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# Colonisation of *Oscillatoria* on submerged polythenes in domestic sewage water of Silchar town, Assam ( India )

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**Abstract**

Disposal of polythene to waste water is a environmental concern. Submerged polythene plays an ideal substratum for colonising of algae. The present paper hightlights the colonisation of *Oscillatoria* on submerged polythene in domestic sewage water, Silchar town, Assam (India). A total of 20 species of *Oscillatoria* were found to be distributed on submerged polythene. *Oscillatoria princeps* , *O. subbrevis* , *O. limosa* , *O. amoena* ,*O. vizagapatensis* , *O. okeni* , *O. limosa and O. laete-virens* are the most common species encountered on the submerged polythene bags. The quality of domestic sewage water were investigated and correlation was made with total *Oscillatoria* species. Water temperature, pH, BOD, nitrate, calcium, sulphate and free $CO_2$ showed positive correlation with total *Oscillatoria* species.

**Key words***:* domestic sewage water, *Oscillatoria*, polythene bags , Silchar, water quality
Running title: *Oscillatoria* on polythene bags

## Introduction

Plastics usage across the world has increased enormously in recent times. A substantial current production involves items of packaging which are rapidly disposed. While plastics bring many societal benefits offering future technological advances, the concerns about usage and their disposal are diverse are fraught with many challenges and opportunities. The accumulation of plastic waste in landfills and in natural habitats leads to ingestion, leaching of chemicals to the environment (Richard *et al.*, 2009). Domestic sewage water mostly coming from bathrooms, kitchen and laundry sources and small scale industries consists of nitrate and phosphates in addition to moderately small concentrations of suspended and dissolved organic and inorganic solids. The polythene carry bags after use are generally thrown into landfills or drains which eventually head to other minor water bodies. Algae are known to colonise on such polythenes submerged in waste water (Suseela and Toppo, 2007 and Sharma *et al.*, 2014). Studies of growth of algal species on such polythene substrata are important in the context of sustainable plastic bag waste management. Biodegradation of polyethylenes by algae constitute an attractive environment friendly and cost effective option (Kumar *et al.*, 2017, Michaud *et al.*, 2007). Accordingly, the present work has been carried to study the algal colonisation pattern on low density polyethylene (LDPE) surface with emphasis on a filamentous non-heterocystous blue-green *Oscillatoria* species in the domestic sewage water sites of Silchar town in the state of Assam. Correlation study has been performed to ascertain the influence of sewage water parameters on *Oscillatoria* diversity.

## Material and methods

### *Study area*

The study was carried out in the urban area of Silchar town of Cachar district located in the state of Assam, India (Fig. 1). The study area lies between latitude $24^0 49'$ North and longitude $92^0 48'$ East and altitude of 114.69 meters above sea level on the banks of river Barak. The domestic sewage drains carries waste from household and medium scale industries. The overview of study sites of algae colonized on polythene bags have been shown in plate 1.

A total of 45 samples were collected from five different study sites during July-Dec., 2013. The water samples were collected in the morning and transferred into pre-cleaned polythene bottles and stored for further analysis. The pH and dissolved oxygen (DO) were measured in the field immediately after sampling and other parameters were determined in the laboratory following standard analytical procedure as recommended by APHA (2005). Algal colonised polythene bags were collected from domestic sewage water drains of Silchar town, observed under

microscope and identified using standard keys (Prescott, 1951; Desikachary, 1959) and preserved in 4.5% formalin for further study. The algal samples were finally counted following Lackey's drop method (Trivedy and Goel, 1986).

The surface colonisation of algae on polythene bags collected from fields were viewed at 80x magnification using an optical reflection microscope StereoZoom Leica S8 APO equipped with a polarized and coupled to a computer.

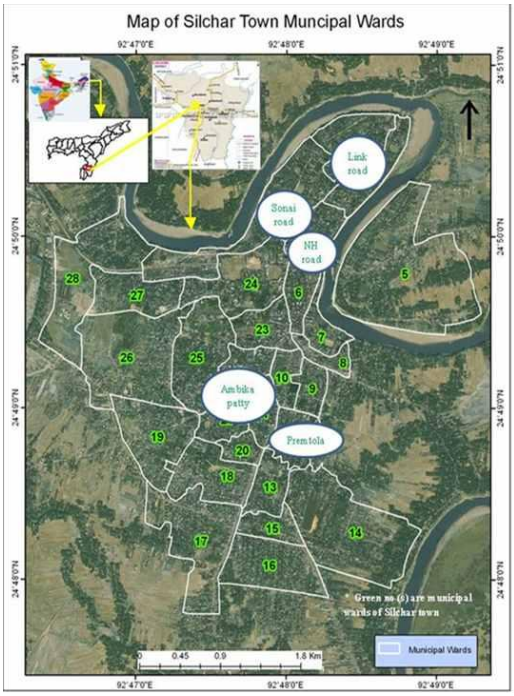


**Fig 1. Map of the study area showing the locations of study sites.**


**Plate 1 The close view of algae colonizing on submerged polythene bags (a – d)**

## Results

The physico chemical propertites of domestic sewage water are shown in Table 1. The colour of domestic sewage water was black to yellowish grey. The temperature of domestic sewage water ranged between 28-34 °C. The site 2 recorded maximum water temperature while site 4 recorded minimum water temperature. The pH values of the different sites were quite at variance with each other. The domestic sewage water of site 2 was slightly acidic while that for site 4 was found to be alkaline. Biological oxygen demand (BOD) ranged between 383-600 mg/L. Maximum BOD has been observed for site 3 while site 4 recorded the minimum. Chemical oxygen demand (COD) ranged between 1511-2189 mg/L. Site 5 recorded highest COD, while site 1 recorded lowest COD. Dissolved oxygen ranged between 1.3-2.4 mg/L. Site 1 recorded lowest DO while site 4 showed highest DO. Alkanity of domestic sewage water ranged between 9-11 mg/L, site 1 recorded minimum value and site 4 recorded maximum value. Free $CO_2$ ranged between 38-42 mg/L. Site 1 recorded minimum value, site 2 recorded maximum value. Nitrate ranged between 12-65 mg/L. Magnesium ranged between 25-178 mg/L with site 4 recording highest value and site 3 lowest. The value of total dissolved solid (TDS) ranged between 500-3210 mg/L. Site 2 recorded highest value, site 1 recorded lowest value. The value of suspended solid (SS) ranged between 500-3210 mg/L. Site 2 recorded highest value, site 1 recorded lowest value. Chlorides ranged between 35-73 mg/L. Site 5 recorded highest value, site 4 recorded lowest value. Calcium ranged between 54-69 mg/L. Site 4 recorded highest value, site 1 recorded lowest value. Sulphate ranged between 50-897 mg/L. Site 4 recorded highest value, site 3 recorded lowest value. Ammonia ranged between 28-34 mg/L. Site 4 recorded highest value, site 1 recorded lowest value. The value of phosphate ranged between 58-72 mg/L. Site 5 recorded highest value while site 4 recorded lowest value.

**Table 1: Physico-chemical properties of domestic sewage drain water**

| Water Parameters | Site1(Link Road) | Site2(Sonai Road) | Site3(National Highway road)(NH road) | Site4(Premtola) | Site5(Ambikapatty) |
|---|---|---|---|---|---|
| Colour and odour | Black, present | Black, present | Black, present | Yellowish grey,present | Yellowish grey,present |
| Temperature | 32°C | 34°C | 29°C | 28°C | 35°C |
| pH | 7.3±0.23 | 5.8±0.10 | 6.3±0.13 | 8.1±0.23 | 6.4±0.21 |
| BOD (mg/l) | 586.3±0.45 | 483±0.14 | 600±0.18 | 383±1.2 | 509±2.3 |
| COD (mg/l) | 1511±0.67 | 1520±0.56 | 1520±0.18 | 1764±0.24 | 2189±0.78 |
| DO (mg/l) | 1.3±0.12 | 2.3±0.15 | 2.2±0.23 | 2.4±0.21 | 2.2±0.12 |
| Alkanity(mg/l) | 9±0.34 | 9.8±0.12 | 10±1.4 | 11±0.12 | 9.8±0.23 |
| Free $CO_2$ (mg/l) | 38±0.13 | 42±0.13 | 36.98±0.13 | 39±0.21 | 36±1.2 |
| TDS (mg/l) | 500±1.2 | 3210±1.4 | 500±0.14 | 1546±2.4 | 578±2.5 |
| Suspended solids (mg/l) | 51±0.56 | 200±0.13 | 50±0.35 | 53±0.13 | 58±0.23 |
| Chlorides(mg/l) | 62±0.21 | 78±0.34 | 60±0.06 | 73±0.21 | 35±0.12 |
| Ca (mg/l | 54±0.13 | 65±0.23 | 60±0.13 | 69±0.23 | 63±0.13 |
| $SO_4^{-2}$ (mg/l) | 880±1.3 | 876±1.4 | 50±1.6 | 897±3.2 | 783±0.23 |
| Nitrate (mg/l) | 43±0.13 | 44±0.12 | 12±1.5 | 65±0.13 | 46±1.2 |
| Mg (mg/l) | 32±0.24 | 25±0.67 | 30±1.1 | 178±1.3 | 176±2.1 |
| Ammonia (mg/l) | 28±0.12 | 32±0.34 | 30±1.2 | 34±0.12 | 32±0.23 |
| Phosphate(mg/l) | 68±0.23 | 70±0.12 | 70±0.12 | 72±0.24 | 58±0.23 |
| Appearance | Not clear | Not clear | Not clear | Not clear | Not clear |

On the submerged polythene surfaces, *Oscillatoria,* a member of a filamentous non-heterocystous blue green alga was found to be a dominant species. A total of twenty species of *Oscillatoria* were found to colonize on the surfaces of polythene bags. Plate 2 describes the clear colonization pattern of *Oscillatoria* as observed under the microscope**.** Attachment of *Oscillatoria princeps* was clearly seen on the polythene surfaces with a thallus spread over ( Plate 2a ) . The *Oscillatoria subbrevis* filamentous net like forms with a mixed consortia with other algae is also prominent on the polythene surfaces (Plate2b). A massive growth of *Oscillatoria limosa* along with *Lyngbya* species is observed and an initiation of the polythene degradation is under progress ( Plate 2c ). Photomicrographs of twenty species of *Oscillatoria* have been presented in Plate 3 & Plate 4. During our field observation, it has been noted that the *Oscillatoria* mat comes up to the surface of the sewage water from the polythene surfaces. It has been observed that growth of *Oscillatoria* species and formation of mats was more prominent during bright sunshine. A giant form of *Oscillatoria* belonging to *O.peronata* was found to contribute to the waste water system as well as the polythene surface colonization. The *Oscillatoria princeps* present in all the study sites formed dark blue green mats on the polythene surface. During bright sunshine period, a brownish mats has also been obserevd. The *Oscillatoria tenuis* when present was found to occur as a solitary member on the polythene surface. The *Oscillatoria geitleriana* has been found in combination with *Oscillatoria earlei.* Among the other common species encountered on submerged polythene bags were *Oscillatoria subbrevis*, *O.princeps*, *O. limosa, O. amoena*, *O. vizagapatensis*, *O. okeni, O.limosa and O. laetevirens*. The characteristic features alongwith the thallus morphology of twenty *Oscillatoria* species have been described below.

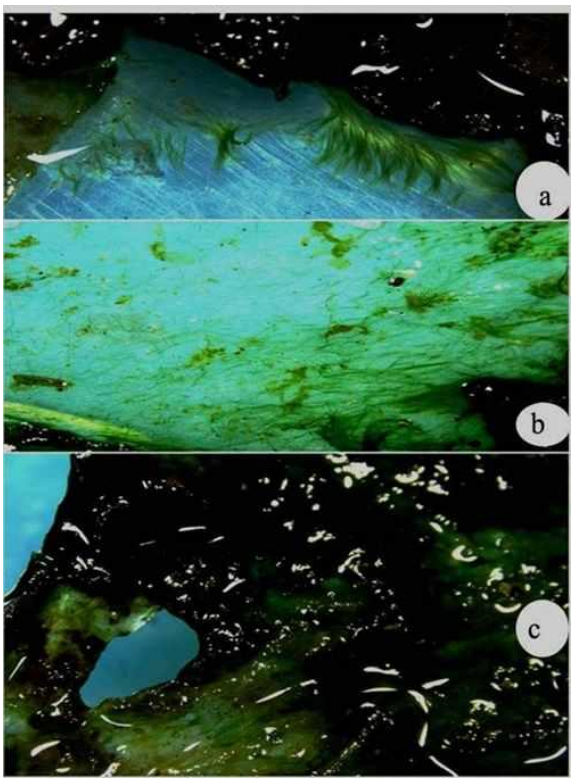


**Plate 2. Micrography (OM) of some selected polythene bags showing colonization of algae found in domestic sewage**

**Plate 3 Photomicrographs of some of the *Oscillatoria* species during study period**

1-*Oscillatoria curviceps* Ag.(after Gomont),2- *O.limosa* Ag.(after Gomont),3- *O.princeps* Vaucher (orig.),4-*O.subbrevis* Schmidle (orig.), 5- *O.amoena* Gom.(after Skuja) ,6–*O.chalybea* Martens (after Gomont),7- *O.peronata* Skuja (after Skuja),8 *O.tenuis*Ag.(afterGomont),,9-*O.willei* Gardner em.Drouet (after Gardner),10- *O.rubescens* DC (after Gomont),11- *O.vizagapatensis* Rao (after Rao,C.B)

**Plate .4 Photomicrographs of some of the *Oscillatoria* species during study period**

12- *Oscillatoria geitleriana* (Frémy) Elenkin (after Frémy),13- *O. formosa* Bory (after Frémy),14- *O. splendida* Grev. (after Gomont),15- *O. okeni Ag.(after Gomont)*,16-*O. limnetica* Lemm.(Orig.),17- *O. earlei* Gardner (after Gardner),18- *O. salina* biswas f.major f.n. (orig.).,19- *O. laetevirens* v.*minimus* Biswas (after Biswas),20- *O. acuminata* Gom.( after Frémy)

1. ***Oscillatoria subbrevis* Schmidle (orig.), Desikachary, 1959, Plate 40, Fig.1**
   Thallus yellow grey to green- yellowish; trichome single, straight, slightly tapering at the end; cells 8 µm x 2 µm; apical cell rounded, without calyptra.

**Locality :** Link road,Sonai road and Premtola
**Collection No. and Date** :EC/JR/PS/CY2 and 12/07/2013

2. ***Oscillatoria limosa* Ag.(after Gomont), Desikachary, 1959, Plate 38, Fig.1**
Thallus expanded bright blue-green to brown; trichome, straight or rarely curved; cells 12 µm x 2 µm, cross wall frequently granulated; apical cell flat or obtuse rounded with thickened wall.
**Locality :** Link Road,Sonai Road,and National highway Road
**Collection No. and Date:** EC/JR/PS/CY11 and 23/08/2013
3. ***Oscillatoria princeps* Vaucher (after Frémy), Desikachary, 1959, Plate 37, Fig.13,14**
Thallus expanded, attached, forming mats blue green, brownish; trichome mostly straight, slightly attenuated at the apices, occasionally with thin sheaths; cells 10µm x 2 µm; apical cell flatly rounded, slightly capitate, truncate, fragmented part containing two horns like structure
**Locality :** Link Road,Sonai Road,and National highway Road and Premtola
**Collection No. and Date:** EC/JR/PS/CY13 and 24/08/2013
4. ***Oscillatoria okeni* Ag.(after Gomont), Desikachary, 1959, Plate 38, Fig.17**
Thallus dark blue green, trichome 5.5-9 µm in diameter straight,distinctly constricted at joints, apical cell somewhat pointed, not capitate, Calyptra none, cell 4µm×2µm in length, apical cell somewhat quadrate up to 8 µm in length, cell content finely granular.
**Locality :** Link Road,Sonai Road,and National highway Road and Premtola
**Collection No. and Date:** EC/JR/PS/CY17 and 13/09/2013
5. ***Oscillatoria acuminata* Gom.( after Frémy), Desikachary, 1959, Plate 40 , Fig.13**
Thallus blue-green; trichome more or less straight, not constricted at cross-walls, 4-5µ broad, at the ends briefly tapering, sharply pointed, bent; cells longer than broad, 6-8µ long, sometimes granulated at the cross-walls.
**Locality :** Link Road,Sonai Road,and National highway Road
**Collection No. and Date:** EC/JR/PS/CY19 and 23/09/2013

6. ***Oscillatoria willei* Gardner em.Drouet (after Gomont), Desikachary, 1959, Plate 38, Fig.4, 5**
Trichomes pale blue green, bent at the ends or screw like, cells 7µm×3µm in length constricted at the cross walls, ends not attenuated, not capitate at the cross walls, end cells rounded without a thickened membrane.
**Locality :** Link Road and Sonai Road
**Collection No. and Date:** EC/JR/PS/CY18 and 14/10/2013

7. ***Oscillatoria splendida* Grev. (after Gomont), Desikachary, 1959, Plate 38, Fig.10**
Trichomes solitary and scattered,rarely aggregated in small, flake-like masses; straight or curved ,tapering for a long distance to a fine hair at the apex.Apical cell conical and capitate.Cells 2.2-2.8µ in diameter,7.2-9µ long,not constricted at the cross walls; cell contents finely granular or homogeneous,pale blue-green.
**Locality :** National highway Road and Ambikapatty
**Collection No. and Date:** EC/JR/PS/CY20 and 11/11/2013
8. ***Oscillatoria tenuis* Ag.(after Gomont), Desikachary, 1959, Plate 42, Fig.15**
Thallus forming flat mats, blue green; trichome straight or slightly curved; cells 6 µm x 3 µm; apical cell rounded with slightly thickened wall.
**Locality :** Link Road,Sonai Road,and National highway Road
**Collection No. and Date:** EC/JR/PS/CY22 and 12/11/2013
9. ***Oscillatoria limnetica* Lemm.(Orig.), Desikachary, 1959, Plate 37, Fig.3**
Thallus blue green, trichomes straight or slightly bent, constricted at the cross walls, pale blue green, 1-2 µm broad, filaments not attenuated, not capitate, cells 1.5 µm broad, 3 µm long, usually 2 1/2 -6 times as long as broad,
**Locality :** National highway Road and Premtola
**Collection No. and Date:** EC/JR/PS/CY24 and 13/11/2013
10. ***Oscillatoria peronata* f.attenuata Skuja (after Skuja), Desikachary, 1959, Plate 41, Fig.9**
Trichome, pale blue- green, erect or flexuous, apices briefly attenuated or curved; cells 10 µm x 3 µm, distinctly constricted and granulated at the cross wall; apical cell hemispherical without calyptra.

**Locality :** Premtola
**Collection No. and Date:** EC/JR/PS/CY7 and 22/11/2013

11. ***Oscillatoria geitleriana*** **(Frémy) Elenkin (after Frémy), Desikachary, 1959, Plate 40, Fig.9**
Trichome single, long flexible, blue-green, 4.1 µ broad not constricted at the cross-walls, ends erect, not attenuated, sub capitates, cells 1½ times longer than broad, 4-5 µ long septa not granulated; end cells with a convex distinctly thick membrane
**Locality :** Sonai Road
**Collection No. and Date:** EC/JR/PS/CY9 and 23/11/2013
12. ***Oscillatoria chalybea*** **Marrens (after Gomont), Desikachary, 1959, Plate 38, Fig.3**
Thallus dark blue green, trichome nearly straight, constricted at cross walls, attenuated at the apex end bent, living trichomes show forward and rotatory movement, 3 µm broad cells, 1/2-1/3 times as long as broad or nearly quadrate (5 µm broad), 2 µm long, septa not granulated, end cells obtuse not capitates, without calyptra, gas vacuoles present.
**Locality :** Link Road,Sonai Road
**Collection No. and Date:** EC/JR/PS/CY11 and 25/11/2013
13. ***Oscillatoria laetevirens*** **v.minimus Biswas (after Biswas), Desikachary, 1959, Plate 39, Fig.2,3**
Thallus thin,membranous,green;trichome yellowish green,straight,fragile,slightly constricted at the cross-walls,3µ broad,apices attenuated undulate or bent,cells nearly as long as broad,2 µm long,sometimes granualated at the cross-walls;end-cells not capitate,more or less obtuse or conical,without calyptra.
**Locality :** Link Road
**Collection No. and Date: :** EC/JR/PS/CY32 and 26/11/2013
14. ***Oscillatoria salina*** **biswas f.major f.n. (orig.)., Desikachary, 1959, Plate 37, Fig.16,17**
Plant mass were forming a deep blue-green thin membrane extending over muddy soil and after separation floating on the water surface. Filaments are straight with single, trichome 5-3µm broad, cells shorter than broad, 2µ long, transverse septa indistinct cell content homogenous blue-green.
**Locality :** Sonai Road
**Collection No. and Date:** EC/JR/PS/CY25 and 30/11/2013
15. ***Oscillatoria rubescens*** **f.forma (orig.), Desikachary, 1959, Plate 37, Fig.9,18**
Trichome are nearly straight, at the ends gradually attenuated, 8µm broad, not constricted at the cross-walls, cells ½-1/3 as long as broad, 2 µm long, often granulated at the septa, with gas-vacuoles; end cell capitate, with convex calyptra
**Locality :** Sonai Road
**Collection No. and Date:** EC/JR/PS/CY22 and 02/12/2013
16. ***Oscillatoria vizagapatensis*** **Rao (after Rao,C.B.), Desikachary, 1959, Plate 39, Fig.16,18**
Thallus blue green; trichome straight or slightly bent, uniformly broad except at the extreme apex; cells 9µm x 2 µm; apical cell broadly rounded, forming a cap with slightly thickened outer wall.
**Locality :** Ambikapatty and Sonai road
**Collection No. and Date:** EC/JR/PS/CY26 and 04/12/2013
17. ***Oscillatoria earlei*** **Gardner (after Gardner), Desikachary, 1959, Plate 38, Fig.15**
Trichomes short,straight,bent at the ends,tip attenuated 3 µm broad,not constricted at the cross walls;cells quadrate,6 µm long;ends prominently pointed.
**Locality :** Link road
**Collection No. and Date:** EC/JR/PS/CY28 and 09/12/2013
18. ***Oscillatoria curviceps*** **Ag.(after Gomont), Desikachary, 1959, Plate 38, Fig.2**
Thallus bright blue green or blackish mats; trichome, straight, long, hooked or loosely spirally coiled at the end; cells 10 µm x 3 µm; apical cell rounded with thickened wall.
**Locality :** Sonai road
**Collection No. and Date:** EC/JR/PS/CY30 and 10/12/2013
19. ***Oscillatoria formosa*** **Bory (after Frémy), Desikachary, 1959, Plate 40, Fig.15**
Thallus dark blue green, trichomes 4µm in diameters, straight to flexuous, usually slightly constricted at the cross walls, apex of the trichome slightly tapering and bent end cells blunt conical, nearly obtuse, not capitate without calyptra, cells nearly quadrate up to 1/2 is long as broad, 2µm long septa some time granulated, cell content bright blue green.
**Locality :** Ambikapatty and National Highway road

**Collection No. and Date:** EC/JR/PS/CY33 and 12/12/2013

**20. *Oscillatoria amoena* Gom.(after Skuja), Desikachary, 1959, Plate 41, Fig.1-4**

Thallus green mass or scattered among other algae. Trichome long, straight, distinctly attenuated and slightly bend, single, 6 µm dia. Terminal cell conical, elongated with thick wall and distinct calyptra, septa clear, granulated.

**Locality :** Ambikapatty and National Highway road

**Collection No. and Date:** EC/JR/PS/CY27 and 23/12/2013

Pearson's correlation coefficients calculated between various physico-chemical properties of water and total *Oscillatoria* present on submerged polythene bags in domestic sewage water drains have been presented in Table 2**.** Water temperature has positive correlation ($r=0.583^{**}$, $p< 0.01$) with total *Oscillatoria* species. BOD has positive correlation with total *Oscillatoria* species ($r =0.942^{**}$,$p <0.01$) in the domestic sewage water. pH has positive correlation ($r=0.311^{**}$, $p< 0.01$) with total *Oscillatoria* species. COD has negative correlation with total *Oscillatoria* species ($r= -0.281^{*}$ ,$p<0.05$). DO has positive correlation with total *Oscillatoria* species ($r=0.656^{**}$, $p< 0.01$). Total alkanity (TLK) has positive correlation with total *Oscillatoria* species ($r=0.923^{**}$, $p< 0.01$). Suspended solid (SS) has positive correlation with total *Oscillatoria* species ($r=0.960^{**}$, $p< 0.01$).Sulphate,nitrate,calcium and free $CO_2$ has positive correlation with total *Oscillatoria* species ($r=0.585^{**}$,$0.446^{**}$,$0.440^{**}$ ,$0.629^{**}$,$p<0.01$). Total dissolved solid showed no significant correlation on the distribution of total *Oscillatoria* species. This possibly could be the reason for their maximum colonisation on polythene surface during winter period.

**Discussion:**

A total of twenty species of *Oscillatoria* were found to colonize on the surfaces of polythene bags. *Oscillatoria subbrevis*, *O.princeps*, *O. limosa, O. amoena*, *O. vizagapatensis*, *O. okeni, O.limosa and O. laetevirens* are the common species found on submerged polythene bags. Site 4 recorded highest nitrate and phosphate concentration.Nitrate and phosphate concentration present in domestic sewage water affected the colonisation pattern and distribution of total *Oscillatoria* species. water temperature also affected the distribution of total *Oscillatoria* species . This findings are consistent with the observation made by Robarts and Zohary (1987), who explained that cyanobacteria blooms are likely to occur during the summer in temperate water. The ranged of pH and concentration of free $CO_2$ of domestic sewage water influenced the distribution pattern of total *Oscillatoria* species. The growth of cyanobacterial population were influenced by high pH and low free $CO_2$ ( Shapiro,1990).

Due to heavy discharge by household and small scale industries to domestic sewage water drains, nitrate,sulphate and calcium were found to be present in high amount. Nitrate,sulphate and calcium showed positive correlation with total *Oscillatoria* species. Higher concentration of ammonium and phosphate were ascertained to be favourable for bloom of cyanobacterial populations (Chellappa *et al*., 2000; Gabriela and Alessandra, 2004 ; Vidya *et al.,* 2014). Nitrogen and phosphorus are both responsible for abundance of phytoplankton polulation (Gabriela and Alessandra, 2004).Nitrogen and phosphate concentration were found to be directly proportional to phytoplankton abundance in water (Coelho *et al*., 2003).

In the present investigation, dissolved oxygen ranged between 1.3-2.4mg/l revealing domestic sewage water is highly polluted. Low dissolved oxygen primarily results from excessive algae growth caused by phosphorus. The DO has positive correlation with total *Oscillatoria* species. Calcium concentration of domestic sewage water ranged between 54-69 mg/l. The abundance of cyanobacterial population is known to be influenced by calcium concentration (Sarojini, Y., 1996). Lower DO concentration and other physiochemical parameters showed that domestic sewage water are highly polluted. The genus *Oscillatoria* has been earlier noted to be tolerant to pollutants in water (Rai and Kumar, 1976). Free $CO_2$ value ranged between 36-42 mg/l in our present study and showed positive correlation with total *Oscillatoria* species. Lower free $CO_2$ value influenced the growth of cyanobacterial population. It has been observed earlier that green algae cannot thrive in low free $CO_2$ concentration (King, 1970). Effect of anthropogenic stressors, effluent influenced the growth of phytoplankton diversity. In our present investigation, high nutrients conditions influence the abundance of *Oscillatoria* population. The domestic sewage water drains of Silchar town carries domestic waste, municipal waste and small scale industries waste. Water qualities of the domestic sewage water were analysed and showed high amount of organic and inorganic substances present. Singh *et al.,* (2013) reported that physiochemical parameters greatly affected the cyanobacterial population in river Gomati. The domestic sewage, industrial waste, municipal waste water, human excreta, agricultural runoff and burning of corpse polluted

the Gomati river in Uttar Pradesh. A total number of 35 genera of algae, Cyanophyceae (11 genera), Chlorophyceae (12 genera), Euglenophyceae (1 genera) and bacillariophyceae (11 genera) were recorded in their observation. Jaiswal *et al*., (2017) reported the occurrence of organic pollutants in different water habitats and correlated the physico-chemical parameters with palmer algal genus index. They found that *Oscillatoria* alongwith frequently with other algal genera constituted around 49% of the total algal cover. This matches with the present findings of *Oscillatoria* occuring as largest genus on submerged polythene bags in domestic sewage water. A study on algal colonization on polythenes and their degradation revealed fifteen species including *Oscillatoria* in and around water bodies of Lucknow city in Uttar Pradesh (Suseela and Toppo, 2007). Sharma *et al*., (2014) detected ten algal species *Phormidium tenue, Oscillatoria tenuis, Navicula cuspidata, Monoraphidium contortum, Microcystis aeruginosa, Closterium costatum, Chlorella vulgaris* on polythenes on waste water of Kota city,Rajasthan. The species *Oscillatoria* thus may be useful in some monitoring programme (Cairns and Dickson,1971; James and Evison,1979) and also in the bidegaradation of polythene (Kumar *et al.,* 2017 , Sharma *et al*.,2014).

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Table 2: Bivariate correlation analysis of the physico-chemical and biological parameters using Pearson correlation coefficients

| **Correlations** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Temp | BOD | pH | COD | DO | TLK | SS | Chlorides | sulphate | Nitrate | Calcium | TDS | FreeCO2 | TOS |
| temp | 1 | | | | | | | | | | | | | |
| BOD | .145 | 1 | | | | | | | | | | | | |
| pH | -.099 | **.280*** | 1 | | | | | | | | | | | |
| COD | .226 | **.519**** | **-.327**** | 1 | | | | | | | | | | |
| DO | .072 | .214 | **.767**** | **-.258*** | 1 | | | | | | | | | |
| TLK | -.084 | **.282*** | **.997**** | **-.322**** | **.809**** | 1 | | | | | | | | |
| SS | -.060 | -.060 | **.614**** | **-.543**** | **.519**** | **.610**** | 1 | | | | | | | |
| Chlorides | -.034 | .067 | **.460**** | **-.369**** | **.334**** | **.453**** | **.351**** | 1 | | | | | | |
| sulphate | .106 | **.468**** | .113 | **.536**** | .090 | .109 | -.108 | **-.476**** | 1 | | | | | |
| Nitrate | -.146 | -.125 | **.496**** | **-.510**** | **.386**** | **.494**** | .232 | **.774**** | **-.553**** | 1 | | | | |
| Calcium | -.100 | -.158 | **.651**** | **-.677**** | **.483**** | **.639**** | **.925**** | **.517**** | **-.296*** | **.499**** | 1 | | | |
| TDS | -.177 | **-.687**** | -.041 | **-.879**** | -.020 | -.042 | **.369**** | **.243*** | **-.582**** | **.288*** | **.454**** | 1 | | |
| FreeCO2 | -.070 | **.381**** | **.980**** | **-.293*** | **.775**** | **.976**** | **.617**** | **.444**** | .181 | **.459**** | **.640**** | -.083 | 1 | |
| TOS | **.583**** | **.942**** | **.311**** | **-.281*** | **.656**** | **.923**** | **.960**** | -.084 | **.585**** | **.446**** | **.440**** | .131 | **.629**** | 1 |