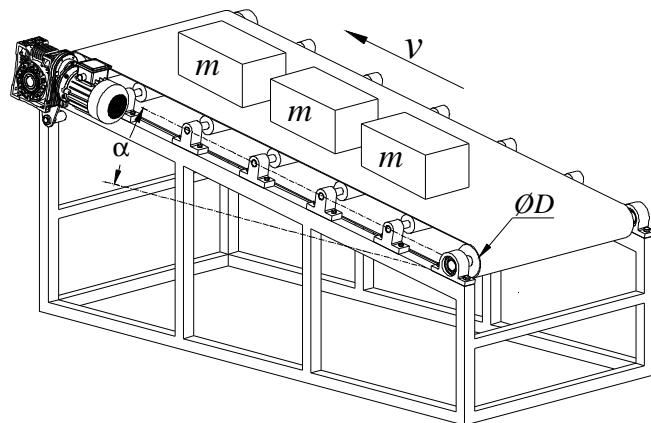
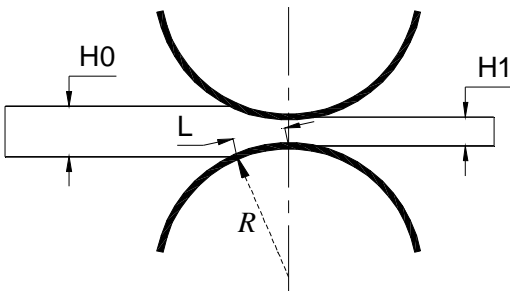
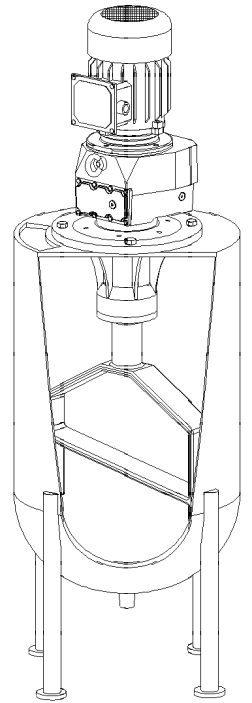


Uygulama Örnekleri

Application Examples

Berechnungs Beispiele





Hesaplama Temelleri:

1. Motorun harcadığı güç:

$$P = \sqrt{3} \cdot U \cdot I \cdot \cos \varphi \div 1000$$

P : Güç (kW)
 U : Gerilim (volt)
 I : Akım (amper)
 $\cos \varphi$: Güç faktörü

2. Motorun verdiği mekanik güç:

$$P = \sqrt{3} \cdot U \cdot I \cdot \cos \varphi \cdot \eta \div 1000$$

P : Güç (kW)
 U : Gerilim (volt)
 I : Akım (amper)
 $\cos \varphi$: Güç faktörü
 η : Verim

3. Harcanan güç:

a) Doğrusal hareket:

$$P = \frac{F \cdot v}{1000 \cdot h} (kW)$$

$$F = m \cdot g \cdot m (N)$$

$$P = \frac{m \cdot g \cdot m \cdot v}{1000 \cdot h} (kW)$$

b) Dönme hareketi:

$$P_2 = \frac{M \cdot n}{9550 \cdot h} (kW)$$

c) Vantilatör gücü:

$$P_2 = \frac{V \cdot n}{1000 \cdot h} (kW)$$

d) Kaldırma hareketi:

$$P = \frac{m \cdot g \cdot v}{1000 \cdot h} (kW)$$

e) Pompa gücü:

$$P = \frac{V \cdot p}{1000 \cdot h} (kW)$$

P : Güç (kW)
 F : Kuvvet (N)
 v : Hız (m/s)
 h : Verim
 M : Moment (Nm)
 n : Devir (d/d)
 V : Debi (m³/s)
 p : Toplam basınç (Pa)
 m : Kütle (kg)
 g : Yer çekimi ivmesi (m/s²)
 m : Sürtünme katsayısı

Principles of Calculations:

1. Consumed capacity of the motor:

$$P = \sqrt{3} \cdot U \cdot I \cdot \cos \varphi \div 1000$$

P : Power (kW)
 U : Voltage (volt)
 I : Current (ampere)
 $\cos \varphi$: Power factor

2. Mechanical output power:

$$P = \sqrt{3} \cdot U \cdot I \cdot \cos \varphi \cdot \eta \div 1000$$

P : Power (kW)
 U : Voltage (volt)
 I : Current (ampere)
 $\cos \varphi$: Power factor
 η : efficiency

3. Consumed capacity:

a) Linear movement:

$$P = \frac{F \cdot v}{1000 \cdot h} (kW)$$

$$F = m \cdot g \cdot m (N)$$

$$P = \frac{m \cdot g \cdot m \cdot v}{1000 \cdot h} (kW)$$

b) Rotating movement:

$$P_2 = \frac{M \cdot n}{9550 \cdot h} (kW)$$

c) Ventilator drive:

$$P_2 = \frac{V \cdot n}{1000 \cdot h} (kW)$$

d) Stroke movement:

$$P = \frac{m \cdot g \cdot v}{1000 \cdot h} (kW)$$

e) Pump drive:

$$P = \frac{V \cdot p}{1000 \cdot h} (kW)$$

P : Rated Power (kW)
 F : Force (N)
 v : Velocity (m/s)
 h : Efficiency
 M : Torque (Nm)
 n : Speed (d/d)
 V : Flow Rate (m³/s)
 p : Total pressure (Pa)
 m : Mass (kg)
 g : Gravity (m/s²)
 m : Friction coefficient

Berechnungsgrundlagen:

1. Aufgenommene Leistung des Motors:

$$P = \sqrt{3} \cdot U \cdot I \cdot \cos \varphi \div 1000$$

P : Leistung (kW)
 U : Spannung (V)
 I : Strom (A)
 $\cos \varphi$: Leistungsfaktor

2. Abzugebende Leistung des Motors:

$$P = \sqrt{3} \cdot U \cdot I \cdot \cos \varphi \cdot \eta \div 1000$$

P : Leistung (kW)
 U : Spannung (volt)
 I : Strom (amper)
 $\cos \varphi$: Leistungsfaktor
 η : Wirkungsgrad

3. Leistungsbedarf:

a) Linearbewegung:

$$P = \frac{F \cdot v}{1000 \cdot h} (kW)$$

$$F = m \cdot g \cdot m (N)$$

$$P = \frac{m \cdot g \cdot m \cdot v}{1000 \cdot h} (kW)$$

b) Drehbewegung:

$$P_2 = \frac{M \cdot n}{9550 \cdot h} (kW)$$

c) Lüfterantrieb:

$$P_2 = \frac{V \cdot n}{1000 \cdot h} (kW)$$

d) Hubbewegung:

$$P = \frac{m \cdot g \cdot v}{1000 \cdot h} (kW)$$

e) Pumpenantrieb:

$$P = \frac{V \cdot p}{1000 \cdot h} (kW)$$

P : Leistung (kW)
 F : Kraft (N)
 v : Geschwindigkeit (m/min)
 h : Wirkungsgrad
 M : Drehmoment (Nm)
 n : Drehzahl (1/min)
 V : Fördermenge (m³/s)
 p : Gesamter Gegendruck (Pa)
 m : Masse (kg)
 g : Schwerkraft (m/s²)
 m : Reibungszahl



4. Döndürme Momenti:

$$M = 9550 \cdot \frac{P}{n} (Nm)$$

P : Güç (kW)
 n : Devir (d/d)

5:Atalet momenti:

a) Silindir için:

$$J = 98 \cdot r \cdot L \cdot D^4 \text{ (kg} \cdot \text{m}^2)$$

b)Delik mil için:

$$J = 98 \cdot r \cdot L \cdot (D^4 - d^4) \text{ (kg} \cdot \text{m}^2)$$

r :Özgül kütle (kg/dm³)
 L :Uzunluk (m)
 D :Dış çap (m)
 d :İç çap (m)

6:Lineer hareketin motor atalet momentini etkisine çevrilmesi:

$$J = 91.2 \cdot m \cdot \frac{v^2}{n_1} \text{ (kg} \cdot \text{m}^2)$$

m :Hareket eden kütle (kg)
 v :Hız (m/s)
 n_1 :Motor devri (d/d)

7: Farklı devirlerde oluşan atalet momentlerinin motor miline indirgenmesi:

$$J_{ind} = \frac{J_2 \cdot n_2^2 + J_3 \cdot n_3^2}{n_1^2} \text{ (kg} \cdot \text{m}^2)$$

n_1 = Motor devri (d/d)
 J_{ind} = İndirgenmiş atalet momentini

8:Atalet momenti:

$$FI = \frac{J_E + J_{ind}}{J_E}$$

J_E =Tahrik atalet momentini
 J_{ind} =İndirgenmiş atalet

9:Motor Hızlanma Zamanı:

a) Frensiz motorlar:

$$t_a = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_A - M_L)} \text{ (sn)}$$

$$J_{top} = J_E + J_{ind} \text{ (kg} \cdot \text{m}^2)$$

(Motor atalet momentini ve ek atalet momentini)
 n_1 =Motor devri (d/d)
 M_A =Motor start momentini (Nm)
 M_L =Gerekli tahrik momentini (Nm)

4.Torque:

$$M = 9550 \cdot \frac{P}{n} (Nm)$$

P :Power (kW)
 n :Speed (rpm)

5.Moment of inertia:

a) For a cylinder:

$$J = 98 \cdot r \cdot L \cdot D^4 \text{ (kg} \cdot \text{m}^2)$$

e) For hollow shaft:

$$J = 98 \cdot r \cdot L \cdot (D^4 - d^4) \text{ (kg} \cdot \text{m}^2)$$

r :Density (kg/dm³)
 L :Length (m)
 D :Outer diameter (m)
 d :Inner diameter (m)

6.Conversion of linear inertia to a flywheel effect at the motor shaft:

$$J = 91.2 \cdot m \cdot \frac{v^2}{n_1} \text{ (kg} \cdot \text{m}^2)$$

m :Mass in motion (kg)
 v :Velocity (m/s)
 n_1 :Motor speed (rpm)

7.Converting moment of inertia of different speeds to a common moment of inertia at the motor speed:

$$J_{ind} = \frac{J_2 \cdot n_2^2 + J_3 \cdot n_3^2}{n_1^2} \text{ (kg} \cdot \text{m}^2)$$

n_1 =Motor speed (rpm)
 J_{ind} =Reduced moment inertia

8.Factor of inertia:

$$FI = \frac{J_E + J_{ind}}{J_E}$$

J_E =Moment of Intertia of excitation
 J_{ind} =Reduced inertia

9.Starting Period:

a) For motors without brake:

$$t_a = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_A - M_L)} \text{ (sec)}$$

$$J_{top} = J_E + J_{ind} \text{ (kg} \cdot \text{m}^2)$$

(Moment of Intertia of geared motor and additional inertia)
 n_1 =Motor speed (rpm)
 M_A =Starting torque of motor (Nm)
 M_L =Required excitation torque (Nm)

4.Drehmoment:

$$M = 9550 \cdot \frac{P}{n} (Nm)$$

P :Leistung (kW)
 n :Drehzahl (rpm)

5.Massenträgheitsmoment:

a) Zylinder:

$$J = 98 \cdot r \cdot L \cdot D^4 \text{ (kg} \cdot \text{m}^2)$$

e) Hohlzylinder:

$$J = 98 \cdot r \cdot L \cdot (D^4 - d^4) \text{ (kg} \cdot \text{m}^2)$$

r :Dichte (kg/dm³)
 L :Länge (m)
 D :Außendurchmesser (m)
 d :İnendurchmesser (m)

6.Umrechnung Geradlinig bewegter Maschinen teile in ein J auf der Motorwelle:

$$J = 91.2 \cdot m \cdot \frac{v^2}{n_1} \text{ (kg} \cdot \text{m}^2)$$

m :Masse in bewegung (kg)
 v :Geschwindigkeit (m/s)
 n_1 :Motor Drehzahl (upm)

7.Umrechnung mehrerer Massenträgheitsmomente auf der Motorwelle reduziertes Massenträgheitsmoment:

$$J_{ind} = \frac{J_2 \cdot n_2^2 + J_3 \cdot n_3^2}{n_1^2} \text{ (kg} \cdot \text{m}^2)$$

n_1 =Motor Drehzahl (upm)
 J_{ind} = Red. Massenträgheitsmoment

8.Trägheitsfaktor:

$$FI = \frac{J_E + J_{ind}}{J_E}$$

J_E =Eigene Massenträgheitsmoment
 J_{ind} = Red. Massenträgheitsmoment

9:Starting Period:

a) Motor ohne Bremse:

$$t_a = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_A - M_L)} \text{ (sec)}$$

$$J_{top} = J_E + J_{ind} \text{ (kg} \cdot \text{m}^2)$$

(Eigene und Zusatzträgheitsmassenträgheitsmoment)
 n_1 = Drehzahl des Motors (upm)
 M_A =Anzugsmoment des Motors (Nm)
 M_L = Treibmoment der Maschine (Nm)



b) Frenli motorlar:

$$t_a = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_A - M_L)} + t_1 \text{ (sn)}$$

t_1 =Fren bırakma zamanı (sn)

10.Durma Zamanı:

a) Frensiz motorlarda:

$$t_b = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_B \pm M_L)} \text{ (sn)}$$

M_B = Fren Momenti (Nm)

M_L = Gereki tahrik momentini (Nm)

+ :Yük frenleyici etki yapıyorsa (örnek yukarı çıkan asansör)

- : Yük tahrik etkisi yapıyorsa (örnek aşağı inen asansör)

b)Frenli Motorlarda:

$$t_b = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_A - M_L)} + t_2 \text{ (kg} \cdot \text{m}^2)$$

t_2 = Frenleme zamanı (sn)

11.Durma Devir Sayısı:

a) Frensiz Motorlarda:

$$U_n = \frac{n \cdot t_b}{120}$$

n =Milin devir sayısı (d/d)

t_b =Durma zamanı (sn)

b)Frenli Motorlarda:

$$U_n = \frac{n \cdot (t_b + t_2)}{120}$$

t_2 =Frenleme zamanı (sn)

11.Relatif açma zamanı:

$$ED = \frac{\text{Bir çevrimde toplam çalışma zamanı (sn)} \times 100}{\text{Bir çalışma çevrimi (sn.) zamanı}}$$

ED :Relatif açma zamanı (sn)

Maksimum 10 dakikalık çalışma çevrimi zamanına kadar ED sayısı norm olan %20, 40, 60, 80 sayılarına yuvarlatılır. 10 Dakikanın üstündeki çalışma çevrimleri sürekli çalışma kabul edilir.

b) For Motors with Brake :

$$t_a = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_A - M_L)} + t_1 \text{ (sec)}$$

t_1 =Actuating time of brake (sec)

10.Arresting Period:

a) For motors without Brake:

$$t_b = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_B \pm M_L)} \text{ (sec)}$$

M_B = Braking torque (Nm)

M_L = Required excitation torque (Nm)

+ :When ML has braking effect (lift moving up)

- :When ML has driving effect (lift moving down)

b) For Motors with Brake :

$$t_b = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_A - M_L)} + t_2 \text{ (kg} \cdot \text{m}^2)$$

t_2 = Braking time (s)

11. Number of Turns of Shaft until Full

Stop:

a) For motors without brake:

$$U_n = \frac{n \cdot t_b}{120}$$

n = Speed of shaft (rpm)

t_b =Arresting period (sec)

b) For motors with brake:

$$U_n = \frac{n \cdot (t_b + t_2)}{120}$$

t_2 = Braking time (sec)

11.Rating Period:

$$ED = \frac{\text{Total operation time per cycle (sec.)} \times 100}{\text{Cycle time (sec.)}}$$

ED : Rating Period (sec)

To be rounded of the standard values of 20,40,60,80 % for a cycle time of 10 min. continuous running is required.

b) Bei Bremsmotoren:

$$t_a = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_A - M_L)} + t_1 \text{ (sec)}$$

t_1 = Einschaltzeit der Bremse (sec)

10.Bremszeit:

a) Bei Motoren Ohne Bremse:

$$t_b = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_B \pm M_L)} \text{ (sec)}$$

M_B = Bremsmoment (Nm)

M_L = Lastmoment (Nm)

+ : wenn Lastmoment bremsend wirkt (Aufzüge bei Aufwärtsfahrt)

- : wenn Lastmoment treibend wirkt (Aufzüge bei Abwärtsfahrt)

b) Bei Bremsmotoren:

$$t_b = \frac{J_{top} \cdot n_1}{9.55 \cdot (M_A - M_L)} + t_2 \text{ (kg} \cdot \text{m}^2)$$

t_2 = Ausschaltzeit der Bremse (s)

11.Nachlaufumdredungen

a) Bei Motoren Ohne Bremse:

$$U_n = \frac{n \cdot t_b}{120}$$

n =Drehzahl der Welle(upm)

t_b =Bremszeit (sec)

b) Bei Bremsmotoren:

$$U_n = \frac{n \cdot (t_b + t_2)}{120}$$

t_2 = Ausschaltzeit der Bremse (sec)

11.Relative Einschaltdauer:

$$ED = \frac{\text{Summe der Einschaltzeiten je Betrieb (sec.)} \times 100}{\text{Betriebszeit (sec.)}}$$

ED :Relatif Einschaltdauer (sec)

Jewils auf die genormten Werte 20, 40, 60, 80 %bei maximum spieldauer von 10 min. aufbzw. abrunden.



FORMÜLLER

1. Rayda Yürütme:

Ray Teker arası oluşan toplam direnç kuvveti;

$$F = m \cdot g \cdot \frac{2}{D} \cdot \left(\left(m \cdot \frac{d}{2} + f \right) + c \right) \text{ (N)}$$

m: Toplam kütle (kg)
g: Yerçekimi ivmesi (m/sn²)
D: Teker çapı (m)
 μ : Sürtünme katsayısı
d: Şaft Çapı (m)
f: Yuvarlanma sürtünme sayısı
c: Ek kayma direnci

Gerekli güç:

$$P = \frac{F \cdot v}{1000 \cdot h} \text{ (kW)}$$

v: Araba hızı (m/s)
h: Diğer Verimler

Kalkış anında ivmelenmeden dolayı ek atalet kuvvetleri oluşur.

$$F_a = m \cdot a \text{ (N)}$$

$$a = \frac{v}{t} \text{ (m/sn}^2\text{)}$$

a: ivme (m/sn²)
t: motor kalkış zamanı (sn)

2. Kaldırma Sistemleri:

Gerekli kaldırma gücü:

$$P = \frac{m \cdot g \cdot v}{1000 \cdot h} \text{ (kW)}$$

m: Toplam yük (kg)
g: Yerçekimi ivmesi (m/sn²)
v: Yükün kaldırma hızı (m/sn)
h: Verim

Gerekli tambur devri:

$$n = \frac{v \cdot 60}{p \cdot D} \cdot k \text{ (d/d)}$$

v: Kaldırma hızı (m/sn)
D: Tambur çapı (m)
k: Donam Sayısı

EQUATIONS

1. Linear Movement on Rail:

Total resistance by moving on a rail;

$$F = m \cdot g \cdot \frac{2}{D} \cdot \left(\left(m \cdot \frac{d}{2} + f \right) + c \right) \text{ (N)}$$

m: Total weight (kg)
g: Gravity (m/s²)
D: Wheel diameter (m)
 μ : Friction coefficient
d: Shaft diameter of wheel (m)
f: Rolling friction resistance
c: Additional friction

Required power:

$$P = \frac{F \cdot v}{1000 \cdot h} \text{ (kW)}$$

v: Vehicle velocity (m/s)
h: Efficiency

Additional force caused by acceleration.

$$F_a = m \cdot a \text{ (N)}$$

$$a = \frac{v}{t} \text{ (m/sec}^2\text{)}$$

a: acceleration (m/sn²)
t: motor starting time (sn)

2. Lifting System:

Required lifting Power:

$$P = \frac{m \cdot g \cdot v}{1000 \cdot h} \text{ (kW)}$$

m: Total weight (kg)
g: Gravity (m/sn²)
v: Lifting speed (m/sn)
h: Efficiency

Required Drum Speed:

$$n = \frac{v \cdot 60}{p \cdot D} \cdot k \text{ (rpm)}$$

v: Lifting Speed (m/sn)
D: Drum Diameter (m)
k: Rope number

GLEICHUNGEN

1. Linearbewegung über Bahn:

Widerstand des Rades über Bahn;

$$F = m \cdot g \cdot \frac{2}{D} \cdot \left(\left(m \cdot \frac{d}{2} + f \right) + c \right) \text{ (N)}$$

m: Total Gewicht (kg)
g: Schwerkraft (m/s²)
D: Rad Durchmesser (m)
 μ : Reibungszahl
d: Wellen Durchmesser des Rades (m)
f: Drehreibungszahl
c: Zusätzliche Reibungszahl

Gebrauchte Leistung:

$$P = \frac{F \cdot v}{1000 \cdot h} \text{ (kW)}$$

v: Vagen Geschwindigkeit (m/s)
h: Wirkungsgrad

Zuzätzliche Kraft wegen Beschleunigung.

$$F_a = m \cdot a \text{ (N)}$$

$$a = \frac{v}{t} \text{ (m/sec}^2\text{)}$$

a: Beschleunigung (m/sn²)
t: Motor Anlaufzeit (sn)

2. Hebungssysteme:

Geforderte Hebung Leistung:

$$P = \frac{m \cdot g \cdot v}{1000 \cdot h} \text{ (kW)}$$

m: Total Gewicht (kg)
g: Schwerkraft (m/sn²)
v: Last Geschwindigkeit (m/sn)
h: Wirkungsgrad

Gebrauchte Trommel Drehzahl:

$$n = \frac{v \cdot 60}{p \cdot D} \cdot k \text{ (upm)}$$

v: Last Geschwindigkeit (m/sn)
D: Trommel Durchmesser (m)
k: Seilen Zahl



FORMÜLLER

3. Bantlı eğik konveyör:

m: Konveyörün üstündeki toplam yük
R: Tamburun yarıçapı
v: Yükün hızı

Hareket veren tamburdaki moment:

$$M = A \cdot m \cdot R$$

A değeri eğime bağlı olarak Tablo 1'de verilmiştir.(Sayfa 769)

Hareket veren tambur devri:

$$n = 9.55 \cdot \frac{v}{R}$$

Motor gücü:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h}$$

Dökme yük için:

$$m = \frac{m_t \cdot 1000 \cdot L}{3600 \cdot v}$$

m:Konveyörün toplam yükü (kg)
m_t: birim zamanda konveyöre boşaltılan yük (ton/saat)

4. Döner Tabla:

m_c: Yük (kg)
m_f: Tablanın yükü (kg)
R: Yuvarlanma yarıçapı (m)
k_f: Yuvarlanma sürtünme katsayısı
n: Tabla devri (d/d)
k_f değeri tablo 5'de verilmiştir.
 (sayfa 773)

Tablanın eksenine göre momenti:

$$M = (m_c + m_f) \cdot R \cdot k_f$$

Motor gücü:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h}$$

5. Silindirik karıştırıcılar:

Silindir eksenine göre moment:

$$M = m \cdot R \cdot C \text{ (Nm)}$$

m:Kütle (kg)
R: Silindir yarıçapı (m)
C: Doldurma faktörü (N/kg)
C değerleri tablo 4'de verilmiştir.
 Sayfa 772

EQUATIONS

3. Roller belt conveyor:

m: Total load on the conveyor
R: Radius of the pulley
v: Velocity of the load

Torque at the head pulley:

$$M = A \cdot m \cdot R$$

Factor 'A' is given for the angle on the table1.(Page 769)

Speed of the head pulley:

$$n = 9.55 \cdot \frac{v}{R}$$

Motor power:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h}$$

For bulk load on the conveyor:

$$m = \frac{m_t \cdot 1000 \cdot L}{3600 \cdot v}$$

m :Bulk load on the conveyor (kg)
m_t :Unit load poured on to the conveyor (t/h)

4. Turntable:

m_c: Load (kg)
m_f: Mass of the table (kg)
R: Rolling rase radius (m)
k_f: Rolling friction coefficient
n: Rotation speed (rpm)
k_f value is given in table 5.(page 773)

Torque of the axis of table:

$$M = (m_c + m_f) \cdot R \cdot k_f$$

Motor power:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h}$$

5. Cylindrical mixer:

Torque *M* at the axis of the cylinder:

$$M = m \cdot R \cdot C \text{ (Nm)}$$

m: Mass (kg)
R: Cylinder radius (m)
C: Filling factor (N/kg)
 The value of *C* is given in the table 4.
 Page 772

GLEICHUNGEN

3. Gurtbandanförderer:

m: Gesant last auf der Band
R: Radius des Antriebrades
v: Gechwindigkeit des Förderer

Drehmoment des Antriebrades:

$$M = A \cdot m \cdot R$$

Die A Werte können aus der table1 entnommen werden.(Seite 769)

Drehzahl des Antriebrades:

$$n = 9.55 \cdot \frac{v}{R}$$

Motor Leistung:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h}$$

Masse auf der Band:

$$m = \frac{m_t \cdot 1000 \cdot L}{3600 \cdot v}$$

m :Last auf der Band (kg)
m_t : Geförderte Masse pro stunde(t/St.)

4. Drehtisch:

m_c: Last (kg)
m_f: Mass of the table (kg)
R: Rollungsdurchmesser (m)
k_f: Reibungszahl
n: Drehzahl des Tisches (rpm)
k_f Werte können aus der table5 entnommen werden.(Seite 773)
 Drehmoment:

$$M = (m_c + m_f) \cdot R \cdot k_f$$

Motor Leistung:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h}$$

5. Zylinder Mixer:

Drehmoment *M* an der Achse:

$$M = m \cdot R \cdot C \text{ (Nm)}$$

m: Gewicht (kg)
R: Halbdurchmesser (m)
C: Füllungszahl (N/kg)
 C Werte können aus der table4 entnommen werden. Seite 772



6. Tahrik makaralı silindir:

m: Kütle (kg)
R_g: Tahrik makarası yarı çapı (m)
R: Silindir yarı çapı (m)
k_f: Yuvarlanma sürtünmesi faktörü (N/kg)
k_f değeri tablo 5'de (Sayfa 773)
B: Açılı faktörü
B değeri tablo 6'da (Sayfa 775)

Makara devri:

$$n_g = \frac{n \cdot R}{R_g} \text{ (d/d)}$$

n: Makara devri (d/d)

Makara eksenine göre moment:

$$M = m \cdot R_g \cdot k_f \cdot B \text{ (N} \cdot \text{m)}$$

Motor gücü:

$$P = \frac{M \cdot n_g}{9550 \cdot h} \text{ (kW)}$$

7. Tel çekme:

α: Kalıp açısı (derece)
d_o: Telin ilk çapı (mm)
d₁: Telin son çapı (mm)
K: Kopma Gerilmesi (MPa)
v: Poision Oranı
v: Tel hızı (m/sn)
μ: Tel ile kalıp arası sürtünme kat.
 Ortalama tel çapı veya yüksekliği:

$$h = \frac{d_o + d_1}{2} \text{ (mm)}$$

Yuvarlak kesitler için:

$$j = 0.88 + 0.12 \cdot h \div L$$

$$e = \ln \frac{A_o}{A_1}$$

Tüp ile tel arasındaki temas uzunluğu:

$$L = \frac{d_o - d_1}{2 \cdot \sin \alpha} \text{ (mm)}$$

$$Q_{dr} = (1 + m \cdot \cot \alpha) \cdot j \cdot e$$

Ortalama akma gerilmesi:

$$s_{fm} = K \cdot \frac{e^v}{v+1} \text{ (MPa)}$$

Tel çekme için gerekli kuvvet:

$$F_{dr} = s_{fm} \cdot Q_{dr} \cdot A_1 \text{ (N)}$$

Tel çekme için gerekli güç:

$$P = F_{dr} \cdot v \text{ (Watt)}$$

6. Roller supported cylinder :

m: Mass (kg)
R_g: Drive roller radius (m)
R: Cylinder radius (m)
k_f: Rolling friction factor (N/kg)
 Rolling friction factor *k_f* is given in the table 5. (Page 773)
B: Angle factor
 Value 'B' is given in the table 6. (Page 775)

Drive roller speed:

$$n_g = \frac{n \cdot R}{R_g} \text{ (rpm)}$$

n: Speed of the pulley (rpm)

Torque at axis of the roller:

$$M = m \cdot R_g \cdot k_f \cdot B \text{ (N} \cdot \text{m)}$$

Motor power:

$$P = \frac{M \cdot n_g}{9550 \cdot h} \text{ (kW)}$$

7. Wire drawing:

α: Angle of matrix (degree)
d_o: First diameter of wire (mm)
d₁: Final diameter of wire (mm)
K: Brake stress (MPa)
v: Poision rate
v: Wire Speed (m/s)
μ: Matrix-Wire friction factor
 Mean diameter or height:

$$h = \frac{d_o + d_1}{2} \text{ (mm)}$$

For circular cross section:

$$j = 0.88 + 0.12 \cdot h \div L$$

$$e = \ln \frac{A_o}{A_1}$$

Contact length between tube and wire:

$$L = \frac{d_o - d_1}{2 \cdot \sin \alpha} \text{ (mm)}$$

$$Q_{dr} = (1 + m \cdot \cot \alpha) \cdot j \cdot e$$

Mean flow stress:

$$s_{fm} = K \cdot \frac{e^v}{v+1} \text{ (MPa)}$$

Required force for drawing:

$$F_{dr} = s_{fm} \cdot Q_{dr} \cdot A_1 \text{ (N)}$$

Required power for drawing:

$$P = F_{dr} \cdot v \text{ (Watt)}$$

6. Zylinder mit Trommelstütz:

m: Gewicht (kg)
R_g: Antriebstrommel Radius (m)
R: Zylinder Radius (m)
k_f: Reibungszahl (N/kg)
 Reibungszahl ist angegeben an tabelle 5. (Seite 773)
B: Winkelzahl
B ist angegeben an tabelle 6. (Seite 775)

Antriebtrommel Drehzahl:

$$n_g = \frac{n \cdot R}{R_g} \text{ (upm)}$$

n: Zylinder Drehzahl (upm)

Drehmoment an der Zylinder Achse:

$$M = m \cdot R_g \cdot k_f \cdot B \text{ (N} \cdot \text{m)}$$

Motor Leistung:

$$P = \frac{M \cdot n_g}{9550 \cdot h} \text{ (kW)}$$

7. Draht ziehen:

α: Winkel des ziehe Matrize (derece)
d_o: Erste Durchmesser (mm)
d₁: Letzte Durchmesser (mm)
K: Abbrech Spannung (MPa)
v: Poision Zahl
v: Draht Gechwindigkeit (m/s)
μ: Reibungszahl der Matrize-Draht.
 Mittel durchmesser:

$$h = \frac{d_o + d_1}{2} \text{ (mm)}$$

Für rundes draht:

$$j = 0.88 + 0.12 \cdot h \div L$$

$$e = \ln \frac{A_o}{A_1}$$

Berührlänge für draht:

$$L = \frac{d_o - d_1}{2 \cdot \sin \alpha} \text{ (mm)}$$

$$Q_{dr} = (1 + m \cdot \cot \alpha) \cdot j \cdot e$$

Mittel Ausdehn Spannung:

$$s_{fm} = K \cdot \frac{e^v}{v+1} \text{ (MPa)}$$

Ziehe Kraft:

$$F_{dr} = s_{fm} \cdot Q_{dr} \cdot A_1 \text{ (N)}$$

Ziehe Leistung:

$$P = F_{dr} \cdot v \text{ (Watt)}$$



8. Soğuk Düz Haddeleme :

w: Levhanın genişliği (mm)
 R: Silindirin yarıçapı (mm)
 v: Levhanın hızı (m/s)
 K: Levhanın kopma gerilmesi (Mpa)
 Ho: Levha giriş kalınlığı
 H1: Levha çıkış kalınlığı
 H: Levhanın ortalama kalınlığı
 m: Levha ile silindir arasındaki sürtünme katsayısı
 v : Poisson Oranı

Parça ile silindir yüzeyi arasında kalan parça uzunluğu:

$$L = \sqrt{R \cdot (H_o - H_1)} \quad (\text{mm})$$

$$H = \frac{H_o + H_1}{2} \quad (\text{mm})$$

Eğer $H/L > 1$:

$$Q = 0.3 \cdot (H \div L) + 0.7$$

Eğer $H/L < 1$:

$$Q = \frac{H}{m \cdot L} \cdot \left(e^{m \cdot (L \div H)} - 1 \right)$$

Soğuk çekme:

$$s_{fm} = K \cdot \frac{e^v}{v+1} \quad (\text{MPa}), \quad e = \ln \frac{H_o}{H_1}$$

Gerekli ovalama kuvveti:

$$F = 1.15 \cdot L \cdot w \cdot Q \cdot s_{fm} \quad (\text{N})$$

Gerekli ovalama gücü:

$$P = F \cdot L \cdot (v \div R) \quad (\text{Watt})$$

8.Flat Cold Rolling:

w: Width of the sheet (mm)
 R: Radius of the cylinder (mm)
 v: Speed of the sheet (m/s)
 K: Levhanın kopma gerilmesi (Mpa)
 Ho: Input height of the sheet
 H1: Output height of the sheet
 H: Mean height of the sheet
 m: Friction coefficient between sheet and cylinder
 v : Poisson Ratio

Contact length between cylinder and sheet:

$$L = \sqrt{R \cdot (H_o - H_1)} \quad (\text{mm})$$

$$H = \frac{H_o + H_1}{2} \quad (\text{mm})$$

If: $H/L > 1$:

$$Q = 0.3 \cdot (H \div L) + 0.7$$

If: $H/L < 1$:

$$Q = \frac{H}{m \cdot L} \cdot \left(e^{m \cdot (L \div H)} - 1 \right)$$

Cold rolling:

$$s_{fm} = K \cdot \frac{e^v}{v+1} \quad (\text{MPa}), \quad e = \ln \frac{H_o}{H_1}$$

Required drawing force:

$$F = 1.15 \cdot L \cdot w \cdot Q \cdot s_{fm} \quad (\text{N})$$

Required drawing power:

$$P = F \cdot L \cdot (v \div R) \quad (\text{Watt})$$

8.Kalt Platte Wälzen:

w: Platten breite
 R: Wälzzylinder Radius (mm)
 v: Platte Geschwindigkeit (m/s)
 K: Bruch Spannung der Platte (Mpa)
 Ho: Eingang Platten Dicke
 H1: Ausgang Platten Dicke
 H: Mittel Dicke
 m: Reibungszahl für Zylinder-Platte
 v : Poisson Zahl

Berühr Länge der Platte:

$$L = \sqrt{R \cdot (H_o - H_1)} \quad (\text{mm})$$

$$H = \frac{H_o + H_1}{2} \quad (\text{mm})$$

Wenn $H/L > 1$:

$$Q = 0.3 \cdot (H \div L) + 0.7$$

Wenn $H/L < 1$:

$$Q = \frac{H}{m \cdot L} \cdot \left(e^{m \cdot (L \div H)} - 1 \right)$$

Kalt Wälzen:

$$s_{fm} = K \cdot \frac{e^v}{v+1} \quad (\text{MPa}), \quad e = \ln \frac{H_o}{H_1}$$

Ziehe Kraft:

$$F = 1.15 \cdot L \cdot w \cdot Q \cdot s_{fm} \quad (\text{N})$$

Wälz Leistung:

$$P = F \cdot L \cdot (v \div R) \quad (\text{Watt})$$

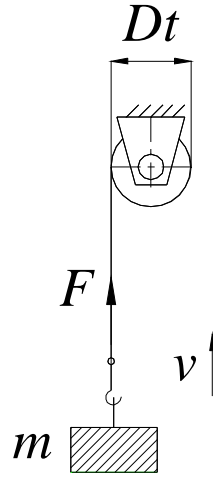


Tek Halatlı Kaldırma
 Mekanizması

On Puley Lifting Unit

Ein Seil Last Hebung

$m = 1000 \text{ kg}$
 $Dt = 200 \text{ mm}$
 $v = 0.2 \text{ m/s}$
 $\eta = 0.9$
 $n = ?$
 $P = ?$



Örnek 1: 1000kg ağırlığındaki yük 0.2 m/s hızla yukarı doğru çekilmektedir. Makara devrini ve motor gücünü bulunuz.

Example 1: 1000kg load is pulled up with a velocity of 0.2 m/s. Find the angular velocity of the drum and motor power.

Beispiel 1: 1000kg Last wird mit 0.2 m/s Geschwindigkeit Abgehoben. Gesucht ist Scheibendrehzahl und Motor Leistung.

$$v = \frac{p \cdot Dt \cdot n}{60} \Rightarrow n = \frac{v \cdot 60}{p \cdot Dt}$$

$$v = \frac{p \cdot Dt \cdot n}{60} \Rightarrow n = \frac{v \cdot 60}{p \cdot Dt}$$

$$v = \frac{p \cdot Dt \cdot n}{60} \Rightarrow n = \frac{v \cdot 60}{p \cdot Dt}$$

$$n = 0.2 \cdot 60 \div (p \cdot 0.2) = 19 \text{ d/d}$$

$$n = 0.2 \cdot 60 \div (p \cdot 0.2) = 19 \text{ rpm}$$

$$n = 0.2 \cdot 60 \div (p \cdot 0.2) = 19 \text{ upm}$$

$$P = \frac{F \cdot v}{1000 \cdot h} \Rightarrow P = \frac{m \cdot g \cdot v}{1000 \cdot 0.9}$$

$$P = \frac{F \cdot v}{1000 \cdot h} \Rightarrow P = \frac{m \cdot g \cdot v}{1000 \cdot 0.9}$$

$$P = \frac{F \cdot v}{1000 \cdot h} \Rightarrow P = \frac{m \cdot g \cdot v}{1000 \cdot 0.9}$$

$$P = \frac{1000 \cdot 9.81 \cdot 0.2}{1000 \cdot 0.9} = 2.18 \text{ kW}$$

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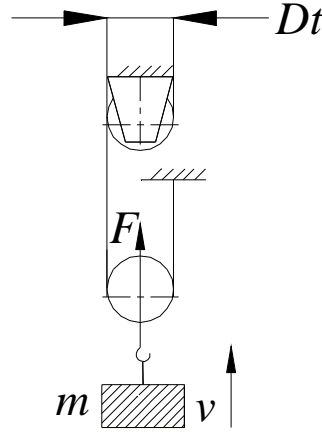


Çift Halatlı Kaldırma
Mekanizması

Double Pulley Lifting Unit

Zwei Seil Last Hebung

$m = 1000 \text{ kg}$
 $Dt = 200 \text{ mm}$
 $v = 0.2 \text{ m/s}$
 $\eta = 0.9$
 $n = ?$
 $P = ?$



Örnek 2: 1000 kg ağırlığındaki yük 0.2 m/s hızla yukarı doğru çekilmektedir. Makara devrini ve motor gücünü bulunuz.

Example 1: 1000kg load is pulled up with a velocity of 0.2 m/s. Find the angular velocity of the drum and motor power.

Beispiel 2: 1000kg Last wird mit 0.2 m/s Geschwindigkeit Abgehoben. Gesucht ist Scheibendrehzahl und Motor Leistung.

$$v = \frac{p \cdot Dt \cdot n}{2 \cdot 60} \Rightarrow n = \frac{2 \cdot v \cdot 60}{p \cdot Dt}$$

$$v = \frac{p \cdot Dt \cdot n}{2 \cdot 60} \Rightarrow n = \frac{2 \cdot v \cdot 60}{p \cdot Dt}$$

$$v = \frac{p \cdot Dt \cdot n}{2 \cdot 60} \Rightarrow n = \frac{2 \cdot v \cdot 60}{p \cdot Dt}$$

$$n = 2 \cdot 0.2 \cdot 60 \div (p \cdot 0.2) = 38 \text{ d/d}$$

$$n = 2 \cdot 0.2 \cdot 60 \div (p \cdot 0.2) = 38 \text{ rpm}$$

$$n = 2 \cdot 0.2 \cdot 60 \div (p \cdot 0.2) = 38 \text{ upm}$$

$$P = \frac{F \cdot v}{1000 \cdot h} \Rightarrow P = \frac{m \cdot g \cdot v}{1000 \cdot 0.9}$$

$$P = \frac{F \cdot v}{1000 \cdot h} \Rightarrow P = \frac{m \cdot g \cdot v}{1000 \cdot 0.9}$$

$$P = \frac{F \cdot v}{1000 \cdot h} \Rightarrow P = \frac{m \cdot g \cdot v}{1000 \cdot 0.9}$$

$$P = \frac{1000 \cdot 9.81 \cdot 0.2}{1000 \cdot 0.9} = 2.18 \text{ kW}$$

$$P = \frac{1000 \cdot 9.81 \cdot 0.2}{1000 \cdot 0.9} = 2.18 \text{ kW}$$

$$P = \frac{1000 \cdot 9.81 \cdot 0.2}{1000 \cdot 0.9} = 2.18 \text{ kW}$$

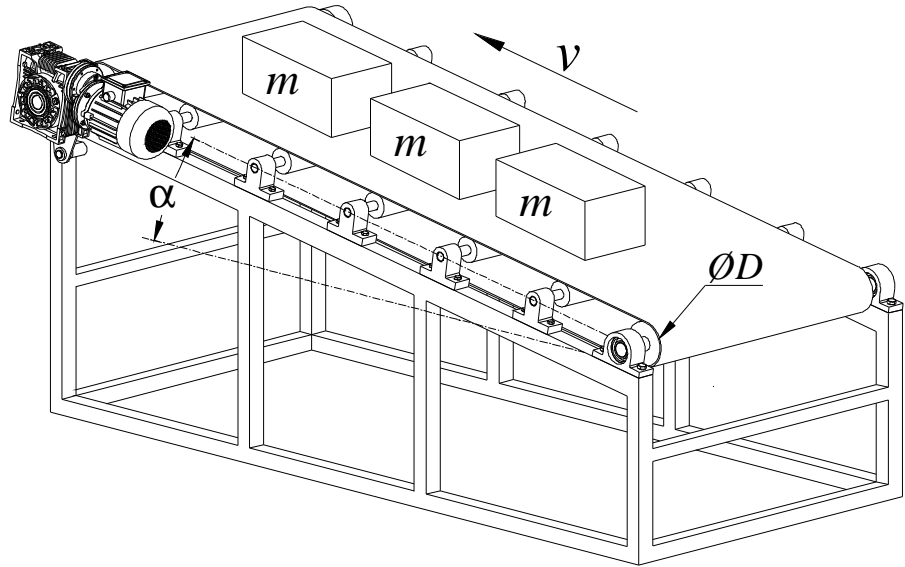


Parça Yüklü Konveyör

Roller Belt Conveyor With Partial Load

Gurtbandförderer Mit Teil Last

$m = 20 \times 15 = 300 \text{ kg}$
 $D = 150 \text{ mm}$
 $v = 0.4 \text{ m/s}$
 $\eta = 0.9$
 $\alpha = 20^\circ$
 $n = ?$
 $P = ?$



Örnek 3: Her biri 20 kg olan 15 kasa 0,4 m/s lik bir hızla taşınacaktır. Konveyörün eğimi 20° dir. Hareket veren tambur çapı 150 mm , verim 0,9 dür. Tamburun devrini ve motor gücünü bulunuz.

Tamburun yarıçapı:

$$r = \frac{D}{2} = \frac{0.15}{2} = 0.075 \text{ m}$$

Konveyör üstündeki yük:

$$m = 15 \times 20 = 300 \text{ kg}$$

Afaktörü: 3.6 N/kg

Hareket veren tamburun momenti:

$$M = A \cdot m \cdot r$$

$$M = 3.6 \cdot 300 \cdot 0.075 = 81 \text{ Nm}$$

Tahrik Devri:

$$n = 9.55 \times v / R$$

$$n = 9.55 \cdot \frac{0.4}{0.075} = 50.9 \text{ d/d}$$

Motor gücü:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h} = \frac{3.6 \cdot 300 \cdot 0.4}{1000 \cdot 0.9}$$

$$P = 0.48 \text{ kW}$$

Example 3: 15 cases of 20 kg each will be carried at 0,4 m/s: the conveyor is inclined at 20° from the horizontal. Head pulley diameter is 150 mm , efficiency is 0,9. Find the speed of the drum and motor power.

Head pulley radius:

$$r = \frac{D}{2} = \frac{0.15}{2} = 0.075 \text{ m}$$

Load on the conveyor:

$$m = 15 \times 20 = 300 \text{ kg}$$

Afactor: 3.6 N/kg

Torque on the head pulley:

$$M = A \cdot m \cdot r$$

$$M = 3.6 \cdot 300 \cdot 0.075 = 81 \text{ Nm}$$

Speed:

$$n = 9.55 \times v / R$$

$$n = 9.55 \cdot \frac{0.4}{0.075} = 50.9 \text{ rpm}$$

Motor power:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h} = \frac{3.6 \cdot 300 \cdot 0.4}{1000 \cdot 0.9}$$

$$P = 0.48 \text{ kW}$$

Beispiel 3: 15 kasten jeder mit 20 kg gewicht wird gefördert mit 0.4 m/s geschwindigkeit. Winkel des bandes ist 20° . Antriebstrommel Durchmesser ist 150 mm , Wirkungsgrad ist 0,9. Gesucht ist Antriebsdrehzahl und Leistung.

Antriebstrommel Radius;

$$r = \frac{D}{2} = \frac{0.15}{2} = 0.075 \text{ m}$$

Last auf der Bant:

$$m = 15 \times 20 = 300 \text{ kg}$$

Afaktor: 3.6 N/kg

Moment an der Antriebstrommel:

$$M = A \cdot m \cdot r$$

$$M = 3.6 \cdot 300 \cdot 0.075 = 81 \text{ Nm}$$

Antrieb Drehzahl:

$$n = 9.55 \times v / R$$

$$n = 9.55 \cdot \frac{0.4}{0.075} = 50.9 \text{ upm}$$

Motor Leistung:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h} = \frac{3.6 \cdot 300 \cdot 0.4}{1000 \cdot 0.9}$$

$$P = 0.48 \text{ kW}$$

Tablo 1 / Table 1 / Tabelle 1

a8	08	108	208	308	408	508	608	708	808	908
A(N/kg)	0.25	2.35	3.6	5.1	6.5	7.7	8.7	9.3	9.7	10

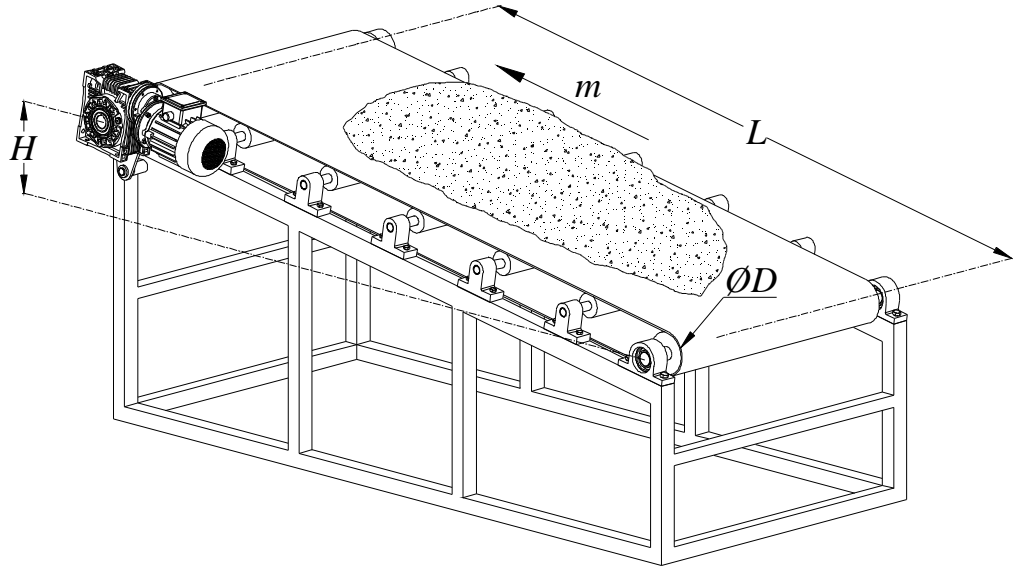


Dökme Yük Taşıyan Konveyör

Belt Conveyor With Bulk Load

Gurtbandförderer Mit Schüttgut

- $m = 250 \frac{\text{ton}}{\text{saat}}$
- $D = 350 \text{ mm}$
- $v = 0.6 \text{ m/s}$
- $h = 0.96$
- $L = 90 \text{ m}$
- $H = 12.5 \text{ m}$
- $n = ?$
- $P = ?$



Örnek 4: Saatte 250 ton çakıl taşınacaktır. Konveyör uzunluğu 90 m. yüksekliği 12.5 m dir. Konveyör hızı 0.6 m/s hareket veren tambur çapı 350 mm, redüktör verimi 0.96 dır. Güç ve tambur devrini hesaplayınız. Tamburun devrini ve motor gücünü bulunuz.

Tamburun yarıçapı:

$$r = \frac{D}{2} = \frac{0.35}{2} = 0.175 \text{ m}$$

Konveyör üstündeki yük:

$$m_t = \frac{m \cdot 1000 \cdot L}{3600 \cdot v} = 10416 \text{ kg}$$

$$a = a \sin\left(\frac{H}{L}\right) = a \sin\left(\frac{12.5}{90}\right) = 8^\circ$$

A_{faktörü}: 2.35 N/kg (tablo 2 den)

Hareket veren tamburun momenti:

$$M = A \cdot m \cdot r$$

$$M = 2.35 \cdot 10416 \cdot 0.175 = 4283 \text{ Nm}$$

Hareket veren tambur devri:

$$n = 9.55 \cdot v \div r$$

$$n = 9.55 \cdot \frac{0.6}{0.175} = 32.74 \text{ d/d}$$

Motor gücü:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h} = \frac{2.35 \cdot 10416 \cdot 0.6}{1000 \cdot 0.93}$$

$$P = 15.8 \text{ kW}$$

Example 4: 250 tons of gravels gravels will be conveyed per hour: conveyor length is 90 m, elevation is 12.5 m, conveyor speed 0.6 m/s, head pulley speed diameter 350 mm, efficiency is 0.96. Find the angular speed of drum and motor power.

Head pulley radius:

$$r = \frac{D}{2} = \frac{0.35}{2} = 0.175 \text{ m}$$

Load on the conveyor:

$$m_t = \frac{m \cdot 1000 \cdot L}{3600 \cdot v} = 10416 \text{ kg}$$

$$a = a \sin\left(\frac{H}{L}\right) = a \sin\left(\frac{12.5}{90}\right) = 8^\circ$$

A_{factor}: 2.35 N/kg (from table 2)

Torque on the head pulley:

$$M = A \cdot m \cdot r$$

$$M = 2.35 \cdot 10416 \cdot 0.175 = 4283 \text{ Nm}$$

Angular speed of the pulley:

$$n = 9.55 \cdot v \div r$$

$$n = 9.55 \cdot \frac{0.6}{0.175} = 32.74 \text{ rpm}$$

Motor power:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h} = \frac{2.35 \cdot 10416 \cdot 0.6}{1000 \cdot 0.93}$$

$$P = 15.8 \text{ kW}$$

Beispiel 4: 250 tonen pro stunde Kiesel wird gefördert: Band länge ist 90 m, höhe 12.5 m, Band geschwindigkeit 0.6 m/s, Antriebstrommel durchmesser ist 350 mm, Wirkungsgrad 0,96. Gesucht ist Antriebstrommel Drehzahl und Leistung. Antriebstrommel Radius:

$$r = \frac{D}{2} = \frac{0.35}{2} = 0.175 \text{ m}$$

Last auf der Band:

$$m_t = \frac{m \cdot 1000 \cdot L}{3600 \cdot v} = 10416 \text{ kg}$$

$$a = a \sin\left(\frac{H}{L}\right) = a \sin\left(\frac{12.5}{90}\right) = 8^\circ$$

A_{factor}: 2.35 N/kg (von Tabelle)

Drehmoment an der Antriebstrommel

$$M = A \cdot m \cdot r$$

$$M = 2.35 \cdot 10416 \cdot 0.175 = 4283 \text{ Nm}$$

Antriebstrommel Drehzahl:

$$n = 9.55 \cdot v \div r$$

$$n = 9.55 \cdot \frac{0.6}{0.175} = 32.74 \text{ upm}$$

Motor Leistung:

$$P = \frac{A \cdot m \cdot v}{1000 \cdot h} = \frac{2.35 \cdot 10416 \cdot 0.6}{1000 \cdot 0.93}$$

$$P = 15.8 \text{ kW}$$

Tablo 2 / Table 2 / Tabelle 2

a8	08	108	208	308	408	508	608	708	808	908
A(N/kg)	0.25	2.35	3.6	5.1	6.5	7.7	8.7	9.3	9.7	10

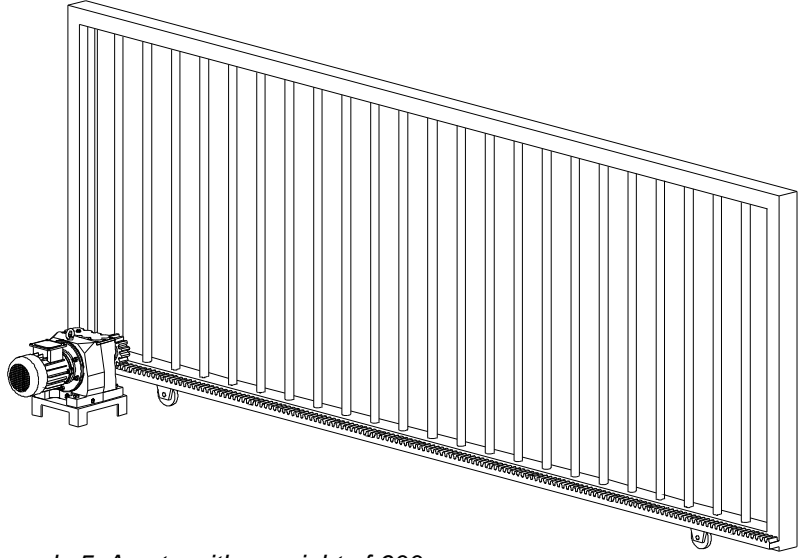


Kapı Yürütme Sistemi

Moving Gate Application

Tür Bevegung Beispiel

$m = 600 \text{ kg}$
 $D = 125 \text{ mm}$ (Teker Çapı / Wheel
Dia./ Rad
Durchmesser)
 $m_n = 6$ (Kramiyer modülü /
Rack modul /
Zahnschine
Modul)
 $v = 0.5 \text{ m/s}$
 $z = 17$ (Pinyon diş sayısı / Pinion
tooth number / Ritzel
Zähnezahl)
 $L = 8 \text{ m}$
 $n = ?$
 $P = ?$



Örnek 5: 8 m uzunluğunda ve 600 kg ağırlığında bir kapı rulmanlı tekerler yardımıyla hareket ettirilecektir. Redüktör devrini ve gücünü hesaplayınız.
Düz dişli çapı: $d = m_{\text{modül}} \times z$

$$\Rightarrow d = 6 \cdot 17 = 102 \text{ mm}$$

$$\Rightarrow r = 51 \text{ mm} = 0.051 \text{ m}$$

Redüktör çıkış devri:

$$n = 9.55 \cdot \frac{V}{R} = 9.55 \cdot \frac{0.5}{0.051}$$

$$\Rightarrow n = 94 \text{ d/d}$$

$$M = F \cdot r = m \cdot g \cdot kr \cdot r$$

$$M = 600 \cdot 9.81 \cdot 0.13 \cdot 0.051$$

$$\Rightarrow M = 39 \text{ Nm}$$

Motor gücü:

$$P = \frac{M \cdot n}{9550 \cdot h} = \frac{39 \cdot 94}{9550 \cdot 0.9 \cdot 0.96}$$

$$\Rightarrow P = 0.45 \text{ kW}$$

Example 5: A gate with a weight of 600 kg and a length of 8 m is supported on 2 roller bearings. Find the gearbox speed and motor power.

Spur gear pitch diameter: $d = m_{\text{modül}} \times z$

$$\Rightarrow d = 6 \cdot 17 = 102 \text{ mm}$$

$$\Rightarrow r = 51 \text{ mm} = 0.051 \text{ m}$$

Output speed of geared motor:

$$n = 9.55 \cdot \frac{V}{R} = 9.55 \cdot \frac{0.5}{0.051}$$

$$\Rightarrow n = 94 \text{ rpm}$$

$$M = F \cdot r = m \cdot g \cdot kr \cdot r$$

$$M = 600 \cdot 9.81 \cdot 0.13 \cdot 0.051$$

$$\Rightarrow M = 39 \text{ Nm}$$

Motor power:

$$P = \frac{M \cdot n}{9550 \cdot h} = \frac{39 \cdot 94}{9550 \cdot 0.9 \cdot 0.96}$$

$$\Rightarrow P = 0.45 \text{ kW}$$

Beispiel 5: Ein tür mit einem 600 kg gewicht und 8 m länge soll über zwei räder Angetrieben werden. Gesucht ist Getriebe Drehzahl und Motor Leistung.

Teikreis des Ritzel: $d = m_{\text{modül}} \times z$

$$\Rightarrow d = 6 \cdot 17 = 102 \text{ mm}$$

$$\Rightarrow r = 51 \text{ mm} = 0.051 \text{ m}$$

Getriebe Drehzal:

$$n = 9.55 \cdot \frac{V}{R} = 9.55 \cdot \frac{0.5}{0.051}$$

$$\Rightarrow n = 94 \text{ upm}$$

$$M = F \cdot r = m \cdot g \cdot kr \cdot r$$

$$M = 600 \cdot 9.81 \cdot 0.13 \cdot 0.051$$

$$\Rightarrow M = 39 \text{ Nm}$$

Motor Leistung:

$$P = \frac{M \cdot n}{9550 \cdot h} = \frac{39 \cdot 94}{9550 \cdot 0.9 \cdot 0.96}$$

$$\Rightarrow P = 0.45 \text{ kW}$$

Tablo 3 / Table 3 / Tabelle 3

Tekerlek Çapı / Wheel Diameter Raddurchmesser	D (mm)	100	125	160	200	250	315	400	500	630
Bilyalı Çelik Tekerlek Steel Wheel On Bearing Stahl rad mit Zylinderrollenlager	kr (N/kg)	0.14	0.13	0.12	0.1	0.09	0.08	0.07	0.06	0.06

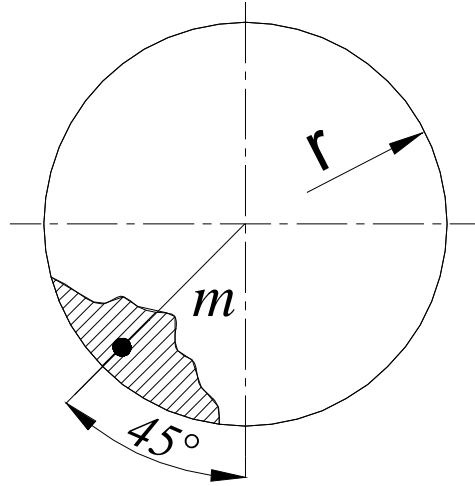


Eksenî Etrafında Dönen Silindirler

Cylinder Rotating around its axis

Zylinder Dreht Sich Um Seine Eigenen Achse

- $m = 400 \text{ kg}$ (Ağırlık/Weight/Gewicht)
- $r = 0,6 \text{ m}$ (Yarıçap/Radius/Radius)
- $n = 20 \text{ rpm}$ (Devir/Speed/Drehzahl)
- $i = 5$ (Zincir Dişli Tahvili/Chain Drive Ratio/
Kettentrieb Übersetzung)
- $\eta_k = 0.9$ (Zincir Verimi/Efficiency of Chain Drive/
Kettentrieb Wirkungsgrad)
- $\eta_r = 0.98$ (Redüktör Verimi/Efficiency of Gearbox
/Getriebe Wirkungsgrad)
- C: Doldurma faktörü / Filling Factor /
Füllungszahl
- $P = ?$



Örnek 6: Silindirik bir karıştırıcı 1.2 m çapındadır. İki devirli bir redüktör ve 1/5 oranında zincir dişlilerle (verim = 0.9) tahrik edilmektedir. Silindir devri 20 dır. Silindir 1/4 doludur. Yük ağırlığı 400 kg dır. Redüktör devrini ve gücünü hesaplayınız. (Redüktör verimi = 0.98)

Example 6: A cylinder blender 1.2m in diameter is driven at 20 rpm in rotation around its axis through chain and sprockets, ratio 5 to1, efficiency 0.9. It is quarter full and the weight of the product is 400 kg. Calculate the output gearbox speed and motor power.(efficiency of the drive 0.98)

Beispiel 6: Ein Zylinder Mixer mit 1.2m Durchmesser wird bei 20rpm mit Kettentrieb (Übersetzung 5, Wirkungsgrad 0.9) Angetrieben. Zylinder ist 1/4 voll mit 400 kg Last. Gesucht ist Getriebe Drehzahl und Leistung (Getriebe Wirkungsgrad 0.98)

Silindir eksenine göre M momenti:

$$M = m \cdot r \cdot C \text{ (Nm)}$$

Doldurma faktörü:

$$C = 4.5 \text{ (N/kg) (Tablo 4 den)}$$

$$M = 400 \cdot 0.6 \cdot 4.5$$

$$\Rightarrow M = 1080 \text{ Nm}$$

Redüktör çıkış milindeki moment:

$$M_s = \frac{1080}{5.9} \Rightarrow M_s = 240 \text{ Nm}$$

Redüktörün devri:

$$n = 20 \cdot 5 = 100 \text{ d/d}$$

Motor gücü:

$$P = M \cdot n \div (9550 \cdot h)$$

$$P = \frac{240 \cdot 100}{9550 \cdot 0.98} \Rightarrow P = 2.6 \text{ kW}$$

Torque at the axis of the cylinder:

$$M = m \cdot r \cdot C \text{ (Nm)}$$

Filling factor :

$$C=4.5 \text{ (N/kg) (from table 4)}$$

$$M = 400 \cdot 0.6 \cdot 4.5$$

$$\Rightarrow M = 1080 \text{ Nm}$$

Gearbox output shaft Torque:

$$M_s = \frac{1080}{5.9} \Rightarrow M_s = 240 \text{ Nm}$$

Gearbox output speed:

$$n = 20 \cdot 5 = 100 \text{ rpm}$$

Motor power:

$$P = M \cdot n \div (9550 \cdot h)$$

$$P = \frac{240 \cdot 100}{9550 \cdot 0.98} \Rightarrow P = 2.6 \text{ kW}$$

Drehmoment an der Zylinder Shaft :

$$M = m \cdot r \cdot C \text{ (Nm)}$$

Füllungszahl :

$$C=4.5 \text{ (N/kg) (von Tabelle 4)}$$

$$M = 400 \cdot 0.6 \cdot 4.5$$

$$\Rightarrow M = 1080 \text{ Nm}$$

Getriebe Drehmoment:

$$M_s = \frac{1080}{5.9} \Rightarrow M_s = 240 \text{ Nm}$$

Reducer's maximum output speed:

$$n = 20 \cdot 5 = 100 \text{ upm}$$

Motor Leistung:

$$P = M \cdot n \div (9550 \cdot h)$$

$$P = \frac{240 \cdot 100}{9550 \cdot 0.98} \Rightarrow P = 2.6 \text{ kW}$$

Tablo 4 / Table 4 / Tabelle 4

Silindir /Cylinder /Zylinder	C
1/4 dolu / full / voll	4.5
1/2 dolu / full / voll	3
3/4 dolu / full / voll	1.6

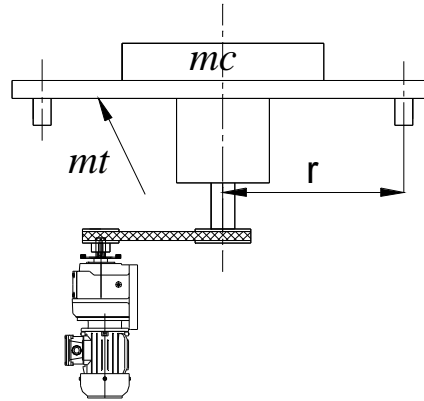


Rulmanlı Döner Tabla

Bearing Supported Turntable

Drehtisch Mit Walzlager

$m_c = 1500$ kg (Yük / Weight/ Gewicht)
 $m_t = 800$ kg (Tabla kütlesi / Turn Table Weight /
 Drehtisch Gewicht)
 $r = 2.5$ m (Tabla yarıçapı/Turn Table Radius/
 Drehtisch Radius)
 $n = 6$ d/d (Tablanın devri/Turn Table Speed/
 Drehtisch Drehzahl)



$\eta = 0.97$

Çelik yüzey üzerine çelik teker
 Steel wheels over steel Surface
 Stahl Rad über Stahl Platte

$P = ?$

Örnek 7: 5 m çapındaki bir döner tabla 1500 kg yük taşımaktadır. Döner tablanın ağırlığı 800 kg ve devir sayısı 6 d/d dir. Tabla eksenini 1/4 oranında V kayışı ile (verim 0.85) redüksüyon yapılarak bir redüktör ile tahrik edilmektedir. Taşıyıcılar çelik teker üzerinde çelik olup, tablanın 2.5 m çapına monte edilmiştir. Redüktör verimi 0.97 dir. Tambur devrini ve motor gücünü hesaplayınız.

Tablanın eksenine göre momenti:

$$k_f = 0.25 \text{ (tablo 5 den)}$$

$$M = (m_c + m_t) \times r \times k_f$$

$$M = (1500 + 800) \times 2.5 \times 0.25$$

$$M = 1437.5 \text{ Nm}$$

Redüktör çıkış milindeki moment:

$$M_S = \frac{1437.5}{4 \cdot h} \Rightarrow M_S = 396,3 \text{ Nm}$$

Redüktör çıkış devri:

$$n = 6 \times 4 \Rightarrow N = 24 \text{ d/d}$$

Motor gücü:

$$P = \frac{m \cdot n}{9550 \cdot h} = \frac{396,3 \cdot 24}{9550 \cdot 0.97}$$

$P = 0.93 \text{ kW}$

Example 7: A turntable in diameter of 5m will rotate a 1500 kg load. The turntable weight is 800 kg, and rotates at a speed of 6 rpm. The axis is driven through belt and pulleys ratio is 4 to 1 (efficiency 0.85). A ring of steel casters riding on steel and located at a 2.5m diameter supports the table and gear box efficiency is 0.97. Find the output speed of the gear box and motor power.

Torque at the axis of the turntable:

$$k_f = 0.25 \text{ (from table 5)}$$

$$M = (m_c + m_t) \times r \times k_f$$

$$M = (1500 + 800) \times 2.5 \times 0.25$$

$$M = 1437.5 \text{ Nm}$$

Torque at the gear box shaft :

$$M_S = \frac{1437.5}{4 \cdot h} \Rightarrow M_S = 396,3 \text{ Nm}$$

Output speed of the gear box:

$$n=6 \times 4 \Rightarrow N = 24 \text{ rpm}$$

Motor power:

$$P = \frac{m \cdot n}{9550 \cdot h} = \frac{396,3 \cdot 24}{9550 \cdot 0.97}$$

$P = 0.93 \text{ kW}$

Example 7: Ein Drehtisch mit 5m Durchmesser und mit 1500 Gewicht wird gedreht. Drehtisch Gewicht ist 800 kg und Drehzahl des Tisches ist 6 upm. Tisch achse wird mit Riementrieb angetrieben (Wirkungsgrad 0.85, Übersetzung 4). Das Drehtisch läuft über Stahl mit Stahl Räder. Die Räder sind in 2.5m Durchmesser. Getriebe Wirkungsgrad ist 0.97. Gesucht ist Getriebe Drehzahl und Leistung.

Drehmoment auf der Drehtisch Achse:

$$k_f = 0.25 \text{ (von Tabelle 5)}$$

$$M = (m_c + m_t) \times r \times k_f$$

$$M = (1500 + 800) \times 2.5 \times 0.25$$

$$M = 1437.5 \text{ Nm}$$

Drehmoment auf der Getriebe Welle:

$$M_S = \frac{1437.5}{4 \cdot h} \Rightarrow M_S = 396,3 \text{ Nm}$$

Getriebe Drehzahl:

$$n=6 \times 4 \Rightarrow N = 24 \text{ upm}$$

Getriebe Leistung:

$$P = \frac{m \cdot n}{9550 \cdot h} = \frac{396,3 \cdot 24}{9550 \cdot 0.97}$$

$P = 0.93 \text{ kW}$

Tablo 5 / Table 5 / Tabelle 5

Taşıyıcı Cinsi / Type of support / Walzlager typ	Kf
Bilyalı Rulmanlar / Ball Bearings / Kugellager	0.01
Makaralı Rulmanlar / Roller Bearings / Zylinderrollenlager	0.015
Eksenel Bilyalı Rulmanlar / Thrust ball bearings / Rillenkugellager	0.034
Çelik yüzey üzerine çelik teker / Steel on steel / Stahlrad auf Stahl	0.25

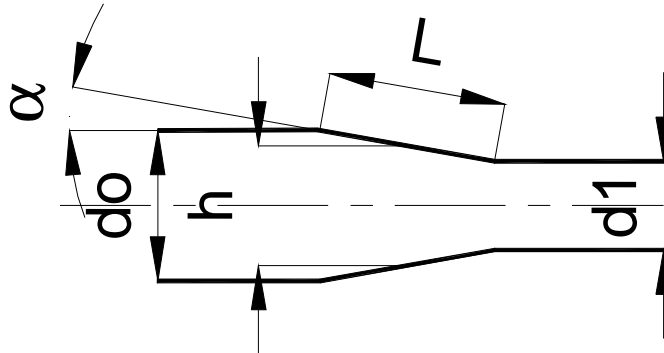


Tel Çekme

Wire Drawing

Draht Ziehen

$d_0 = 3 \text{ mm}$
 $A_0 = 7.07 \text{ mm}^2$
 $A_1 = 5 \text{ mm}^2$
 $k = 1300 \text{ MPa}$
 $n = 0.3$
 $\mu = 0.05$
 $v = 1 \text{ m/s}$
 $\alpha = 68$
 $P = ?$



Örnek 8: 3 mm çapındaki tel 5 mm²'lik kesit alanına çekiliyor. Gerekli kuvveti, gücü hesaplayınız.

$$e = \ln \frac{A_0}{A_1} = 0.346$$

Ortalama akma gerilmesi:

$$s_{fm} = k \cdot \frac{e^n}{n+1} = \frac{1300 \cdot 0.346^0.3}{1.3}$$

$$\sigma_{fm} = 727 \text{ MPa}$$

Çekilen telin çapı:

$$d_1 = \sqrt{(5 \cdot 4) \div p} = 2.52 \text{ mm}$$

Ortalama Yükseklik:

$$h = \frac{3 + 2.52}{2} = 2.76 \text{ mm}$$

Tel ile tüp arasındaki temas yüzeyi uzunluğu:

$$L = \frac{d_0 - d_1}{2 \sin \alpha} = \frac{0.48}{2 \cdot \sin 6^\circ} = 2.3 \text{ mm}$$

$$w = 0.88 + 0.12 \times h / L$$

$$w = 0.88 + 0.12 \times 2.76 / 2.3 = 1.03$$

$$Q_{dr} = (1 + \mu \times \cot \alpha) \times w \times e$$

$$Q_{dr} = (1 + 0.05 \times \cot 6^\circ) \times 1.03 \times 0.346$$

$$Q_{dr} = 0.53$$

Tel çekme kuvveti:

$$F_{dr} = \sigma_{fm} \times Q_{dr} \times A_1$$

$$F_{dr} = 727 \times 0.53 \times 5$$

$$F_{dr} = 1926 \text{ N}$$

Motor gücü:

$$P = F_{dr} \times v = 1926 \times 1 / 1000 = 1.92 \text{ kW}$$

Example 8: 3 mm diameter stainless steel wire is drawn so that the final cross section area become 5 mm². Find the drawing force and power.

$$e = \ln \frac{A_0}{A_1} = 0.346$$

Flow mean stress:

$$s_{fm} = k \cdot \frac{e^n}{n+1} = \frac{1300 \cdot 0.346^0.3}{1.3}$$

$$s_{fm} = 727 \text{ Pa}$$

Diameter of drawn wire:

$$d_1 = \sqrt{(5 \cdot 4) \div p} = 2.52 \text{ mm}$$

Mean height:

$$h = \frac{3 + 2.52}{2} = 2.76 \text{ mm}$$

Contact length between tube and wire:

$$L = \frac{d_0 - d_1}{2 \sin \alpha} = \frac{0.48}{2 \cdot \sin 6^\circ} = 2.3 \text{ mm}$$

$$w = 0.88 + 0.12 \times h / L$$

$$w = 0.88 + 0.12 \times 2.76 / 2.3 = 1.03$$

$$Q_{dr} = (1 + \mu \times \cot \alpha) \times w \times e$$

$$Q_{dr} = (1 + 0.05 \times \cot 6^\circ) \times 1.03 \times 0.346$$

$$Q_{dr} = 0.53$$

Drawing force:

$$F_{dr} = s_{fm} \times Q_{dr} \times A_1$$

$$F_{dr} = 727 \text{ Pa} \times 0.53 \times 5$$

$$F_{dr} = 1926 \text{ N}$$

Motor power:

$$P = F_{dr} \times v = 1926 \times 1 / 1000 = 1.92 \text{ kW}$$

Beispiel 8: 3 mm Stahl Draht wird gezogen bis 5 mm² fläche. Gezucht ist Draht Zieh Kraft und Motor Leistung.

$$e = \ln \frac{A_0}{A_1} = 0.346$$

Mittel Ausdehn Spannung:

$$s_{fm} = k \cdot \frac{e^n}{n+1} = \frac{1300 \cdot 0.346^0.3}{1.3}$$

$$s_{fm} = 727 \text{ Pa}$$

Durchmesser des gezogenen Draht:

$$d_1 = \sqrt{(5 \cdot 4) \div p} = 2.52 \text{ mm}$$

Mittel Dicke:

$$h = \frac{3 + 2.52}{2} = 2.76 \text{ mm}$$

Berühr Länge:

$$L = \frac{d_0 - d_1}{2 \sin \alpha} = \frac{0.48}{2 \cdot \sin 6^\circ} = 2.3 \text{ mm}$$

$$w = 0.88 + 0.12 \times h / L$$

$$w = 0.88 + 0.12 \times 2.76 / 2.3 = 1.03$$

$$Q_{dr} = (1 + \mu \times \cot \alpha) \times w \times e$$

$$Q_{dr} = (1 + 0.05 \times \cot 6^\circ) \times 1.03 \times 0.346$$

$$Q_{dr} = 0.53$$

Zieh Kraft:

$$F_{dr} = s_{fm} \times Q_{dr} \times A_1$$

$$F_{dr} = 727 \text{ Pa} \times 0.53 \times 5$$

$$F_{dr} = 1926 \text{ N}$$

Motor Leistung:

$$P = F_{dr} \times v = 1926 \times 1 / 1000 = 1.92 \text{ kW}$$

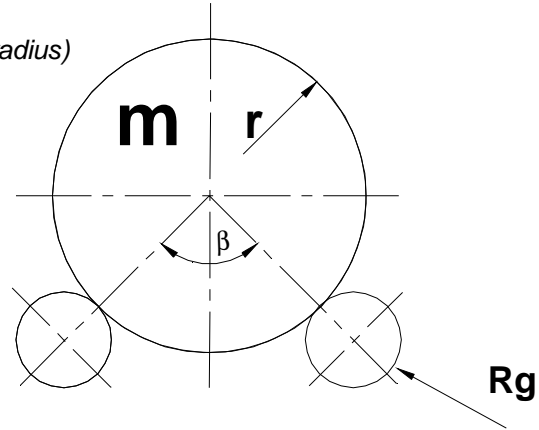


Silindirik Karıştırıcı

Cylindrical Mixer

Drehtisch

$m = 400$ kg (**Yük**) (muss)
 $r = 1.2$ m (**Silindir çapı**) (Cylinder diameter)
 $r_g = 0.1$ m (**Tahrik makarası yarıçapı**) (excitation roller radius)
 $v = 1$ m/s
 $\beta^\circ = 60^\circ$
 $k_f = 0.25$
 $\eta_{red.} = 0.98$ (**Redüktör verimi/ Gearbox efficiency/ Getriebe Wirkungsgrad**)
 $n = ?$
 $P = ?$



Örnek 9: 1000 kg ağırlığındaki silindir 0.1 m yarıçaplı tahrik makaraları üstünde 1 m/s hızla taşınmaktadır. Makara devrini ve gerekli motor gücünü bulunuz.

Example 9: A 1000 kg cylinder moves on the horizontal axis supported cylinders with a velocity of 1 m/s. System efficiency is 0.98. Find the required power.

Beispiel 9: Ein Zylinder mit 1000 kg Gewicht wird auf einem Horizontalern Achse läufende Stütztrommeln gedreht. Zylinder

Umfangsgeschwindigkeit ist 1 m/s. Gesamt Wirkungsgrad ist 0,98. Gesucht ist Motor Leistung.

B = Winkel Faktor (Unten auf der Tabelle angegeben)

B = Açı faktörü (Aşağıdaki tabloda verilmiştir)

B = Angle factor (it is given in the table below)

B = 1.15 (60° için tablodaki değer)
 Makara devri:

B = 1.15 (value for 60° in the table)
 Speed of roller:

B = 1.15 (von der Tabelle für 60°)
 Zylinder Drehzahl:

$$n_{silindir} = 9.55 \cdot v \div r = \frac{9.55}{1.2}$$

$$n_{cylinder} = 9.55 \cdot v \div r = \frac{9.55}{1.2}$$

$$n_{zylinder} = 9.55 \cdot v \div r = \frac{9.55}{1.2}$$

⇒ $n_{silindir} = 7.95$ d/d

\hat{P} $n_{cylinder} = 7.95$ rpm

\hat{P} $n_{zylinder} = 7.95$ rpm

Makara devri:

Drive roller speed:

Trommel Drehzahl:

$$n_g = \frac{n \cdot r}{r_g} = \frac{7.95 \cdot 1.2}{0.1} = 95.4 \text{ d / d}$$

$$n_g = \frac{n \cdot r}{r_g} = \frac{7.95 \cdot 1.2}{0.1} = 95.4 \text{ rpm}$$

$$n_g = \frac{n \cdot r}{r_g} = \frac{7.95 \cdot 1.2}{0.1} = 95.4 \text{ upm}$$

Makara eksenine göre moment:

Torque at axis of the roller:

Stütztrommel Drehmoment:

$$M = m \times r_g \times k_f \times B$$

$$M = 1000 \times 0.1 \times 0.25 \times 1.15$$

$$\Rightarrow M = 28.75 \text{ Nm}$$

$$M = m \times r_g \times k_f \times B$$

$$M = 1000 \times 0.1 \times 0.25 \times 1.15$$

$$\hat{P} M = 28.75 \text{ Nm}$$

$$M = m \times r_g \times k_f \times B$$

$$M = 1000 \times 0.1 \times 0.25 \times 1.15$$

$$\hat{P} M = 28.75 \text{ Nm}$$

Motor gücü:

Motor power:

Motor Leistung:

$$P = \frac{M \cdot n_g}{9550 \cdot h} = \frac{28.75 \cdot 95.4}{9550 \cdot 0.98}$$

$$P = \frac{M \cdot n_g}{9550 \cdot h} = \frac{28.75 \cdot 95.4}{9550 \cdot 0.98}$$

$$P = \frac{M \cdot n_g}{9550 \cdot h} = \frac{28.75 \cdot 95.4}{9550 \cdot 0.98}$$

⇒ $P = 0.3$ kW

\hat{P} $P = 0.3$ kW

\hat{P} $P = 0.3$ kW

Tablo 6 / Table 6 / Tabelle 6

b8	08	208	408	508	608	708	808	908
B	1	1.02	1.06	1.1	1.15	1.22	1.31	1.41

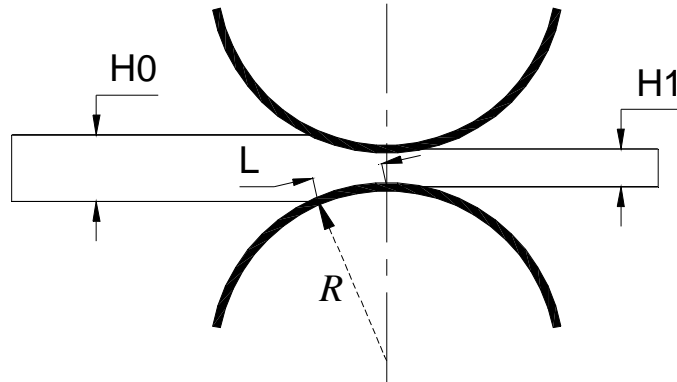


Soğuk Düz Haddeme

Flat Cold Rolling

Kalt Platte Wälzen

Malzeme / Material / Material: AISI 1015
 $H_0 = 3 \text{ mm}$
 $H_1 = 2.5 \text{ mm}$
 $w = 600 \text{ mm}$ (Plaka genişliği/Plate Width/
 Platte breite)
 $R = 300 \text{ mm}$
 $\mu = 0.08$
 $K = 450 \text{ MPa}$
 $v = 0.33$
 $H = (H_0 + H_1) / 2$
 $H = 2.75 \text{ mm}$



Örnek 10: 3 mm yüksekliğinde, 600 mm genişliğinde bakır levha 2.5 mm yüksekliğe 300 mm çaplı silindirle bir defa da 1.5 m/s hızla çekilecektir. Gerekli çekme kuvvetini ve gücü bulunuz.

Example 10: A copper alloy sheet with a dimension of 600 mm width and 3 mm thickness in single pass using rolls of 300 mm radius, and the coefficient of friction is 0.08. Find the power.

Beispiel 10: Ein Kupfer Platte mit 600 mm breite und 3mm dicke wird kalt gewälzt zu 2.5 mm. Wälztrommel Radius ist 300 mm. Reibungszahl ist 0.08. Gesucht ist Motor Leistung.

Temas yüzeyi uzunluğu:

$$L = \sqrt{r \cdot (H_0 - H_1)}$$

$$L = \sqrt{300 \cdot (3 - 2.5)} = 12.25 \text{ mm}$$

Eğer $H/L > 1$:
 $Q = 0.3 \times (H/L) + 0.7$

Eğer $H/L < 1$:

$$Q = \frac{H}{m \cdot L} \cdot (e^{m(L/H)} - 1)$$

$$s_{fm} = K \cdot \frac{e^v}{v+1}, \quad e = \ln \frac{H_0}{H_1}$$

$$H/L = 2.75 / 12.25 = 0.22 < 1$$

$$Q = 2.75 / (0.08 \times 12.25) \times (e^{0.08 \times (12.25/2.75)} - 1)$$

$$Q = 1.2, \quad \epsilon = \ln(3/2.5) = 0.182$$

$$s_{fm} = \frac{450 \cdot (0.182)^{0.33}}{(0.33+1)} = 192.8 \text{ MPa}$$

Silindirdeki kuvvet:
 $F = 1.15 \times L \times w \times Q \times \sigma_{fm}$
 $F = 1.15 \times 12.25 \times 600 \times 1.2 \times 192.8$
 $F = 1955570 \text{ N}$

Motor gücü:
 $P = F \times L \times (v/r) / 1000 \text{ (kW)}$
 $P = 1956 \times 12.25 \times (1.5 / 300)$
 $P = 119 \text{ kW}$

Contact surface length:

$$L = \sqrt{r \cdot (H_0 - H_1)}$$

$$L = \sqrt{300 \cdot (3 - 2.5)} = 12.25 \text{ mm}$$

If $H/L > 1$:
 $Q = 0.3 \times (H/L) + 0.7$
 If $H/L < 1$:

$$Q = \frac{H}{m \cdot L} \cdot (e^{m(L/H)} - 1)$$

$$s_{fm} = K \cdot \frac{e^v}{v+1}, \quad e = \ln \frac{H_0}{H_1}$$

$$H/L = 2.75 / 12.25 = 0.22 < 1$$

$$Q = 2.75 / (0.08 \times 12.25) \times (e^{0.08 \times (12.25/2.75)} - 1)$$

$$Q = 1.2, \quad \epsilon = \ln(3/2.5) = 0.182$$

$$s_{fm} = \frac{450 \cdot (0.182)^{0.33}}{(0.33+1)} = 192.8 \text{ MPa}$$

Force on the cylinder:
 $F = 1.15 \times L \times w \times Q \times \sigma_{fm}$
 $F = 1.15 \times 12.25 \times 600 \times 1.2 \times 192.8$
 $F = 1955570 \text{ N}$

Motor power:
 $P = F \times L \times (v/r) / 1000 \text{ (kW)}$
 $P = 1956 \times 12.25 \times (1.5 / 300)$
 $P = 119 \text{ kW}$

Berühr Länge:

$$L = \sqrt{r \cdot (H_0 - H_1)}$$

$$L = \sqrt{300 \cdot (3 - 2.5)} = 12.25 \text{ mm}$$

If $H/L > 1$:
 $Q = 0.3 \times (H/L) + 0.7$
 If $H/L < 1$:

$$Q = \frac{H}{m \cdot L} \cdot (e^{m(L/H)} - 1)$$

$$s_{fm} = K \cdot \frac{e^v}{v+1}, \quad e = \ln \frac{H_0}{H_1}$$

$$H/L = 2.75 / 12.25 = 0.22 < 1$$

$$Q = 2.75 / (0.08 \times 12.25) \times (e^{0.08 \times (12.25/2.75)} - 1)$$

$$Q = 1.2, \quad e = \ln(3/2.5) = 0.182$$

$$s_{fm} = \frac{450 \cdot (0.182)^{0.33}}{(0.33+1)} = 192.8 \text{ MPa}$$

Kraft auf der Zylinder:
 $F = 1.15 \times L \times w \times Q \times \sigma_{fm}$
 $F = 1.15 \times 12.25 \times 600 \times 1.2 \times 192.8$
 $F = 1955570 \text{ N}$

Motor Leistung:
 $P = F \times L \times (v/r) / 1000 \text{ (kW)}$
 $P = 1956 \times 12.25 \times (1.5 / 300)$
 $P = 119 \text{ kW}$

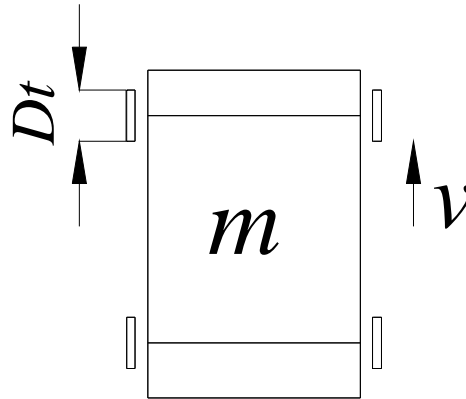


Doğrusal Hareket

Linear Movement

Linearbewegung

$m = 800 \text{ kg}$
 $D_t = 250 \text{ mm}$
 $d = 60 \text{ mm}$ (Teker Shaft Çapı /
 Shaft dimension of
 wheel / Radwelle
 Durchmesser)
 $v = 0.5 \text{ m/s}$
 $\eta = 0.85$
 $t = 1 \text{ s}$ (Motor Kalkış süresi / Motor
 Starting time / Motor
 Anlaufzeit)
 $P = ?$



Örnek 11: Toplam ağırlığı 800 kg, tekerlek çapı 60 mm, sistem verimi 0.85 olan araç 1 saniyede 0.5 m/s hıza ulaşarak hareketine aynı hızda yatay olarak devam edecektir (Teker milleri rulman yataklıdır).Gerekli motor gücünü hesaplayınız.

1 saniyede hızlanması için gerekli ivme:

$$a = \frac{v}{t} = \frac{0.5}{1} = 0.5 \text{ m/s}^2$$

$$F = m \times a = 800 \times 0.5 = 400 \text{ N}$$

Tekerin dönmesi için gerekli moment:

$$M_{teker} = F \times R_{teker}$$

$$M_{teker} = 400 \times 0.125 = 50 \text{ Nm}$$

Tekerin devri:

$$n = 9.55 \cdot \frac{v}{r} = 9.55 \cdot \frac{0.5}{0.125}$$

$$n = 38 \text{ d/d}$$

$$P_{teker} = \frac{M_{teker} \cdot n}{9550} = 0.2 \text{ kW}$$

Sürtünme kuvveti:

$$F = m \cdot g \cdot \left(\frac{2}{D} \cdot \left(\mu \cdot \frac{d}{2} + f \right) + c \right)$$

Rulman yataklar ve çelik üzerine çelik yüzeyler için:

$\mu = 0.005$ $f = 0.5$ $c = 0.003$ (Tablodan Sayfa 778)

$$F = 800 \cdot 9.81 \cdot \left(\frac{2}{250} \right) \cdot \left(0.005 \cdot \frac{0.60}{2} + 0.5 + 0.003 \right) = 64 \text{ N}$$

Example 11: A car with a total weight of 800 kg ,wheel axis diameter 60 mm, system efficiency 0.85 accelerates to 0.5 m/s velocity in 1 second and then moves at the same speed in the horizontal

direction (wheel shafts has roller bearings). Calculate the required power. Acceleration in 1 second:

$$a = \frac{v}{t} = \frac{0.5}{1} = 0.5 \text{ m/s}^2$$

$$F = m \times a = 800 \times 0.5 = 400 \text{ N}$$

Required torque to rotate the wheel:

$$M_{wheel} = F \times R_{wheel}$$

$$M_{wheel} = 400 \times 0.125 = 50 \text{ Nm}$$

Angular wheel speed:

$$n = 9.55 \cdot \frac{v}{r} = 9.55 \cdot \frac{0.5}{0.125}$$

$$n = 38.21 \text{ rpm}$$

$$P_{wheel} = \frac{M_{wheel} \cdot n}{9550} = 0.2 \text{ kW}$$

Friction force:

$$F = m \cdot g \cdot \left(\frac{2}{D} \cdot \left(m \cdot \frac{d}{2} + f \right) + c \right)$$

For roller bearings and steel on steel surfaces:

$\mu = 0.005$ $f = 0.5$ $c = 0.003$ (From table Page 778)

$$F = 800 \cdot 9.81 \cdot \left(\frac{2}{250} \right) \cdot \left(0.005 \cdot \frac{0.60}{2} + 0.5 + 0.003 \right) = 64 \text{ N}$$

Beispiel 11: Ein Wagen mit 800 kg Gewicht wird gefördert. Radwellen durchmesser ist 60 mm, Gesamt Wirkungsgrad ist 0.85. Wagen Geschwindigkeit ist 0.5 m/s und Anlaufzeit ist 1 sekunde. (Rollenkugellager auf Radschaft). Gesucht ist Motorleistung.

Anlauf Beschleunigung:

$$a = \frac{v}{t} = \frac{0.5}{1} = 0.5 \text{ m/s}^2$$

$$F = m \times a = 800 \times 0.5 = 400 \text{ N}$$

Drehmoment des Rades für Anlauf:

$$M_{rad} = F \times R_{rad}$$

$$M_{rad} = 400 \times 0.125 = 50 \text{ Nm}$$

Drehzahl des Rades:

$$n = 9.55 \cdot \frac{v}{r} = 9.55 \cdot \frac{0.5}{0.125}$$

$$n = 38 \text{ upm}$$

$$P_{rad} = \frac{M_{rad} \cdot n}{9550} = 0.2 \text{ kW}$$

Reibungs Kraft:

$$F = m \cdot g \cdot \left(\frac{2}{D} \cdot \left(m \cdot \frac{d}{2} + f \right) + c \right)$$

Für Kugellager und Stahl Rad über Stahl:

$m = 0.005$ $f = 0.5$ $c = 0.003$ (von Tabelle Seite 778)

$$F = 800 \cdot 9.81 \cdot \left(\frac{2}{250} \right) \cdot \left(0.005 \cdot \frac{0.60}{2} + 0.5 + 0.003 \right) = 64 \text{ N}$$



Sürtünme kuvveti için gerekli güç:

$$P_{\text{sürtünme}} = \frac{F \cdot v}{1000} = \frac{64 \cdot 0.5}{1000}$$

$P_{\text{sürtünme}} = 0.32 \text{ kW}$

Motor gücü:

$$P_{\text{motor}} = \frac{(P_{\text{teker}} + P_{\text{sürtünme}})}{h}$$

$$P_{\text{motor}} = \frac{0.2 + 0.32}{0.85}$$

$P_{\text{motor}} = 0.27 \text{ kW}$

Required power for friction force:

$$P_{\text{friction}} = \frac{F \cdot v}{1000} = \frac{64 \cdot 0.5}{1000}$$

$P_{\text{friction}} = 0.32 \text{ kW}$

Motor power:

$$P_{\text{motor}} = \frac{(P_{\text{whell}} + P_{\text{friction}})}{h}$$

$$P_{\text{motor}} = \frac{0.2 + 0.32}{0.85}$$

$P_{\text{motor}} = 0.27 \text{ kW}$

Leistung für Reibung:

$$P_{\text{reibungs}} = \frac{F \cdot v}{1000} = \frac{64 \cdot 0.5}{1000}$$

$P_{\text{reibungs}} = 0.32 \text{ kW}$

Motor Leistung:

$$P_{\text{motor}} = \frac{(P_{\text{rad}} + P_{\text{reibungs}})}{h}$$

$$P_{\text{motor}} = \frac{0.2 + 0.32}{0.85}$$

$P_{\text{motor}} = 0.27 \text{ kW}$

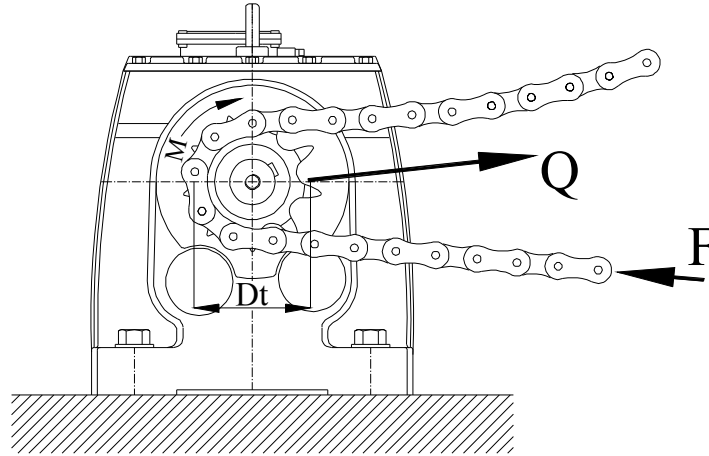
Yuvarlanma sürtünmesi / Coefficient of rolling friction / Rollreibung	f
Çelik üzerine çelik / Steel on steel / Stahl auf stahl	0.5
Çelik üzerine polimer / Polymer on steel / Polymer auf stahl	2
Rulman sürtünme katsayısı / Coefficient of friction for bearing / Lagerreihwerte	mL
Rulman yataklar / Roller bearings / Wölzlager	0.005
Kaymalı yataklar / Sleeve bearings / Gleitlager	0.08-0.1
Teker dış bileziğindeki sürtünme faktörleri / Factors for rim friction on the wheels / Beiwerte für Spurhranz und Seitenreibung	c
Rulmanlı tekerler / W heels with roller bearings / Wölzlagerte Röder	0.003
Kaymalı yataklı tekerler / Wheels with Sleeve bearing / Gleitlagerte Röder	0.005
Klavuz tekerler / Guide rollers / Seitliche Führungsrollen	0.002



Zincirle tahrik sistemlerinde dikkat edilecek hususlar

Important points bu using chain drives,

Folgende Punkte Beachten bei Kettenriemen



Zincir dişli ile kullanılan redüktörlerin çıkış milleri üzerine ilave değişken radyal yükler gelmektedir. Zincir dişlilerde poligon tesiri denilen etki nedeni ile oluşan bu yükler çok yüksek değerlere ulaşabilir.

Zincirler çokgen (poligon) gibi davranan zincir dişliler üzerinde yuvarlanmaktadır.

Dişli üzerindeki etkin yuvarlanma çapı 'd' ile $d \cdot \cos(t/2)$ arasında değişmekte ve bu da dişli sabit bir açısız hız ile döner iken, zincirde $u_{max} = w \cdot d / 2000$ ile

$$u_{min} = w \cdot \cos(t/2) \cdot d / 2000$$

arasında hız farkı yaratmaktadır. Arka sayfadaki grafiklerde yol, hız ve ivmenin zamana bağlı olarak nasıl değiştiği gösterilmiştir. Grafiklerde görüldüğü gibi lineer gibi görünen yüklerde dahi zincir dişliler darbeli yük etkisi yaratmaktadır. Bu etki diş sayısı azaldıkça artmaktadır. DIN 8195'de zincir dişliler için en düşük diş sayısı bu etkiler nedeni ile 17 olarak önerilmektedir. Arkadaki sayfalarda diş sayısına bağlı olarak oluşan max. hız değişim oranı ve yine 11,17 ve 25 diş sayısına sahip dişlilerin bir turda oluşturduğu hız değişim oran grafiği gösterilmektedir.

Gearboxes which are used with chain drives are loaded with additional radial loads. Because of the polygon effect of chain drives these loads can be very high which endangers the gearbox.

The chain lies on a sprocket wheel in the form of a polygon; hence, the effective pitch circle diameter will vary from 'd' to $d \cdot \cos(t/2)$ therefore from $u_{min} = w \cdot \cos(t/2) \cdot d / 2000$ to $u_{max} = w \cdot d / 2000$ On the following graphic, change of way, speed and acceleration in relation to the angle are shown. As it can be understood from the graphics, even linear loads can cause moderate or heavy shock loads because of the polygon effect of chain gears. This "polygon effect" becomes more pronounced as the number of sprocket teeth is reduced. For a number of reasons DIN 8195 "selection of chain drives" recommends that chain sprockets with at least 17 teeth should be chosen. On the following tables, the polygon effect and the resulting cyclic irregularity of the chain speed are shown in relation to the number of teeth on the driving sprocket.

Kettenräder auf Getriebe Abtriebswellen verursachen Zusatzkräfte auf Getriebe Abtriebswelle Diese kräfte können sehr hoch sein weil die so genannte "polygon effekte" auftreten.

Infolge der vieleckförmigen Auflage der Kette auf den Rad schwänkt der wirksame Durchmesser am Rad nach dem unten angegeben bilden zwischen

'd' und $d \cdot \cos(t/2)$ und damit bei konstanter Winkelgeschwindigkeit die Kettengeschwindigkeit zwischen $u_{max} = w \cdot d / 2000$ und

$$u_{min} = w \cdot \cos(t/2) \cdot d / 2000$$

Die unten angegebenen bilden zeigen die Änderung der Kettengeschwindigkeit, Kettenweg und Kettenbeschleunigung gegen Zeit. Aus diesen Bildern kann man sehen das auch ein linearer Antrieb mit einem Kettenriemen höhere Stoßkräfte verursachen kann. Kleinere Zahnzahlen vergrößern diesen Polygoneffekt, darum ist es im DIN 8195 Zahnzahl größer als 17 empfohlen. Unten ist die Zahnzahl abhängige Geschwindigkeit Änderung und Schwingungen nach 11,17 und 25 Zahnzahlen gezeigt.



Zincir dişlilerin kullanıldığı redüktörlerin bağlandığı zeminin çok rijit olmasına dikkat edilmelidir. Zincir dişlilerde oluşan gergi kuvvetleri redüktör milini kendine doğru çekmeye çalışırken, aynı zamanda bağlantı şasisini esnetebilir ise, zincir bakla atlatabilir. Zincir atlatma esnasında oluşan şok yükler nominal yüklerin 10 katına kadar ulaşabilir. Oluşan bu ani yükler nedeni ile redüktör mili, rulmanı ve hatta gövdesi hasar görebilir. Bu neden ile şasisinin rijitliği büyük önem taşımaktadır.

Zincir dişliler aşındığında, zincir ve zincir dişli set olarak değiştirilmelidir. Aksi takdirde oluşan taksimat farkları nedeni ile her dişliden dişliye geçişte yüksek darbeli yükler oluşabilir.

Zincir dişli tahriklerde, zincir bakla büyüklüğünün doğru seçilmemiş olması bir diğer problemdir. Uygun büyüklükte seçilmeyen zincirler kısa süre içerisinde çekme tarafında uzama yaparak, boşalma tarafında sarkmalara neden olur. Yeterince kontrol altında tutulmayan uygulamalarda bu etki nedeni ile bakla atlattılar ve yukarıda bahsedilen problemlerin ortaya çıkması muhtemeldir.

If gearboxes are used with chain and sprockets, the plate where the gearboxes are assembled must be very rigid. Because of the radial force acting to the output shaft, the gearbox together with its plate can stretch towards the load like a loaded spring especially with weak mounting plates. These affect dangers the gearbox output shaft, bearings or even the housing of the gearbox because of the risk that the chain skips the teeth and jumps to the next. At this time the resulting force can be 10 times higher than the nominal values. Therefore the mounting plates must be very rigid to prevent damages.

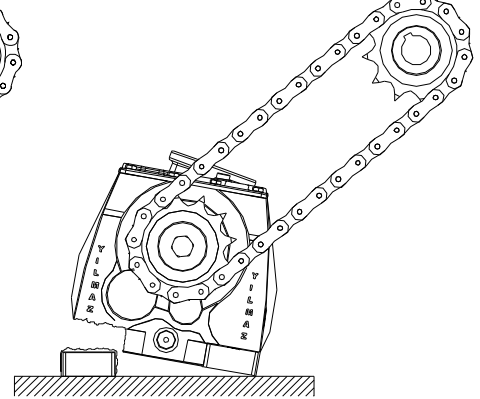
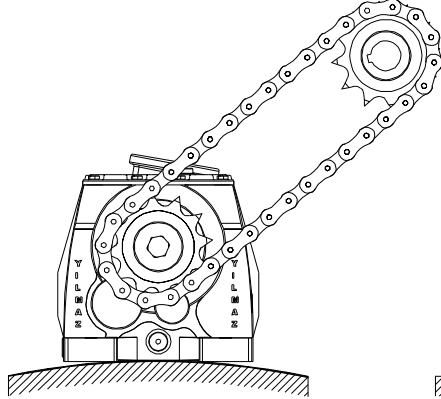
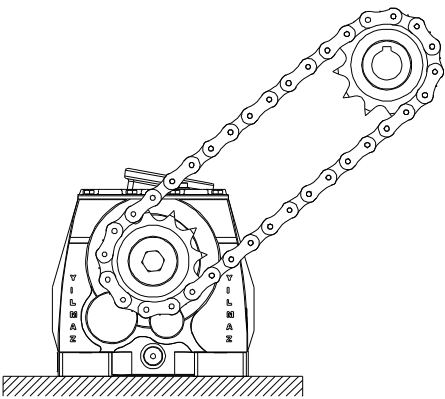
If chain or sprocket is worn out, they must be changed in sets. Changing only the chain or sprocket will result in pitch deviations. These deviations can cause high pick loads on each teeth change and can damage the gearbox.

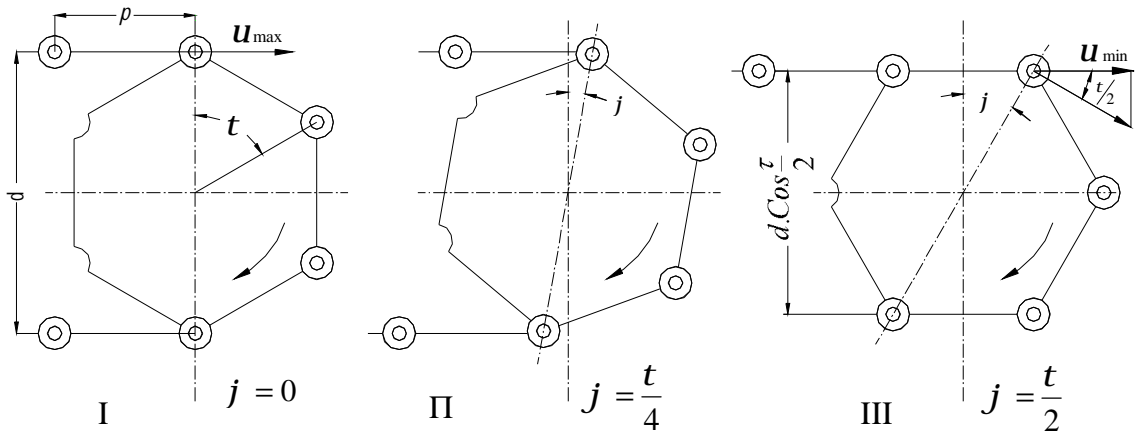
Selecting the suitable chain size according the required power is very important. Smaller chain sizes than required, can lead to extents on the chains. The extended chain can cause teeth jumps which result heavy shock loads. Again the above mentioned risks are likely to appear.

Getrieben mit Zahnriemenabtrieb müssen sehr stabil montiert werden. Die entstehende Zahnriemenkräfte ziehen die Getriebe Abtriebswelle und wenn die Befestigungsplatte nicht stabil genug ist - dann auch die Befestigungsplatte zusammen wie ein Feder. Die Kette kann in dieser Zeit ein Spring machen und 10 mal größere Radialkräfte verursachen. Diese Kräfte können Getriebewelle, Lager oder Gehäuse Schaden verursachen. Darum müssen die Befestigungsplatten stabil genug sein.

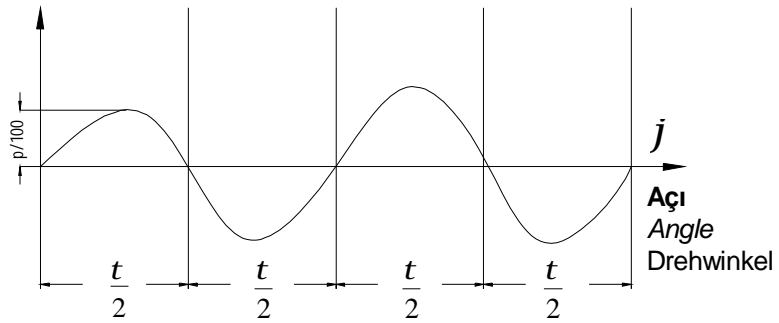
Wenn Kette oder Kettenrad sich abnutzen dann müssen beide Teile als Satz gewechselt werden. Sonst können Teilungsfehler entstehen. Diese Teilungsfehler können zu höheren Radialkräften führen und Getriebe Schaden können entstehen.

Die richtige Kettengröße Auswahl für die übertragene Leistung ist sehr wichtig. Bei falscher Kettengröße Auswahl kann die Kette sich verlängern und zum Zahn sprung führen wieder die oben genannte Gefahren können die Getriebe Schaden.

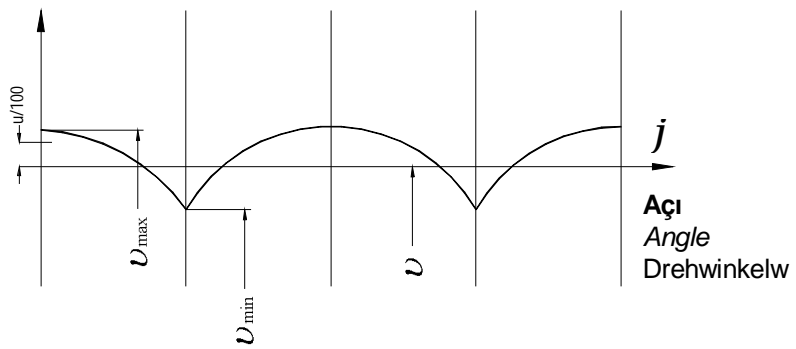




Yol değişimi
 Change of way (ΔS)
 Wegänderung

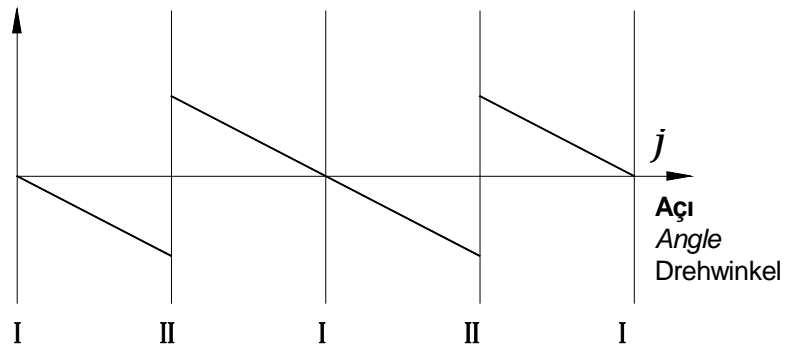


Hız değişimi
 Speed change (Δu)
 Geschwindigkeits
 änderung



İvme değişimi
 Acceleration change
 Beschleunigungs
 änderung

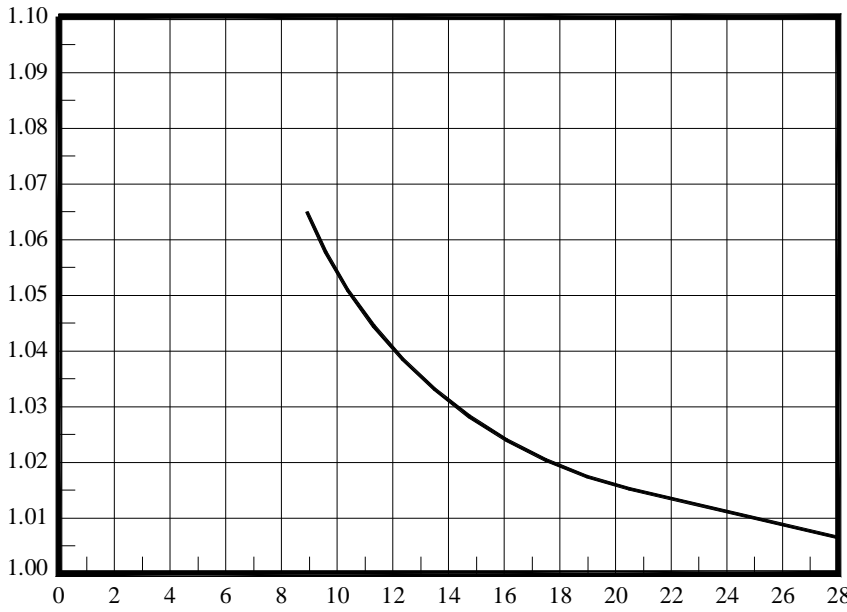
$$b = du/dt$$



j : Açı
 Angle
 Drehwinkel

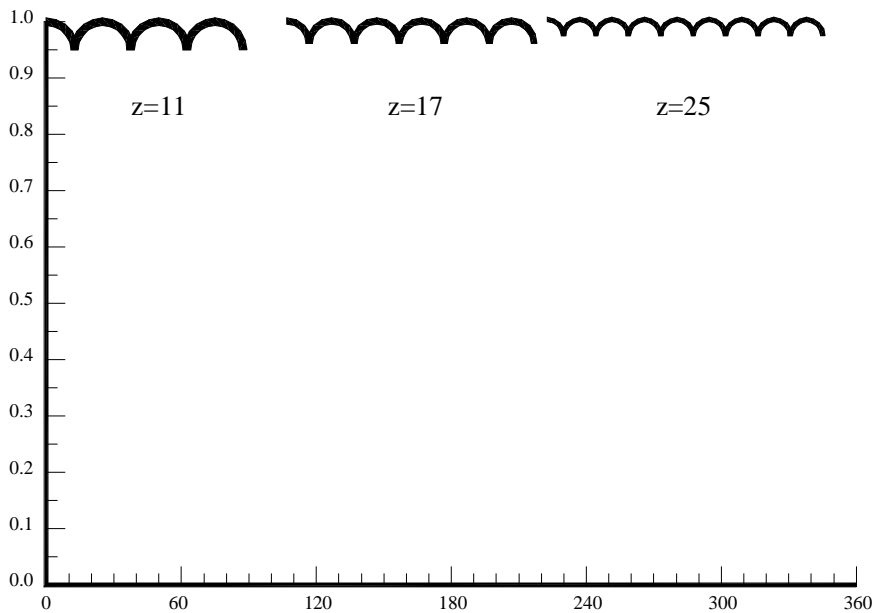


U_{\max}/U_{\min}



Diş sayısı
Teeth number
Zähnezahl

u/u_{\max}



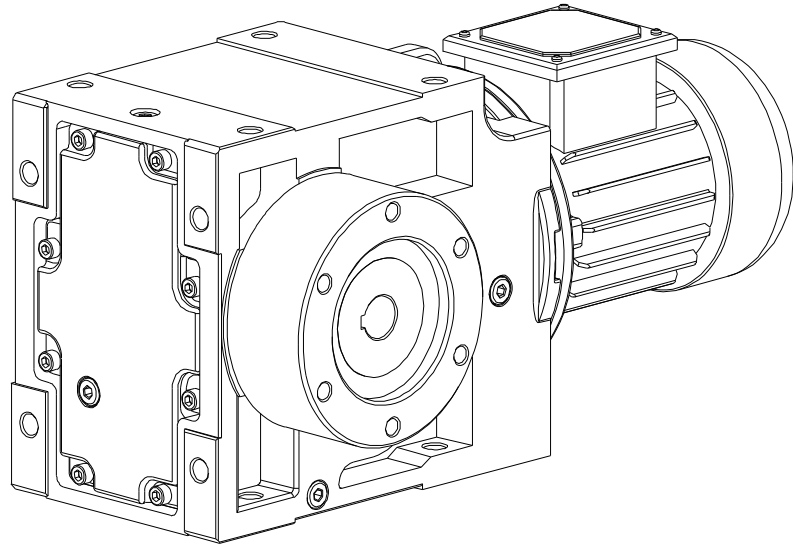
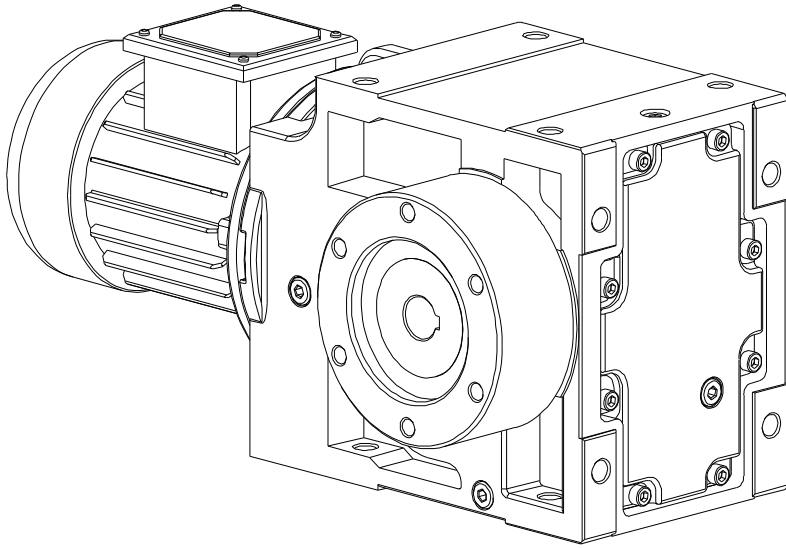
j : Açı
Angle
Drehwinkel



KR Tipi ekstruderler için lütfen firmamıza danışınız

Please convey your request for KR series extruder types to YILMAZ REDUKTOR

Bitte rüchfragen für KR Serien mit extruder flansch.



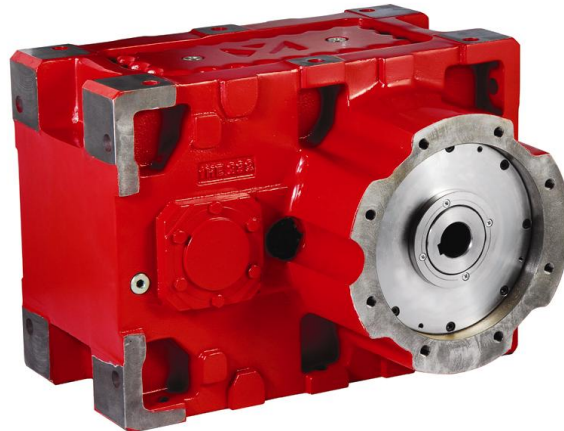
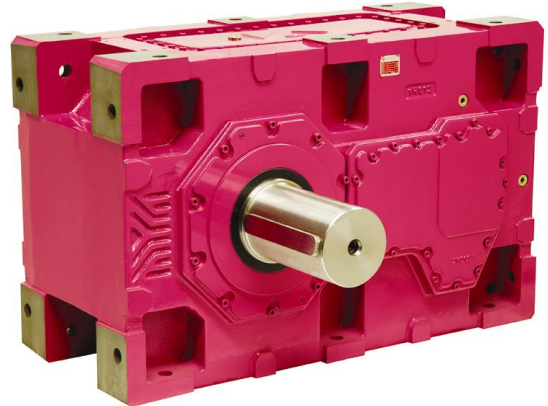


YENİ H SERİSİ / NEW H SERIES

80.000 Nm'ye kadar standart olarak 10 büyüklük halinde sunulan H serisi modüler ve monoblok yapıda olup, opsiyonel yağlama ve soğutma özellikleri ile opsiyonel çıkış flanşı, IEC B5 motor akuplesi, çift giriş, çift çıkış gibi opsiyonel uygulamalarla, standart olarak sunulmaktadır. Katalog ve daha detaylı bilgi için firmamıza danışınız.

The new H series Gearboxes are manufactured up to 80.000 in 10 different sizes. The gearboxes are manufactured as single housing. Optional forced lubrication, cooling options, output flanges or IEC B5 flanges, different shaft arrangements are available. For a catalogue and more information please contact us.

Tip Type	Çenrim oranı Ratio	Max. Moment Max. Torque
H23	6,02-21,8	3600 Nm.
H27	6,28-91,36	6700 Nm.
H31	5,75-82,24	11200 Nm.
H35	7,17-102,51	14700 Nm.
H38	5,95-345,12	21000 Nm.
H42	7,27-421,25	26600 Nm.
H45	6,33-358,57	33400 Nm.
H50	7,64-431,33	42000 Nm.
H54	8,92-338,38	61000 Nm.
H61	7,52-430,23	80000 Nm.

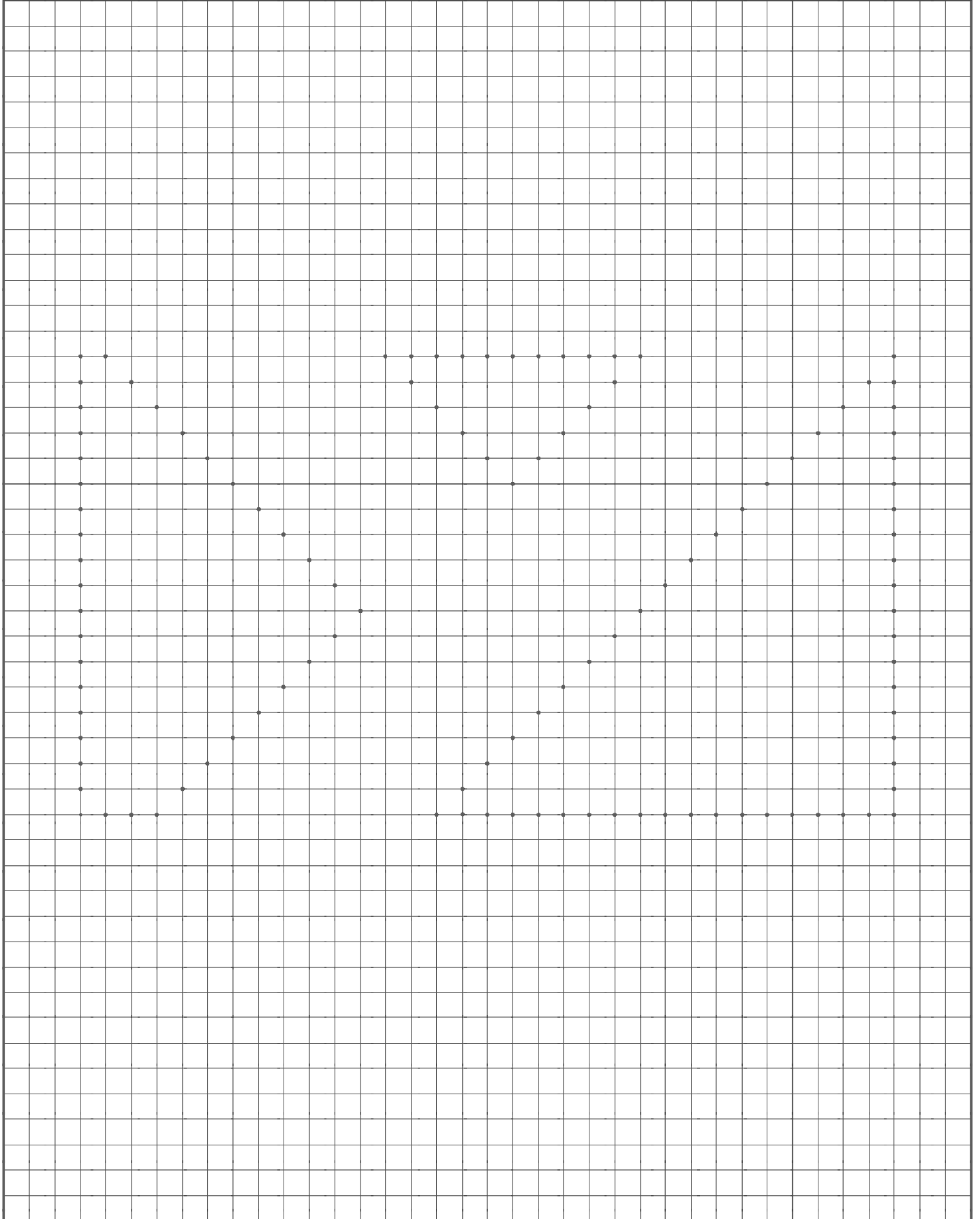




Notlar

Notes

Notizen





YENİ H SERİSİ / NEW H SERIES

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