

Pneumatic conveying calculation for flour (175 m – 75mm)

Pressure pneumatic conveying calculation Input screen

Client: MERSAM File path: c:\V\dmersam1753.txt Product: Flour

Gas medium: Air Nitrogen

Gas pump: Screwcompressor Blower Compressor data 2-stage Predefined screwcompressor 2-stage Blower data Predefined blower Constant mass pump (sonic choke/turbo) Centrifugal fan

Maximum conveying pressure: 25000 mmWC
Gas mass: 0,13 kg/sec < 0,08232 kg/sec

Booster: Installed Screwcompressor Predefined screwcompressor Blower data Predefined blower

Gas Volume: m3/sec
Injection point

Rotary lock feeder: Install Capacity: tons/hr Lock volume: m3 RPM: /min Leakage: m3/sec

Eductor feeder: No

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Ambient (Compressor intake):
Ambient temperature: 25 degr C Altitude: 0 m
Intake temperature: 25 degr C Altitude pressure: 1013 mbar
Ambient pressure: 1000 mbar 1 bar
Relative Humidity: 80 % Show air intake conditions
 Override RH air density calculation for >373 degrC and >220 bar

Temperatures:
Flour temperature: 20 degr C Pressure dewpoint
 Compressor gas cooling degr C Dryer degr C
 Booster gas cooling degr C Dryer degr C
Heat transmission factor pipewall: 0,1 kCal/sec/degC/m2

Material properties:
Flour particle density: 1420 kg/m3
Bulk density: 750 kg/m3
Particle size <mesh >: 80 micron
Suspension velocity: 1,38 -> 1,38 m/sec
Product loss constant
Product loss factor: 1,10585E-08
Wall friction factor: 0,5
Material intake pressure drop: 150 mmWC
v-wall / v-susp: 1,5
Filter resistance factor: 1500000
Specific heat content: 0,2 kCal/kg/C
 product loss factor constant y/n

Change product

Filter:
Filter area: 40 m2 Filter exhaust fan
Silo constant (back-) pressure: mmWC

Convey pipeline:
Convey distance horizontal: 275 m
Convey distance vertical: 8 m-up 0 m-down
Convey distance slope: 0 m-up 0 m-down
Total conveying length: 283 m
Number of Bends: 11 -
Pipe diameter begin: 75 mm
Pipe diameter end: 75 mm

Calculate empty pipeline pressure drop: mmWC

Calculation settings:
Set capacity: 1,1 tons/hr
Conveying pressure: 7900 mmWC 0,79 bar
Back pressure: 0 mmWC 0 bar
Set pressure drop: 7900 mmWC 0,79 bar
Calculate intake gas pressure drop: Yes
Time domain dt: 0,001 seconds Default

Calculation selection:
 Pressure fixed -> capacity calculated
 Capacity fixed -> pressure calculated
 Pressure and capacity fixed -> intake pressure drop calculated
 Pressure and capacity fixed -> constant loss factor calculated
 Pressure and capacity fixed -> material loss factor calculated
 product loss factor (cwp) kept constant

Calculate

Calculation Table Pressure Conveying

Client: MERSAM Filepath: c:\V\dmersam1753.txt Product: Flour

Convey distance horizontal: 275 m
Convey distance vertical: 8 m
Total conveying length: 283 m
Number of Bends: 11
Compr. displ: 0,1107 m3/sec
Volumetric efficiency: 100 %
Booster displacement: 0 m3/sec
Rotarylock leakage: 0 m3/sec
Gas displacement at end: 0,1105 m3/sec

Capacity: 1,1 tons/hr at 7900 mmWC 0,79 bar
Back pressure: 0 mmWC 0 bar
Pressure drop: 7900 mmWC 0,79 bar
Loading ratio: 2,4

Pipeline energy consumption: 24,55 kWh/ton
Compressor power: 28 kW
Conveying energy: 6,5 kW
Pneumatic conveying efficiency: 23,1 %
Bend losses: 0,3 kW Material intake loss: 0,11 kW

Re-number: 1,164 * 10⁻⁵
Empty pipeline pressure drop: 9 mmWC
Empty pipeline filter press. drop: 4804 mmWC
Material loss factor constant: 0,0139
Material Loss factor: 1,10585E-08
Material intake pressure drop: 150 mmWC

Progress: Filter Iteration

Back to start menu Print calculation Change product New Calculation Calculation results Condensation intake 2.3 ltrs/hr

Part	Part description	Length(m)	v-gas m/sec	v-product m/sec	Pressure drop mmWC	Pressure bar	v-wall/v-susp	residence time	mass kg	temperature degC	kW	% kW	Bend loss kW	% kW	Sediment	RH's
1	Intake 75 hor	1	14,64	14,68	253	0,76	5,94	0,0756	0	34	0,1	2,7				58
2	Pipe 75 hor	18	14,57	13,55	616	0,72	5,48	1,4065	0	25	0,2	3,5				99
3	Bend		14,81	6,92	617	0,72		1,4242	0	25	0	0	0,3			
4	Pipe 75 hor	18	14,92	13,85	1030	0,68	5,54	2,7422	0	24	0,2	4,1				97
5	Bend		15,17	7,07	1030	0,68		2,7595	0	25	0	0	0,3			
6	Pipe 75 hor	18,01	15,3	14,18	1452	0,64	5,61	4,0485	0	24	0,2	4,3				94
7	Bend		15,55	7,24	1453	0,64		4,0654	0	25	0	0	0,3			
8	Pipe 75 hor	18	15,72	14,53	1884	0,6	5,69	5,3235	0	24	0,2	4,5				92
9	Bend		15,96	7,42	1885	0,6		5,34	0	25	0	0	0,3			
10	Pipe 75 hor	18	16,16	14,91	2327	0,55	5,77	6,567	0	24	0,3	4,7				89
11	Bend		16,41	7,61	2328	0,55		6,5831	0	25	0	0	0,3			
12	Pipe 75 hor	19,01	16,67	15,34	2805	0,5	5,86	7,8441	0	24	0,3	5,2				86
13	Bend		16,92	7,84	2806	0,5		7,8597	0	25	0	0	0,4			
14	Pipe 75 hor	12,01	17,03	15,64	3129	0,47	5,92	8,6397	0	24	0,2	3,6				84
15	Diameter Transfer		17,03	15,64	3129	0,47		8,6397			0	0				
16	Pipe 75 hor	7	17,23	15,81	3298	0,46	5,95	9,0847	0	24	0,1	1,9				83
17	Bend		17,48	8,06	3298	0,46		9,0999	0	25	0	0	0,4			
18	Pipe 75 hor	118	22,09	19,8	6528	0,13	6,74	15,8298	2	24	2,7	42,4				65
19	Bend		22,37	10,1	6529	0,13		15,8419	0	25	0	0	0,7			
20	Pipe 75 hor	18,01	23,34	20,79	7139	0,07	6,92	16,7349	0	24	0,6	9,3				61
21	Bend		23,62	10,5	7139	0,07		16,7465	0	25	0	0	0,7			
22	Pipe 75 up	0,01	23,46	11,55	7143	0,07	6,96	16,7475	0	25	0	0				60
23	Diameter Transfer		23,46	11,55	7143	0,07		16,7475			0	0				
24	Pipe 75 up	8,01	24,15	21,17	7502	0,03	7,04	17,1375	0	24	0,3	5,7				59
25	Bend		24,44	10,77	7502	0,03		17,1489	0	25	0	0	0,8			
26	Pipe 75 hor	10,02	25,08	22,16	7889	0	7,18	17,6149	0	24	0,4	6,4				57
27	Bend		25,37	11,38	7890	0		17,6257	0	25	0	0	0,8			
28	Outlet		25,37	11,38	7890	0		17,6257		25	0,0425	0,6				56
29	After Filter	40	0,1	m/min	7900	-0,01		17,6257			0,0106	0,1	dp = 9			56

Calculation results pressure conveying

Client: MERSAM
 Filepath: c:\Vdmersam1753.txt
 Product: Flour

Installation

Convey distance horizontal: 275 m
 Convey distance vertical: 8 m
 Total conveying length: 283 m
 Number of Bends: 11
 Pipe diameter(s): 75 mm / 75 mm
 Compressor displacement: 0,11 m3/sec / 0,13 kg/sec
 Booster displacement: 0 m3/sec / 0 kg/sec
 Total gas displacement: 0,11 m3/sec / 0,13 kg/sec

Calculation results

Capacity: 1,1 tons/hr
 Pressure: 7900 mmWC / 0,79 bar
 Booster pressure: 0 mmWC / 0 bar
 Back pressure: 0 mmWC / 0 bar
 Pressure drop: 7900 mmWC / 0,79 bar
 Loading ratio: 2,4
 Volumetric loading ratio: 0,0034 to 0,0022
 Empty pipeline pressure: 4804 mmWc
 Residence time: 17,62 seconds
 Re-number * 10⁻⁵: 1,164
 Mixture density: 4 kg/m³
 Mass of material in pipeline: 5,5 kg
 Exit dynamic force: 0,05 kN

Pressure drops

Product intake: 150 mmWC / 1,8 %
 Nozzle (total dp): 253 mmWC / 3,2 %
 Acceleration excl product dp: 501 mmWC / 6,3 %
 Product resistance: 2876 mmWC / 36,4 %
 Elevation: 24 mmWC / 0,3 %
 Suspension: 118 mmWC / 1,4 %
 Gas: 4259 mmWC / 53,9 %
 Filter: 9 mmWC / 0,1 %

Feeder system

Installation system:
 1-vessel system
 2-vessel system
 3-vessel system
 Bulk trailer unloading
 screw feeder

Vessel factor: 1000 tons/hr/m³/bar(a)
 Nominal capacity: 0 tons/hr
 Vessel volume: 2 m³
 Vessel product volume: 1,5 m³
 pressure begin pressurizing: -0,05 bar
 pressure valve open: 2,5 bar
 pressure valve close: 25 % > 0,19 bar
 temperature begin pressurizing: 35 C
 temperature after pressurizing: 60 C
 pressurizing time: 24,1 seconds
 Discharging time: 3562,3 seconds
 purging time of pipe: 13,3 seconds
 valve time: 2 seconds
 filling time: seconds
 cycletime: 3601,8 seconds
 Number of kettles/hr: 0,9 -

vessel capacity: 61,8 tons/hr
 Vessel content: 1,12 tons
 pipevolume: 1,25 m³
 pipe content: 5,5 kgs
 Pipeline capacity: 1,1 tons/hr
 System capacity at pressure: 1,1 tons/hr / 0,79 bar
 Pipeline energy consumption: 24,65 kWh/ton
 System energy consumption: 24,78 kWh/ton
 Total energy consumption: 24,78 kWh/ton

Energy
 (Constant mass pump: Piston compr/Sonic choke / Turbo)
 Compressor power: 28 kW
 Mechanical efficiency: 90 %

No booster
 Product loss energy pipes -> heat: 2,081 kW/ton
 Product loss energy bends -> heat: 0,334 kW/ton
 Pipeline energy consumption/ton: 24,652 kW/ton

Temperatures

Ambient temperature: 25 degr C
 Outlet temperature compressor: 63 degr C

No booster
 Material temperature: 20 degr C
 Mixture temperature begin: 34 degr C
 Mixture temperature end: 25 degr C

Table calculation

Begin capacity: 1,1 tons/hr
 Begin pressure: 7900 mmWc
 lowest pressure: 2500 mmWc
 pressure decrement: 270 mmWc

Kettle capacity > capacity --> extra air valve active

Calculate system capacity

Back to start menu | Print calculation result | New Calculation

ma	ms	m	P-guess	Pavg	pavg	Cavg	Re	λf	Fr	λs	Pair	Pbends	Pfrictor	Ptotal	P/P
0,13	1,28	9,846154	79	140,5	1,670809	17,61177	122608	0,020411	17,38118	0,009669	10,44507	12,845198	57,559245	80,849515	0,977124 mersam
0,13	0,3056	2,4	79				116400				42,59	??	28,76	79	TT

Table calculation

Pressure conveying

Client: MERSAM
 Filepath: c:\N\dmsam1753.txt
 Product: Flour
 Altitude: 0 m

Convey distance horizontal: 275 m
 Convey distance vertical: 8 m-up
 Total conveying length: 283 m
 Number of Bends: 11
 Pipe diameter begin: 75 mm
 Pipe diameter end: 75 mm

Mass displ. pump: 0,13 kg/sec (Piston compr/Sonic choke / Turbo)
 Booster displacement: 0 m3/sec
 Gas volume end: 0,1102 m3/sec

Two vessel installation

MM-DD-YY: 08-28-2010

Pressure bar	pipe line capacity tons/hr	system capacity tons/hr	Number of kettles/hr	< Kettle range>	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
2,5	2,1	2	1,8	>capacity	4,5	7,8	25,7	18,3	13,83	30,64	No sedimentation	Condensation
2,45	2,1	2	1,8	>capacity	4,4	7,9	25,7	17,9	13,83	30,28	No sedimentation	Condensation
2,4	2	2	1,8	>capacity	4,4	8	25,7	17,5	13,83	29,92	No sedimentation	Condensation
2,35	2	2	1,7	>capacity	4,3	8,1	25,7	17,2	13,83	29,56	No sedimentation	Condensation
2,3	2	2	1,7	>capacity	4,3	8,2	25,7	16,8	13,84	29,2	No sedimentation	Condensation
2,25	2	1,9	1,7	>capacity	4,3	8,2	25,7	16,4	14,57	28,83	No sedimentation	Condensation
2,2	2	1,9	1,7	>capacity	4,2	8,4	25,7	16	14,57	28,47	No sedimentation	Condensation
2,15	1,9	1,9	1,7	>capacity	4,2	8,5	25,7	15,6	14,57	28,1	No sedimentation	Condensation
2,1	1,9	1,9	1,7	>capacity	4,1	8,6	25,6	15,3	14,57	27,74	No sedimentation	Condensation
2,05	1,9	1,9	1,6	>capacity	4,1	8,7	25,6	14,9	14,58	27,38	No sedimentation	Condensation
2	1,9	1,8	1,6	>capacity	4	8,9	25,6	14,5	15,39	27,01	No sedimentation	Condensation
1,95	1,9	1,8	1,6	>capacity	4	9	25,6	14,2	15,39	26,64	No sedimentation	Condensation
1,9	1,8	1,8	1,6	>capacity	3,9	9,1	25,6	13,8	15,4	26,27	No sedimentation	Condensation
1,85	1,8	1,8	1,6	>capacity	3,9	9,3	25,6	13,4	15,4	25,9	No sedimentation	Condensation
1,8	1,8	1,7	1,5	>capacity	3,8	9,4	25,6	13,1	16,31	25,53	No sedimentation	Condensation
1,75	1,8	1,7	1,5	>capacity	3,8	9,6	25,6	12,7	16,31	25,16	No sedimentation	Condensation
1,7	1,7	1,7	1,5	>capacity	3,7	9,7	25,6	12,3	16,31	24,79	No sedimentation	Condensation
1,65	1,7	1,7	1,5	>capacity	3,7	9,9	25,6	12	16,32	24,41	No sedimentation	Condensation
1,6	1,7	1,7	1,5	>capacity	3,6	10,1	25,5	11,6	16,32	24,04	No sedimentation	Condensation
1,55	1,7	1,6	1,4	>capacity	3,6	10,3	25,5	11,2	17,35	23,66	No sedimentation	Condensation
1,5	1,6	1,6	1,4	>capacity	3,5	10,5	25,5	10,9	17,35	23,28	No sedimentation	Condensation

Empty pipeline system pressure drop: 4803 mmWC
 Filter without exhaust fan

Buttons: Back to start menu, Print table, New Calculation

Table calculation

Pressure conveying

Client: MERSAM
 Filepath: c:\N\dmsam1753.txt
 Product: Flour
 Altitude: 0 m

Convey distance horizontal: 275 m
 Convey distance vertical: 8 m-up
 Total conveying length: 283 m
 Number of Bends: 11
 Pipe diameter begin: 75 mm
 Pipe diameter end: 75 mm

Mass displ. pump: 0,13 kg/sec (Piston compr/Sonic choke / Turbo)
 Booster displacement: 0 m3/sec
 Gas volume end: NaN m3/sec

Two vessel installation

MM-DD-YY: 08-28-2010

Pressure bar	pipe line capacity tons/hr	system capacity tons/hr	Number of kettles/hr	< Kettle range>	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
1,45	1,6	1,6	1,4	>capacity	3,5	10,7	25,5	10,5	17,35	22,88	No sedimentation	Condensation
1,4	1,6	1,5	1,4	>capacity	3,4	10,9	25,5	10,1	18,51	22,5	No sedimentation	Condensation
1,35	1,5	1,5	1,3	>capacity	3,3	11,1	25,5	9,8	18,52	22,11	No sedimentation	Condensation
1,3	1,5	1,5	1,3	>capacity	3,3	11,4	25,5	9,4	18,52	21,73	No sedimentation	Condensation
1,25	1,5	1,5	1,3	>capacity	3,2	11,6	25,5	9,1	18,53	21,34	No sedimentation	Condensation
1,2	1,4	1,4	1,3	>capacity	3,1	11,9	25,5	8,7	19,85	20,96	No sedimentation	Condensation
1,15	1,4	1,4	1,2	>capacity	3	12,1	25,4	8,3	19,86	20,57	No sedimentation	Condensation
1,1	1,4	1,4	1,2	>capacity	3	12,4	25,4	7,9	19,86	20,17	No sedimentation	Condensation
1,05	1,3	1,3	1,2	>capacity	2,9	12,7	25,4	7,6	21,4	19,78	No sedimentation	Condensation
1	1,3	1,3	1,1	>capacity	2,8	13	25,4	7,2	21,4	19,38	No sedimentation	Condensation
0,95	1,3	1,2	1,1	>capacity	2,7	13,4	25,4	6,8	23,19	18,97	No sedimentation	Condensation
0,9	1,2	1,2	1,1	>capacity	2,6	13,7	25,4	6,4	23,2	18,57	No sedimentation	Condensation
0,85	1,2	1,1	1	>capacity	2,5	14,1	25,3	6	25,32	18,15	No sedimentation	Condensation
0,8	1,1	1,1	1	>capacity	2,4	14,5	25,3	5,6	25,33	17,73	No sedimentation	Condensation
0,75	1	1	0,9	>capacity	2,2	14,9	25,3	5,1	27,87	17,3	No sedimentation	Condensation
0,7	1	1	0,8	>capacity	2,1	15,4	25,3	4,7	27,88	16,86	No sedimentation	Condensation
0,65	0,9	0,9	0,8	>capacity	1,9	15,9	25,3	4,1	30,99	16,4	No sedimentation	Condensation
0,6	0,8	0,8	0,7	>capacity	1,7	16,4	25,2	3,5	34,89	15,92	No sedimentation	Condensation
0,55	0,6	0,6	0,5	>capacity	1,3	17,1	25,2	2,7	46,56	15,37	No sedimentation	Condensation
0,5	0,2	0,2	0,1	>capacity	0,4	18,2	25,1	0,8	139,99	14,72	No sedimentation	Condensation
0,45	NaN	0,1	0,1	<capacity	NaN	NaN	NaN	NaN	280,1	0,01	No sedimentation	No condensation

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

Buttons: Back to start menu, Print table, New Calculation