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AERATION AND ALGAL CULTURING — A METHOD OF BIOLOGICAL TREATMENT FOR CRUMB RUBBER PROCESSING FACTORY EFFLUENT

JACOB MATHEW, R. KOTHANDARAMAN and KOCHUTHRESIAMMA JOSEPH
Rubber Research Institute of India, Kottayam 686 009, *Kerala, India*

ABSTRACT

Crumb rubber processing factory effluent was subjected to aeration with and without culturing *Chlorella vulgaris*. The treated effluent was analysed for pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), total nitrogen, total solids, suspended solids and bacterial population. Considerable reduction in the above parameters were noted due to aeration and culturing of *C. vulgaris*. The population of *C. vulgaris* increased remarkably upon aeration. The pH was also found to increase upon aeration with and without algal culturing. The feasibility of aerobic effluent treatment method in reducing the pollution load is discussed.

INTRODUCTION

Processing of technically specified block rubber in the form of crumb was introduced in India during 1970's. Crumb is made either from latex or from field coagulum called scraps. Enormous quantity of water is used for washing and cleaning during this process, which along with non-rubber constituents goes to form the effluent. The quantity and quality of the effluent depend on the type of raw rubber used and the quantum of rubber processed. Over 20 litres of effluent is generated for each kilogram of processed rubber. Indiscriminate discharge of this effluent into water ways and land for irrigation is prohibited by pollution control act.

Many biological treatment methods like trickling filter (Ponniah, Chick and Scow, 1975) anaerobic followed by aerobic ponding (Muthurajah, John and Henry Lee, 1973) were reported to be useful for the treatment of effluent from rubber processing factories. Attempts were also made to treat waste water by culturing algae (Jayangoundar et al, 1984; Chaudhari, Krishnamoorthi and Lalitha, 1983) in waste water with the aim to reduce pollution and get some return in the form of protein rich algae. (Kulkarni, Peter and Stanton, 1973) also reported the possibility of culturing of *Chlorella vulgaris* in rubber factory effluent. In order to monitor the effect of *C. vulgaris* culturing on crumb rubber processing factory effluent, a laboratory study was carried out and the same is reported in this communication.

MATERIALS AND METHODS

Stock culture of *C. vulgaris* was maintained in the laboratory in specific synthetic media as prescribed by Venkataraman (1969).

Effluent samples were collected from the outlet of crumb rubber processing factory at hourly intervals for 24 hours and pooled. The consolidated samples were analysed for pH, BOD, COD, total nitrogen, total solids suspended solids and bacteria using the methods prescribed in standard methods for

the examination of water and waste water (Apha, Anna and WPCF, 1975). The effluent samples were treated as per the treatments listed below:

1. Effluent samples without either aeration or inoculation with *C. vulgaris*; 2. Aeration only; 3. Inoculation with *C. vulgaris* only and 4. Aeration and *C. vulgaris* inoculation.

Five replications were maintained for each treatment. *C. vulgaris* culture was multiplied in synthetic broth medium and used for inoculating the effluent at the rate of 5×10^4 cells/ml. Air supply was given continuously for 5 days from a compressor at the rate of 146 cc air/min. The experiment was conducted in the laboratory providing artificial light at 10,000 lux for 10 hours daily.

RESULTS

Subjecting the effluent from crumb rubber processing to aeration or *C. vulgaris* inoculation alone and aeration with *C. vulgaris* inoculation have reduced the levels of different parameters like BOD, COD, total nitrogen, total solids, suspended solids and bacterial population (Table I).

The degree of reduction in pollution differed in various treatments. Maximum reduction was recorded in aeration with *C. vulgaris* inoculation followed by aeration alone. Inoculation of *C. vulgaris* without aeration though reduced the pollution it is not appreciable. Algal growth is 80% more when the inoculated effluent was aerated. The pH of

Table I. *Effect of aeration along with algal culturing in crumb rubber processing factory effluent*

Parameters	Control		Aeration	*C. vulgaris*	Aeration and *C. vulgaris* inoculation
	Initial	Final			
pH	5.2	5.7	7.5	7.0	8.2
BOD	290 mg/l	233 mg/l (20)	95 mg/l (67)	190 mg/l (34)	43 mg/l (85)
COD	720 ,,	607 ,, (15.5)	150 ,, (79)	280 ,, (61)	70 ,, (90)
Total nitrogen	45.8,,	38.5 ,, (16)	30.4 ,, (34)	35.5 ,, (22)	25 ,, (45)
Total solids	4670 ,,	4580 ,, (2)	3245 ,, (31)	4062 ,, (13)	2960 ,, (37)
Suspended solids	1650 ,,	1480 ,, (10)	968 ,, (41)	1340 ,, (19)	820 ,, (50)
Algae	—	—	—	25×10^6/ml	45×10^6/ml
Bacteria	49×10^5/ml	48×10^5/ml (2)	30×10^4/ml (93)	24×10^4/ml (95)	12×10^3/ml (99)

(Figures in parenthesis indicate the percentage of reduction)

the treated effluent was around neutral in all the treatments.

DISCUSSION

The basic principle involved in the biological treatment of effluent is the supply of oxygen to favour the oxidation of organic matter. Obviously low levels of various parameters recorded in aerated effluent is due to the enhanced supply of oxygen. Similar results were obtained by John et al (1974) Muthurajah et al (1973) and Ponniah et al. (1975), while treating anaerobically digested effluent from different types of rubber processing. The values of BOD, COD and total nitrogen are below the limits prescribed for discharging the effluent into water ways. The high levels of suspended solids in the treatment of *C. vulgaris* inoculation with aeration might be due to the biomass of *Chlorella*.

Chlorella sp. grow well in wastes containing low levels of BOD (John et al, 1974) and at higher levels they completely disappear. The low counts of *C. vulgaris* in inoculated effluent without aeration might be due to higher levels of BOD. Aerating the effluent resulted in low levels of BOD, which favoured the multiplication of *C. vulgaris*. This finding is in confirmity with that of Kulkarni et al. (1973). The enhanced population of *C. vulgaris* is also due to raise in pH to 8.2 as it requires a pH around 8 (Chaudhari et al, 1983) for maximum biomass production.

Effluent treatments in general are capable of reducing the bacterial population especially indicator bacteria like Coliforms (John et al, 1974). In the present study also the bacterial population is less. Lesser bacterial population in effluent upon aeration with and without culturing of *C. vulgaris* might be due to nonavailability of easily decomposable organic matter or competition for mineralised nutrients by *C. vulgaris* or the antibacterial activity of the algae (Venkataraman, 1969).

Seeding the effluent with *C. vulgaris* and maintaining the tanks aerated in light, were thus effective in promoting a rich algal growth and concomitant reduction in pollution load. Further studies on recovery of *C. vulgaris* by appropriate techniques and use of treated effluent rich in algae for fish culture are being initiated.

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