



**Sample 2: P30 =40 microns**

For n=1, particle size (mm) = 0.225

For n=2, particle size (mm) = 0.120

For n=3, particle size (mm) = 0.0675

For n=4, particle size (mm) = 0.0225

For n=1, amount read from PSD (%) = 2.8

For n=2, amount read from PSD (%) = 40.6

For n=3, amount read from PSD (%) = 26.4

For n=4, amount read from PSD (%) = 30.2

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Critical deposition velocity (m/s) = 1.35 m/s

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Critical laminar/turbulent transition velocity = 1.7 m/s

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Deposition safety margin = 0.15 m/s

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Operating flow velocity at Year 0 (m/s) = 2.2 m/s

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Safety factor on friction loss calculations = 12%

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Length of pipeline (km) = 187

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Pressure drop (Mpa) = 10.116 (Single Pump Station with (2 operating + 1 standby) PD pump)

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Specific weight of slurry (N/cum)= 16349.350000

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Discharge of slurry (cum/s) = 1.307

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Efficiency of pump (%) = 80.00

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Total required pump capacity (kW) = 16529.398

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Total required pump capacity (hP) = 22157.369

Wave velocity for water hammer pressure (WHP) calculation (m/s) = 1036.60

WHP for worst condition of sudden valve closure at terminal valve station (Mpa) = 13.8007 7

Minimum time of valve closure for preventing WHP (s) = 360.7960

Use of Carbon Steel Pipe 5L X65 is assumed

Pipe wall thickness required to sustain WHP (mm) = 5 mm throughout the length of pipeline

Rupture Disc at Terminal Valve Station is recommended to decrease the wall thickness requirement for WHP

Pipe wall thickness required to sustain steady state hydraulic pressure (mm) = 9 mm at starting (Pump Station) decreasing uniformly to zero value at end of pipeline (Terminal Valve Station)

Variable pipe wall thickness along the length is recommended to counteract steady state hydraulic pressure and WHP optimally

Settling velocity [unhindered( $w_0$ ); hindered( $w$ )]:

n	$w_0$ (m/s)	w(m/s)
1	.03166666	.00704028
2	.01173122	.00200328
3	.00435532	.00069356
4	.00048392	.00007345

Normalized concentration of individual sizes( $C_{vj}/C_{vjf}$ )

y/D	n=1	n=2	n=3	n=4
.1	1.203	1.047	1.007	.989
.2	1.148	1.035	1.005	.991
.3	1.104	1.025	1.004	.993
.4	1.052	1.013	1.001	.996
.5	.992	.999	.999	.999
.6	.933	.984	.996	1.002
.7	.884	.971	.994	1.004
.8	.845	.960	.991	1.006
.9	.797	.946	.988	1.009

Overall Concentration Profile:

y/D	$C_v(y)/C_{vf}$	$C_v(y)(\%)$
.1	1.02299	34.09612
.2	1.01704	33.89794
.3	1.01204	33.73113
.4	1.00591	33.52710
.5	.99858	33.28252
.6	.99106	33.03208
.7	.98451	32.81382
.8	.97896	32.62865
.9	.97211	32.40035

Wear at pipe bottom (mm/yr)= 0.37929310  
Wear at pipe top (mm/yr)= 0.36868610  
Pipe thickness provided (mm)= 20.0000  
Pipe thickness available for wear (mm)= 11.0000  
Life of pipe if not rotated periodically (yrs)= 29.024  
Life of pipe if rotated periodically (yrs)= 29.491  
Pipe diameter at end of life EOL (mm) = 892  
Flow velocity to sustain required discharge (1.307 cum/s) in m/s = 2.1  
Safe minimum operating velocity at EOL (m/s) = 1.9 m/s  
Pipe will run without deposition for its entire life.