 90 % fines</th>
<th>100 % coarse</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta \leq 20^\circ$</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>$20^\circ \leq \theta \leq 30^\circ$</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

**TRANSPORT CAPACITY**

- The belt speed has to be as big as possible so that width is short.
- Speed depends on material properties:
  - Fluidity. Dust risk.
  - Abrasion. Belt cut risk.
  - Friable. Material split risk.
  - Size. Great impacts on the belt take place for big sizes and heavy ones, thus weakening the belt.

<table>
<thead>
<tr>
<th>Material</th>
<th>B (mm)</th>
<th>$V$ (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains and other materials that have a good fluidity and are not abrasive</td>
<td>500</td>
<td>2.62</td>
</tr>
<tr>
<td></td>
<td>650 to 800</td>
<td>3.35</td>
</tr>
<tr>
<td></td>
<td>1000 to 1200</td>
<td>4.19</td>
</tr>
<tr>
<td></td>
<td>1400 to 2400</td>
<td>5.24</td>
</tr>
<tr>
<td>Gravel, clay, sand, silt, gravel, and other materials of fine size</td>
<td>500</td>
<td>2.09</td>
</tr>
<tr>
<td></td>
<td>650 to 1000</td>
<td>3.35</td>
</tr>
<tr>
<td></td>
<td>1200 to 1200</td>
<td>4.19</td>
</tr>
<tr>
<td></td>
<td>1400 to 2400</td>
<td>5.24</td>
</tr>
<tr>
<td>Non-abrasive</td>
<td>Any width</td>
<td>1.05 - 1.08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>B (mm)</th>
<th>$V$ (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minerals with sharp edge, hard and heavy, or grained stones of little size</td>
<td>500</td>
<td>1.08</td>
</tr>
<tr>
<td></td>
<td>650 to 800</td>
<td>2.09</td>
</tr>
<tr>
<td></td>
<td>1000 to 2400</td>
<td>3.35</td>
</tr>
<tr>
<td>Prepared cast-iron sands or compacted</td>
<td>Any width</td>
<td>1.31 to 2.09</td>
</tr>
<tr>
<td>Discharge belts, flat or picking for fine non-abrasive materials or medially abrasive</td>
<td>Any width</td>
<td>0.3 to 0.6</td>
</tr>
</tbody>
</table>
**TRANSPORT CAPACITY**

- **Standard speeds in m/s (DIN 22101)**

<table>
<thead>
<tr>
<th>Speed</th>
<th>0.066</th>
<th>0.84</th>
<th>1.05</th>
<th>1.31</th>
<th>1.68</th>
<th>2.09</th>
<th>2.62</th>
<th>3.35</th>
<th>4.19</th>
<th>5.24</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>For horizontal belt conveyors:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>500</td>
</tr>
<tr>
<td>650</td>
</tr>
<tr>
<td>800</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1200</td>
</tr>
<tr>
<td>1400</td>
</tr>
<tr>
<td>1600</td>
</tr>
</tbody>
</table>

**Capacity in m³/hour for v = 1 m/s**

**Cross section in m²**

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**TRANSPORT CAPACITY**

- **EXAMPLE**

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**Limestone**
- Specific weight = 1.4 T/m³
- Particle size:
  - 10% of coarse, maximum size: 250 mm
  - Dynamic slope angle: 15°
  - Not abrasive, friable but no reduction in price, due to a needed later grinding

**Belt geometry:**
- L = 805 m, vertical extent = 150 m, incline = 10,73°
- For the previous incline, the capacity reduction coefficient k = 0.95
- Picking angle = 35°

**Capacity to be transported:** 1500 T/hour
**BELT CONVEYORS II**

**TRANSPORT CAPACITY**

**EXAMPLE**

<table>
<thead>
<tr>
<th>Slope angle (degrees)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>θ ≤ 20º</td>
<td>1.0</td>
<td>0.99</td>
<td>0.98</td>
<td>0.97</td>
<td>0.95</td>
<td>0.93</td>
<td>0.91</td>
<td>0.89</td>
<td>0.85</td>
<td>0.81</td>
</tr>
</tbody>
</table>

θ = 15º

<table>
<thead>
<tr>
<th>Dynamic slope angle</th>
<th>10% coarse, 90% fine</th>
<th>100% coarse</th>
</tr>
</thead>
<tbody>
<tr>
<td>θ ≤ 20º</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>20º ≤ θ ≤ 30º</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

Maximum grain size 250 mm:

\[ B = 3 \cdot \text{Maximum size} = 3 \cdot 250 = 750 \text{ mm} \]

\[ B = 800 \text{ mm} \]

**BELT CONVEYORS II**

**TRANSPORT CAPACITY**

**EXAMPLE**

\[ \lambda = 35º \]

<table>
<thead>
<tr>
<th>B/m</th>
<th>0º</th>
<th>20º</th>
<th>25º</th>
<th>30º</th>
<th>35º</th>
<th>40º</th>
<th>45º</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>38</td>
<td>74</td>
<td>80</td>
<td>87</td>
<td>91</td>
<td>95</td>
<td>98</td>
</tr>
<tr>
<td>650</td>
<td>69</td>
<td>133</td>
<td>144</td>
<td>156</td>
<td>164</td>
<td>172</td>
<td>176</td>
</tr>
<tr>
<td>800</td>
<td>108</td>
<td>208</td>
<td>227</td>
<td>244</td>
<td>258</td>
<td>300</td>
<td>325</td>
</tr>
<tr>
<td>1000</td>
<td>173</td>
<td>336</td>
<td>365</td>
<td>394</td>
<td>415</td>
<td>434</td>
<td>445</td>
</tr>
<tr>
<td>1200</td>
<td>255</td>
<td>494</td>
<td>537</td>
<td>580</td>
<td>610</td>
<td>638</td>
<td>654</td>
</tr>
<tr>
<td>1400</td>
<td>351</td>
<td>680</td>
<td>738</td>
<td>798</td>
<td>840</td>
<td>878</td>
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</tr>
<tr>
<td>1600</td>
<td>464</td>
<td>898</td>
<td>976</td>
<td>1055</td>
<td>1110</td>
<td>1160</td>
<td>1190</td>
</tr>
</tbody>
</table>

For 1 m/s:

\[ Q_{11} = 258 \text{ m}^3/\text{s} \]
TRANSPORT CAPACITY

**EXAMPLE**

\[
Q = 3600 \cdot v \cdot A \cdot \gamma \cdot k \quad [\text{t/h}]
\]

\[
\gamma = \frac{Q}{\gamma} = 3600 \cdot v \cdot A \cdot k \quad [\text{m}^3/\text{h}]
\]

<table>
<thead>
<tr>
<th>Material</th>
<th>B (mm)</th>
<th>(v) (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains and other materials that have a good fluidity and are not abrasive</td>
<td>500</td>
<td>2.62</td>
</tr>
<tr>
<td></td>
<td>650 x 800</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>1000 x 1200</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td>1400 x 2400</td>
<td>1.02</td>
</tr>
<tr>
<td>Coal, clay pan, soft minerals and soils, grainedstones of little size</td>
<td>500</td>
<td>2.09</td>
</tr>
<tr>
<td></td>
<td>650 x 1000</td>
<td>3.35</td>
</tr>
<tr>
<td></td>
<td>1200 x 1200</td>
<td>3.35</td>
</tr>
<tr>
<td></td>
<td>1400 x 2400</td>
<td>3.35</td>
</tr>
<tr>
<td>Non abrasive</td>
<td>Any width</td>
<td>1.05 – 1.68</td>
</tr>
</tbody>
</table>

- Because \(A_{v1} = A_{v2}\):

\[
Q_{v1} = \frac{Q_{v2}}{v_1 \cdot v_2 \cdot k} = \frac{258}{1.1}, 3.35 \cdot 0.95 = 821 \text{m}^3/\text{hour}
\]

\[
Q_{v2} = \gamma \cdot Q_{v1} = 1150 \text{t/h} < 1500 \text{t/h}
\]

**TRANSPORT CAPACITY**

**EXAMPLE**

- We select \(B = 1000\) mm

<table>
<thead>
<tr>
<th>Wt.</th>
<th>(\theta)</th>
<th>0°</th>
<th>20°</th>
<th>25°</th>
<th>30°</th>
<th>35°</th>
<th>40°</th>
<th>45°</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>38</td>
<td>74</td>
<td>80</td>
<td>87</td>
<td>91</td>
<td>95</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>650</td>
<td>0.0191</td>
<td>133</td>
<td>144</td>
<td>156</td>
<td>164</td>
<td>172</td>
<td>176</td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>0.0500</td>
<td>208</td>
<td>227</td>
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<tr>
<td>1000</td>
<td>0.0480</td>
<td>336</td>
<td>365</td>
<td>394</td>
<td>415</td>
<td>454</td>
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<tr>
<td>1200</td>
<td>0.0710</td>
<td>494</td>
<td>537</td>
<td>580</td>
<td>610</td>
<td>638</td>
<td>654</td>
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</tr>
<tr>
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<td>0.0990</td>
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<td>798</td>
<td>840</td>
<td>878</td>
<td>900</td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td>0.1294</td>
<td>898</td>
<td>976</td>
<td>1055</td>
<td>1110</td>
<td>1160</td>
<td>1190</td>
<td></td>
</tr>
</tbody>
</table>
**TRANSPORT CAPACITY**

**EXAMPLE**

- We select \( B = 1000 \text{ mm} \)

<table>
<thead>
<tr>
<th>Material</th>
<th>( B (\text{mm}) )</th>
<th>( v (\text{m/s}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains and other materials that have a good fluidity and are not abrasive</td>
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<td>3,35</td>
</tr>
<tr>
<td></td>
<td>1000 a 1200</td>
<td>4,19</td>
</tr>
<tr>
<td></td>
<td>1400 a 2400</td>
<td>5,24</td>
</tr>
<tr>
<td>Coal, clay pan, soft minerals and soils, grained stones of little size</td>
<td>500</td>
<td>2,09</td>
</tr>
<tr>
<td></td>
<td>650 a 1000</td>
<td>3,35</td>
</tr>
<tr>
<td></td>
<td>1200 a 1200</td>
<td>4,19</td>
</tr>
<tr>
<td></td>
<td>1400 a 2400</td>
<td>5,24</td>
</tr>
<tr>
<td>Non abrasive</td>
<td>Any width</td>
<td>1,05 – 1,68</td>
</tr>
</tbody>
</table>

- Standard speeds in m/s (DIN 22101)

| \( v (\text{m/s}) \) | 0,66 | 0,84 | 1,05 | 1,31 | 1,68 | 2,09 | 2,62 | 3,35 | 4,19 | 5,24 |

So as not to over design \( v = 3,35 \text{ m/s} \)

**TRANSPORT CAPACITY**

**EXAMPLE**

- Selecting \( B = 1000 \text{ mm} \) ⇒ \( Q_{c1} = 415 \text{ m}^3/\text{h} \text{ y } v_1 = 3,35 \text{ m/s} \)

\[
Q_{c1} = \frac{Q_{c1}}{v_1 \cdot k_1} = \frac{415}{1,1} \cdot 3,35 \cdot 0,95 = 1320,7 \text{ m}^3/\text{hora}
\]

\[Q = \gamma \cdot Q_{c1} = 1849 \text{ t/hour}
\]

\[B = 1000 \text{ mm and } v = 3,35 \text{ m/s} \]

OK