Physical, chemical and Actinobacterial characteristics of textile wastewater, Port Said, Egypt

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ABSTRACT

Wastewater originating from the textile-dying industries is a complex mixture of potentially polluted substances consisting of textile dyes, heavy metals associated with dyes and other auxiliaries used during dyeing process. The present study was conducted in an attempt to examine the physical, chemical and microbial changes as a result of industrial wastewater discharge into the main drain station in the industrial free zone area at Port Said, Egypt. Results showed that physical, chemical and microbial characteristics of water are deteriorated and many of these parameters figures exceeded the legislation limits. However, considering the textile industry, an increase is expected in concentrations of turbidity and TSS as a consequence of the exceeding amounts of fibers encountered in this industry 102 pure identified actinobacterial isolated previously were tested and proved to be capable of degrading industrial pollutants applied. The 102 isolates were screened to explore their capability with the effluent of the factory of Dolphin .Isolate N° Ndd7 proved and showed the highest ability to degrade the main dye used in the industrial process in the factory.

Keywords: Wastewater, textile dyes Actinobacteria, heavy metal

INTRODUCTION

Pollution of natural waters with waste effluents arising from various industries has become a serious problem in Egypt, as industrial growth and development have been on a very large scale. The ecological and toxicological problems resulting from the discharge of wastewaters from these industries into drainage have been among the most important water pollution problems. Apart from the aesthetic deterioration and obscuring the penetration of light into natural water bodies, some of the metallodyes, dye precursors and dye degradation products are reported to be carcinogenic and mutagenic in nature. These chemicals contribute to a vast array of environment-related diseases such as eczema, contact dermatitis, asthma, chronic bronchitis, cancer, and irritation of the eyes (Kanu *et al*., 2011). The aquatic toxicity of textile industry wastewater varies considerably among production facilities. The sources of aquatic toxicity can include salt, surfactants, ionic metals and their complexed metals therein, toxic organic chemicals, biocides, and toxic anions (EPA, 1995 and Society of Dyers and Colourists, 1976). In addition, textile industries have shown a significant increase in the use of synthetic complex organic dyes as a colouring material. The annual world production of textiles requires about 700,000 tones of different dyes (O'Neill *et al*., 1999) (Jebapriy a. *et al*., 2013). Over 90% of some 4000 dyes tested in an ETAD (The Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers) survey had LD50 high values ranging between 2 - 103 mg/kg.

The highest rates of toxicity were found amongst basic and diazo direct dyes (Shore, 1996). Actinobacteria, particularly Streptomyces species, are known to produce extracellular peroxidases that have a role in the biodegradation of lignin, have also been shown to catalyse hydroxylation, oxidation, and dealkylation reactions against various dye compounds that are structurally related to lignin (Goszczynski *et al*., 1994). The first comprehensive attempt to isolate and characterize actinobacteria associated with wastewater treatment system was made by Lechevalier *et al*. (1977) on activated sludge type, reporting Nocardia as predominant genus .

The present work aims to assess of physical, chemical and actinobaterial wastewater quality of textile industry in Port Said free zone.

MATERIALS AND METHODS

Wastewater sampling:

Water samples from effluent channel of the textile dyes wastewater of Dolphin factory and main drain station were collected in sterile clean bottles. The bottles were kept immediately in ice bags until transported to the laboratory for Physico-chemical and microbial analyses.

Physico-chemical and microbiological analyses:

The pH, turbidity, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, total suspended solids, chloride and sulphate were analysis according to the methods of APHA(1998). Physico-chemical analyses were carried out immediately at the sampling sites or immediately on arrival to the laboratory.

One hundred two isolates of Actinobacteria isolated from wastewater of textile factories at 10th Ramadan City by Dr. El-Shatoury, Faculty of Science, Suez Canal University (El-Shatoury, 2001) were used in the present study.

The isolates are belonging to the genera: *Kineospora* sp. (one isolate), *Micromonospora* sp. (9 isolates), *Planobispora* sp. (one isolate), *Streptomyces* sp. (29 isolates), *Nocardiopsis* sp. (8 isolates), *Nocardiopsis* sp. (8 isolates), *Nocardioides* sp. (41 isolates), *Pseudonocardia* sp. (3 isolates), *Kitasatosporia* sp. (one isolate), *Nocardia* sp. (2 isolates) and *Actinomadura* sp. (one isolate).

Total viable count of bacteria was carried out according to the standard method described by the American Public Health Association (APHA, 2012), on starch casein agar medium using spread plate technique.

RESULTS

Physico-chemical analysis:

For water quality measurements, samples were collected from the final effluent of the factory as well as final effluent of the industrial zone (including other factories) to compare and reveal the magnitude of pollutants discharged from that factory with the whole industrial zone.

Results Table 1 and Fig. 1 showed that pH in the main drain station effluent in almost all samples collected throughout the day ranged from 6.6 to 7.3, and ranged from 7.82 to 10.2 in samples from Dolphin factory effluent throughout the day. The average of pH recorded was 6.9 in case of main drain station effluent and was 8.67 in case of Dolphin factory effluent throughout the day. In general, the minimum value (6.6) was recorded at 11:00 am to 12:00 am in the main drain station, while the maximum value (10.2) was reported at 1:00 pm from Dolphin Factory outlet.

Table 1: Physical, chemical and microbiological characteristics of textile effluents:

Parameters (mean)	pH	Turbidity (ntu)	DO (mg/l)	COD (mg/l)	TSS (mg/l)	TDS (mg/l)	Chloride (mg/l)	Sulphates (mg/l)	Tvb (cfu/ml)
Effluents from Dolphin factory	8. 7	140	7.33	472.7	32	584	190.3	134.7	**270000**
Effluents from main drain station	6.9	175. 4	3.6	417.3	88.285 71	2523.4	1168.6	501.4	**1211429**
Egyptian law (48/1982) standards	**6-9**	**50**	**4≤**	**100**	**60**	**2000**	**1**	**60**	**5000**

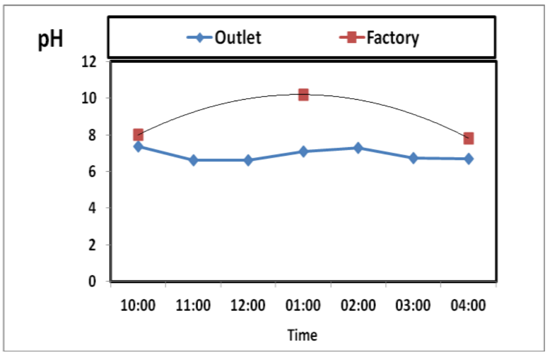

Fig. 1: pH values of textile wastewater throughout the day.

As it is cleared from Table 1 and Fig. 2, in the main drain station effluent in almost all samples collected throughout the day Turbidity ranged from 145 to 231 ntu. It ranged from 111to159 ntu in samples from Dolphin Factory effluents throughout the day. Average of turbidity was 175.14 ntu through the day. Minimum value (111ntu) was recorded at 1:00 pm from Dolphin factory effluent, while the maximum value (231ntu) was reported at 2:00 pm in the main drain station. From Table 1 and Fig. 3 it is the clear that the dissolved oxygen (DO) in the main drain effluent in almost all samples collected throughout the day, ranged from 1.67 to 6.32mg/l, and ranged from 6.7 to 7.7mg/l in case of samples from Dolphin Factory effluent throughout the day. The average of DO recorded was 3.68mg/l in case of main drain station effluent and was 7.34 mg/l in case of Dolphin Factory effluent throughout the day.

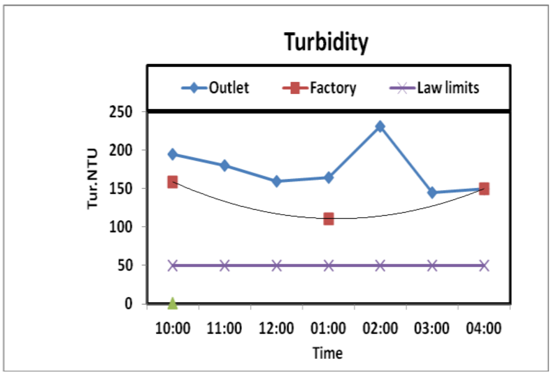

Fig. 2: Turbidity values of textile wastewater throughout the day

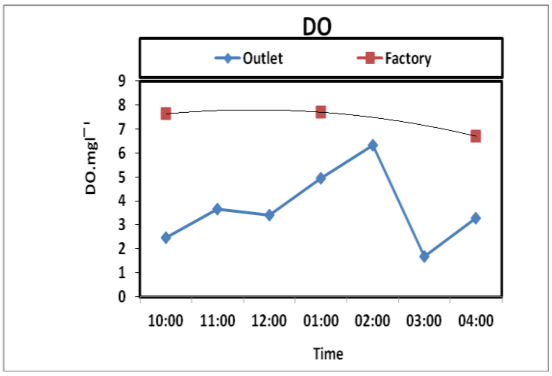

Fig. 3: Dissolved oxygen values of textile wastewater throughout the day.

In general, the minimum DO value (1.67mg/l) was recorded at 03:00 pm in the main drain station, while the maximum (7.63 mg/l) was reported at 10:00 am from Dolphin Factory outlet.

Data in Table 1 and Fig. 4 showed that biological oxygen demand (BOD) in main drain effluent in almost all samples collected throughout the day was ranging from 3.78 mg/l to 10.125 mg/l and ranged from 6.8 mg/l to 8.2 mg/l in samples from Dolphin Factory effluent throughout the day. The average of (BOD) record was 7.063 mg/l in case of the main drain effluent and was7.33 mg/l in case of Dolphin Factory effluent throughout the day.

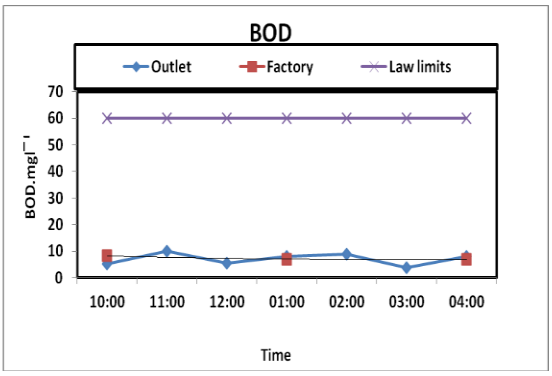

Fig. 4: Biological oxygen demand BOD values in textile wastewater throughout the day.

As it is clear from Table 1 and Fig. 5, results showed that chemical oxygen demand (COD) in the main drain effluent in almost all samples collected throughout the day was ranged from 238.3 mg/l to 635 mg/l, and ranged from 305 mg/l to 785 mg/l in samples from Dolphin Factory effluent throughout the day.

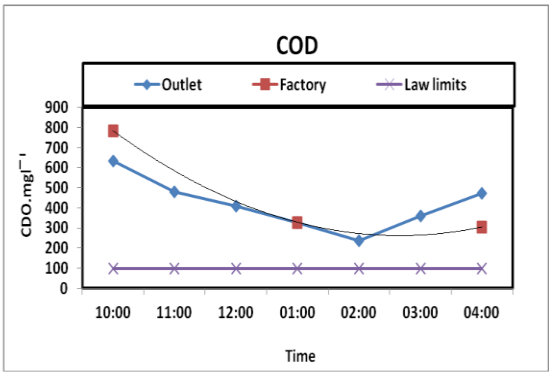

Fig. 5: Chemical oxygen demand values of textile wastewater throughout the day.

The average of (COD) recorded was 417.38 mg/l in case of the main drain effluent and was 472.7 mg/l in case of Dolphin Factory effluent throughout the day.

In general the minimum value of COD (238.3mg/l) was recorded at 02:00 pm in the main drain station, while the maximum (785 mg/l) was reported at 10:00 am from Dolphin Factory outlet.

From Table 1 and Fig. 6, the total suspended solid (TSS) in the main drain effluent samples collected throughout the day ranged from 24 to 214 mg/l, and ranged from 15 to 65mg/l in samples from Dolphin Factory effluent throughout the day. The average of TSS record was 88.28 mg/l in case of the main drain effluent and was 32 mg/l in case of Dolphin Factory effluent throughout the day.

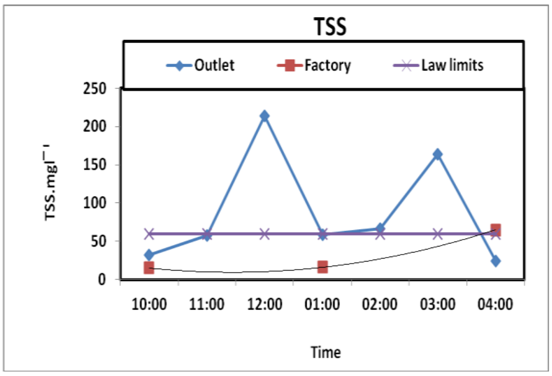

Fig. 6: Total suspended solid values of textile wastewater throughout the day.

In general, the minimum value of TSS (15 mg/l) was recorded at 10:00 am from Dolphin Factory, outlet while the maximum (214 mg/l) was reported at 12:00 am in the main drain station.

Data in Table 1 and Fig. 7 shows that total dissolved solid (TDS) in the main drain effluent in almost all samples collected throughout the day ranged from 1788 to 3158 mg/l and ranged from 318 to 726 mg/l in samples from Dolphin factory effluent throughout the day. The average of TDS recorded was 2523.4 mg/l in case of the main drain effluent and was 584 mg/l in case of Dolphin Factory effluent throughout the day.

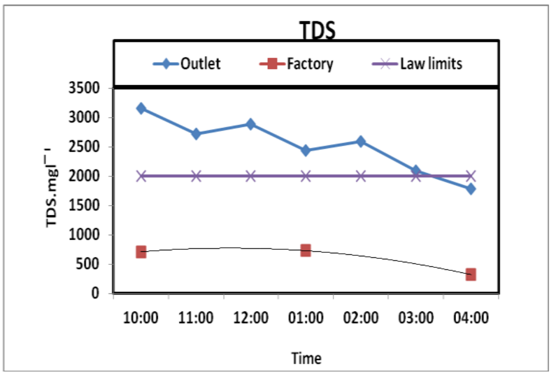

Fig. 7: Total dissolved solid values of textile wastewater throughout the day.

In general, the minimum value (318 mg/l) was recorded at 04:00 pm from Dolphin Factory effluent, while the maximum (3158 mg/l) was reported at 10:00 am in the main drain station.

Results of Table 1 and Fig. 8 shows that chloride in the main the drain effluent in almost all samples collected throughout the day was ranged from 840 mg/l to 1600 mg/l, and ranged from 100mg/l to 286mg/l in samples from Dolphin Factory effluent throughout the day. The average of recorded chloride was 1168 mg/l in case of the main drain effluent and was190.3 mg/l in case of Dolphin Factory effluent throughout the day.

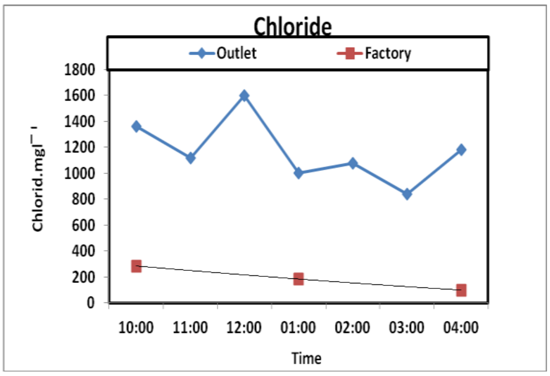

Fig. 8: Values of chloride in textile wastewater throughout the day.

In general, the minimum value of chloride (100mg/l) was recorded at 4:00 pm from Dolphin Factory outlet, while the maximum (1600mg/l) was reported at 12:00 am in the main drain station.

Results of Table 1 and Fig. 9 reveal that sulphate in the main drain station effluent in almost all samples collected throughout the day was ranged from 400 mg/l to 550mg/l, and ranged from 52mg/l to 182 mg/l in samples from Dolphin Factory effluent throughout the day. The average of sulphate record was 501.42 mg/l in case of the main drain station effluent and was134.6mg/l in case of Dolphin Factory effluent throughout the day. In general the minimum value (52mg/l) was recorded at 10:00 am from Dolphin Factory outlet, while the maximum (550mg/l) was reported at 10:00am to 03:00pm o'clock in the main drain station.

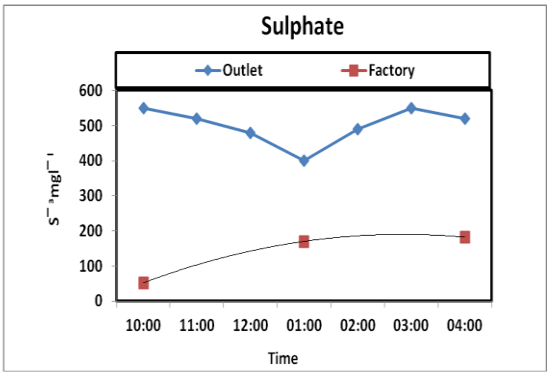

Fig. 9: Values of sulphate in textile wastewater throughout the day

Total viable count of bacteria in wastewater from study site.

Data in Table 1 and Fig. 10 shows that total viable bacterium (TVB) in the main drain station effluent in almost all samples collected throughout the day was ranging from $1.08x10^5$ cfu/ml to $93x10^4$ cfu/ml. and ranged from $2x10^4$ cfu/ml to $76x10^3$ cfu/ml in samples from Dolphin Factory effluent throughout the day. The average of (TVB) record was 121142 cfu/ml in case of the main drain effluent and was $27x10^4$ cfu/ml in case of Dolphin Factory effluent throughout the day.

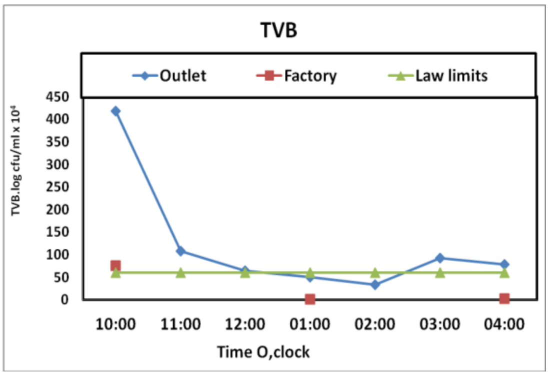

Fig. 10: Total viable bacterial count TVB values in textile wastewater throughout the day.

In general, the minimum value of TVB ($2x10^4$cfu/ml) was recorded at 01:00 pm from Dolphin Factory outlet, while the maximum ($93x10^4$cfu/ml) was reported at 03:00 pm in the main drain station.

The ability of Actinobacterial isolates to degrade textile dyes:

Table (2) summarized the results of the dye decolorization for colonies of the studied 102 isolates from Actinobacteria on different media M56 / M56+glucose.

-*Nocardioides* and *Streptomyces* species have the highest dye declorization ability.

Results shown in Table (2) are evaluating the ability of Actinobacterial to degrade the textile dyes .It is clear that some actinobacterial isolates were not able to grow or to remove dyes using M56 and M56+1% glucose as in case of isolates number (*Micromonospora* 36, 18 & *Planobispora* 34 & *Streptomyces* 100, 48, 59, 44, 91, 96; *Nocardiopsis* 55, 76; *Nocardioides* 86, 68, 10, 78, 101, 63.89.106, 77, 90 and *Pseudonocardia* 47,72) , while many isolates have the ability to grow and degrade the dye.

The isolates number (*Nocardioides* 3, 2, 27, 29, 26, 8 & *Kineospora* 66, *Micromonospora* 17 & *Streptomyces* 57, 71 and *Kitasatosporia* 65, have the ability to grow on the M 56, while on M56+1%gl these isolate *Micromonospora* 54, 19& *Streptomyces* 102, 49 & *Nocardioides* 41, 13, 51, 98 and *Actinomadura* 107 have the ability to grow.

In isolates number (*Nocardioides* 7, 13, 12, 93 & *Nocardiopsis* 11and *Streptomyces* 99,28) growth diameter of actinobacterial colonies were ranging from 0.1cm (*Streptomyces* 87) to 2.3 cm (*Nocardioides* 35) on the M56 while on M56+ 1%gl colonies diameter ranged from 0.1 cm (*Micromonospora*37) to 2cm (*Nocardioides* 79).

Only one isolates (*Nocardioides93)* was able to remove the dye on M56 media (Removal zone 1.6), While on M56+1%gl dye removal was ranging from 0.8 cm (*Streptomyces* 84) to 2.9 cm (*Nocardioides* 7).

Tab. 2: Diameters of Actinobacteria colony and dye removal on M56 and M56 enriched with 1% glucose.

Actinobacterial Isolates	No.of Isolates	56 media			' 56 media +1% glucose		
		Colony diameter (cm)	Diameter of clear zone (cm)	Colony colour	Colony diameter (cm)	Diameter of clear zone (cm)	Colony colour
***Kineospora* sp.**	*Kin 66*	0.3	_	**Blacks**	___	_	_
***Micromonospora* sp.**	*micro17*	0.6	__	**Orange**	___	__	___
	32 *micro*	0.3	___	**Gray**	0.3	__	**White**
	36 *micro*						
	37 *micro*	0.1	__	**of White**	0.1	__	**White**
	54 *micro*	__	__	__	0.9	__	**Black**
	62 *micro*	0.7	0.1	**Black**	0.3	1.2	**White**
	18 *micro*	__	__	__	__	__	__
	19 *micro*	__	__	__	0.3	__	**Black**
	56 *micro*	0.2	__	**Gray**	0.6	1.3	**Black**
***Planobispora* sp**	*Plano 34*	__	__	__	__	__	__
***Streptomyces* sp**	84 *strept*	0.3	__	**Gray**	0.3	0.8	**of White**
	100 *strepto*	__	__	__	__	__	__
	48 *strepto*	__	__	__	__	__	__
	5 *strepto*	0.4	___	**of White**	1.3	1.7	**of White**
	59 *strepto*	__	__	__	__	__	__
	102 *strept*	__	__	__	2.1	__	**Gray**
	strepto 44	__	__	__	__	__	__
	69 *strept*	0.8	___	**of White**	1.1	___	**of White**
	95 *strepto*	0.3	__	**Gray**	1	__	**of White**
	105 *strepto*	0.1	__	**Gray**	0.1	__	**Brown**
	97 *strepto*	0.1	__	**Gray**	0.3	1.1	**Gray**
	99 *strepto*	1.4	0.2	**Gray**	2.3	1.9	**White**
	28 *strepto*	1.9	__	**Black**	1.4	___	**Gray**
	104 *strepto*	0.1	__	**Black**	1.6	1.9	**Black**
	64 *strepto*	0.8	__	**Black**	1.6	1.3	**Black**
	75 *strepto*	1.3	__	**Gray**	2	1.8	**Gray**
	57 *strepto*	0.4	__	**Gray**	__	__	__
	85 *strepto*	0.1	__	**Gray**	0.6	__	**Brown**
	30 *strepto*	1	__	**Gray**	1.4	2	**Gray**
	87 *strepto*	0.1	__	**Black**	0.7	1.3	**Black**
	88 *strepto*	__	__	__	__	__	__
	83 *strepto*	0.1	__	**Black**	0.1	__	**Off White**
	71 *strepto*	.1	__	**Off White**	__	__	__
	70 *strepto*	0.3	__	**Gray**	0.1	___	**White**
	91 *strepto*	__	__	__	__	__	__
	74 *strepto*	1.2	__	**Gray**	1.6	__	**Gray**
	40 *strepto*	1.7	__	**Gray**	1.5	__	**Gray**
	96 *strepto*	__	__	__	__	__	__
	49 *strepto*	__	__	__	1.5	1.6	**White**
***Nocardiopsis* sp**	50 *No. p.*	0.7	__	**Black**	0.1	__	**Gray**
	*No.p.*55	__	__	__	__	__	__
	11 *No. p.*	1.3	0.3	**Off White**	+1.8	+1.6	**Gray**
	39 *No. p.*	1.1	__	**Gray**	+0.9	+1.4	**Black**
	81 *No.p.*	0.1	__	**Black**	0.1	__	**Off White**
	76 *No.p.*	__	__	__	__	__	__
	73 *No.p.*	1.3	__	**Gray**	1.5	1.9	**Off White**
	61 *No.p.*	0.1	___	**White**	0.1	___	**Off White**
***Nocardioides* sp**	52 *No.d.*	1.4	__	**Black**	1.4	2.1	**White**
	3 *No.d.*	0.3	___	**White**	__	__	__
	86 *No.d.*	__	__	__	__	__	__
	1 *No.d.*	1.5	___	**White**	1.7	___	**Off White**
	68 *No.d.*	__	__	__	__	__	__
	2 *No.d.*	0.9	__	**Gray**	__	__	__
	7 *No.d.*	2.1	0.4	**Black**	2.4	2.9	**Black**
	4 *No.d.*	0.1	__	**Gray**	0.1	__	**Black**
	27 *No.d.*	1.4	__	**Black**	__	__	__
	93 *No.d.*	1.1	1.6	**Off White**	0.6	1.4	**White**

Con. Table 2:

	29 *No.d.*	1.7	__	**Off White**	__	__	__
	38 *No.d.*	0.4	___	**White**	0.1	___	**Off White**
	41 *No.d.*	__	__	__	1	1.3	**Gray**
	10 *No.d.*	__	__	__	__	__	__
	35 *No.d.*	2.3	__	**Gray**	+1.8	__	**Gray**
	79 *No.d.*	1.5	1	**White**	2	1.9	**White**
	92 *No.d.*	0.8	__	**Off White**	0.5	1.4	**White**
	46 *No.d.*	1.2	__	**Gray**	1.1	__	**Gray**
	26 *No.d.*	0.7	__	**Black**	__	__	__
	80 *No.d.*	0.1	__	**Off White**	0.4	1.4	**Gray**
	78 *No.d.*	__	__	__	__	__	__
	94 *No.d.*	1.2	___	**White**	1.5	1.9	**White**
	101 *No.d.*	__	__	__	__	__	__
	8 *No.d.*	0.4	__	**Gray**	__	__	__
	12 *No.d.*	0.5	__	**White**	__	__	__
	9 *No.d.*	0.1	___	**White**	0.3	__	**Gray**
	43 *No.d.*	0.8	__	**Gray**	1.1	1.5	**Black**
	60 *No.d.*	1.2	__	**Gray**	1.6	1.7	**Black**
	63 *No.d.*	__	__	__	__	__	__
	67 *No.d.*	0.7	__	**Gray**	0.3	1.6	**Black**
	13 *No.d.*	__	__	__	0.1	___	**Off White**
	25 *No.d.*	0.9	___	**White**	0.9	1.4	**White**
	14 *No.d.*	0.1	___	**White**	1.2	2	**Gray**
	89 *No.d.*						
	53 *No.d.*	0.1	___	**White**	0.3	1.5	**Black**
	22 *No.d.*	0.5	__	**Gray**	0.1	__	**Gray**
	106 *No.d.*						
	82 *No.d.*	1	___	**White**	1.2	1.5cm	**White**
	103 *No.d*	0.1	___	**White**	1.1	1.5	**Off White**
	42 *No.d.*	1.6	___	**White**	1.6	__	**White**
	23 *No.d.*	1.1	___	**White**	1.3	1.9	**White**
	6 *No.d.*	0.1	___	**White**	0.4	1.6	**White**
	77 *No.d.*	__	__	__	__	__	__
	51 *No.d.*	__	__	__	0.6	___	**Off White**
	15 *No.d.*	0.7	___	**White**	0.4	__	**Gray**
	98 *No.d.*	__	__	__	0.6	1.8	**Off White**
	90 *No.d.*	__	__	__	__	__	__
***Pseudonocardia* sp**	47 *pseudo*						
	45 *pseudo*	1.3	__	**Gray**	1.6	1.5	**Gray**
	72 *pseudo*	__	__	__	__	__	__
***Kitasatosporia* sp**	*Kita65*	1.2	___	**White**	__	__	__
***Nocardia* sp**	*Nocar 20*	0.2	___	**White**	0.1	__	**Gray**
	31 *Nocar*	1.2	__	**Off White**	0.7	1	**Off White**
***Actinomadura* sp**	*Actino107*	__	__	__	0.3	__	**Off White**

DISCUSSION

Textile industry represents a significant part of the Egyptian economy. As all industries, it is expected that textile factories will produce industrial pollutants that -if not properly treated - will in force serious environment of problems.

Industrial effluent of textile factories will include acids, alkalis, salts, ect (Verma, Dash *et al*. 2012). 1 the research work in this thesis aimed to explore the applicability of a biological solution for eliminating chemical pollutants included in the effluent of a textile factory found in Port Said. Actinobacteria were used for that purpose-as the biological factor-to investigate such assumption. Several Actinobacterial pure isolates previously isolated from the industrial waste of 10 th of

Ramadan City and proved intensive capacity of degrading industrial waste were chosen as a start to commence this treatment.

The Dolphin textile factory effluent was thoroughly investigated to provide deep and detailed information about its physical, chemical as well as biological characteristics. To execute this task, a cohort sampling program was followed as to collect samples around the clock from the factory effluent as well as the main effluent of the industrial zone of Port Said. The sampling program covered the two working shifts of the factory, as from 10:00 am up to 2:00 pm, followed by a second shift from 2:00 pm up to 6:00 pm.

It was found in the chemical analysis that turbidity is affected by some factors such as coloring chemicals and materials that have different light-scattering properties, TSS is just a measurement of the amount of suspended particles. For example, a stream with a certain concentration of clay particles in the water will give a different turbidity reading than a stream with that same concentration of silt particles because clay and silt particles have different light-scattering properties. Therefore, on-site testing must be completed at each site before turbidity can be used to estimate TSS. For these reasons, using turbidity measurements, though they are quick and easy, to estimate TSS is generally not feasible for each temporary construction site (Packman, Comings *et al*, 1999).

It has been noticed that turbidity of the effluent is at highest always in the beginning of the working shift (approximately at 10:00 am), then it starts to decrease. A second increase usually happens at around 2:00 pm, with commence of the second period, then values returns back to the morning levels. This relates to the contaminant of fibers and other debris. Dissolved oxygen concentrations increases throughout the day as a result of the turbulence of the water by the washers. This also usually noticed after commence of the morning shift as well as with the afternoon shift.

Taking the type of industry in account, which is textile in this research, and as it was noticed with turbidity profiles, total suspended solids (TSS), showed two peaks, obviously related to the two shifts regimes in the factory. First increase in TSS concentration noticed approximately at 12:00 am and the second increase at around 3:00 pm. Both two peaks are related to the work regimes of two shifts.

Concentration of chlorides were related to total dissolved salts (TDS) as it rises at the being of the working shift , then starts to decrease gradually . Same attitude with the second working shift, the chemical additives in the factory and the timing of the working shift, played a role in these patterns. Concentrations of sulphate (So_4^{-2}) showed similar patterns as previous indicators. The first peak was at around 10:00 am where the first shift starting addition of chemicals for the manufacturing treatment. A second peak appears in the second shift after the increase of So_4^{+2} and as washing process starts, concentrations start to decrease. Biological oxygen demand (BOD) concentrations were at minimum as organic compounds are not included in this particular industrial process.

In case of chemical oxygen demand (COD), again there were two peaks throughout the day. First increase in concentrations coincided with the morning working shift and the second peak coincided with the second shift. COD concentrations decreased as the shifting work approached its end due to the washing effect. In washing process, all chemicals added in the morning were diluted. As for all discussed indicators it can be concluded that by the addition of chemicals at the being of the working shift, concentrations started to increase, then as a result of the washing process, concentrations decreased.

Unfortunately, concentrations of turbidity, COD, TSS, and TDS were not in accordance with the guidelines of the Egyptian Environmental law N (48) standards for the year (1982) for the discharge of industrial effluents into the public sewage network.

The pH values were in some cases higher than the permissible standards (pH= 6 – 9) and these high values (pH = 10.2) may be attributed to the application of bleaching agents and chemicals such as NaOCl, NaOH, as well as surfactants and sodium phosphate (Paul, Chavan *et al*. 2012). Same observation was reported from other workers in case of textile manufacturing as for example Ramamurthy *et al* (2011). Also, lower pH than the law standards were observed (pH= 6.6) and reported in value previous studies as for example (Desai and Kore, 2011).

The Egyptian law determined the permissible limit of Turbidity as not above 50ntu. However, turbidity in the effluent from Dolphin factory reservoir throughout the day ranged between 145 ntu to 231 ntu. As stated above, this is relating to the type of the industry which includes fibers and debris, while turbidity is affected by factors such as coloring chemicals and materials that have different light-scattering properties, TSS is just a measurement of the amount of suspended particles. For example, a stream with a certain concentration of clay particles in the water will give a different turbidity reading than a stream with that same concentration of silt particles because clay and silt particles have different light-scattering properties. Therefore, on-site testing must be completed at each site before turbidity can be used to estimate TSS. For these reasons, using turbidity measurements, though they are quick and easy, to estimate TSS is generally not feasible for each temporary construction site.

COD is an important pollution indicator which reflects the chemical quality of effluent. High COD values are reported for all samples from Dolphin factory reservoir and ranged between 238.3mg/l to 785 mg/l, while the permissible value is 100mg/l.

Dissolved oxygen of the factory (Dolphin) which reflects the pollution strength and nature of effluent if contaminated with organic matter. Mean value of (DO) in the effluent (3.677143 mg/l) was found to be was low than the legislated value in Egypt law limits (4≤ mg/l). However, that figure is close to the permissible levels. Higher values (7.63mg /l) for raw effluent has been previously reported (Mohabansi *et al*., 2011).

As for textile factory, BOD value (7.063 mg/l) was below the permissible levels (60 mg/l).However, higher BOD values were reported in other cases as for example Grag and Kaushik, (2008), and it was 1626mg/l.

TSS solids present in dissolved form in an effluent comprise TSS. It is important to monitor and regulate suspended solids in runoff and discharges because high TSS can adversely affect water quality in receiving water bodies. Less **TSS** values are reported for all samples from Dolphin factory reservoir, in the present investigation, values of TSS for different samples were ranged between 16 mg/l to 214 mg/l, while the permissible value is 60 mg/l.

TDS which corresponds to the effluent salinity was 2523.4 mg/l above the permissible value which is 2000mg/l. Similar findings have been reported by Desai and Kore (2011) (Desai and Kore 2011) and Paul *et al*., (2012) (Paul, Chavan et al. 2012)

Chloride is one of the major inorganic anions in waste water. Its presence in textile in textile effluents is mainly attributed to the presence of bleaching agents. High Chloride values are reported for all samples from Dolphin factory reservoir and ranged between 100 mg/l to 1360 mg/l, while the permissible value is 1 mg/l.

The amount average of sulphate record was varied values all samples collected and ranged between 52 mg/l to 550 mg/l, while the permissible value is 500 mg/l.

TVB is an important pollution indicator which reflects the biological activity. High TVB values are reported for all samples from Dolphin factory reservoir and ranged between 20000 mg/l to 4180000 mg/l, while the permissible value is 5000 mg/l.

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ARABIC SUMMARY

الخصائص الفيزيائيه والكيميائيه والاكتينوباكتيريه لمياه صرف صباغة النسيج بالمنطقة الصناعية ببورسعيد، مصر

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يهدف البحث الى معرفه نوعيه ماء الصرف الصناعي وامكانيه التخلص من المواد الصناعية الضارة بها باستخدام الاكتينوبكتريا ولتحقيق ذلك : تم اجراء دراسه على ماء الصرف الناتج من مصنع دولفين بالمنطقه الصناعيه ببورسعيد وتم الاستعانه بعدد 102عزله من الاكتينوبكتريا والتى سبق عزلها وتعريفها من ماء الصرف الصناعى بمدينه العاشر من رمضان.

أولا: تم عمل التحاليل (الفيزيائيه ,الكيميائيه,الميكروبيولوجيه)لماء الصرف الصناعى من مصنع دولفين بالمنطقه الصناعيه ببورسعيد حيث تم سحب عينات متتاليه على مدار اليوم لتحديد خصائص هذا الماء .فكانت متوسط تركيزاتهم كالتالي : الاس الهيدروجيني 8.6 والعكاره 140 ,الاكسجين الذائب 7.3 ملجم/لتر و COD 427.7 ملجم/لتر و BOD 7.3 ملجم/لتر والمواد الصلبة المعلقة 32 ملجم/لتر والمواد الصلبة الذائبة 584 ملجم/لتر و الكلوريدات 190.3 ملجم/لتر والسلفات 134.6 ملجم/لتر. ولوحظ إزدياد تركيزات المعدلات التى سبق ذكرها فى فترتين محددتين اثناء اليوم ترتبط كل فتره بورديه تشغيل داخل المصنع حيث تقوم كل ورديه فى بدايه التشغيل بإضافه مواد كيميائية تؤدى الى ارتفاع تركيزات المعدلات السابق ذكرها.

ثانيا: الخصائص الميكروبيولوجيه لماء الصرف الصناعى للمصنع : كان متوسط العد البكتيري $10^4 \times 27$ وحده مكونه للمستعمرة

ثالثا: قدره الاكتينوبكتريا على تحليل صبغه الازو Vilmafix® Blue RR-BB والتى يستخدمها المصنع: تم اختيار عدد102 عزله من الاكتينوبكتريا باستخدام الوسط الغذائى M56 وكذلك الوسط الغذائى M56 مضافا إليه الجلكوز لمعرفه قدرتها على تكسير وتحليل صبغه الازو Vilmafix® Blue RR-BB. وكانت العزلات المستخدمه من اجناس *Micromonospora* sp., *Streptomyces* sp., *Nocardiopsis* sp., *Nocardioides* sp., *Pseudonocardia* sp., *Nocardia* sp., *Kineospora* sp., *Planobispora* sp., *Kitasatosporia* sp. and *Actinomadura* sp.. بعض العزلات لم تبد اى قدره على تحليل الصبغه فى حين ان هناك بعض العزلات أظهرت قدرتها المتفاوته على تحليل وتكسير الصبغه وكانت من اجناس (*Nocardioides Streptomyces*).