APRON CONVEYORS

Design principles

1 - SCOPE

Apron conveyors are continuous conveyors, with chains as driving components, and with flat, (corrugated), or curved plates, flanged or unflanged, spaced or overlapping, as carrying components attached to the chain.

The chain may also be made of the carrying components, by direct coupling of the carrying components.

The carrying components are themselves carried and held by rollers moving with the apron or by rollers fixed to the supporting structure.

The apron conveyors are used for the transport of both loose bulk materials and unit loads.

2 - APPLICATION

These design principles are applicable to :

- apron conveyors according to nomenclature FEM II - 214 081.
- pan conveyors according to nomenclature FEM II - 214 082.
- apron conveyors with closed pans according to nomenclature FEM II - 214 083.
- slat conveyors (metal or wood) according to nomenclature FEM II - 2.21.04, 2.21.041, 2.21.042.

These design principles are not applicable to apron conveyors, which are used for silo tapping.

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3 - SYMBOLS AND UNITS

SYMBOL	DESCRIPTION	UNIT
a	distance between pans (pitch between pans)	m
a_{St}	average distance of unit loads	m
A	filling cross section	m^2
A_{th}	theoretical filling cross section	m^2
b	material carrying width	m
b_1	open space of chute	m
B	conveyor width	m
c	rolling friction coefficient (in flanged rollers)	-
e	rolling friction lever arm	mm
f	hypothetical friction value	-
F_{dyn}	dynamic chain pull	N
F_H	main resistance	N
F_K	maximum chain pull	N
F_{K1}	maximum chain pull in nominal service	N
F_{K2}	maximum chain pull when starting	N
F_N	secondary resistance	N
F_R	resistance due to friction	N
F_S	special resistance	N
F_{St}	resistance due to the slope	N
F_U	driving wheels peripheral force	N
F_V	initial tension pull per strand	N
g	acceleration of gravity	m/s^2

SYMBOL	DESCRIPTION	UNIT
h	filling height	m
h_1	height of the conveyed cross section	m
h_2	height of the adjoining pan partition	m
h_B	height of the trough or pan side partitions	m
H	conveyor lift (ascending positive, descending negative)	m
I_M	mass capacity	kg/s
I_{St}	unit load capacity	units/s
I_V	volume capacity	m^3/s
k	reducing factor due to slope	-
ℓ	travel length between skirtplates	m
L	conveyor centre distance	m
L_1	loaded length of conveyor	m
m_{St}	average mass of unit loads	kg/unit
N	number of teeth on the chain wheel	-
P_A	driving power applied to the chain wheel(s)	W
P_{Mot}	motor power	W
q_G	mass per metre of conveyed material (load per section)	kg/m
q_K	mass per metre of conveyor chain (moving rollers included)	kg/m
q_{Ro}	mass of the revolving parts of upper carrying rollers per metre of conveyor length	kg/m
q_{Ru}	mass of the revolving parts of lower carrying rollers per metre of conveyor length	kg/m
r	pivot radius of carrying rollers moving or fixed	mm
R	external radius of carrying rollers moving or fixed	mm
t	chain pitch	m
v	conveying speed (chain speed)	m/s
V	filling volume of an individual pan	m^3
V_{th}	theoretical filling volume of a pan	m^3

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SYMBOL	DESCRIPTION	UNIT
β	maximum angle of repose of bulk material	-
β_{dyn}	dynamic angle of repose of bulk material	-
δ	conveyor slope angle	-
η_{ges}	efficiency between motor and chain wheel	-
μ_W	friction value between conveyed material and skirtplates	-
μ_Z	bearing friction coefficient	-
ρ	density of conveyed bulk material	kg/m^3
φ	filling factor	-
ω	angular speed of the chain wheel	rad/s

4 - CAPACITY

4.1 Volume capacity for continuous conveying of bulk material
(for apron conveyors and pan conveyors)

The volume capacity I_V is the product of the conveying speed v by the filling cross section A

$$I_V = v \cdot A \qquad (1)$$

4.2 Volume capacity in pulsatory conveyance of bulk materials
(apron conveyor with closed pans)

The volume capacity I_V is the product of the filling volume V of each individual pan by the quotient of the conveying speed v by the distance a separating the pans :

$$I_V = V \cdot \frac{v}{a} \qquad (2)$$

4.3 Unit load capacity

The unit load capacity I_{St} is equal to the quotient of the transport speed by the average distance a_{St} separating the unit loads :

$$I_{St} = \frac{v}{a_{St}} \qquad (3)$$