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Appendices

- Appendix A - Raw Water Quality in Kalu Ganga in Year 2010 and Year 2011
- Appendix B - Raw Water Quality in Kelani Ganga in Year 2015 and Year 2016
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Appendix - A

Raw Water Quality in Kalu Ganga in Year 2010 and Year 2011

Sample No	Raw Water Parameter		
	pH	Colour	Turbidity
1	4.14	7.11	10
2	6.57	7.2	10
3	7.23	6.9	20
4	7.25	6.9	15
5	7.68	6.5	15
6	8.55	6.9	20
7	9.3	6.9	20
8	9.88	6.9	25
9	9.92	7.1	20
10	10.3	7.1	25
11	10.4	6.9	20
12	11.6	6.9	25
13	11.8	7.1	25
14	12.2	6.8	25
15	12.2	6.9	25
16	12.6	6.7	25
17	13.8	6.5	25
18	16.1	6.7	25
19	16.2	7	25
20	17	6.5	25
21	18.1	6	30
22	18.2	6.3	25
23	18.3	6.8	40
24	20.7	6.3	35
25	21.6	6.7	45
26	22.3	6.6	25
27	22.5	6.5	45

Sample No	Raw Water Parameter		
	pH	Colour	Turbidity
28	23.4	6.9	40
29	23.5	6.5	45
30	29.17	6.3	40
31	31.2	6.7	45
32	32.5	6.6	45
33	32.7	6.1	50
34	33.1	6.3	50
35	34.5	6.5	50
36	34.8	6.5	65
37	39.2	6.5	70
38	41.4	6.3	60
39	42.3	6.5	70
40	44.9	6.7	50
41	47.6	6.3	70
42	52.8	6.5	45
43	53.2	6.5	80
44	61.2	6.9	80
45	62.2	6.5	80
46	69.2	6	90
47	71.6	6.7	90
48	72.5	6.5	90
49	81.8	6.4	90
50	86.5	6.5	100
51	103.6	6.5	140
52	118.7	6.4	175
53	121.9	6.3	160
54	136	6.1	100

Appendix –B

Raw Water Quality in Kelani Ganga in Year 2015 and Year 2016

Sample No	Raw Water Parameter			Sample No	Raw Water Parameter		
	pH	Colour	Turbidity		pH	Colour	Turbidity
1	6.8	8	18.5	41	6.9	4	9.36
2	6.9	20	13.9	42	6.7	3	7.25
3	6.8	6	12.5	43	6.8	5	9.21
4	6.9	6	10.6	44	6.6	30	37.5
5	6.9	2	4.6	45	6.9	11	18.6
6	6.8	3	6.4	46	6.8	6	11.36
7	6.9	4	7.3	47	6.7	20	14.3
8	6.8	6	22.1	48	6.6	18	25.2
9	6.8	3	8.9	49	6.6	18	25.2
10	6.9	2	6.4	50	6.7	3	7.85
11	6.9	5	9.29	51	6.7	2	5.01
12	6.8	5	8.65	52	6.6	2	4.97
13	6.8	6	10.5	53	6.6	3	8.22
14	6.9	4	5.6	54	6.7	2	6.87
15	6.8	4	10.3	55	6.9	26	26
16	6.7	5	6.23	56	6.7	33	20.1
17	6.8	5	14	57	6.7	7	24.2
18	6.7	5	9.31	58	6.6	17	46.5
19	6.9	4	6.5	59	6.7	4	11.9
20	7	4	5.52	60	6.7	3	9.7
21	6.9	5	7.34	61	6.8	6	17.2
22	6.9	6	13.2	62	6.6	6	15.8
23	6.8	6	18.91	63	6.7	6	14.1
24	6.6	8	29.4	64	6.6	33	60.4
25	6.5	12	24.7	65	6.7	32	51.2
26	6.8	5	8.79	66	6.3	48	104
27	6.6	6	9.25	67	6.9	5	19
28	6.7	2	4.89	68	6.9	5	19
29	6.8	2	5.15	69	6.7	4	16.8
30	6.7	2	5.55	70	6.6	6	14.5
31	6.8	3	5.85	71	6.9	19	48.2
32	6.7	4	6.37	72	6.8	10	29.8
33	7	4	4.51	73	6.9	42	97.5
34	6.9	5	8.52	74	6.9	42	97.5
35	6.5	3	5.87	75	6.9	15	34
36	6.6	6	14.7	76	6.8	8	19.1
37	6.9	22	15.5	77	6.9	6	16.6
38	6.9	4	9.59	78	6.7	16	37.3
39	6.6	10	27.1	79	6.7	17	54.6
40	6.9	2	5.07	80	6.8	13	28.5

Sam ple No	Raw Water Parameter		
	pH	Colo ur	Turbidity
81	6.8	5	19.5
82	6.7	5	12.1
83	6.8	3	10.5
84	6.8	2	5.2
85	6.9	5	13.2
86	6.8	8	18.2
87	6.7	7	13.3
88	6.9	8	20.4
89	6.6	9	18
90	6.9	4	8.84
91	6.9	3	6.18
92	6.9	2	5.98
93	6.9	8	9.21
94	6.9	10	12.5
95	6.9	9	11.4
96	6.7	32	69.7
97	6.5	10	11.8
98	6.6	10	12.5
99	6.9	2	6.2
100	6.9	25	7.12
101	0	0	0
102	6.9	30	9.5
103	7	29	8.9
104	6.7	8	15.2
105	6.9	42	27.4
106	7.1	9	15
107	6.6	13	12.2
108	6.5	10	11.5
109	6.7	11	12.5
110	6.8	10	12.4
111	6.8	10	12.4
112	6.7	14	9.35
113	6.9	5	13.4
114	6.9	11	11.5
115	6.6	10	7.37
116	6.8	12	10.26
117	6.7	8	6.32
118	6.9	6	7.37
119	6.5	11	6.42
120	6.6	2	4.51

Sam ple No	Raw Water Parameter		
	pH	Colou r	Turbidity
121	6.5	11	9.79
122	6.5	12	6.37
123	6.6	8	5.96
124	6.4	4	5.67
125	6.7	4	4.72
126	6.8	5	6.31
127	6.9	3	7.31
128	6.9	3	7.31
129	6.8	15	4.69
130	6.4	9	3.71
131	6.8	11	4.44
132	6.9	14	6.89
133	6.7	10	4.12
134	6.8	8	9.25
135	6.8	9	4.89
136	6.7	14	13
137	6.6	12	11.1
138	6.6	8	4.35
139	6.8	9	4.71
140	6.8	6	10.7
141	6.8	5	4.22
142	6.7	5	4.71
143	6.7	16	6.47
144	6.7	15	6.47
145	6.8	3	8.8
146	6.7	5	7.25
147	6.5	9	6.35
148	6.5	15	7.62
149	6.6	16	8.35
150	6.5	10	12.26
151	6.5	1	13.2
152	6.5	20	8.3
153	6.5	18	8.02
154	6.5	15	7.73
155	6.5	14	6.95
156	6.6	38	23.22
157	6.6	20	8.32
158	6.5	12	11.43
159	6.5	10	10.31
160	6.4	14	14.52

Appendix -C

**Treated Water Quality Using Aluminium Sulphate in Kalu Ganga
Water Source**

Sa mpl e No	Raw Water Parameters				Treated Water Parameters by Aluminium Sulphate				
	Turbid ity Range	Turbid ity (NTU)	PH	Colour (Hu)	Alum Dosage (ppm)	Turb idity (NTU)	pH	Colour (Hu)	Diamet er Type
1	0-10	4.14	7.11	10	6	2.3	6.9	7.5	C
2		6.57	7.2	10	8	2.16	7	5	D
3		7.23	6.9	20	7	2.02	6.9	2.5	D
4		7.25	6.9	15	6	1.6	6.9	5	F
5		7.68	6.5	15	5	2.07	6.4	2.5	D
6		8.55	6.9	20	7	1.85	6.9	5	E
7		9.3	6.9	20	7	1.65	6.9	2.5	D
8		9.88	6.9	25	6.5	1.73	6.9	2.5	E
9		9.92	7.1	20	5.5	1.12	7	2.5	D
10	11-20	10.3	7.1	25	6	2.12	6.9	5	E
11		10.4	6.9	20	7	1.38	6.8	2.5	E
12		11.6	6.9	25	7.5	1.92	6.9	5	E
13		11.8	7.1	25	7	1.64	7	5	E
14		12.2	6.8	25	6	1.67	6.7	2.5	E
15		12.2	6.9	25	9.5	1.82	6.3	2.5	E
16		12.6	6.7	25	10	1.38	6.6	2.5	E
17		13.8	6.5	25	8.5	2.05	6.4	5	E
18		16.1	6.7	25	8	1.88	6.3	2.5	E
19		16.2	7	25	9	1.93	6.8	2.5	E
20		17	6.5	25	4.5	2.93	6.5	2.5	E
21		18.1	6	30	6.5	1.92	6	2.5	E
22		18.2	6.3	25	5.5	2.28	6.3	2.5	E
23		18.3	6.3	40	8.5	2.03	6.3	5	E
24	21 -40	20.7	6.3	35	5	2.87	6.3	2.5	E
25		21.6	6.7	45	10	1.94	6.6	2.5	E
26		22.3	6.6	25	10	2.79	6.3	5	E
27		22.5	6.5	45	10	1.59	6.3	2.5	E
28		23.4	6.9	40	9	1.71	6.9	2.5	E
29		23.5	6.5	45	7	4.32	6.1	5	E
30		29.17	6.3	40	6.5	2.48	6.3	2.5	F
31		31.2	6.7	45	8.5	1.82	6.3	2.5	E
32		32.5	6.6	45	10.5	1.38	6.2	2.5	E
33		32.7	6.1	50	5.5	2.05	6.1	5	E
34		33.1	6.3	50	10	2.68	6.2	5	E
35		34.5	6.5	50	4.5	1.92	6.5	2.5	E
36		34.8	6.5	65	12	1.43	6.2	2.5	E
37		39.2	6.5	70	13	1.96	6.4	5	E

Sample No	Turbidity Range	Turbidity (NTU)	PH	Colour (Hu)	Alum Dosage (ppm)	Turbidity (NTU)	pH	Colour (Hu)	Diameter Type
38	41-60	41.4	6.3	60	12	1.76	6.2	2.5	E
39		42.3	6.5	70	10.5	1.86	6.46	2.5	E
40		44.9	6.7	50	7.5	3.63	6.4	5	F
41		47.6	6.3	70	11	1.93	6.1	2.5	E
42		52.8	6.5	45	7	1.32	6.3	2.5	F
43		53.2	6.5	80	14	3.08	6.2	5	F
44	61-80	61.2	6.9	80	11	2.02	6.4	5	E
45		62.2	6.5	80	10	3.12	6.2	5	E
46		69.2	6	90	7.5	3.26	6.9	5	D
47		71.6	6.7	90	13.5	3.65	6.8	10	D
48		72.5	6.5	90	14.5	2.49	6.3	5	F
49	81-140	81.8	6.4	90	12.5	2.96	5.76	5	E
50		86.5	6.5	100	15	3.36	6.2	5	E
51		103.6	6.5	140	13.5	2.49	6.2	5	E
52		118.7	6.4	175	14.5	1.78	6.1	2.5	E
53		121.9	6.3	160	14	2.28	6.2	2.5	E
54		136	6.1	100	13.5	2.26	6.1	2.5	E

Treated Water Quality Using Poly Aluminium Chloride in Kalu Ganga Water Source

	Raw Water Parameters				Treated Water Parameters by Poly Aluminium Chloride				
	Turbidity Range	Turbidity (NTU)	PH	Colour (Hu)	PACL Dosage (ppm)	Turbidity (NTU)	pH	Colour (Hu)	Diameter Type
1	0-10	4.14	7.11	10	3.5	2.3	6.9	6.9	D
2		6.57	7.2	10	3.5	2.25	7.1	5	C
3		7.23	6.9	20	4	2.88	6.9	5	E
4		7.25	6.9	15	2.5	3.63	7.1	5	C
5		7.68	6.5	15	3	1.73	6.9	2.5	D
6		8.55	6.9	20	3.5	3.11	6.7	5	E
7		9.3	6.9	20	3	2.8	6.9	5	C
8		9.88	6.9	25	4	2.98	6.4	5	D
9		9.92	7.1	20	4	3.21	6.9	5	D
10	11-20	10.3	7.1	25	3.5	1.91	6.9	5	F
11		10.4	6.9	20	3	2.6	6.9	5	D
12		11.6	6.9	25	3.5	2.64	6.8	5	D
13		11.8	7.1	25	3.5	2.23	6.9	5	E
14		12.2	6.8	25	4.5	2.39	6.9	5	E
15		12.2	6.9	25	4.5	2.39	6.9	5	E
16		12.6	6.7	25	3.5	3.33	6.9	5	C
17		13.8	6.5	25	3.5	3.32	6.7	5	E
18		16.1	6.7	25	3	2.15	6.7	5	F
19		16.2	7	25	3	2.89	6.6	5	E
20		17	6.5	25	3	3.55	6.5	5	D
21	18.1	6	30	2.5	2.53	6.5	5	F	
22	18.2	6.3	25	5.5	3.01	6	5	E	
23	18.3	6.3	40	3.5	2.33	6.3	5	D	
24	21 -40	20.7	6.3	35	2.5	2.24	6.6	2.5	E
25		21.6	6.7	45	4.5	3.11	6.9	2.5	E
26		22.3	6.6	25	5	2.68	6.5	5	E
27		22.5	6.5	45	4.5	2.37	6.42	2.5	F
28		23.4	6.9	40	4.5	3.62	5.92	5	E
29		23.5	6.5	45	4.5	3.62	5.92	5	E
30		29.17	6.3	40	4.5	3.18	6.1	5	E
31		31.2	6.7	45	5	2.84	6.7	2.5	E
32		32.5	6.6	45	4.5	3.48	6.5	5	E
33		32.7	6.1	50	2.5	2.32	6.1	5	E
34		33.1	6.3	50	2.5	2.64	6.7	5	D
35		34.5	6.5	50	4	2.42	6.3	5	E
36		34.8	6.5	65	4	2.42	6.3	5	E
37		39.2	6.5	70	5	2.43	6.1	5	F

	Raw Water Parameters				Treated Water Parameters by Poly Aluminium Chloride				
	Turbidity Range	Turbidity (NTU)	PH	Colour (Hu)	PACL Dosage (ppm)	Turbidity (NTU)	pH	Colour (Hu)	Diameter Type
38	41-60	41.4	6.3	60	7	3.93	6.9	5	E
39		42.3	6.5	70	3.5	2.84	6.3	2.5	F
40		44.9	6.7	50	4	3.48	6.5	5	E
41		47.6	6.3	70	5.5	1.71	6.3	2.5	F
42		52.8	6.5	45	3	3.76	6.3	5	F
43		53.2	6.5	80	5	2.72	6.3	5	F
44	61-80	61.2	6.9	80	6.5	2.84	6.3	5	E
45		62.2	6.5	80	4.5	2.8	6.4	5	E
46		69.2	6	90	5.5	2.07	6	5	F
47		71.6	6.7	90	3.5	3.58	6.7	2.5	F
48		72.5	6.5	90	6.5	2.11	6.5	5	G
49	81-140	81.8	6.4	90	6.5	2.96	5.76	5	E
50		86.5	6.5	100	6.5	2.95	6.3	5	F
51		103.6	6.5	140	5	3.12	6.2	5	F
52		118.7	6.4	175	5	1.73	6	2.5	F
53		121.9	6.3	160	6	2.24	6.5	2.5	F
54		136	6.1	100	6.5	2.26	6	2.5	G

Appendix -E

Treated Water Quality Using Alum and PACL in Kelani Ganga Water Source

Sample No	Raw Water Parameter			Settled Water Parameter							
	Raw Water Turbidity Range	Turbidity	Colour	Aluminium Sulphate				Poly Aluminium Chloride			
				Dosage (ppm)	Turbidity	PH	Colour	Dosage (ppm)	Turbidity	PH	Colour
1	0-15	9.66	84	9	2.52	6.84	23	4.5	2.03	6.86	20
2		11.2	112	13	2.13	6.65	25	5.5	1.88	6.86	22
3		14.6	40	12	2.34	6.98	10	5.5	2.08	6.96	10
4		15	40	12	4.47	6.93	20	5	1.86	7.2	10
5	16-30	15.8	123	13	2.54	6.41	15	5	2.03	6.83	15
6		16.6	108	14	2.32	6.89	24	5	2.16	6.75	26
7		21.4	75	14	2.64	6.82	10	5	2.12	6.94	10
8		22	198	15	2.96	6.81	40	5.5	2.75	6.94	33
9		24.8	45	12	3.19	6.83	10	6	1.59	7.17	5
10		27.3	211	15	2.98	6.87	24	6.5	2.58	6.96	12
11		30	231	16	3.18	6.94	27	5.5	2.81	7.25	26
12	31-85	33.8	251	13	4.52	6.59	41	6	3.31	7.45	29
13		60.7	90	13	4.99	6.68	20	6.5	4.02	7.02	20
14		85.3	682	15	10.2	6.64	113	7	3.58	7	44

Questionnaire Survey

Name :

Position :

Present Work Place :

Previous Work Place :

Poly Aluminium Chloride as an alternative to Alum as a coagulant in Water Treatment

1. Have you used chemical coagulants in water treatment?
 - i) Yes
 - ii) No

2. Which coagulant you are familiar in the water treatment process?
 - i) Aluminium Sulphate (Alum)
 - ii) Poly Aluminium Chloride (PACL)
 - iii) Both

3. How many years of experience do you have in Water Treatment Plants?
 - i) < 2 years
 - ii) 2 – 5 years
 - iv) 6 – 10 years
 - v) >10 years

4. How long have you been working at the present Treatment Plant?
 - i) < 2 years
 - ii) 2 – 5 years
 - iii) 6 – 10 years
 - iv) >10 years

5. What is the capacity of your Water Treatment Plant you are presently working?
 - i) < 10,000 m³/day
 - ii) 10,000 -20,000 m³/day

iii) 20,000 -50,000 m³/day

iv) > 50,000 m³/day

6. What is the type of coagulant that you presently use?

i) Aluminium Sulphate (Alum)

ii) Poly Aluminium Chloride (PACL)

iii) Any others – Please specify

7. What is the most preferable type of coagulant according to your experience?

i) Aluminium Sulphate (Alum)

ii) Poly Aluminium Chloride (PACL)

iii) Any others – Please specify

8. What do you think about the coagulant dosage for the two chemicals?

i) Aluminium Sulphate and Poly Aluminium Chloride Dosages are equal.

ii) Approximately Half of Aluminium sulphate dosage is equal to Aluminium Chloride dosage

iii) Approximately Half Aluminium Chloride of dosage is equal to Aluminium sulphate dosage

iv) Other

If other Ratio, please specify

.....

9. How did you answer the above question (Question 8)

i) I have used both chemicals in treatment plants

ii) I have learnt/ read about it

iii) I have heard other chemists/operators talk about it

iv) I do not know, I just guessed

10. If you like to use Alum, what are the benefits you expect by using Alum Other than the Poly Aluminium chloride ? (prefer 1 or more, please tick)

i) Less dependent on Quality of the raw water

ii) Better Quality of the treated water

iii) Cost effectiveness

iv) Easy maintenance

v) Sludge volume consideration

- vi) Labour and equipment for storage, feeding and handling
- vii) Availability in market

11. If you like to use Poly Aluminium Chloride, what are the benefits you expect by using Poly Aluminium Chloride Other than the Alum? (prefer 1 or more, please tick)

- i) Less dependent on Quality of the raw water
- ii) Better Quality of the treated water
- iii) Cost effectiveness
- iv) Easy maintenance
- v) Sludge volume consideration
- vi) Labour and equipment for storage, feeding and handling
- vii) Availability in market

12. How much turbidity is reduced on average as a percentage, when using the following coagulants?

- Aluminium Sulphate

0-25% 26- 50% 51-75%

75-100%

- Poly Aluminium Chloride

0-25% 26- 50% 51-75%

75-100%

- I do not know

13. What do you think about the organic matter removal by Aluminium Sulphate and Poly Aluminium Chloride?

- i) Aluminium Sulphate (Alum) is better
- ii) Poly Aluminium Chloride (PACL) is better
- iii) Both are equal
- iv) I do not know

14. Which coagulant makes the O&M activities easier?

- i) Aluminium Sulphate (Alum)
- ii) Poly Aluminium Chloride (PACL)

15. Are any changes in equipment required to change over from Alum to PACL?

i) Aluminium Sulphate (Alum)

.....

ii) Poly Aluminium Chloride (PACL)

.....

16. What are the personnel (Man power) requirements for setting up both coagulants in the plant?

i) Aluminium Sulphate (Alum)

.....

ii) Poly Aluminium Chloride (PACL)

.....

17. What is the time required to floc preformation for both chemical?

i) Aluminium Sulphate (Alum)

.....

ii) Poly Aluminium Chloride (PACL)

.....

18. What is the more economical chemical out of these two chemicals?

i) Aluminium Sulphate (Alum)

.....

ii) Poly Aluminium Chloride (PACL)

.....

19. Are there any equipment (Dust extractors, chemical stirrers; etc) required to be fixed to use Aluminium Sulphate (Alum)/Poly Aluminium Chloride ?

i) Aluminium Sulphate (Alum)

.....

ii) Poly Aluminium Chloride (PACL)

.....

20. What do you think about the Floc formation Efficiency when both chemicals are compared?

- i) Aluminium Sulphate (Alum) produces less sludge than PACL
- ii) Poly Aluminium Chloride (PACL) produces less sludge than Alum

21. How is the availability of Aluminium Sulphate (Alum)/Poly Aluminium Chloride in the market? Please mention, whether there was any shortage in the recent past or at present?

- i) Aluminium Sulphate (Alum)
.....
- ii) Poly Aluminium Chloride (PACL)
.....

22. Were there any complaints from the operators or neighbours when using either of the chemicals? If yes, please give details

- i) Aluminium Sulphate (Alum)
- ii) Poly Aluminium Chloride (PACL)

**Poly Aluminium Chloride as an alternative to Alum
as a coagulant in Water Treatment
Questionnaire Survey Analysis**

The conclusions of the questionnaire survey analysis are as follows:

1. Questions 01 to 04

- Regarding the coagulants familiarization, period of experience in WTP, and period of working in the present.

All respondents were aware of both coagulants. Out of the total, 21 numbers of persons, approximately 50%, used Alum or PACL.

2. Questions 05 and 06

- Consisted of the capacity of WTP presently working and the type of coagulant t presently used.

61% plants are using Alum while 56% plants are using PACL. The DGM (Western Province) said that, in the Western Province, seven WTPs are in operation under NWSDB. However, only two WTPs use PACL.

Details of Western province WTPs details are shown in the following table:

	Water Treatment Plant	Source	Production (m³/day)	Coagulant Used
01	<i>Ambatale (Old)</i>	<i>Kelani Ganga</i>	<i>180,000</i>	<i>Alum</i>
02	<i>Ambatale (New)</i>	<i>Kelani Ganga</i>	<i>292,500</i>	<i>Alum</i>
03	<i>Kalatuwawa</i>	<i>Kalatuwawa Reservoir</i>	<i>90,000</i>	<i>PACL</i>
04	<i>Labugama</i>	<i>Labugama Reservoir</i>	<i>45,000</i>	<i>Alum</i>
05	<i>Bambukuliya</i>	<i>Ma Oya</i>	<i>36,000</i>	<i>Alum</i>
06	<i>Kandana</i>	<i>Kalu Ganga</i>	<i>127,000</i>	<i>Alum</i>
07	<i>Kethhena</i>	<i>Kalu Ganga</i>	<i>56,000</i>	<i>PACL</i>

3. Question 07

- Relevant to the most preferable type of coagulant

Three persons out of 21 prefer to use Alum. The others are willing to use PACL (18/21). The majority of the people know about PACL and its effectiveness in the treatment process.

4. Questions 08 and 09

- What do you think about the coagulant dosage of the two chemicals?

In the survey 13/21 said that approximately 50% of Alum dosage is required compared with PACL for the water treatment process, whereas only one preferred Alum and PACL in equal doses.

5. Questions 10 and 11

- The benefits expected from using Alum rather than Poly Aluminium Chloride and Poly Aluminium Chloride rather than Alum

Comparison of coagulant benefits as a percentage % are presented in the following table:

	Description	Coagulant Benefits (%)	
		Alum	PACL
1	<i>Less dependent on Quality of the raw water</i>	5.6	55.6
2	<i>Better Quality of the treated water</i>	11.1	94.4
3	<i>Cost effectiveness</i>	27.8	55.6
4	<i>Easy maintenance</i>	55.6	11.1
5	<i>Sludge volume consideration</i>	16.7	61.1
6	<i>Labour and equipment for storage, feeding and handling</i>	27.8	33.3
7	<i>Availability in market</i>	44.4	11.1

6. Question 12

- The percentage of turbidity reduced efficiency by using Alum and PACL

Most of them were of the opinion that between 75 and 100% efficiency could be achieved by using both coagulants. Very few persons were of the opinion that 51-75% efficiency could be obtained from Alum.

7. Question 13

- The organic matter removal by Alum and PACL

Eleven persons (11/21) accepted that more organic matter could be removed with PACL rather than with Alum whereas seven persons (7/21) disagreed..

8. Question 14

- Coagulant type which makes O&M activities easier.

The 28.6% and 52.4% said O&M activities were easier with Alum and PACL respectively. However, some of them stated that PACL was more corrosive than Alum.

9. Question 15

- Any changes in the equipment required to change over from Alum to PACL
About 80% commented that PACL is a corrosive agent. Therefore, the equipment should be replaced with non- corrosive materials.

10. Question 16

- The personnel (manpower) required for setting up both coagulants in the plant.

Seven participants replied that high manpower was required for Alum while one participant said that high manpower was required for PACL. Six participants said the same manpower was required for both chemicals.

11. Question 17

- The time required for floc preformation in both chemicals.

The respondents said that floc formation time was faster with PACL; the others had not commented on the comparison.

12. Question 18

- The more economical chemical of these two chemicals.

All participants, except three, commented that PACL was more economical than Alum. They formed a percentage of 85.7%. Among them, one had said that “Considering present market prices, Alum is more economical even though the dosage required is considerably high. But, considering shipping, transport and storage cost PACL is more economical. And, also less lime was needed with PACL”.

13. Question 19

- Any equipment (dust extractors, chemical stirrers, etc) required to be fixed to use Aluminium Sulphate (Alum)/Poly Aluminium Chloride

Most of the participants had mentioned that dust extractors were needed when using PACL. They commented about the need for special equipment such as dust extractors and chemical stirrers to control corrosion caused by PACL dust. Six out of 21 had commented that they were needed for both chemicals; 4/21 did not answer.

14. Question 20

- Floc Formation Efficiency when both chemicals are compared.

Among the respondents 81% accepted that less sludge is produced with PACL. About 19% disagreed; others did not respond.

15. Question 21

- The availability of Alum/PACL in the market and any shortage in the recent past or at present

The respondents commented in different ways. Seventeen persons said that both chemicals were available in the market whereas two persons out of the total commented that PACL was less available in the market.

DGM (Supplies) and Manager (Supplies) commented that both chemicals were available in the market. However, recently Alum imports from China was suspended because some factories were closed down by the Chinese Government owing to some environmental problem.

16. Question 22

- Any complaints from the operators or neighbours when using either of the chemicals

Most of the respondents replied that with regard to Alum there were no complaints, but PACL caused corrosion due to dust, solidifying due to moisture, difficulty in breathing due to dust, and difficulty in storing for long periods. To prevent this they proposed eliminating dust accumulation when handling PACL.