暐宇貿易

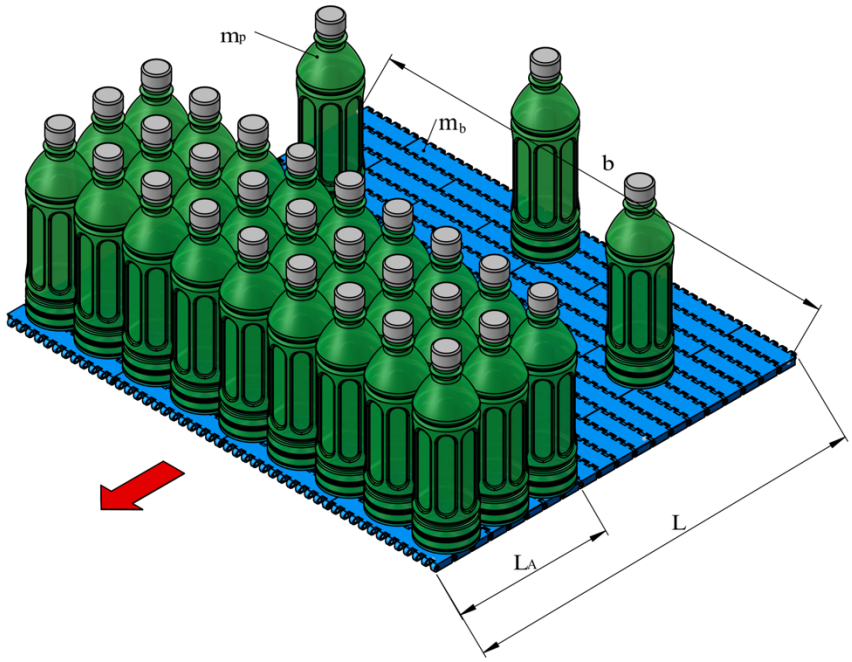
直線網帶拉力計算

02-22182201 02-22182231
staruni168@yahoo.com.tw
http://www.staruni168.com
新北市新店區民生路17號

Belt Calculations(直線網帶計算)

Tensile Forces(拉力計算)

The tensile force in a straight running belt conveyor with horizontal transport can be calculated by using of below equation.



Variable Key

F_B	=	Tensile force in the belt, N (lbf)	網帶拉力
m_p	=	Product weight, kg/m^2(lb/ft^2)	輸送物重量(m^2)
m_b	=	Belt weight, kg/m^2 (lb/ft^2)	網帶重量(m^2)
L	=	Conveyor length, m(ft)	輸送帶長度(m)
L_A	=	Length where accumulation occurs, m (ft)	堆積長度(m)
μ_1	=	Friction coefficient, belt-wearstrip.	網帶-墊片間摩擦係數
μ_2	=	Friction coefficient, belt-product.	網帶-輸送物間摩擦係數
b	=	Belt width, m (ft)	網帶寬度(m)
F_{ad_j}	=	Maximum adjusted permissible tensile force.	受環境影響許可最大拉力
C	=	Force conversion factor. Metric:9.8 ; Imperial:1.0	換算係數
SF	=	Service factor.	輸送帶啟動次數

Equations (計算方程式)

$$F_B=\left[\left(m_P+2\times m_b\right)\times L\times \mu_1+m_P\times L_A\times \mu_2\right]\times b\times C\right]\times SF$$

The possibilities of choosing a different belt material, using reinforcement links in the belt or changing in the parameters m_p, L, L_A, μ_1 or μ_2 should be considered if their load is too heavy.

Load Control(負載控制)

$$\frac{F_B}{b}<F_{ad_j}$$

Calculation Factors（計算係數）

Values provided in the tables below are dynamic friction under clean conditions. Values will be 0.1 to 0.2 higher at the starting moment. If possible it is recommended to start the conveyor unloaded and gradually apply load.

Friction Coefficient (μ_1) between Chain/Belt and Wearstrip（網帶與墊片摩擦係數）

Chain/Belt Material	Wearstrip Material					
	UPE (Dry)	UPE (Wet)	UPE (Oil)	Nylatron (Oil)	SS-Steel (Dry)	SS-Steel (Wet)
POM-NL	0.20	0.15	0.12	0.22	0.25	0.21
POM-D	0.19	0.14	0.12	0.21	0.24	0.20
POM-LF	0.18	0.13	0.12	0.20	0.23	0.19
POM-SLF	0.17	0.12	0.12	0.19	0.22	0.18
POM-SX	0.15	0.10	0.11	0.17	0.20	0.16
PP	0.25	0.20	0.15	0.28	0.30	0.27
PE	0.25	0.20	0.15	0.28	0.25	0.20
PA6.6	0.20	-	0.15	0.22	0.30	-
GR	0.26	0.22	0.18	0.29	0.32	0.25
AR	0.26	0.22	0.18	0.29	0.32	0.25

Friction Coefficient, (μ_2) between Chain/Belt and Procuct（網帶材質與輸送物摩擦係數）

Chain Material	Lubrication	Product Material			
		Glass	Metal	Plastic	Cardboard
Carbon Stainless Steel	Water	0.25	0.25	0.2	-
	Water + soap	0.15	0.15	0.1	-
	Oil	0.15	0.15	0.1	-
POM-D (Acetal)	Dry	0.18	0.24	0.22	0.27
	Water	0.16	0.21	0.19	-
POM-LF (Acetal)	Dry	0.15	0.20	0.18	0.21
	Water	0.12	0.18	0.16	-
POM-SLF (Acetal)	Dry	0.12	0.15	0.15	0.19
	Water	0.10	0.14	0.14	-
AR/GR	Dry	0.27	0.32	0.26	0.31
	Water	0.25	0.30	0.25	-
PP	Dry	0.19	0.32	0.17	0.22
	Water	0.17	0.30	0.15	-
PE	Dry	0.10	0.13	0.10	0.15
	Water	0.09	0.11	0.09	-

Calculation Factors

Service Factors (SF) (輸送機啟動次數/時)

Conveyor Condition/ Start-Stop per hour	Straight Conveyor	Incline/Decline Conveyor	Curve Conveyor
Clean	0-4/hour	1.0	1.2	1.4
Clean	5 or more /hour	1.2	1.3	1.5
Averagae	0-4/hour	1.2	1.4	1.5
Averagae	5 or more/hour	1.4	1.5	1.6
Dirty	0-4/hour	1.4	1.6	1.8
Dirty	5 or more/hour	1.5	1.7	1.9

Speed Factors (C_s) (網帶移動速度)

0-20 m/min	1.00
at 30 m/min	0.85
at 45 m/min	0.75
at 60 m/min	0.70
above 120 m/min	0.65

Note: Speed factor can be used for all belts and chains. For sideflexing belts, please check load/speed relations first and only use speed factor if the load/speed relation for your particular belt/weartrip combination is not listed.

Temperature Factors (C_T) (溫度係數)

	POM	PP	PE	PA6.6	PA6.6-GFH
at -79°C	n/a	n/a	1.35	n/a	n/a
at -40°C	1.05	n/a	1.30	1.10	1.00
1°C	1.05	1.00	1.10	1.05	1.00
20°C	1.00	1.00	1.00	1.00	1.00
40°C	0.95	0.85	0.50	0.90	1.00
60°C	0.90	0.60	0.40	0.55	-
80°C	0.60	0.40	0.25	0.30	-
90°C	0.40	0.35	-	0.25	-
100°C	-	-	-	0.20	-
120°C	-	-	-	0.17	-
140°C	-	-	-	0.16	-
160°C	-	-	-	-	-
180°C	-	-	-	-	-

Belt Calculations

Expansion and Contraction of the Belt (網帶膨脹、收縮)

Expansion/contraction of the belt may occur at special working conditions where the belt is exposed to changes in temperature.

Such changes in the belt width and belt length must be taken into consideration when the conveyor is constructed.

Variable Key

ΔL	=	Lengh/width expansion, mm(in.)	膨脹長度(m)
L	=	Lengh/width of belt at temperature T_1, m(ft)	輸送帶總長度(m)
T_2	=	Working temperature, ℃(℉)	工作溫度
T_1	=	Surrounding temperature, ℃(℉)	環境溫度
e_c	=	Expansion coefficient. See table below	材質膨脹(如下圖)

Expansion and Contraction (e_c) (膨脹、收縮係數)

	$\frac{mm}{m \times ℃}$	$\frac{in.}{ft \times ℉}$
POM	0.12	0.0008
PP	0.13	0.0009
PE	0.18	0.0012
PA6/PA6.6	0.11	0.0007

The change in belt dimensions formula (網帶膨脹計算)

$$\Delta L = L \times e_c \times (T_2 - T_1)$$

Expansion/contraction in the longitudinal direction can be minimized by use of steel reinforcement links.

Example:

Belt material: PP

Belt width: 2.414m

Belt lenght: 10m

Belt type: OPB-Rib-PP/G-PP-2414

$$\Delta L = L \times e_c \times (T_2 - T_1)$$
$$\Delta L = 10 \times 0.13 \times (75 - 25)$$
$$\Delta L = 65mm \text{ (膨脹長度)}$$

Note: 輸送機設計須預留 65mm 長度設計

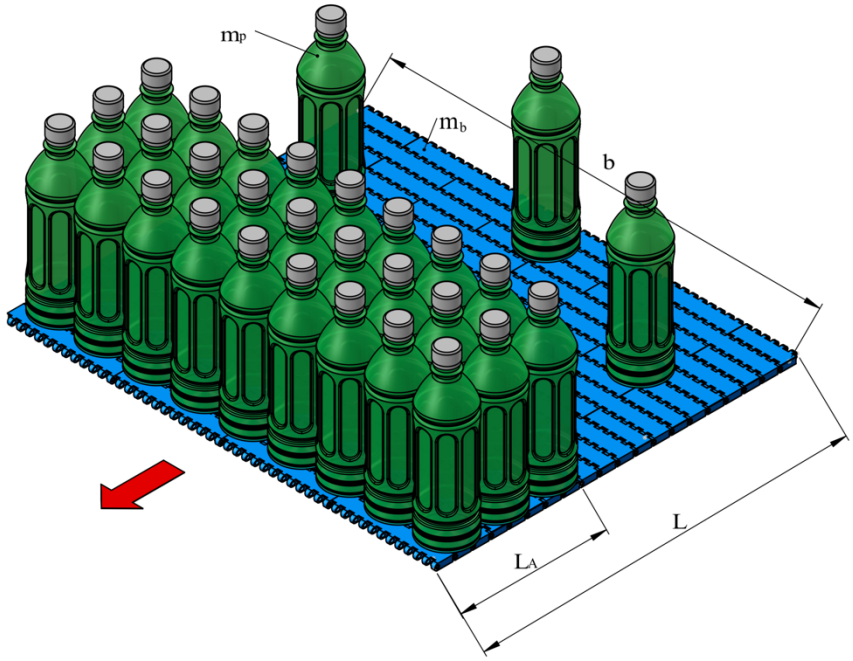
Special Design Guidelines (特殊設計指南)

Expansion due to Water Absorption (吸水膨脹率)

All plastic materials absorb water from the surroundings, but very often it is not a major factor – except when dealing with Nylon (PA) material. With Nylon there can be a considerable change in dimension depending on the environment where the part is placed. The absorption of water causes the plastic part to swell and thus leads to a volume increase. The chart below shows the dimensional expansion of different materials due to moisture absorp-tion. Please note that the expansion shown here does not necessarily translate into belt/chain dimensions as there are many other factors involved.

Material	Water Absorption ISO 62 / ASTM D570		Linear Dimensional Expansion Water Absorption	
	Equilibrium 23℃ / 50% RH(%)	Saturation 23℃(%)	Equilibrium 23℃ / 50% RH(%)	Saturation 23℃(%)
PP	0.02%	0.03%	0.01%	0.01%
PE	0.02%	0.03%	0.01%	0.01%
POM	0.22%	0.80%	0.10%	0.37%
PA6	2.80%	8%-10%	1.05%	3%-3.38%
PA6.6	2.50%	7%-8.5%	0.95%	2.7%-3.2%
PA6.6-GFH	2.00%	6.00%	0.80%	2.36%
PBT	0.20%	0.50%	0.09%	0.22%
PBT-GR	0.15%	0.40%	0.07%	0.19%
NBWR	0.20%	0.60%	0.08%	0.24%

Example:



網帶資料:

Belt material: POM

Pin material: Polypropylene

Belt type: OPB 4V-23% Rib

Belt width: 1.97m

輸送條件:

m_p = 60.0 kg/m^2

m_b = 14.6 kg/m^2

L= 9 m

L_A= 4 m

μ_1 = 0.18 $\mu_1$start = 0.34

μ_2 = 0.15 $\mu_2$start = 0.31

b = 9 m

計算公式:

$$F_B=\left[\left[(m_P+2\times m_b)\times L\times \mu_1+ m_P\times L_A\times\mu_2\right]\times b\times C\right]\times SF$$

$$F_B=\left[\left[(60+2\times 14.6)\times 9\times 0.34+ 60\times 4\times 0.31\right]\times 2.1\times 9.8\right]\times 1$$

F_B= 7149N(啟動瞬間)

$F_{B,\ permissible}$ = 22000 N/m

$\frac{F_B}{b} < F_{ad_j}$ $\quad \frac{7149}{2.1} = 3404\ \text{N/m} < 22000\ \text{N/m}$