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Assessment of removal of TDS from synthetic water through the Process of Phyco-remediation

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Abstract: Phyco-remediation is a technology deal with the use of algae for remediation purpose of waste water. The present research work has been carried out to remove total dissolved solids from synthetic water. Two commonly found macro-algae were utilized for treatment. The total dissolved solids of synthetic water were kept in range 500-35000 mg/l. The selected algal species were *Chara* & *Oedogonium*. The experiments were carried out in batch studies for 20 days. The results conclude that *Oedogonium* reduces 39 % and *Chara* 40 % of total dissolved solids respectively. The present methodology is a simple, safe, reliable and cost-effective method for biological treatment using algae to remove total dissolved solids from water & wastewater through phyco-remediation process.

Index Terms **- Water, Synthetic water, Algae, Total Dissolved Solids, Phyco-remediation, Biological Treatment**

I. INTRODUCTION

Today's growing water supply consist not only massive demand but also by increased pollution and mineralization of rivers, lakes and underground resources. Population adds vast amount of wastes including salts to surface and underground waters. Over pumping of groundwater also causes lowering of water table and evaporation take a considerable portion of the surface water in land areas and put them back into the endless hydrological cycle.

There is always a necessity for identifying new sources. The technologies have barely made any success to prevent pollution of existing water resource as well as there is no reclamation of polluted water into fresh water, except on depending to some costly chemical methodologies for desalting. Biological desalination is one of the strategies to augment our present resource utilization. Now a days phyco-remediation have vast industrial and economic potential for removal of nutrients from waste water.

In the present research work, the identified algae were utilized for removing total dissolved solids under different concentrations levels and conditions from artificially prepared synthetic water at laboratory scale and further been thoroughly investigated.

II. RESEARCH METHODOLOGY

2.1 Sampling

The two commonly found macro-algal species namely *Chara* and *Oedogonium* were collected from Sakkardara and Gandhisagar lake respectively for phyco-remediation of synthetic water. Algae of suitable amount were collected in sterilized plastic container with the help of forceps.The collected algae were cleaned thrice with tap water and isolated in separate aquariums. After 5 day of isolation algae of both species were utilized for experimental purpose.

2.2 Preparation of Synthetic water

The synthetic water with different concentration of TDS was prepared by adding NaCl in distilled water. TDS of synthetic water was calculated with the help of gravimetric method (APHA, 2010).The total dissolved solids of synthetic water were kept in range 500-35000 mg/l.

2.3 Optimization study

2.3.1 Optimization of pH: Synthetic water containing TDS value of 100 mg/L were feed in a set of beakers. The experimental species 1 g of *Chara* and *Oedogonium* was added separately in each set and the pH ranges was variedfrom 5 - 9. The set were kept for 5 days to obtain the optimum pH value.

2.3.2 Optimization of dose: Set of beakers containing 100 ml of synthetic water with TDS value 100 mg/L were feed by varying doses of algae. The dose of both the species were kept in range of 0.5 – 1.5 g. The sets were kept for 5 days to confirm the doses of *Chara* and *Oedogonium* to obtain the optimum dose.

2.3.3 Optimization of temperature: After obtaining optimum pH & doses, the set were kept for study of optimization of temperature. Synthetic water containing pH 7, 1 g of algal species and TDS value 100 mg/L were kept for 5 days with varying range of temperature from 15 - 35^{0}C to obtain the optimum temperature.

2.4 Experimental Set-up

An experimental set of 5 beakers were feed with 500 ml of synthetic water containing different concentration of TDS (500, 5000, 15000, 25000 & 35000 mg/l) along with one control. Nutrient in form of Bold and Basal media were added accordingly in the synthetic water to fulfill the nutrient requirement of experimental species. The beakers were stirred regularly twice a day for exchange of gases. The set was kept under artificial white fluorescent light of 15 watts at a distance of 4 inches for Light and dark cycleof 10 hours per day.

The initial pH and TDS were measured before addition of algae. The experimental set-up was operated at room temperature. Each beaker was feed with 5 g of algae. The study was conducted at laboratory scale with optimize conditions for 20 days. The sample was periodically analysis after every 5 days interval for pH and TDS. The similar experimental technique was also utilized by S. Murugesan *et al*, 2007 for bioremediation of thermal wastewater.

Plate 1: Experimental Setup for *Chara*

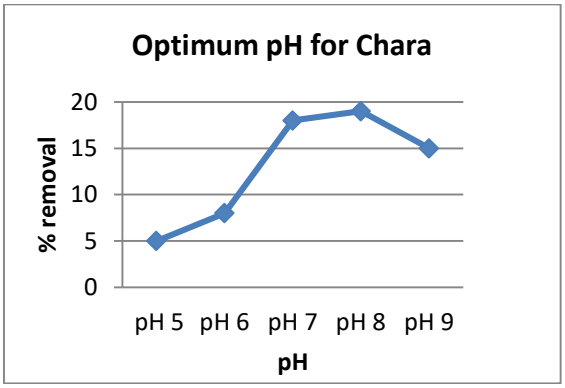
Plate 2: Experimental Setup for *Oedogonium*

Plate 3: Sampling at Sakkardara Lake

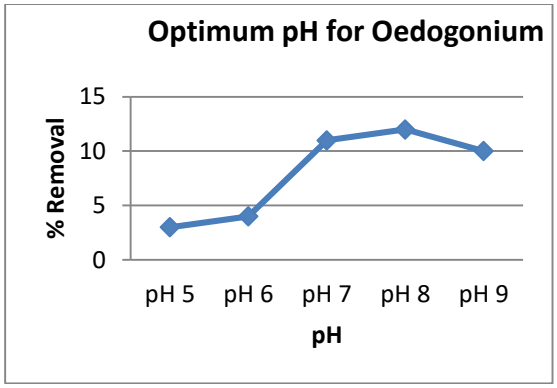
IV. RESULTS AND DISCUSSION

4.1 Result of optimization study

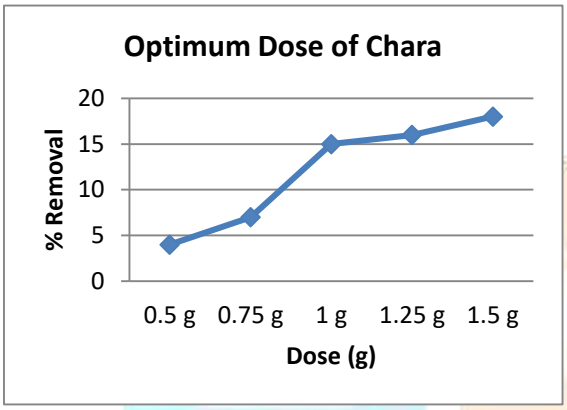
The observation of optimum study shows that pH range from 7 – 8, dose of 1 g for 100 ml of synthetic water and temperature in range of 25-30 ^{0}C were obtained for *Chara* and *Oedogonium*.



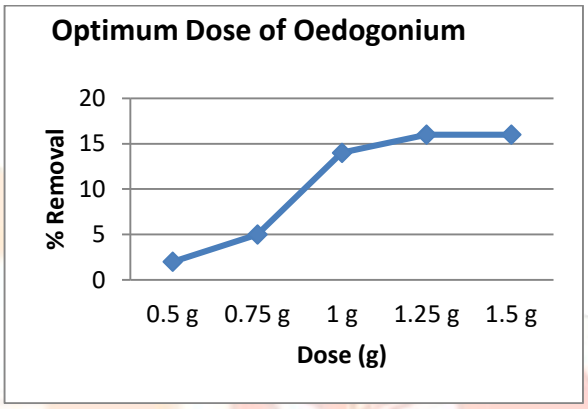
Graph 1: Optimum pH for *Chara*



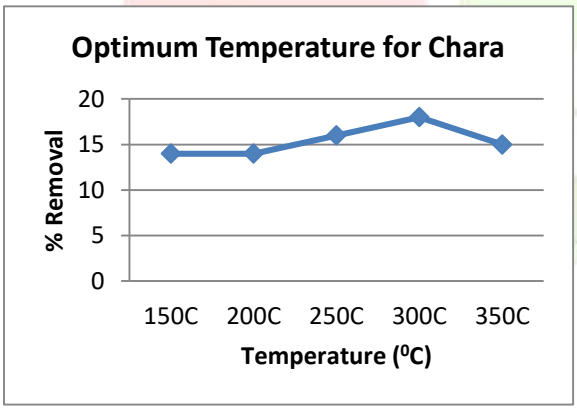
Graph 2: Optimum pH for *Oedogonium*



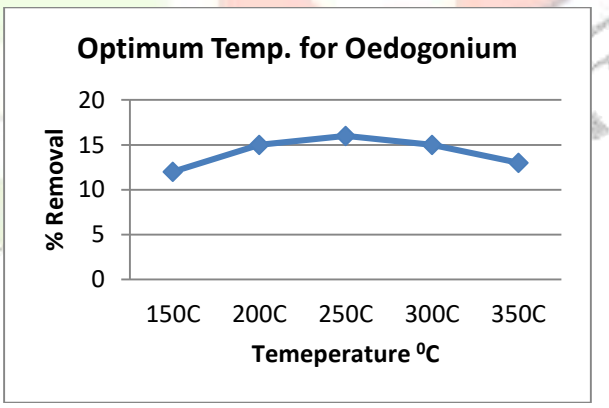
Graph 3: Optimum Dose of *Chara*



Graph 4: Optimum dose of *Oedogonium*



Graph 5: Optimum Temperature for *Chara*



Graph 6: Optimum Temperature for *Oedogonium*

4.2 Result of TDS removal

The pH values of both the sets showed no significant changes after 20 days of phyco-remediation with *Chara* and *Oedogonium*. The study reveals that there was slight increase in pH,The results are depicted in table 2 & 3. The reduction in TDS value with *Chara* was 290, 3000, 8850, 15000 and 21000 mg/L on 5th, 10th, 15th and 20th day respectively (Table 1). The average percentage removal of TDS by *Chara* was 40.00 %. (Graph 7)

The decreased in TDS values of synthetic water with *Oedogonium* was 300, 3100, 9300, 15200 and 21350 mg/L (Table 4). The reduction rate of TDS removal for *Oedogonium* was 39.00 %.(Graph 8). From the above data it can be confirmed that the rate of removal of TDS by both the algae were progressively increased on 5th, 10th, 15th and 20th day.

According to the morphological assessment it has been observed that the algae showed loss of pigmentation may be because of high concentration of TDS. The thallus of *Chara* showed loss of the chlorophyll pigment after 10 day, the colour of thallus changed from green to yellow green. In set of *Chara*'s the color of synthetic water was observed changed from colorless to yellowish green. The filaments of *Oedogonium* showed white deposited on it after 10 day in all sets. No change of colour was noted in *Oedogonium*. It has also been observed that the removal rate was decreased after 10 day in both the sets. Algae grown in high TDS water shown that the condition was not prevailing for its growth.

Table 1: Removal of TDS by *Chara*

Initial Day→	During Experiment							
	5		10		15		20	
TDS (mg/L)	TDS	%	TDS	%	TDS	%	TDS	%
500	420	16	350	34	300	40	290	42
5000	4250	15	3500	30	3125	37	3000	40
15000	12450	17	10350	31	9810	34	8850	41
25000	21000	16	17000	32	15500	38	15000	40
35000	29400	16	23450	33	22750	35	21000	40

Table 2: Change in pH value in set of *Chara*

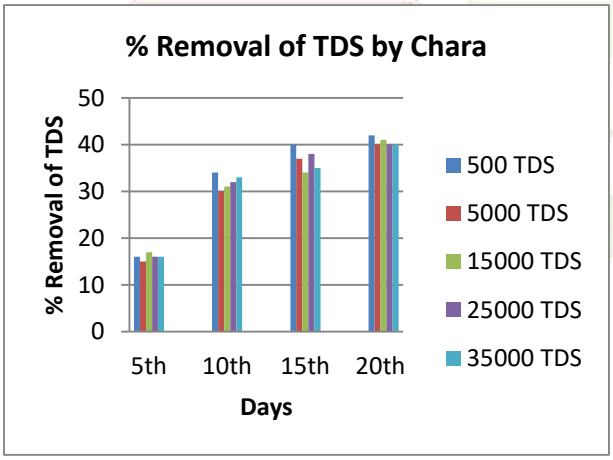
Sr.no.	Initial	During Experiment			
	Day→	5	10	15	20
	pH	pH	pH	pH	pH
1	7.22	7.26	7.30	7.28	7.30
2	7.34	7.38	7.36	7.40	7.34
3	7.63	7.60	7.68	7.65	7.70
4	7.89	7.92	7.92	7.95	7.90
5	8.10	8.15	8.13	8.15	8.14
6	8.36	8.39	8.38	8.40	8.40

Table 3: Change in pH value in set of *Oedogonium*

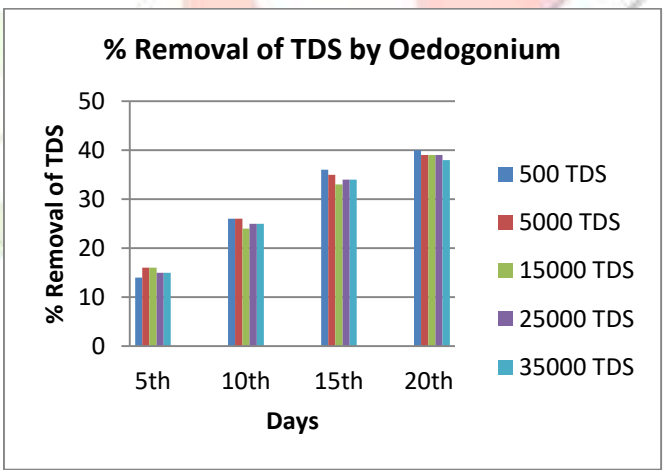
Sr.no.	Initial	During Experiment			
	Day →	5	10	15	20
	pH	pH	pH	pH	pH
1	7.32	7.30	7.30	7.34	7.33
2	7.46	7.39	7.43	7.40	7.45
3	7.89	7.88	7.89	7.90	7.89
4	8.10	7.98	7.99	8.06	8.08
5	8.16	8.15	8.16	8.14	8.15
6	8.25	8.24	8.26	8.25	8.30

Table 4: Removal of TDS by *Oedogonium*

Initial Day→	During Experiment							
	5		10		15		20	
TDS (mg/L)	TDS	%	TDS	%	TDS	%	TDS	%
500	430	14	370	26	320	36	300	39
5000	4200	16	3700	26	3250	35	3100	40
15000	1260	16	11400	24	10050	33	9300	38
25000	21250	15	18750	25	16500	34	15200	39
35000	29750	15	26250	25	23100	34	21350	39



Graph 7: % Removal of TDS by *Chara*



Graph 8: % Removal of TDS by *Oedogonium*

4.3 Conclusion

From results it can be concludedthat present investigation show *Chara* and *Oedogonium* used for removal of TDS from synthetic water leads to importance of phyco-remediation. The result shows that both the algae have good potential to remove TDS from synthetic water by 35-40 %. Among *Chara* & *Oedogonium*, *Chara* shown good potential for TDS removal then *Oedogonium*, but morphologically *Oedogonium* was more stable than *Chara*. The system can be useful to promote a low-cost green technology for de-salination of brine water. It may also be advantageous to apply phyco-remediation towards waste water treatment for TDS organic nutrients removal in developing countries.

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