DYNAMIC ENGINEERING CONSULTANTS
PO Box 2072
Ellenbrook
WA 6069
www.dynamicengineering.com.au

Calculation Record

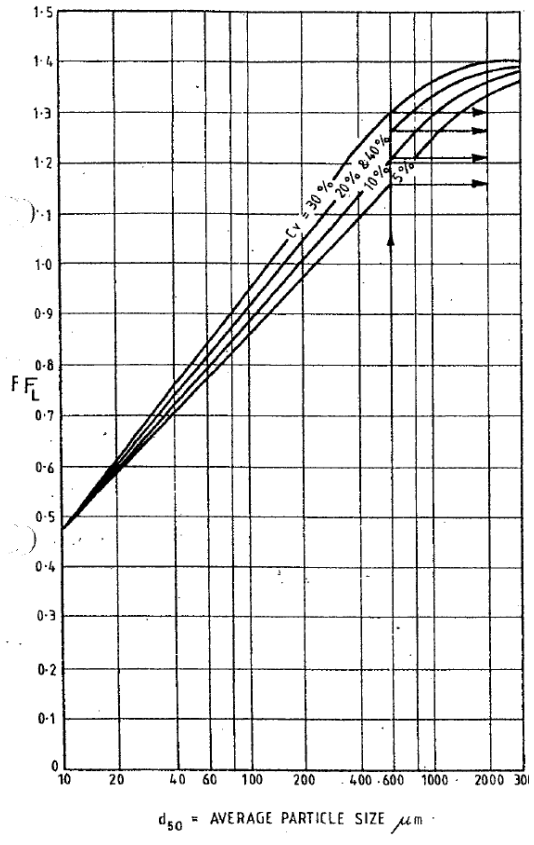
Form ET2 August 96

Project No	JN12-144	File	
SHEET No		OF	
PREPARED BY	SVDV	DATE	
CHECKED BY		DATE	

PROJECT:	JN12-144	PACKAGE:	342-PU-662 App A
TASK:	20% Flow increase	ELEMENT:	

Description	
Pumping from	
Pumping to	
Line No	

	Flowrates		Minimum	Design (max)	Froth 20% increase	Comments
1	Slurry Rheology		Heterogeneous			
2	Water temperature	deg C	40	40	40	
3	Atmospheric pressure on site	hPa	950	950	950	
4	Mass of solids to be transported	tph	16	23	23	
5	Mass of water to be transported	tph	48	69	69	
6	Specific gravity of Solids	SG	4.18	4.2	4.2	
7	Specific gravity of liquid	SG	1	1	1	
8	Particle Distribution	d80/d20	2.0	2.0	2.0	if >5 then cave's
9	Average particle size	d50 mm	0.05	0.05	0.05	
10	Relative viscosity		1.25	1.25	1.25	
11	Viscosity of water at temp	Pa s	6.53E-04	6.53E-04	6.53E-04	
	Froth Volume Factor (FVF)				1.70	
12	Volume of solids to be transported	l/s	1	2	2	
13	Volume flow of water	l/s	13	19	19	
14	Volume flow of slurry (water + solids)	l/s	14	21	42.2	increase by 20%
15	Volume Concentration of solids (Cv)	%	7.39%	7.35%	7.35%	
16	Weight concentration of solids	%	25%	25%	25%	cw=msol/(ml+msol)
17	Relative Density of the mixture	kg/m3	1.23	1.24	0.73	
18	Slurry Viscosity	Pa s	0.000816	0.000815	0.000815	



C_V[%]	μ_m/μ_L	C_V[%]	μ_m/μ_L
1	1.029		
3	1.089	45	8.950
5	1.156	46	9.932
7	1.233	47	11.07
10	1.365	48	12.40
12	1.465	49	13.94
14	1.575	50	15.75
16	1.696	51	17.86
18	1.83	52	20.33
20	1.978	53	23.22
22	2.142	54	26.62
25	2.426	55	30.61
27	2.649	56	35.29
29	2.907	57	40.80
31	3.210	58	47.28
33	3.573	59	54.91
35	4.017	60	63.89
37	4.570	61	74.47
39	5.273	62	86.94
42	6.734	63	101.63
43	7.37	64	118.95
44	8.103	65	139.4

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PROJECT:	**JN12-144**	**PACKAGE:**	**342-PU-662 App A**
TASK:	**20% Flow increase**	**ELEMENT:**	

	Suction Line					
	Flowrates		**nominal**	**max**	**Froth 20% increase**	**Comments**
19	Pipe DN	mm	160	160	160	
20	Pipe ID	mm	136	136	136	
21	Lining		PN12.5 PE100			
22	Durand FL number		0.74	0.74	0.74	Warman
23	Pipe roughness	mm	0.045	0.045	0.045	
24	Pipeline length	m	0.10	0.10	0.10	
25	Pipe sectional area	m^2	0.01	0.01	0.01	
26	Durand's Limiting Settling Velocity	m/s	2.16	2.16	2.16	Vl=Fl*sqrt(2gD(S-1))
27	10% safety margin on Durand	m/s	2.37	2.37	2.37	
28	Horizontal Settling Limiting Flow	l/s	31.3	31.3	31.3	
29	Actual velocity	m/s	0.99	1.42	2.91	
30	Reynolds Number for slurry	Re	203903	293487	352184	
31	Relative Roughness	mm/mm	0.00033	0.00033	0.00033	
32	Friction Factor - Churchill Equation		0.018	0.017	0.017	
33	Friction Head due to Piping	m	0.0	0.0	0.0	
34	Foot Valve (k=15)	qty	0	0	0	
35	Gate Valve (k=0.2)	qty	0	0	0	
36	Strainer (k=5)	qty	0	0	0	
37	90deg bends (k=1.1)	qty	0	0	0	
38	45deg bends (k=0.35)	qty	0	0	0	
39	User defined #1	k val	0.5	0.5	0.5	entrance
40	Number of user defined fittings #1	qty	0.00	0.00	0.00	
41	User defined #1	k val	12	12	12	
42	Number of user defined fittings #2	qty	0.00	0.00	0.00	
43	User defined #1	k val	23	23	23	
44	Number of user defined fittings #3	qty	0.00	0.00	0.00	
45	Friction Head due to Fittings	m	0.0E+00	0.0E+00	0.0E+00	
46	Relative level of inlet	m	0.00	0.00	0.00	
47	Relative level of outlet	m	0.00	0.00	0.00	
48	Head due to relative level of inlet and outlet		0.00	0.00	0.00	
49	Total Suction Head	m	0.00	0.00	0.01	
50	Level of surface above suction cl	m	0.00	0.00	0.00	
51	Atmospheric pressure head of water	m	9.50	9.50	9.50	
52	Vapour pressure head of water	m	1.07	1.07	1.07	
53	**NPSH available**	m	6.83	8.43	8.43	

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PROJECT:	JN12-144	PACKAGE:	342-PU-662 App A
TASK:	20% Flow increase	ELEMENT:	

	Delivery Line						
	Flowrates		nominal	max	Froth 20% increase	Comments
54	Pipe DN	mm	160	160	160	
55	Pipe ID	mm	136	136	136	
56	Lining		PN12.5 PE100			
57	Durand FL number		0.74	0.74	0.74	
58	Pipe roughness	mm	0.045	0.045	0.045	
59	Pipeline length	m	200.10	200.10	200.10	
60	Pipe sectional area		0.01	0.01	0.01	
61	Durand's Limiting Settling Velocity	m/s	2.16	2.16	2.16	Vl=Fl*sqrt(2gD(S-1))
62	10% safety margin on Durand	m/s	2.37	2.37	2.37	
63	Horizontal Settling Limiting Flow	l/s	31.30	31.30	31.30	
64	Actual velocity	m/s	0.99	1.42	2.91	
65	Reynolds Number for slurry	Re	204007	293636	352364	
66	Relative Roughness	mm/mm	0.00033	0.00033	0.00033	
67	Friction Factor - Churchill Equation		0.018	0.017	0.017	
68	Friction Head due to Piping	m	1.3	2.6	10.8	
69	Foot Valve (k=15)	qty	0	0	0	
70	Gate Valve (k=0.2)	qty	1	1	1	
71	Strainer (k=5)	qty	0	0	0	
72	90deg bends (k=1.1)	qty	15	15	15	
73	45deg bends (k=0.35)	qty	3	3	3	
74	User defined #1	k val	0.1	0.1	0.1	30deg bend
75	Number of user defined fittings #1	qty	0.00	0.00	0.00	
76	User defined #1	k val	0.6	0.6	0.6	60deg bend
77	Number of user defined fittings #2	qty	0.00	0.00	0.00	
78	User defined #1	k val	1.2	1.2	1.2	y piece
79	Number of user defined fittings #3	qty	1.00	1.00	1.00	
80	Friction Head due to Fittings	m	0.9	2.0	8.2	
81	Relative level of inlet	m	0.00	0.00	0.00	
82	Relative level of outlet	m	13.43	13.43	13.43	
83	Head due to relative level of inlet and outlet		13.43	13.43	13.43	
84	Total Delivery Head	m	15.7	18.0	32.4	

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PROJECT:	JN12-144	PACKAGE:	342-PU-662 App A
TASK:	20% Flow increase	ELEMENT:	

	Pumps					
	Flowrates		**nominal**	**max**	**Froth 20% increase**	**Comments**
85	Average particle size	d50 (mm)	0.05	0.05	0.05	
86	Impeller diameter	mm	388	388	388	
87	Number of pumps in series		1	1	1	
88	Number of pumps in parralel		1	1	1	
89	Total flow	l/s	14.4	20.7	42.2	
90	Total Head Hm	m	15.7	18.0	32.4	
91	SG of solids		4.18	4.18	4.18	
92	Concentration of solids by volume	%	7.4%	7.4%	7.4%	
93	d50/D impeller ratio	mm	0.0001	0.0001	0.0001	
94	Head Ratio	HR	0.95	0.95		
	froth Head Ratio	HRf			0.72	see chart
95	Total head - corrected to water	Hw	16.5	18.9	45.0	
96	Required clean water Head per pump	m	16.5	18.9	45.0	
97	Flow per pump	l/s	14.4	20.7	42.2	
98	Flow per pump	m3/h	52	74	152	
99	Pressure per Pump	Bar	1.88	2.16	2.28	
100	Efficiency Ratio	ER	0.95	0.95		
	froth Efficiency Ratio	ERf			0.71	see chart
101	Clean Water Pump Efficiency	%	0.330	0.420	0.540	
102	Efficiency of Pump Pumping Slurry	%	31.3%	39.8%	38.3%	
103	Pump Power	kW	9.2	11.9	35.3	
104	V-Belt Drive Losses (8%)	kW	0.7	1.0	2.8	
105	Motor Service Factor		1.15	1.15	1.15	
106	Required Motor Rating	kW	11.4	14.8	43.8	
107	Selected Motor	kW	37	37		not feasible
108	**Selection**					
109	**Flowrates**		**nominal**	**max**	**Froth 20% increase**	**Comments**
110	Pump Make/Model		4D-AHF			
111	Pump Flow	l/s	14.4	20.7	42.2	
112	Pump Head (water)	m	16.5	18.9	45.0	
113	Impeller Curve		0.0	0.0	0.0	
114	Liner		rubber			
115	Impeller Dia	mm	388	388	388	
116	Speed	rpm	800	855	1159	
117	Speed Limit for Polymer/Rubber Liner 27	rpm				
118	Efficiency	%	33%	42%	54%	
119	Required NPSH	m	2	2	2	flooded suction
120	Available NPSH	m	6.83	8.43	8.43	
121	NPSH Safety Margin	m	4.83	6.43	6.43	
122	Motor	kW	37	37	0	
123	Motor Speed	rpm	1480	1480	1480	
124	Pulley Ratio	:1	1.850	1.731	1.277	
	Motor pulley size		265	265	265	
	New pump pulley size		490	459	338	
125	Pump Frame Size	c/cc/	D	D	D	
126	Discharge Orientation	A/B/C/D	A	A	A	
127	Pump Configuration	ZV/CV	ZV	ZV	ZV	