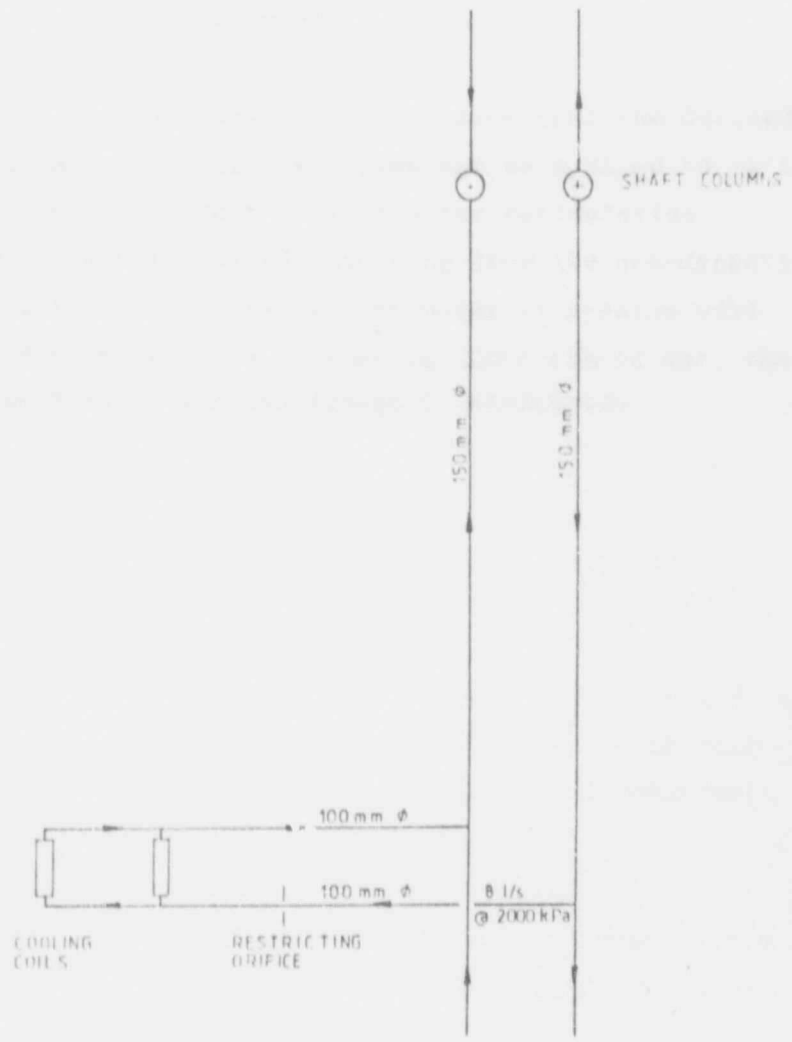

FIGURE 6.3 WATER RETICULATION SYSTEM FOR EXAMPLE (11)

In the event of the pipe fracturing the pressure drop across the orifice then becomes 2000 kPa, and referring to Figure 6.1, the flowrate through the orifice will then become 17 l/s. At this flow and pressure drop cavitation will occur, although in such a situtation that its occurrence is acceptable. If there were not restricting orifice in the pipe, the flowrate would be 95 l/s.

From these two examples, it can be seen that the derived equation for incipient cavitation can be applied to various problems that may occur in mine water reticulation systems. The main hazard resulting from the non-detection of cavitation is tht significant material erosion will occur. Therefore, if a cavitation limit can be set, the possibility of cavitation damage is minimised.

7. CONCLUSIONS

It is believed that the object of this study has been achieved, namely, to determine incipient cavitation limits for the situation where orifice plate pressure dissipators are used. The main conclusions arising from the study are:

i) The use of orifice plates as pressure dissipators in high pressure water lines is satisfactory, providing attention is given to the system operating parameters so that cavitation can be avoided.

ii) The East Driefontein incipient cavitation data shows a definite relationship between upstream pressure, orifice pressure and the occurrence of incipient cavitation, leading to the formulation of an incipient cavitation prediction equation. (This has been presented in a graphical form).

iii) The results also indicated that upstream pressure affects the incipient cavitation limit. At high upstream pressures the pressure drop/upstream pressure ratio is relatively lower than at low upstream pressures.

iv) Immediately downstream of the orifice it is possible to obtain negative gauge pressures. (This condition gives rise to excessive vibration).

v) For incipient cavitation to occur, the pressure downstream of the orifice does not have to drop below atmospheric.

8. RECOMMENDATIONS FOR FUTURE WORK

i) It is suggested that the cavitation inception prediction equation or graph be used to predict cavitation inception limits;

ii) The method used to determine the incipient cavitation points be further developed; and

iii) the work contained in Section 5.3 on bubble size and formation also be developed further.

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APPENDIX

TEST DATA - EAST DRIEFONTEIN GOLD MINE

D (mm)	d/D	Pu (kPa)	Δ P (kPa)	Q (l/s)	N (m/s^2)
97,2	0,206	2000	718	3,6	25
-	-	2010	1447	8,9	30
-	-	2000	1627	9,8	59
-	-	2000	1828	10,5	59
-	-	2000	1920	11,0	103
-	-	2000	1985	11,5	142
-	-	3000	279	8,6	5
-	-	3000	509	9,2	7
-	-	3000	1641	9,4	14
-	-	3000	2143	10,5	40
-	-	3000	2344	10,5	59
-	-	3000	2566	10,7	78
-	-	3000	2874	10,5	98
-	-	3000	3096	10,7	225
-	-	4000	402	8,6	3
-	-	4000	1304	8,3	7
-	-	4000	1899	10,4	9
-	-	4000	2559	10,4	10
-	-	4000	2767	11,0	29
-	-	4000	2967	11,0	59
-	-	4010	3182	11,0	98
-	-	4000	3555	11,0	118
-	-	4000	3799	10,9	137
-	-	4000	3913	11,0	245
-	-	4000	4121	-	294
-	-	5000	1268	4,5	5
-	-	5000	2298	6,6	7
-	-	5000	2903	10,3	10
-	-	5000	3519	10,3	29
-	-	5000	3835	11,2	88
-	-	5000	4343	11,7	147
-	-	5010	4709	12,5	176
-	-	5000	4845	14,5	225
-	-	5000	5131	15,7	539
-	-	6010	2021	7,4	6
-	-	6010	2953	11,0	14

D (mm)	d/D	Pu (kPa)	Δ P (kPa)	Q (l/s)	N (m/s^2)
97,2	0,206	6000	3633	13,9	8
-	-	6000	4100	15,8	29
-	-	6000	4544	17,1	108
-	-	6000	5103	17,1	196
-	-	6000	5150	17,3	216
-	-	6000	5885	18,8	314
-	-	6000	6035	24,2	490
-	-	6000	6135	24,5	686
-	-	7000	2100	12,1	5
-	-	7000	3906	12,9	6
-	-	7010	4673	14,6	16
-	-	7000	5563	16,6	245
-	-	6990	6214	18,5	284
-	-	7000	6780	19,9	372
-	-	7000	7038	21,8	529
97,2	0,276	2000	451	12,2	22,5
-	-	2000	745	14,9	29
-	-	2000	946	16,4	39
-	-	2000	1211	18,4	54
-	-	2000	1362	19,4	78
-	-	2000	1512	20,4	93
-	-	2000	1698	21,5	97
-	-	2000	1806	22,1	118
-	-	2000	1842	22,4	137
-	-	2000	1871	22,7	294
-	-	2000	1899	22,8	127
-	-	2000	1921	22,8	127
-	-	2000	1928	22,9	123
-	-	3000	774	14,9	17
-	-	3000	1261	18,8	26
-	-	3000	1863	21,4	37
-	-	3000	1921	22,8	47
-	-	3000	2164	24,1	83
-	-	3000	2415	25,4	118
-	-	3000	2652	26,8	137
-	-	3000	2785	27,7	162

D (mm)	d/D	Pu (kPa)	ΔP (kPa)	Q (l/s)	N (m/s^2)
97,2	0,276	3000	2867	28,2	191
-	-	3000	2876	28,5	195
-	-	3000	2924	28,7	225
-	-	3000	2953	28,5	255
-	-	4000	1684	21,5	18
-	-	4000	2379	25,7	21
-	-	4000	2637	27,0	29
-	-	4000	2939	29,2	88
-	-	4000	3211	27,8	157
-	-	4000	3576	29,2	167
-	-	4000	3734	29,7	206
-	-	4000	3813	30,0	245
-	-	4000	3885	30,2	372
-	-	4000	3928	30,4	313
-	-	5000	2630	26,8	20
-	-	5000	2960	29,3	22
-	-	5000	3197	27,8	29
-	-	5000	3612	29,3	98
-	-	5000	3820	30,0	176
-	-	5000	4064	30,8	186
-	-	5000	4408	55,1	206
-	-	5000	4673	31,9	225
-	-	5000	4795	33,1	382
-	-	6000	3175	27,7	18
-	-	6000	3440	28,7	21
-	-	6000	3727	29,8	25
-	-	6000	4064	31,0	49
-	-	6000	4365	31,8	157
-	-	6000	4623	32,6	225
-	-	6000	5039	33,8	245
-	-	6000	5390	34,8	255
-	-	7000	4064	30,8	29
-	-	7000	4257	31,4	29
-	-	7000	4616	32,6	78
-	-	7000	4888	33,4	147
-	-	7000	5282	34,5	225

D (mm)	d/D	Pu (kPa)	Δ P (kPa)	Q (1/s)	N (m/s^2)
97,2	0,276	7000	5627	35,6	314
-	-	7000	6035	36,6	314
-	-	7000	6375	37,5	333
97,2	0,330	2000	286	14.5	39
-	-	2000	781	21,5	98
-	-	2000	1132	25,8	125
-	-	2000	1311	28,2	137
-	-	2000	1390	29,8	147
-	-	2000	1476	29,8	150
-	-	2000	1605	31,0	155
-	-	2000	1648	31,4	152
-	-	2000	1670	31,5	147
-	-	3000	666	20,6	28
-	-	3000	1190	26,9	57
-	-	3000	1491	29,9	59
-	-	3000	1706	31,9	69
-	-	3000	1899	33,5	86
-	-	3000	2035	34,6	118
-	-	3000	2365	37,1	135
-	-	3000	2515	35,2	127
-	-	3000	2537	38,3	123
-	-	4000	788	21,7	22
-	-	4000	1328	28,7	33
-	-	4000	1964	34,0	38
-	-	4000	2308	36,7	36
-	-	4000	2444	37,7	49
-	-	4000	2688	39,4	93
-	-	4000	2960	41,?	157
-	-	4000	3175	42,5	172
-	-	4000	3361	43,7	184
-	-	4000	3426	44,1	196
-	-	5000	1412	29,2	27
-	-	5000	2189	35,8	41
-	-	5000	2867	40,6	46
-	-	5000	3161	42,4	74
-	-	5000	3490	44,4	162

D (mm)	d/D	Pu (kPa)	$\triangle$ P (kPa)	Q (1/s)	N (m/s^2)
97,2	0,330	5000	3670	45,5	196
-	-	5000	3949	47,1	216
-	-	5000	4179	48,3	216
-	-	5000	4293	48,9	216
-	-	6000	1923	33,8	32
-	-	6000	2652	39,1	52
-	-	6000	3275	43,2	50
-	-	6000	3526	44,7	59
-	-	6000	3749	46,0	78
-	-	6000	4007	47,4	137
-	-	6000	4286	48,9	186
-	-	6000	4537	50,2	255
-	-	6000	4824	51,7	274
-	-	6000	5017	52,6	284
-	-	6000	5196	53,5	294
-	-	6000	5239	53,7	294
-	-	7000	3118	42,2	69
-	-	7000	3727	45,8	69
-	-	7000	3947	47,1	67
-	-	7000	4136	48.1	54
-	-	7000	4322	49,1	78
-	-	7000	4593	50,5	127
-	-	7000	4723	51,2	176
-	-	7000	4881	51,9	206
-	-	7000	5089	53,0	265
-	-	7000	5290	53,9	333
-	-	7000	5576	55,3	343
-	-	7000	5791	56,2	333
-	-	7000	6049	57,4	323
-	-	7000	6100	57,6	323
97,2	0,377	2000	474	2',1	19
-	-	2020	918	34,5	28
-	-	1970	980	35,4	34,5
-	-	2020	1088	38,3	31
-	-	2000	1170	42,2	35,5
-	-	2000	1260	41,4	176

D (mm)	d/D	Pu (kPa)	Δ P (kPa)	Q (1/s)	N (m/s^2)
97,2	0,377	2030	1340	39,7	147
-	-	2000	1570	41,4	-
-	-	2000	1423	40,0	147
-	-	2000	1420	43,0	-
-	-	2000	1502	43,1	157
-	-	1990	1648	43,8	284
-	-	3010	441	23,1	5
-	-	3010	866	32,6	18
-	-	3000	1375	41,7	15
-	-	3000	1730	39,1	-
-	-	3000	1669	52,1	22
-	-	2990	1800	48,3	-
-	-	3000	1998	46,0	176
-	-	3000	2050	47,9	-
-	-	3000	2155	48,3	132
-	-	3010	2180	52,9	-
-	-	3030	2227	50,0	147
-	-	3000	2286	52,5	186
-	-	3030	2530	54,4	225
-	-	4000	474	23,5	2
-	-	4000	1009	36,6	3
-	-	4000	1310	41,4	-
-	-	4000	1643	51,1	5
-	-	3990	1730	47,2	-
-	-	4000	2150	52,2	-
-	-	4020	2201	48,6	98
-	-	4000	2480	56,4	-
-	-	4050	2743	54,7	167
-	-	4050	2899	56,2	176
-	-	3990	2790	59,8	-
-	-	3950	2900	60,6	-
-	-	4070	3095	58,3	216
-	-	4010	3354	61,9	235
-	-	5000	474	22,7	2
-	-	5000	934	34,3	2
-	-	5000	1689	52,1	1

D (mm)	d/D	Pu (kPa)	Δ P (kPa)	Q (l/s)	N (m/s^2)
97,2	0,377	5000	2024	63,1	29
-	-	5000	2500	56,4	39
-	-	4990	2620	57,9	98
-	-	4950	2435	60,9	118
-	-	5000	2950	62,1	225
-	-	5000	3120	63,7	255
-	-	4970	2938	66,3	260
-	-	4990	3460	66,7	260
-	-	5000	3630	68,3	260
-	-	5010	3853	65,1	284
-	-	5000	4179	70,7	196
-	-	6000	454	23	1
-	-	5990	931	34,6	1
-	-	6000	1656	51,7	1
-	-	6000	2090	63,7	-
-	-	5990	2560	62,1	-
-	-	6050	2236	61,3	39
-	-	6000	2873	65,2	-
-	-	5950	2451	63,7	88
-	-	6000	2997	66,0	-
-	-	6000	3147	67,5	-
-	-	6000	3526	67,9	274
-	-	6000	3298	69,0	-
-	-	6000	4081	74,0	323
-	-	6000	4105	75,2	-
-	-	7000	494	24,8	2
-	-	7030	866	32,2	2
-	-	7000	1584	47,5	2
-	-	6980	2492	45,5	2
-	-	7000	2448	60,2	2
-	-	7000	2873	65,2	3
-	-	7000	3415	69,0	14
-	-	6880	3657	72,1	27
-	-	6660	3905	73,6	33
-	-	6310	4245	76,7	30

D (mm)	d/D	Pu (kPa)	Δ P (kPa)	Q (l/s)	N (m/s^2)
97,2	0,444	2000	19	6,8	157
-	-	2000	65	13,4	157
-	-	2000	234	24,7	167
-	-	2000	376	32,1	167
-	-	2000	480	36,4	157
-	-	2000	584	40,2	167
-	-	2000	824	48,1	172
-	-	2000	837	48,5	176
-	-	2000	896	50,2	186
-	-	2000	961	52,0	196
-	-	2000	1003	53,2	201
-	-	3000	149	19,6	29
-	-	3000	284	28,0	57
-	-	3000	539	38,6	88
-	-	3000	759	46,1	105
-	-	3000	954	51,8	118
-	-	3000	1013	53,5	127
-	-	3000	1162	57,4	137
-	-	3000	1324	61,4	157
-	-	3000	1441	64,1	167
-	-	4000	422	34,0	20
-	-	4000	727	45,1	25
-	-	4000	1026	53,8	29
-	-	4000	1311	61,1	30
-	-	4000	1766	71,2	59
-	-	4000	1869	73,3	67
-	-	4000	1915	74,2	88
-	-	5000	372	31,9	18
-	-	5000	817	47,9	18
-	-	5000	1569	67,0	12
-	-	5000	1949	74,9	14
-	-	5000	2172	79,2	29
-	-	5000	2451	84,3	78
-	-	5000	2487	84,9	147
-	-	6000	566	39,6	18

D (mm)	d/D	Pu (kPa)	Δ P (kPa)	Q (l/s)	N (m/s^2)
97,2	0,444	6000	845	48,7	18
-	-	6000	1569	67,0	15
-	-	6000	2007	76,1	12
-	-	6000	2243	80,5	39