

Lars 8''

Vacuum pneumatic conveying calculation input screen

Client: Lars | File path: c:\Vaslate.txt | Product: Ground slate | Date: 05-08-2013 Time: 16:41:53

Gas medium: Air Nitrogen Oxygen

Gas pump: Screwcompressor with pre-inlet

Ambient (Vacuumpump outlet): Ambient temperature 35 degC, Intake gas temperature 35 degC, Pre inlet-intake temperature 35 degC, Altitude 0 m, Altitude press. 1013 mbar

Temperatures: Ground slate temperature 40 degC, Heat transmission fact. pipewall 0,1 kcal/sec/degC/m2

Material properties: Ground slate particle density 2250 kg/m3, Bulk density 1280 kg/m3, Part. size 17 mesh, Susp. vel. 6,83 m/sec

Convey pipeline: Convey distance horizontal 11 m, Convey distance vertical 5,5 m-up 0 m-down, Convey distance slope 0 m-up 0 m-down, Total conveying length 16,5 m, Number of Bends 3

Calculation settings: High vacuum system, Vacuum 4,267 psi, Set capacity 166008 lbs/hr -> 75,3 tons/hr, Set vacuum 0,3 bar 3000 mmWC

Calculation selection: Vacuum fixed -> capacity calculated

Calculation Table Vacuum Conveying

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Conv. dist.: Hor. 11 m Bends 3

Vert. 5,5 m-up 0 m-down Total 16,5 m

Pump displ. at 0.3 bar(u) 0,742 m3/s 0,588 kg/s

Rotarylock leakage 0 m3/sec

Gas displacement at end 0,7567 m3/sec

Volumetric efficiency 94,08 %

New set capacity 60 tons/hr

Capacity 75,3 tons/hr 3000 mmWC -0,3 bar

Pressure drop 3000 mmWC

Loading ratio 35,5

Rotarylock capacity 0 tons/hr

Pipeline energy consumption 0,46 kWh/ton

Vacuum pump power 34 kW

Conveying power 17,3 kW

Pneumatic conveying efficiency 49,7 %

Bend losses 1,1 kW

Material intake loss 0,8 kW

Material intake pressure drop 100 mmWC

Re-number 1,752 * 10^-5

Empty pipeline pressure drop 798 mmWC

Empty pipeline air displ 0,7676 m3/sec

Empty pipeline filter press. drop 616 mmWC

Material constant loss factor 0,15

Material loss factor 0

Filter receiver diameter => 0,74 m

Can velocity <= 1,724 m/s

Part	Part description	Length(m)	v-gas m/sec	v-product m/sec	Pressure drop mmWC	Vacuum bar	v-wall/v-susp	residence time sec	mass kg	temperature degC	kW	kW%	kW	Bend loss % kW	Sediment	RH%
1	Intake 203 hor	1	18,65	5,78	385	-0,039	1,54	0,2583	1	39	0,9	5,4				58
2	Pipe 203 hor	5	19,48	7,2	979	-0,098	1,54	0,9873	8	39	3,3	19,4				55
3	Diameter Transfer		19,48	7,2	979			0,9873			0	0				
4	Pipe 203 hor	0	19,48	7,2	979	-0,098	1,54	0,9883	0	39	0	0				55
5	Bend		26,9	2,84	986			1,0884	0	39	0	0	0,4	2,6		
6	Pipe 203 up	5	21,51	6,17	1743	-0,175	1,36	2,0054	8	38	4,6	26,8				52
7	Diameter Transfer		21,51	6,17	1743			2,0054			0	0				
8	Pipe 203 up	0,5	21,68	6,22	1813	-0,182	1,36	2,0864	0	38	0,4	2,5				51
9	Bend		28,81	3,21	1822			2,1922	0	38	0	0	0,2	1,7		
10	Pipe 203 hor	5	22,96	7,93	2423	-0,243	1,67	2,9152	7	38	4	23,3				48
11	Bend		27,55	4,7	2430			2,9911	0	38	0	0	0,4	2,4		
12	Outlet		27,55	4,7	2397	-0,24		2,9911		38	0,2273	1,3				
13	Filter 34,5 m2		1,2	m/min	3000	-0,301		2,9911			3,6429	20,9				dp = 533 mmWC

Progress: Filter 5, Iteration 5

Buttons: Back to start menu, Print calculation, Change product, Calculation finished (Recalc.), New Calculation, Calculation results, No condensation

Calculation results vacuum conveying

Client: Lars
 Filepath: c:\V\slate.txt
 Product: Ground slate

Conveypipeline
 Convey dist. hor.: 11 m
 Convey dist. vert.: 5,5 m-up 0 m-down
 Convey dist. slope: 0 m-up 0 m-down
 Total Length: 16,5 m
 Nu of Bends: 3
 Pipe diameter: 203 mm

Calculation results
 Capacity: 75,3 tons/hr
 Vacuum: 0,3 bar
 Pressure drop: 3000 mmWc
 Loading ratio: 35,5
 Volumetric loading ratio: 0,05532 to 0,03928
 Empty pipeline vacuum: 798 mmWc
 Residence time: 2,99 seconds
 Re-number * 10⁻⁵: 1,752
 Mixture density at intake: 40,4 kg/m³
 Mass of material in pipeline: 28,8 kg Sedim. 0 kg

Pressure drops
 Product intake: 100 mmWC 3,3 %
 Nozzle (total dp): 385 mmWC 12,8 %
 Acceleration excl product dp: 240 mmWC 7,9 %
 Product resistance: 886 mmWC 29,5 %
 Elevation: 187 mmWC 6,2 %
 Suspension: 798 mmWC 26,6 %
 Gas: 288 mmWC 9,6 %
 Filter + suction silencer: 533 mmWC 17,7 %
 Vacuum gas piping: 69 mmWC 2,3 %

Vessel system
 Installation: High vacuum system
 Rotary lock/screw feeder
 Filter vessel volume: m³
 Discharge vessel volume: 4,3 m³
 Total vessel volume: m³
 Material volume: 3 m³
 vacuum pipe volume: 0,53 m³
 pressure begin vacuuming: -0,05 bar
 vacuum: 0,3 bar
 temperature begin vacuuming: 38 C
 temperature after vacuuming: 38 C
 begin mass kettle: 5,4 kg gas
 end mass kettle: 3,8 kg gas
 evacuated mass: 1,6 kg gas
 tank pressure after vacuuming: 0,7 bar(abs)
 gas density: 0,8 kg/m³
 vacuumizing time (empty vessel): 2,3 seconds
 Cycle time: 185 seconds
 Number of kettles/hr: 19,3

vessel content: 3,84 tons
 Silo/cargo unloading efficiency: 100 %
 Pipeline cap. at max. press.: 75,3 tons/hr
 Uninterrupted capacity: 75,3 tons/hr
 Interrupted capacity: 74,4 tons/hr
 vacuum: 0,3 bar
 Energy consumption: 0,46 kWh/ton
 Total energy consumption/ton: 0,47 kWh/ton

Vacuum pump
 Screwcompressor with pre-inlet
 Vacuum pump displacement: 0,72 m³/sec
 Vacuum pump mass displacement: 0,571 kg/sec

Energy
 Vacuum pump power: 34,98 kW
 Mechanical efficiency: 90 %
 Pipeline energy consumption/ton: 0,46 kWh/ton
 Product loss energy -> heat: 0,068 kWh/ton

Temperatures
 Ambient temperature: 35 degr C
 Outlet temperature vacuum pump: 119 degr C
 Mixture temperature begin: 39 degr C
 Mixture temperature end: 38 degr C

Table calculation
 Begin capacity: 75,3 tons/hr
 Begin vacuum: 0,3 bar 3000 mmWc
 lowest vacuum: 0,13 bar 1300 mmWc
 vacuum decrement: 0,01 bar 100 mmWc

Calculate interrupted capacity
 Calculate table

Back to start menu Print calculation result New Calculation

Table calculation results vacuum system

Client: Lars
 Filepath: c:\V\slate.txt
 Product: Ground slate
 MM-DD-YY: 05-08-2013

Vacuum conveying
 Conveying gas: Air
 Pump displacement: 0,72 m³/sec
 Two vessel + rotary lock feeder installation (Screwcompressor + pre-inlet)

Convey distance horizontal: 11 m
 Convey distance vertical: 5,5 m-up 0 m-down
 Convey distance slope: 0 m-up 0 m-down
 Total conveying length: 16,5 m 3 bends
 Pipe diameter begin: 203 mm end: 203 mm

Gas volume end: 0,7538 m³/sec 0,724 kg/sec at 0,13 bar
 Altitude: 0 m

System energy consumption: System energy consumption

Vacuum bar	Suction capacity tons/hr	Interrupted capacity tons/hr	Label	Solid Loading Ratio SLR	gas velocity begin m/sec	gas velocity end m/sec	mass in pipeline kg	System energy consumption kWh/ton	residence time seconds	Sediment	Condensation	Choking
0,3	75,4	75,4	Label 119	35,5	18,6	27,5	28,8	0,47	2,99	Sedimentation	No condensation	
0,29	72	72		33,4	18,8	27,1	27,3	0,48	2,98	No sedimentation	No condensation	No choking
0,28	68,6	68,6		31,4	19	26,8	25,8	0,49	2,97	No sedimentation	No condensation	No choking
0,27	68,1	68,1		30,7	19,1	26,7	25,5	0,48	2,96	No sedimentation	No condensation	No choking
0,26	64,8	64,8		28,8	19,3	26,4	24	0,5	2,95	No sedimentation	No condensation	No choking
0,25	61,4	61,4		26,9	19,4	26	22,6	0,51	2,95	No sedimentation	No condensation	No choking
0,24	57,9	57,9		25	19,6	25,7	21,1	0,53	2,94	No sedimentation	No condensation	No choking
0,23	54,4	54,4		23,1	19,8	25,4	19,7	0,55	2,93	No sedimentation	No condensation	No choking
0,22	50,7	50,7		21,3	20	25,1	18,2	0,58	2,93	No sedimentation	No condensation	No choking
0,21	47,1	47,1		19,4	20,1	24,9	16,8	0,61	2,92	No sedimentation	No condensation	No choking
0,2	43,3	43,3		17,6	20,3	24,6	15,3	0,64	2,91	No sedimentation	No condensation	No choking
0,19	39,6	39,6		15,9	20,5	24,3	13,9	0,68	2,91	No sedimentation	No condensation	No choking
0,18	35,7	35,7		14,1	20,7	24,1	12,4	0,73	2,9	No sedimentation	No condensation	No choking
0,17	31,8	31,8		12,4	20,8	23,8	11	0,8	2,9	No sedimentation	No condensation	No choking
0,16	27,9	27,9		10,7	21	23,6	9,5	0,89	2,89	No sedimentation	No condensation	No choking
0,15	23,8	23,8		9	21,2	23,3	8,1	1	2,89	No sedimentation	No condensation	No choking
0,14	19,7	19,7		7,4	21,3	23,1	6,6	1,17	2,89	No sedimentation	No condensation	No choking
0,13	15,6	15,6		5,7	21,5	22,9	5,2	1,43	2,89	No sedimentation	No condensation	No choking

Empty pipeline system pressure drop: 840 mmWC
 Filter without exhaust fan

Back to start menu Print table New Calculation