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Study on influence of liquid hospital waste on bacterial population growth in sewer system and wastewater treatment plant

ANOOP CHATURVEDI[1] and PRAVEEN JAIN[2]

[1]Barkatullah University, Bhopal - 462 026 (India)
[2]M.P. Bhoj open University, Bhopal (India)

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ABSTRACT

The object of the study to determine Total Coliforms (TC) and drug resistant bacteria (DRB) which are present in hospital liquid waste. Five representative location were selected for the monitoring in the Bhopal city. The standard method as prescribed by APHA was followed during sampling and analysis. Maximum counts of the TC observed at Sultania hospital drain $30X10^5$. Minimum number of TC and Feacal was count at Shivagi nagar drain $14X10^5$. In the outlet of the hospital effluent treatment plant counts of the Coliforms were observed nil due to effective chlorination .Counts of harmful bacteria was increase when hospital liquid effluent mixes with city sewer.

Key words: Liquid hospital waste, bacterial population , sewer system.

INTRODUCTION

Hospital waste management and handling is a health care issue which, has ignited wide spread, concerns the world over. Hospital waste have been categorized into ten different types, liquid hospital waste is also one of them. It falls under category no. 8 of Bio Medical Waste (BMW) Rules 1998,. Liquid hospital waste forms an important source of hazardous and infectious waste, which is generated from floor washing, laboratory analysis and other activities. The liquid hospital waste is often drained into the community sewer system without any treatment because none of the hospital is having treatment plant. The community sewer systems finally end in the water bodies like lakes, rivers or percolate in ground without any treatment.

E-coli and feacal are the most common bacteria, found in hospital liquid waste and in sewerage system. The drug resistance bacteria (DRB) also found in hospital liquid waste. This DRB become resist to more then one antibiotics that are used commonly and hence can pose a serious hazard to community health as the pathogen get directly a chance to infect the community. The reported rate of salmonella and shignella bacteria is high in hospital effluent. Salmonella is a gram negative, rod shaped bacteria that cause various disease like typhoid fever and food poisoning and shignella is also a gram negative bacteria and is responsible for dysentery.

Objectives:

(1) Study the population change in public drain before and after confluence of hospital wastes and at various steps of treatment plant like inlet, aeration tank clarifier etc.
(2) To determine Total Coliforms (TC), Feacal Coliforms (FC) and DRB at representative location.

In view of above a study was undertaken at following selected five locations:

1) Waste outlet of Sultania Lady Hospital
2) Before and after confluence of Sultania hospital waste in Patra sewar drain.
3) Waste outlet of Jai Prakash Hospital
4) Before and after confluence of J P hospital drain with municipal sewage system
5) Effluent treatment plant (ETP) of Bhopal memorial hospital research center. (BMHRC)

MATERIAL AND METHODS

Sultania hospital is one of the oldest hospital in Bhopal situated in old city area having 250 bed capacity. J P hospital is a 300 bed hospital and it is situated in new city area . M/s BMHRC is a 350 bed hospital with 8 OPD units located various location in Bhopal. BMHRC have its own ETP. Separate sewage lines for residential area and hospital waste water are joined together just before they enter into ETP. Function of each unit of ETP is explained in Table-1.

Collection of samples

Sterile 300 ml glass bottles were used for the collection of samples from the designated location. Samples were collected at peak hour load of wastewater and were stored in icebox. Microbiological analysis method as prescribed in APHA was followed for the analysis.Endo agar media used for TC and M-7HrFC media used for feacal coli form test. Further MF020 (Hi-media India), MF012 (Hi-media India) was used for enumeration of Salmonella and Signella respectively. For DRB samples where plated on DRB

Table - 1: Function of various treatment unit in ETP

S. No.	Name of the units of ETP	Function
1.	Sump Well	Store the effluent received from various streams.
2.	Bar Screen	Screening and removal of coarse suspended solids from the receiving effluent.
3.	Aeration Tank	Mixing of effluent with the high speed aerator for aeration.
4.	Clarifier	Separate suspended solid.
5.	Chlorine dosing	Chlorine is added continuously to inactive the microbial population before treated effluent goes to lamella filter.
6.	Sand filter	Removed suspended particles.
7.	Carbon filter and softener	Removed odour and soften the water for cooling and gardening purpose.

Table - 2: Bacteriological analysis results.

S. No.	Location of drain	TC	FC	DRB
1.	Patra Nullah before confluence of Sultania hospital waste	$24x10^5$	$15 x10^5$	$11 x10^2$
2.	Drain from Sultania Lady Hospital	$30x10^5$	$17 x10^5$	$13 x10^4$
3.	Patra Nullah after confluence of Sultania Lady Hospital drain	$28x10^5$	$12 x10^5$	$7 x10^3$
4.	Shivaji Nagar Nullah before	$14x10^5$	$6 x10^5$	$33 x10^2$
	confluence of Jai Prakash Hospital (JPH)	$20x10^5$	$12 x10^5$	$11 x10^3$
5.	JPH drain			
6.	Shivaji Nagar Nullah after confluence of JPH drain	$17 x10^5$	$9 x10^5$	$51 x10^2$

TC-Total coliform FC-Feacal coiform DRB-Drug resistant bacteria

agar plat (Mackonkey Hi-media India) in duplicate. For DRB bacteria estimation chloramphnicol and gentamicine were selected because the represent two of the commonly used antibiotic over the last few years and also have greater in-vitro stability. Bacterial growth in sludge has been analyzed as per following method. Sample from clarifier and sludge drying beds was filtered through Whatman Filter Paper no.41. The filtrate was subjected to coliform count and DRB count.

Observation

The bacterial counts observed in samples collected from different locations of drains are shown in table-2. The observation revels that the population of bacterial was lower in drains before confluence of hospital waste in municipal sewage. After confluence the population growth increases. It indicates that the hospital wastes carry significant quantity of pathogen like TC and, FC.

A reduction in bacterial count at each stage of ETP has been observed. Result of analysis of bacterial count has been shown in Table-3. Maximum concentrations of bacteria were shown in aeration tank and after carbon filter value of the pathogenic bacteria were observed nil. Pseudomonas and staphylococci formed the minority and similar praponation of bacterial species were found till the chlorination. The presence of DRB was seen in all units of ETP till chlorination. The residual bacteria seem to concentrate in the liquid sludge collected in sludge drying bed.

Table -3: Bacteriological monitoring results at ETP

S. No.	Units of ETP of BMHRC	TC	FC	DRB
1.	Sump well	$26x10^4$	$20 x10^4$	$3 x10^3$
2.	Aeration tank outlet	$31 x10^5$	$10 x10^5$	$6 x10^3$
3.	Clarifier outlet	$27 x10^3$	$16 x10^3$	$2 x10^3$
4.	Lamella filter after chlorine dosing	$5 x10^2$	120	32
5.	Sand filter	70	Nil	Nil
6.	Carbon filter and softener	Nil	Nil	Nil

TC-Total coliform FC-Feacal coliform DRB-Drug resistant bacteria

Table - 4: Distribution of bacteria flora in solid (residue) and liquid (filtrate) of hospital effluent

S. N o.	Sample type	Parameter	After confluence with Sultania lady hospital drain	After confluence with Jai Prakash waste	Final outlet BHMRC hospital drain
1.	Filtrate	TC	$9x10^5$	$6 x10^5$	160
		FC	$4 x10^5$	$3 x10^5$	28
		DRB	$2 x10^5$	$17 x10^2$	Nil
2.	Residue	TC	$19 x10^5$	$11 x10^5$	400
		FC	$8 x10^5$	$6 x10^5$	90
		DRB	$5 x10^5$	$32 x10^2$	10

Analysis result report in TC,FC./ml

Difference in bacteria counts in samples from clarifier and liquid sludge of sludge drying bed show bacteria adhere to suspended particle rather than free state in aqueous phase. The distribution of bacteria in flora the liquid (filtrate) and the solid waste (residue) of wastewater in different units of ETP is depicted in Table-4 and data support the view that bacteria are largely stuck upon the solid particles.

RESULTS AND DISCUSSIONS

Hospital effluent has been shown to contain diverse pathogen like salmonella, signella, DRB coliforms etc. In the present study the prevalence of DRB bacteria was $13x10^4$ to $11x10^2$ per ml in the hospital effluent, which was resistance to ampicillin, quinolones, tetracycline and chloramphenicol and other available antibiotics. The source of the DRB appears to be hospitals only. Domestic waste from two locations in Bhopal was also studied and compared with the hospital effluent. The samples of domestic waste (sewage) were found to contain extremely low DRB as compared to hospital effluent.

The counts in the sump well and aeration tank were found to be near similar. The number of bacteria in the overflow water of clarifier show dramatic reduction of over up to 10^4 to 10^3 and the bulk of the bacteria were concentrated in the liquid phase.

The sludge from hospital waste treatment facility is a potential source of infectious organism. Protozoal cists such as those of Glardia, Entamoeba Histolytica and parasitic ova may be present in the treated effluent.

Conclusion

1. Aeration and clarification removes bulk of the bacteria by physical process like flocculation.
2. The bacteria get concentrated in sludge and hence the high concentration of chlorine is required for sludge decontamination as compared to treated water.
3. Counts of TC and FC increases when hospital effluent mixed with the city sewage.

Recommendation

1. Hospital liquid waste should not be discharged into sewage drain without treatment.
2. The BOD/COD values don't reflect the presence of pathogen and hence bacterial monitoring need to be includes for the effluent parameter.

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