

Open Reservoir Water Contamination

- ✓ Open reservoirs are ideal environment for growth of algae and bio-film as all required conditions viz. air, water and sun light are available in abundance.
- ✓ Microscopic spores of algae are continuously introduced by wind, dust storms, rain showers, etc. into reservoirs.
- ✓ When algae growth overtakes a water body, water quality deteriorates very sharply to a point of being unusable.
- ✓ All above factors leads to the growth of undesirable organic matter in water

System Description & Constraints in Fresh Water Quality

Mathura Refinery uses following sources of Raw water:

- ✓ Koyala bore well water @ 500 to 550 m3/hr
- ✓ Keetham Lake water @ 350 to 400 m3/hr

Water from these sources are received into 02 numbers of open reservoirs, each of 5000 m3 capacity.

Fresh water is mainly used for :

- ✓ Generation of DM water,
- ✓ Makeup for Cooling Towers
- ✓ Service Water

Average organic matter (OM) values of feed water at source are as under:

- ✓ Keetham: 26-30 ppm
- ✓ Koyala: 15-17 ppm

Quality of Koyala & Keetham water before & after reservoirs is as below:

Reservoir	Keetham	Koyala	Organic matter, ppm		
			Expected	Actual	% increase
R-1	50%	50%	21-23	24-26	10-13%
R-2	100%	0%	26-30	30-34	11-15%

OM further increases by 15-20% in pump suction chamber attached to these two reservoirs.

Rate of Algae formed in pound per Acre per day = $k \cdot F \cdot Sr$

Where, $k = 0.15$; F = amount of sun energy in 60-600 Langley's (cal/cm2/Day) @6-15% efficiency. Sr is the efficiency of algae to use the sun energy, is expressed in hole number ~ 1.0

So, at minimum rate of 10 Gm/m²/day, rate of algae formation is 15 Kg/day. Thus the fresh growth of OM indicated above is unavoidable.

Technology used for Control of Organic Matter (OM) Growth

In order to arrest fresh growth of OM in open reservoirs, Ultrasonic Biomass Reduction Device was installed in following locations:

- ✓ Reservoir-1 : 01 number
- ✓ Reservoir-2 : 01 number
- ✓ Pump Suction chamber : 01 number

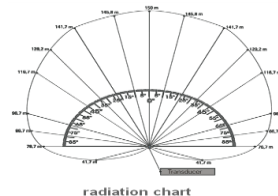
Salient Features & working principle of device:

- ✓ Small unit which floats in the water body
- ✓ Very small continuous power supply @ 45 Watts
- ✓ Continuously emits ultrasound waves at a frequency of 35 KHz in 0 to 180° angle (refer Fig-2)
- ✓ At frequency of 35 KHz, continuous application of vibration wave destroys the organic cells of algae.
- ✓ Minimum required time for destruction of algae cells is 2-3 weeks

Fig-1: Ultrasonic Device



Fig-2: Typical ultrasonic wave distribution pattern



Performance Evaluation

In order to evaluate the performance of the device, 01 no of sample per week was collected from the following locations as shown in Figure-3 & the results are indicated in Table-2:

- ✦ OM of Keetham water : supply point at reservoir
- ✦ OM of Koyala water : supply point at reservoir
- ✦ OM at the outlet of each of Reservoir – 1/2
- ✦ OM in the blended water of discharge of pump suction chamber

Tab-2: Inlet, expected & actual outlet OM Values in Reservoir-1/2, Suction Chamber (After installation)

Date	am Inlet	a Inlet	1 (R-1) outlet		2 (R-2) outlet		Chamber(SC)		% Growth		
	OM	OM	expect	Act	expect	Actu	expec	Actu	R-1	R-	SC
24-Sep-10	27	15	21	23	27	30	24	27	9	9	11
1-Oct-10	25	15	20	22	25	27	23	26	8	8	13
7-Oct-10	25	15	20	20	25	25	21	24	3	2	12
14-Oct-10	25	14	20	21	25	26	22	24	4	2	9
19-Oct-10	25	14	20	21	25	26	22	23	5	2	8
Average % growth in OM after installation									4	2	4

Benefits

- ✦ The fresh growth of OM reduced from 12.0% to 4.0%
- ✦ The overall OM growth reduced to 40%
- ✦ The thick greenish layer of algae on the inner wall surfaces of the reservoirs has become clean within the period of 01 month.
- ✦ DM/RO Plant operations have improved
- ✦ HCL, Caustic, Chlorine & resins consumption reduced

Conclusion

- ✦ This non-chemical & eco-friendly mode of ultrasonic treatment of raw water has successfully reduced fresh growth of organic matter by 40%
- ✦ This kind of technology is implemented for the first time amongst IOC refineries and it is being replicated in other areas as well

About Authors

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Tab-1: Inlet, expected & actual outlet OM Values in Reservoir-1/2, Suction Chamber (Before installation)

Date	Keetham	Koyala	Reservoir - (R-1) outlet		Reservoir - 2 (R-2)		Suction Chamber(SC)		% Growth		
	OM	OM	expect	Act	expect	Actu	expec	Actu	R-1	R-	SC
5-Aug-10	30	17	23	26	30	33	28	32	13	12	15
12-Aug-10	26	17	21	25	26	30	26	30	14	15	19
20-Aug-10	27	16	22	24	27	31	25	29	10	13	15
28-Aug-10	27	15	21	23	28	31	25	29	11	12	15
3-Sep-10	28	16	22	25	28	31	26	30	12	12	15
Average % growth in OM before installation									12	13	16

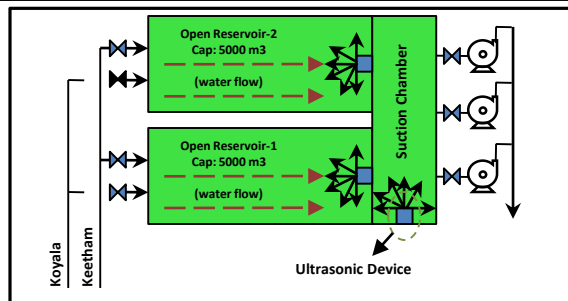


Fig-3: Depiction of water receipt system at Mathura Refinery