JBAAR
Journal of Bioscience and Applied Research
WWW.JBAAR.ORG

A new approach in bacteriological and chemical treatment of surface water for drinking purpose

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Abstract

The surface water contain some dissolved contaminants such as iron and manganese. It is unsuitable for drinking water without appropriate treatment. Under standard and steady-state conditions, the bioreactor was very effective when 2% of the nano polymer composite granules (w/v)borne bioagent bacteria as a substrate for the biofilm formation. The mixture was aerated for 24 hs. The treated water have been uptake for determination the concentration of cations and microbiological analysis. Each 1L of surface water sample with continuous aeration and left for 24h and as a result many physical, chemical and bacteriological changes occurred .For the surface water temperature decreased by 2.2˚ C and 2.0˚ C related to raw water and chlorinated water , pH increased by 0.2 and 0.4 ppm related to raw water and chlorinated water . TDS decrease from (276 to 220 ppm) while in chemical treatment increase to (285 ppm) also conductivity decrease from(434 to 425) US/CM but increase to(442 US/CM) in the chlorinated treatment , while turbidity increase from (9.8 to 10.3) NTU. The elimination of the heavy metals was remarkable in this study as in rate of Fe that decrease from (0.39 to 0.21)ppm and for Mn it remains constant .Total alkalinity decrease from(142 to 130) ppm while in chemical treatment was 120 ppm. calcium hardness decrease from (78 to 54) ppm and as a result the calcium decrease from (31.2 to 21.6)ppm and in chemical one it has the same value of the raw water sample .Magnesium hardness increase from (100 to 108)ppm &for the magnesium ion increase from (10.56 to 16.8) ppm. The chlorides decrease to 20 ppm in the bio treated water sample but it was normal to increase to 31 ppm in the chemical treated sample. Sulfates content decrease from (15.5 to 10.7)ppm but in chemical treatment it increase to 17 ppm. Phosphate content increase from(<0.01 to o.o2) ppm while the nitrate content decrease from(0.86 to 0.5) ppm it also decrease in the chemical treatment to 0.48 ppm and ammonia content decrease from (0.06 to0.01) ppm and in chemical treatment reach to <0.01 ppm a. Drinking water sources are contaminated with coliforms and pathogenic bacteria. The bacteriological results shows that all the bio treated sample had no fecal Coliform growth (<1) C/100ml but give positive results with the total Coliform with confluent colonies whereas in the chemical treatment both the total &fecal Coliform tests were negative.

Key words. Drinking water, Raw Surface water, Total coliform, Fecal Coliform

1 Introduction

Water is essential to sustain life, and availability of safe drinking water is very important. To ensure this, reliance has to be placed on regular bacteriological analyses to assess potability and to determine the best course of action for protecting the population against waterborne diseases. Drinking water should be clear, cool, free from objectionable tastes and odors and from harmful chemicals and microorganisms of these desired sanitary qualities,

freedom from harmful microorganisms is most difficult to achieve. It is not impossible, but it demands constant vigilance and repeated testing. This plan was in need of time for design and construction of these plants. So a decision for using the water treatment compact units was taken as a temporary solution till the finish of the big projects. Now and after about 22 years of their application, with the funding from NOPWASD(1985) , about 560 of these Compact units have been constructed in Egypt, and the compact units become one of the options for production of potable water as a permanent solution in rural areas of Egypt for both villages and towns (El-in Nadi and Refaat,1995). In the compact units water is treated in the same manner as in conventional systems, but in the compact systems filters are reduced to three sand filters. The methods used for the sanitary water analysis were those recommended by the American Public Health Association (APHA, 1995).In Egypt, the River Nile is the main source of drinking water and other purposes; every effort should be made to achieve drinking water quality as high as practicable, otherwise people life are extremely subjected to hazardous effects. Proper selection and protection of water sources to be used for supplying water treatment systems are of prime importance in the provision of safe drinking water.

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Microbial biomass is used to degrade contaminants, nutrients, and organics in wastewater recent developments may mean that biological drinking water treatment may become more feasible and more likely to be accepted by the public. These developments include (1) the rising costs and increasing complexities of handling water-treatment residuals (e.g., membrane concentrates); (2) the emergence of new contaminants that are particularly amenable to biological degradation (e.g., perchlorate); (3) the push for green technologies (i.e., processes that efficiently destroy contaminants instead of concentrating them);(4) regulations limiting the formation of disinfection by-products (DBPs); and (5) the emergence of membrane-based treatment systems, which are highly susceptible to biological fouling (Abdel-Dayem, 1994). Bacteria gain energy and reproduce by mediating the transfer of electrons from reduced compounds (i.e., compounds that readily donate electrons) to oxidized compounds (i.e., compounds that readily accept electrons). Once electrons are donated by a reduced compound, they travel back and forth across a cell's mitochondrial membrane in a series of internal oxidation-reduction reactions. Ultimately, the electrons are donated to the terminal electron-accepting compound. (Madigan *et al*., 1997).The aim of work is using nano composite(nano polymer) plus bacteria biofilm for treatment surface water in Shebin El-kom city Menofia government – Egypt.

2 Materials and Methods

The raw surface water samples of river Nile branch in shebin El-kom city belong to Menofia gov were collected monthly through Mars, July 2012. All water samples were collected according to standards mentioned in (APHA ,1995).Samples were preserved immediately after collection by acidifying with concentrated HNO_3 to pH<2 by adding 5 ml nitric acid to 1 liter water samples and in refrigerator.

Bio treatment of raw polluted water

Non toxic nano polymer composite granules have been prepared by physics dept.; Fac. Sci.

Benha Univ. Three liters of raw surface water were mixed with 60 gm of polymer nano composite (v/w) borne bioagent bacteria as a substrate for biofilm formation. The mixture was aerated for 24 hs. These samples of treated water have been uptake for determination the concentration of cations and microbiological analysis.

Physicochemical parameters

The temperature of treated water samples were measured using a manual thermometer 110(°C) graduated to 0.1(°C).Turbidity was measured directly by using a digital turbidity meter **(WTW)**. pH of treated water sample was measured by using a digital pH meter (Metrohm(827 PH lab).

Two cations (Fe and Mn) were measured in treated water samples using (coupled plasma 400 emission spectrometer Perkin Elemer Emission Spectrometer).Ammonia, Nitrate, Phosphate, Sulfate were measured by the spectrometer (Cecil). Total dissolved solids(TDS) were measured directly by using a digital meter (Conductivity meter selecta).

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Free chlorine 0.5 mL each of buffer reagent and DPD(N,N-diethyl-p-phenyl enediamine) were added to test tube contained 10 mL of water sample. Mix then read color immediately.

Determination of Coliform groups

Detection and enumeration of Total Coliform (TC) and Fecal Coliform were determined by Membrane Filter (MF) technique which depends on sample filtration through a 47-mm, 0.45 µ m pore size cellulose membrane filters that retains the bacteria present in the sample. The filters were put onto the medium ,using a rolling action to avoid trapping air bubbles between the membrane filter and the underlying medium. The plates were inverted and incubated at 35 ± 0.5(°C) for 24h.

Identification of bacteria isolates

Biochemical tests using VITEK2 kit for identification of bacteria isolates(Shobra El Khema laboratory of H.C of water and waste water). All the results are within limits of (Egypt Health Ministry,2007) ,(WHO , 2007) and (Egypt State of Environment Report,2008)

3 Results

Under standard and steady-state conditions, the bioreactor was very effective when 20gm of the nano polymer composite granules were added as a substrate for the biofilm formation for each 1L of the raw surface water sample with continuous aeration for 24h.For the surface water temperature decreased by 2.2 ° C and 2.0 ° C related to raw water and chlorinated water.(TDS) decreased

from (276 to 220 ppm) while in chlorinated treatment increase to (285 ppm) . pH increased by 0.2 and 0.4 ppm related to raw water and chlorinated water . Conductivity decrease from(434 to 425) US/CM but increase to(442 US/CM) in the chlorinated treatment while turbidity increase from (9.8 to 10.3) NTU as shown in the table(1) .

The elimination of the heavy metals was remarkable in this study as in rate of Fe that decrease from(0.39 to 0.21) ppm and for Mn it remains constant .Total alkalinity decrease from(142 to 130)ppm while in chlorinated treatment was 120 ppm. calcium hardness decrease from (78 to 54) ppm and as a result the calcium decrease from (31.2 to 21.6)ppm and in chemical one it has the same value of the raw water sample .Magnesium hardness increase from (100 to 108)ppm &for the magnesium ion increase from (10.56 to 16.8) ppm. The chlorides decrease to 20 ppm in the bio treated water sample but it was normal to increase to 31 ppm in the chlorinated treated sample. Sulfates content decrease from (15.5 to 10.7)ppm but in chlorinated treatment it increase to 17 ppm. Phosphate content increase from(<0.01 to o.o2)ppm while the nitrate content decrease from(0.86 to 0.5) ppm it also decrease in the chlorinated treatment to 0.48 ppm and ammonia content decrease from (0.06 to0.01) ppm and in chlorinated treatment reach to <0.01 ppm as shown in table (2)

Drinking water sources were contaminated with coliforms and pathogenic bacteria. The bacteriological results shows that all the bio treated samples had no fecal Coliform growth (<1) C/100ml but give positive results with the total Coliform with confluent colonies whereas in the chlorinated treatment both the total &fecal Coliform tests were negative as in table (3).

These results indicate that after a moderate exposure to the biofilm as a result to the presence of the nano composite granules , microbial biomass either synthesized or already had the proper enzymes needed for the biosorption of metals so that significant removal of heavy metals was recorded.

Table (1) The physical results of biotreatment & chlorinated treatment of raw surface water .

Sample	*Cond US/CM*	*pH*	*Temp °C*	*Turbidity Before Filtration in NTU*	*T.D.S ppm*
Raw water	434	7.8	22.9	9.8	276
Bio treated water after 24 h	425	8.00	20.7	10.3	220
Treated waterwith chloride	442	7.4	22	0.27	285
Max .Value	1600	6.5-8.5	-----	1	1000

Identification of bacteria isolates:-

Tables(4-17) show the bacterial species were identified according to vitek2 kit tables mainly Gram negative (*Acinetobacter haemolyticus*, *Citrobacter freundii* ,*Raoultella ornithinolytica* ,*Escherichia coli* ,*Pseudomonas putida, Aeromonas salmonicida* ,*Klebsiella pneumoniae ssp ozaenae*) while (*Staphylococcus xylosus, streptococcus agalactiae, Enterococcus casseliflavus, Enterococcus durans , Staphylococcus sciuri, Staphylococcus lentus*) were gram positive species .

4 Discussion

The present study represented both the physiochemical and bacteriological characteristics of different areas of ground &surface water in Shebin El-kom city during the period from February till July, 2012 . Temperature is a factor of great importance for aquatic ecosystem, as it affects the microorganism as well as physicochemical properties of water (Delince ,1992). For the surface water temperature decreased by 2.2° C and 2.0° C related to raw water and chlorinated water as the number of harmful bacteria decrease. (TDS) decreased from (276 to 220 ppm) while in chlorinated treatment increase to (285 ppm). pH increased by 0.2 and 0.4 ppm related to raw water and chlorinated water . Conductivity decrease from(434 to 425) US/CM but increase to(442 US/CM) in the chlorinated treatment while turbidity increase from (9.8 to 10.3) NTU. The elimination of the heavy metals was remarkable in this study as in rate of Fe that decrease from (0.39 to 0.21) ppm and for Mn it remains constant .Total alkalinity decrease from(142 to 130) ppm while in chlorinated treatment was 120 ppm. calcium hardness decrease from (78 to 54) ppm and as a result the calcium decrease from (31.2 to 21.6)ppm and in chemical one it has the same value of the raw water sample. Magnesium hardness increase from (100 to 108)ppm &for the magnesium ion increase from (10.56 to 16.8) ppm. The chlorides decrease to 20 ppm in the bio treated watersample but it was normal to increase to 31 ppm in the chlorinated treated sample. Sulfates content decrease from (15.5 to 10.7)ppm but in chlorinated treatment it increase to 17 ppm. Phosphate content increase from(<0.01 to o.o2) ppm while the nitrate content decrease from(0.86 to 0.5) ppm it also decrease in the chlorinated treatment to 0.48 ppm and ammonia content decrease from (0.06 to0.01) ppm and in chlorinated treatment reach to <0.01 ppm. Drinking

Table (2): The Chemical results of biotreatment &chlorinated treatment of raw surface water

Sample	*NH3 PPm*	*NO3 PPm*	*PO3 ppm*	*SO4 ppm*	*Cl⁻ ppm*	*Mg++ ppm*	*Mg. H ppm*	*Ca++ ppm*	*Ca.H ppm*	*T.H ppm*	*T.Alk ppm*	*Mn ppm*	*Fe ppm*	*Res.chl*
Raw water	0.06	0.86	<0.01	15.5	26	10.56	44	31.2	78	122	142	<0.01	0.39	Nil
Bio treated water after 24 h	0.01	0.5	0.02	10.7	20	16.8	70	21.6	54	124	130	<0.01	0.21	Nil
Treated water with chloride	<0.01	0.48	<0.01	17	31	11.52	48	31.2	78	126	120	<0.01	<0.01	1.4
Max .Value	0.5	45	Nil	250	250	-----	150	----	350	500	500	0.4	0.3	1.5

T.H : Total Hardness T.Alk: Total Alkalinity Ca.H: Calcium Hardness

Table(3): Bacteriological results of biotreatment &chemical treatment of raw surface water

Sample	*Total Coliform C/100ml*	Final result	*Fecal Coliform C/100ml*	Final result
Bio treated	***Confluent***	***+Ve***	***<1***	***-Ve***
Max. Value	***<1***	***-Ve***	***<1***	***-Ve***
Raw	***Confluent***	***+Ve***	***2000***	***+Ve***
Treated with chloride	***<1***	***-Ve***	***<1***	***-Ve***

Table(4): Selected Organism : *Citrobacter Freundii* **Bionumber** :4417610575520011 **Confidence**: Excellent identification

Biochemical Details																	
2	**APPA**	**-**	**3**	**ADO**	**-**	**4**	**PyrA**	**+**	**5**	**IARL**	**-**	**7**	**dCEL**	**-**	**9**	**BGAL**	**+**
10	**H25**	**+**	**11**	**BNAG**	**-**	**12**	**AGLTp**	**-**	**13**	**dGLU**	**+**	**14**	**GGT**	**+**	**15**	**OFF**	**+**
17	**BGLU**	**-**	**18**	**dMAL**	**+**	**19**	**dMAN**	**+**	**20**	**dMNE**	**+**	**21**	**BXYL**	**-**	**22**	**BAlap**	**-**
23	**ProA**	**-**	**26**	**LIP**	**-**	**27**	**PLE**	**-**	**29**	**TyrA**	**+**	**31**	**URE**	**-**	**32**	**dSOR**	**+**
33	**SAC**	**+**	**34**	**dTAG**	**+**	**35**	**dTRE**	**+**	**36**	**CIT**	**+**	**37**	**MNT**	**-**	**39**	**5KG**	**+**
40	**ILATK**	**+**	**41**	**AGLU**	**-**	**42**	**SUCT**	**+**	**43**	**NAGA**	**-**	**44**	**AGAL**	**+**	**45**	**PHOS**	**-**
46	**GlyA**	**-**	**47**	**ODC**	**-**	**48**	**LDC**	**-**	**53**	**IHISa**	**-**	**56**	**CMT**	**-**	**57**	**BGUR**	**-**
58	**O129R**	**+**	**59**	**GGAA**	**-**	**61**	**IMLTa**	**-**	**62**	**ELLM**	**+**	**64**	**ILATa**	**-**			

Table(5): Selected Organism : *Raoultella ornithinolytica* **Bionumber** : 4627735753773011 **Confidence**: Good identification

Biochemical Details																
2	APPA	-	3	ADO	-	4	PyrA	+	5	IARL	-	7	dCEL	+	9	BGAL	+
10	H25	-	11	BNAG	+	12	AGLTp	-	13	dGLU	+	14	GGT	+	15	OFF	+
17	BGLU	+	18	dMAL	+	19	dMAN	+	20	dMNE	+	21	BXYL	+	22	BAlap	-
23	ProA	+	26	LIP	-	27	PLE	+	29	TyrA	+	31	URE	+	32	dSOR	+
33	SAC	+	34	dTAG	-	35	dTRE	+	36	CIT	+	37	MNT	+	39	5KG	-
40	ILATK	+	41	AGLU	+	42	SUCT	+	43	NAGA	+	44	AGAL	+	45	PHOS	+
46	GlyA	+	47	ODC	+	48	LDC	-	53	IHISa	-	56	CMT	-	57	BGUR	-
58	O129R	+	59	GGAA	-	61	IMLTa	-	62	ELLM	+	64	ILATa	-			

Table(6): Selected Organism : *Escherichia coli* **Bionumber** : 0405610540526611 **Confidence**: Excellent identification

Biochemical Details																
2	APPA	-	3	ADO	-	4	PyrA	-	5	IARL	-	7	dCEL	-	9	BGAL	+
10	H25	-	11	BNAG	-	12	AGLTp	-	13	dGLU	+	14	GGT	-	15	OFF	+
17	BGLU	-	18	dMAL	+	19	dMAN	+	20	dMNE	+	21	BXYL	-	22	BAlap	-
23	ProA	-	26	LIP	-	27	PLE	-	29	TyrA	+	31	URE	-	32	dSOR	+
33	SAC	-	34	dTAG	-	35	dTRE	+	36	CIT	-	37	MNT	-	39	5KG	-
40	ILATK	+	41	AGLU	-	42	SUCT	+	43	NAGA	-	44	AGAL	+	45	PHOS	-
46	GlyA	-	47	ODC	+	48	LDC	+	53	IHISa	-	56	CMT	+	57	BGUR	+
58	O129R	+	59	GGAA	-	61	IMLTa	-	62	ELLM	+	64	ILATa	-			

Table(7): Selected Organism : *Pseudomonas putida* **Bionumber** : 0003011103500152 **Confidence**: Excellent identification

Biochemical Details																
2	APPA	-	3	ADO	-	4	PyrA	-	5	IARL	-	7	dCEL	-	9	BGAL	-
10	H25	-	11	BNAG	-	12	AGLTp	-	13	dGLU	+	14	GGT	+	15	OFF	-
17	BGLU	-	18	dMAL	-	19	dMAN	-	20	dMNE	+	21	BXYL	-	22	BAlap	-
23	ProA	+	26	LIP	-	27	PLE	-	29	TyrA	+	31	URE	-	32	dSOR	-
33	SAC	-	34	dTAG	-	35	dTRE	-	36	CIT	+	37	MNT	+	39	5KG	-
40	ILATK	+	41	AGLU	-	42	SUCT	+	43	NAGA	-	44	AGAL	-	45	PHOS	-
46	GlyA	-	47	ODC	-	48	LDC	-	53	IHISa	+	56	CMT	-	57	BGUR	-
58	O129R	+	59	GGAA	-	61	IMLTa	+	62	ELLM	-	64	ILATa	+			

Table (8): Selected Organism *:* *Aeromonas saimonicida*

Bionumber : 5010001000001001 **Confidence**: Acceptable identification

Biochemical Details																	
2	APPA	+	3	ADO	-	4	PyrA	+	5	IARL	-	7	dCEL	-	9	BGAL	-
10	H25	+	11	BNAG	-	12	AGLTp	-	13	dGLU	-	14	GGT	-	15	OFF	-
17	BGLU	-	18	dMAL	-	19	dMAN	-	20	dMNE	-	21	BXYL	-	22	BAlap	-
23	ProA	+	26	LIP	-	27	PLE	-	29	TyrA	-	31	URE	-	32	dSOR	-
33	SAC	-	34	dTAG	-	35	dTRE	-	36	CIT	-	37	MNT	-	39	5KG	-
40	ILATK	-	41	AGLU	-	42	SUCT	-	43	NAGA	-	44	AGAL	-	45	PHOS	-
46	GlyA	+	47	ODC	-	48	LDC	-	53	IHISa	-	56	CMT	-	57	BGUR	-
58	O129R	-	59	GGAA	-	61	IMLTa	-	62	ELLM	+	64	ILATa	-			

Table (9): Selected Organism *:* ***Klebsiella pneumoniae ssp ozaenae***

Bionumber : 0401700150260202 **Confidence**: Excellent identification

Biochemical Details																	
2	APPA	-	3	ADO	-	4	PyrA	-	5	IARL	-	7	dCEL	-	9	BGAL	+
10	H25	-	11	BNAG	-	12	AGLTp	-	13	dGLU	+	14	GGT	-	15	OFF	-
17	BGLU	+	18	dMAL	+	19	dMAN	+	20	dMNE	-	21	BXYL	-	22	BAlap	-
23	ProA	-	26	LIP	-	27	PLE	-	29	TyrA	+	31	URE	-	32	dSOR	-
33	SAC	+	34	dTAG	-	35	dTRE	+	36	CIT	-	37	MNT	-	39	5KG	-
40	ILATK	-	41	AGLU	+	42	SUCT	-	43	NAGA	-	44	AGAL	+	45	PHOS	+
46	GlyA	-	47	ODC	-	48	LDC	-	53	IHISa	-	56	CMT	+	57	BGUR	-
58	O129R	-	59	GGAA	-	61	IMLTa	-	62	ELLM	-	64	ILATa	+			

Table (10): Selected Organism : *Staphylococcus xylosus*

Bionumber : 030446010673031 **Confidence**: Excellent identification

Biochemical Details																	
2	AMY	-	4	PIPLC	-	5	dXYL	-	8	ADH1	+	9	BGAL	+	11	AGLU	-
13	APPA	-	14	CDEX	-	15	AspA	-	16	BGAR	-	17	AMAN	-	19	PHOS	+
20	LeuA	-	23	ProA	-	24	BGURr	+	25	AGAL	-	26	PyrA	+	27	BGUR	+
28	AlaA	-	29	TyrA	-	30	dSOR	-	31	URE	+	32	POLYB	-	37	dGAL	-
38	dRIB	-	39	ILATK	-	42	LAC	-	44	NAG	-	45	dMAL	+	46	BACI	+
47	NOVO	+	50	NC6.5	+	52	dMAN	+	53	dMNE	+	54	MBdG	+	56	PUL	-
57	dRAF	-	58	O129R	-	59	SAL	-	60	SAC	+	62	dTRE	+	63	ADH2s	-
64	OPTO	+															

Table (11) : Selected Organism : *Streptococcus agalactiae*

Bionumber :250412223532631 **Confidence**: Acceptable identification

Biochemical Details																	
2	AMY	-	4	PIPLC	+	5	dXYL	-	8	ADH1	+	9	BGAL	-	11	AGLU	+
13	APPA	-	14	CDEX	-	15	AspA	-	16	BGAR	-	17	AMAN	-	19	PHOS	+
20	LeuA	(+)	23	ProA	-	24	BGURr	-	25	AGAL	-	26	PyrA	+	27	BGUR	-
28	AlaA	-	29	TyrA	+	30	dSOR	-	31	URE	-	32	POLYB	+	37	dGAL	-
38	dRIB	+	39	ILATK	+	42	LAC	-	44	NAG	+	45	dMAL	-	46	BACI	+
47	NOVO	+	50	NC6.5	+	52	dMAN	-	53	dMNE	-	54	MBdG	+	56	PUL	-
57	dRAF	-	58	O129R	+	59	SAL	+	60	SAC	+	62	dTRE	+	63	ADH2s	-
64	OPTO	+															

Table (12): Selected Organism *:* *Enterococcus casseliflavus*

Bionumber : 160 311000341520 **Confidence**: Excellent identification

Biochemical Details																	
2	AMY	+	4	PIPLC	-	5	dXYL	-	8	ADH1	-	9	BGAL	+	11	AGLU	+
13	APPA	-	14	CDEX	-	15	AspA	-	16	BGAR	+	17	AMAN	+	19	PHOS	-
20	LeuA	+	23	ProA	-	24	BGURr	-	25	AGAL	+	26	PyrA	-	27	BGUR	-
28	AlaA	-	29	TyrA	-	30	dSOR	-	31	URE	-	32	POLYB	-	37	dGAL	-
38	dRIB	-	39	ILATK	-	42	LAC	-	44	NAG	+	45	dMAL	+	46	BACI	-
47	NOVO	-	50	NC6.5	-	52	dMAN	+	53	dMNE	+	54	MBdG	-	56	PUL	-
57	dRAF	+	58	O129R	-	59	SAL	+	60	SAC	-	62	dTRE	+	63	ADH2s	-
64	OPTO	-															

Table (13) : Selected Organism : *Enterococcus durans*

Bionumber : 414002325733661 **Confidence**: Acceptable identification

Biochemical Details																	
2	AMY	-	4	PIPLC	-	5	dXYL	+	8	ADH1	+	9	BGAL	-	11	AGLU	-
13	APPA	-	14	CDEX	-	15	AspA	+	16	BGAR	-	17	AMAN	-	19	PHOS	-
20	LeuA	-	23	ProA	-	24	BGURr	-	25	AGAL	-	26	PyrA	+	27	BGUR	-
28	AlaA	+	29	TyrA	+	30	dSOR	-	31	URE	-	32	POLYB	+	37	dGAL	-
38	dRIB	+	39	ILATK	-	42	LAC	+	44	NAG	+	45	dMAL	+	46	BACI	+
47	NOVO	+	50	NC6.5	+	52	dMAN	-	53	dMNE	+	54	MBdG	+	56	PUL	-
57	dRAF	-	58	O129R	+	59	SAL	+	60	SAC	-	62	dTRE	+	63	ADH2s	+
64	OPTO	+															

Table(14) : Selected Organism : *Staphylococcus sciuri*

Bionumber : 050002403463431 **Confidence**: Low discrimination

Biochemical Details																
2	**AMY**	**-**	**4**	**PIPLC**	**-**	**5**	**dXYL**	**-**	**8**	**ADH1**	**+**	**9**	**BGAL**	**(-)**	**11**	**AGLU**	**+**
13	**APPA**	**-**	**14**	**CDEX**	**-**	**15**	**AspA**	**-**	**16**	**BGAR**	**-**	**17**	**AMAN**	**-**	**19**	**PHOS**	**-**
20	**LeuA**	**-**	**23**	**ProA**	**-**	**24**	**BGURr**	**-**	**25**	**AGAL**	**-**	**26**	**PyrA**	**+**	**27**	**BGUR**	**-**
28	**AlaA**	**-**	**29**	**TyrA**	**-**	**30**	**dSOR**	**+**	**31**	**URE**	**-**	**32**	**POLYB**	**-**	**37**	**dGAL**	**-**
38	**dRIB**	**+**	**39**	**ILATK**	**+**	**42**	**LAC**	**-**	**44**	**NAG**	**-**	**45**	**dMAL**	**(-)**	**46**	**BACI**	**+**
47	**NOVO**	**-**	**50**	**NC6.5**	**+**	**52**	**dMAN**	**+**	**53**	**dMNE**	**+**	**54**	**MBdG**	**+**	**56**	**PUL**	**-**
57	**dRAF**	**-**	**58**	**O129R**	**-**	**59**	**SAL**	**+**	**60**	**SAC**	**+**	**62**	**dTRE**	**+**	**63**	**ADH2s**	**-**
64	**OPTO**	**+**															

Table(15): Selected Organism : *Staphylococcus lentus*

Bionumber : 150003403663731 **Confidence**: Excellent identification

Biochemical Details																
2	**AMY**	**+**	**4**	**PIPLC**	**-**	**5**	**dXYL**	**-**	**8**	**ADH1**	**+**	**9**	**BGAL**	**-**	**11**	**AGLU**	**+**
13	**APPA**	**-**	**14**	**CDEX**	**-**	**15**	**AspA**	**-**	**16**	**BGAR**	**-**	**17**	**AMAN**	**-**	**19**	**PHOS**	**-**
20	**LeuA**	**-**	**23**	**ProA**	**-**	**24**	**BGURr**	**-**	**25**	**AGAL**	**+**	**26**	**PyrA**	**+**	**27**	**BGUR**	**-**
28	**AlaA**	**-**	**29**	**TyrA**	**-**	**30**	**dSOR**	**+**	**31**	**URE**	**-**	**32**	**POLYB**	**-**	**37**	**dGAL**	**-**
38	**dRIB**	**+**	**39**	**ILATK**	**+**	**42**	**LAC**	**-**	**44**	**NAG**	**-**	**45**	**dMAL**	**+**	**46**	**BACI**	**+**
47	**NOVO**	**-**	**50**	**NC6.5**	**+**	**52**	**dMAN**	**+**	**53**	**dMNE**	**+**	**54**	**MBdG**	**+**	**56**	**PUL**	**-**
57	**dRAF**	**+**	**58**	**O129R**	**+**	**59**	**SAL**	**+**	**60**	**SAC**	**+**	**62**	**dTRE**	**+**	**63**	**ADH2s**	**-**
64	**OPTO**	**+**															

Table(16) : Selected Organism : *Acinetobacter haemolyticus*

Bionumber : 0040000101400340 **Confidence**: Excellent identification

Biochemical Details																
2	**APPA**	-	3	**ADO**	-	4	**PyrA**	-	5	**IARL**	-	7	**dCEL**	-	9	**BGAL**	-
10	**H25**	-	11	**BNAG**	-	12	**AGLTp**	+	13	**dGLU**	-	14	**GGT**	-	15	**OFF**	-
17	**BGLU**	-	18	**dMAL**	-	19	**dMAN**	-	20	**dMNE**	-	21	**BXYL**	-	22	**BAlap**	-
23	**ProA**	-	26	**LIP**	-	27	**PLE**	-	29	**TyrA**	+	31	**URE**	-	32	**dSOR**	-
33	**SAC**	-	34	**dTAG**	-	35	**dTRE**	-	36	**CIT**	+	37	**MNT**	-	39	**5KG**	-
40	**ILATK**	-	41	**AGLU**	-	42	**SUCT**	+	43	**NAGA**	-	44	**AGAL**	-	45	**PHOS**	-
46	**GlyA**	-	47	**ODC**	-	48	**LDC**	-	53	**IHISa**	+	56	**CMT**	(+)	57	**BGUR**	-
58	**O129R**	-	59	**GGAA**	-	61	**IMLTa**	+	62	**ELLM**	-	64	**ILATa**	-			

Table(17): Selected Organism : *Cronobacter dublinensis ssp dublinensis*

Bionumber :0625736051723011

Biochemical Details																	
2	**APPA**	-	3	**ADO**	-	4	**PyrA**	-	5	**IARL**	-	7	**dCEL**	+	9	**BGAL**	+
10	**H25**	-	11	**BNAG**	+	12	**AGLTp**	-	13	**dGLU**	+	14	**GGT**	-	15	**OFF**	+
17	**BGLU**	+	18	**dMAL**	+	19	**dMAN**	+	20	**dMNE**	+	21	**BXYL**	+	22	**BAlap**	-
23	**ProA**	-	26	**LIP**	+	27	**PLE**	+	29	**TyrA**	-	31	**URE**	-	32	**dSOR**	-
33	**SAC**	+	34	**dTAG**	-	35	**dTRE**	+	36	**CIT**	+	37	**MNT**	-	39	**5KG**	-
40	**ILATK**	+	41	**AGLU**	+	42	**SUCT**	+	43	**NAGA**	-	44	**AGAL**	+	45	**PHOS**	-
46	**GlyA**	+	47	**ODC**	+	48	**LDC**	-	53	**IHISa**	-	56	**CMT**	-	57	**BGUR**	-
58	**O129R**	+	59	**GGAA**	-	61	**IMLTa**	-	62	**ELLM**	+	64	**ILATa**	-			

water sources were contaminated with coliforms and pathogenic bacteria. The bacteriological results shows that all the bio treated samples had no fecal Coliform growth (<1) C/100ml but give positive results with the total Coliform with confluent colonies whereas in the chlorinated treatment both the total &fecal Coliform tests were negative.

The use of microbial biomass for the biosorption of metals from industrial and municipal wastewater has been proposed as a promising alternative to conventional heavy metal management strategies in past decades. Fungal , bacterial and yeast biomass have been studied with respect to the adsorption of toxic or strategic metals, mainly due to low production costs, rapid sorption and release of metals and reutilization. Accumulation of metals in microbial biomass proceeds by different processes such as uptake by transport, entrapment in extra cellular capsules, precipitation and oxidation- reduction reactions. Although the mechanism of metal sorption and uptake by microorganisms is still not completely understood. Sorption to poly-saccharides, proteins or other molecules occurring in the outer layer of the cell wall probably plays the most important role. Bioremoval of heavy metal from industrial wastes has been demonstrated by several biotechnologies. Virous microbial species. Gram positive and Gram negative bacteria mainly Pseudomonas (Hussein et al., 2004) and Bacillus (Mayers and Beveridge, 1989), have been shown to relatively efficient in the bioaccumulation of copper, zinc, Iron and other metal ions present in polluted effluents. Generally, the cell walls of Gram negative and Gram positive bacteria consists of an anionic matrix of biopolymers such as peptidoglycan, techoic acid, techuronic acid phospholipid and lipopoly saccharide as well a various poly peptides and poly saccharide. The wall polymers enable bacteria to sorbs and bind significant amounts of metals from their surrounding (Mayers and Beveridge, 1989). Also no generalizations regarding differences between Gram negative and Gram positive for heavy metals sorption metal removal by one or more process (Mullen et al, 1989).

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