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Sea Water Pollution in Ports and its Effect on Cargo Operation (Alex Harbor as Case of Study)

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Abstract

Water pollution in Egypt is major problem because it affects people health and on their productivity rate. Water pollution has many point and point sources such as acid rains, pesticides, agricultural waste, sewage and industrial water disposal. Alexandria city is one of the major cities in Egypt and it has one of its most important and largest ports which is Alexandria port. As a result of the water pollution Alexandria port suffer from its consequences and from its negative health effects. The negative side effects of water pollution on human health which decrease labors efforts in cargo operation processes, cargo operation processes can be represented in the form of cargo handling rate along the year. This research aimed in first place to correlate the relation between water pollution different items and cargo operation processes for particular period in form of charts and a group of recommendations which were stated at the end of the paper in order to give mythology to avoid such problem.

Keywords: *Water pollution, ports cargo operation, Alex harbor, Dekhila port.*

1. Introduction

the city is supplied with drinking water by many water treatment plants which are located along Mahmodia water canal, Mahmoudia water canal is major canal which is diverted directly from Nile river branch (Rosseta branch) as shown in fig(1).

Rosseta branch and Mahmodia water canal are suffering both from serious water pollution with many toxic elements. Pollution in its general meaning is the contamination of surrounding environment with elevated concentration of substances above standard levels and the contaminated environment could be air, water or soil.

There are two different types of water pollution sources which are:

1-Point sources such as industrial factories disposal, municipal treatment plants effluent, ships fuel leakage and boats waste.
2-Non point sources such as storm water which may contain soil particles, litter, fertilizers and pesticides, Also Houses septic system leakage to unconfined aquifer and then to sea may share in sea water pollution as indirect method.

Harbor aquatic life expose to contamination processes with different pollutants such as copper, selenium, nitrites and sulfate and that leads to changes in water ph Until 1998 there was no comprehension study for north coast water quality but recording campaigns each three month were held to take water sample in order to analyze it, These recording campaigns have been gone to and color. In the same time some of thiese pollutants are essential nutrients for fish feedings which effect on its health and on the health of people who will eat those infected fish. Industrial effluent, sewage disposal and agricultural pesticides are important sources of water pollution. Harbor water pollution leads to aquatic contiguous which result in sea food related diseases and epidemics.

FIG.1 Egypt map (Delta region)

different locations such Alex harbor and Dekhila harbor. Both water physical and chemical properties were detected such as dissolved oxygen (DO), total suspended solids (TSS), Total Coliform bacteria, Streptococci Bacteria, Phosphate phosphorusand (po4-p), chemical oxygen demand (COD) and biochemical oxygen demand (BOD). Egyptian environmental affairs [1].

These parameters were recorded according to their negative effects on human health and marine life as follow:

1) Dissolved oxygen (DO) is used for aquatic organism respiration processes, the required dissolved oxygen amount for each organism vary from one to another. Low rate of DO below the minimum level will cause fish to die and decreasing of its mortality, So if the dissolved oxygen is within the acceptable marginal fish population will be increased as other aquatic species and will contribute food supply for coastal urban area, fish meat is protein source for human muscles building.
2) Total suspended solids(organic and non-organic particles) in sea water cause water turbidity increasing and resist sun ray penetration in water, When sun ray in sea water is decreased aquatic plants photosynthesis as shown in fig(2) will be decreased and that will lead to its death which will affect on fish food sources. Also suspended solids in water absorb more heat which will cause water temperature to be increased and DO will be decreased as a result of that, But in the same time organic suspended solids could be a source of food to fish different species in conditioned to not valid from contaminated source such as sewage disposal. In other hand contaminated pollutants such pathogens and toxic metals cn be attached to suspended solids and cause unhealthy environment for aquatic marine organism.
3) Pathogens such as bacteria (Total Coliform bacteria, Streptococci Bacteria) existing in sea water is caused by untreated human sewage disposal, water contamination with bacterial pathogens (coli form organism) will cause sea foods to be infected with viruses such as gastro-enteritis and infectious hepatitis. viruses are capable of producing a wide variety of symptoms such as rashes, fever, gastroenteritis, meningitis, respiratory system disease, and hepatitis . In general, asymptomatic infections are widely spread as a result of that and the more serious manifestations are rare. Viruses symptoms such as Viral gastroenteritis, usually of with nausea, vomiting and diarrhea, take place in susceptible individuals of all human ages. It was noticed that in the very young or very old age dehydration and electrolyte imbalance can occur rapidly and threaten life if it is not treated without delay. Hepatitis in mild cases may require only rest and restricted activities for a period of time, but when the case is severe it may cause death at the end due to liver failure, Also chronic disease of the liver can take place and cause a lot of troubles for patient. Severe hepatitis is so serious for old ages and less responds for treatment. It is fact that beyond middle age fatality rate increases. FAQ, Fishery Harbor Manual on the Prevention of Pollution [2].

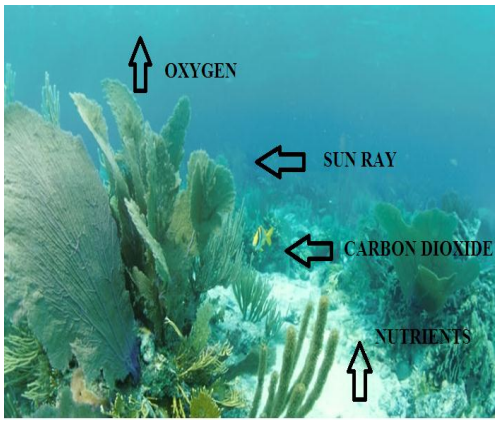

Fig.2 aquatic plant photosynthesis

4) Phosphate phosphorusand (po4-p) in sea water will increase the growth rate of phytoplankton and aquatic plants which is major food supply or aquatic organisms, also aquatic organisms population will be increased as a result of that.
5) Chemical oxygen demand (COD) is the required oxygen amount for chemical breakdown of organic matter to no organic matter. This will reduce the dissolved oxygen in water which is needed for aquatic organism life also it will reduce its population.
6) Biochemical oxygen demand (BOD) is the required oxygen quantity to be consumed by micro-organisms for organic matter oxidation processes, If the amount of BOD in water is increased it will reduce the dissolved oxygen which is needed by aquatic organisms to live, So low water BOD value indicates it good quality

1.1 Criteria and specifications for Water Quality Limit values as given by Law no.4 for Egypt (1994) In the marine environment

Without prejudice to the provisions of Law No. 48 of 1982 concerning the Protection of the River Nile and its Executive Regulations, the discharge of the substances indicated hereunder shall not exceed the levels indicated values in table(1). Environmental Law number 4 of 1994, EGYPT (1994) [3].

In all cases, discharge into the marine environment is not permitted except at a minimum distance of 500 meters from the shoreline and may not be effected in fishing zones, bathing zones or nature reserves in order to preserve the economic or aesthetic value of the area

There are also a lot of Egyptian legal regulation actions against any ship will be caught dumping any prohibited material or any toxic sewage inside marine area, That is also true for the Egyptian regional water.

Table 1 Ambient Water Quality Limit values as given by Law no.4 for Egypt (1994) compared to the World Health Organization (WHO) water quality guideline values. Environmental Law number 4 of 1994, EGYPT (1994) [3]

Pollutant Item	**Maximum limits of Criteria and Specifications (mg/Ltr-unless otherwise indicated.)**
Temperature	Not to exceed 10 degrees over the prevailing rate.
PH	6 - 9
Colour	Free of colouring materials
Biochemical Oxygen Demand (BOD)	60
Chemical Oxgyen Demand (COD)	100
Total Dissolved Solids	2000
Volatile Solids	1800
Suspended materials	60
Turbidity	NTU 50
Sulphides	1
Oil and Greases	15
Hydrocarbons of oil origin	0.5
Phosphates	5
Nitrates	40
Phenolates	1
Fluoride	1
Aluminium	3
Ammonia (nitrogen)	3
Mercury	0.005
Lead	0.5
Cadmium	0.05
Arsenic	0.05
Chromium	1
Copper	1.5
Nickel	0.1
Iron	1.5
Manganese	1
Zinc	5
Silver	0.1
Barium	2
Cobalt	2
Pesticides	0.2
Cyanide	0.1
Estimated Fecal Coliform Count in 100 cm3	5000

2. Alex harbor description

The City of Alexandria is located at the west end of the River Nile between the Mediterranean Sea and Mariot Lake. It is considered the second most important city and the main port in Egypt, it handles over three quarters of Egypt's foreign trade. Alexandria port consists of two harbors (East and west) separated by a T-shaped peninsula. The East harbor is shallow and is not used in navigation. The West harbor is used for commercial shipping. The harbor is formed by two converging breakwaters.

Alex Harbour as shown in Fig(3) is consists of two ports which are Alexandria Port and El-Dekheila Port, Alexandria Port.

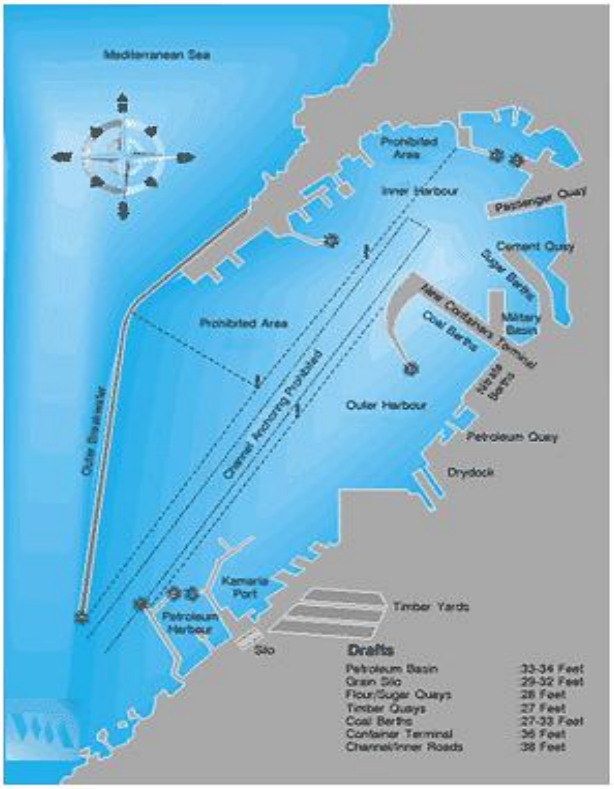

Fig. 3 Alexandia port map

water Surface is of 6.8 km^2 and its Land Surface is of 16 km^2 , It consists of 67 Berths of total length 10600 m. and its depths ranges from 8.5 - 16 m which cover hinter land of 1650000 m^2 including administrative buildings & stores.

El-Dekheila Port water Surface is of 2.74 km^2 and its Land Surface is of 3.5 km^2 , It consists of 14 Berths of total length 7200 m. and its depths ranges from 10 - 20 m which cover hinter land of 3500000 m^2 including administrative buildings & external area(Alexandria Port Authority web site)

Fig.4 Alexandia satellite port map

3. Port operation data

Port Traffic for example during 1/1/2014 to 30/6/2014, Ships and cargo traffic in Alexandria and El Dekhila ports 2014 can be shown from table (2) to table (3) and from fig (5) to fig (6). Alexandria Port Authority web site [4].

3.1 Types of Ships

Ports different types of ships passing through it can be shown from table (2).

Table2 Types of ships

Type of the ship	Arrival	The Ratio of arrival
Gen. Cargo ships without containers	599	26
Dry Bulk ships	343	15
Liquid Bulk ships	291	13
Container ships	793	34
Ferries	207	9
Cruises	1	0
Others	93	4
Total	2327	100

And this can be summarized in pie chart shape as shown in fig (3).

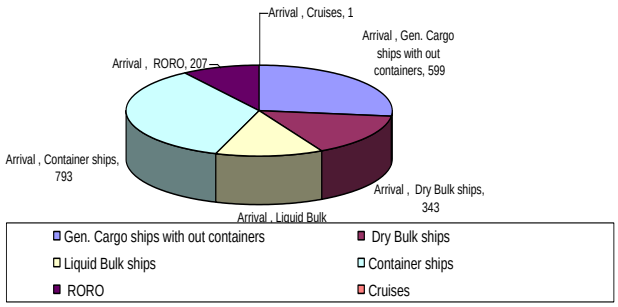

Fig.5 Ship types in Alex harbor during 1/1/2014 to 30/6/2014

3.2 Handled cargo

Handled cargo during 1/1/2014 to 30/6/2014 That can be shown in table (3) and in fig (5).

Table 3 Handled cargo during 1/1/2014 to 30/6/2014

Item	Imp.	Exp.	Total	Ratio of the total
Gen. Cargo	3262068	515012	3777080	13
Dry Bulk cargo	13648549	426689	12075238	43
Liquid Bulk cargo	3230750	1227887	4458637	16
Total of non containerized cargo	18141367	2169588	20310955	72
Non containerized general cargo	4617793	3153130	7771923	28
Total	22760160	5322718	28082878	100

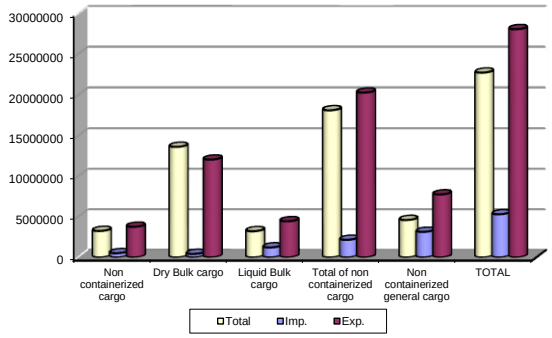

Fig.6 Handled cargo in Alex port

3.3 Containers Traffic

Handled containers in Alexandria and El Dekhila ports for example during 1/1/2014 to 30/6/2014 show in table (4) and in fig (7) (Alexandria Port Authority web site).

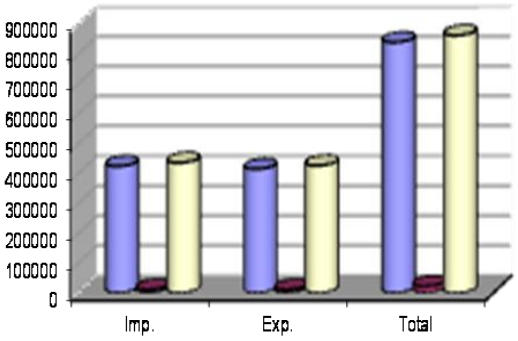

Fig.7 Containers Traffic in El Dekhila port

Table 4 Handled containers in Alexandria and El Dekhila ports during 1/1/2014 to 30/6/2014

Item	Imp.	Exp.	Total	Ratio of the Total %
Local	4488633	3025495	7514128	97
Transit	130160	127635	257795	3
Total	4618793	3153130	7771923	100

4. Egypt environmental authorities Mediterranean campaign

Egypt environmental affairs authorities started in 1994 in environmental monitoring program o record sea water data along Mediterranean Egyptian coast as shown in fig (8)

The data included many sea water parameters such as water dissolved oxygen (DO), a total Coliform bacteria, Streptococci Bacteria and a total suspended solids was recorded as shown in fig (9), (10), (11) and (12) respectively for July (2014) campaign as an example. EEAA, Egyptian environmental affairs, (2014) [5].

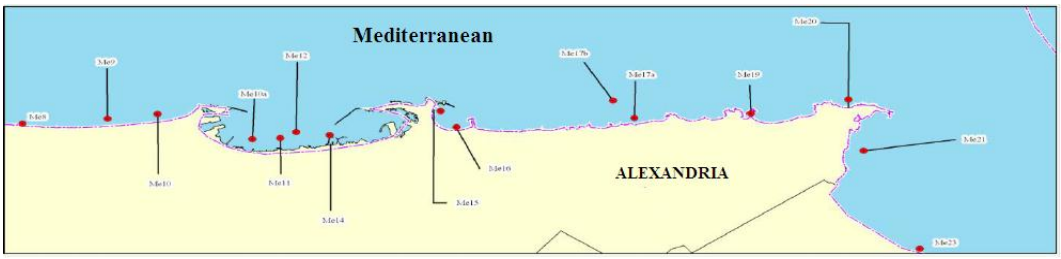

Fig.8 Nat (Alexandria different monitoring locations)

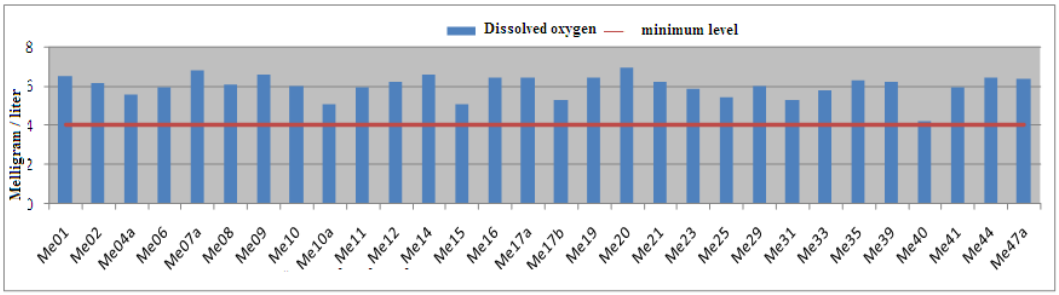

Fig.9 water dissolved oxygen (DO)

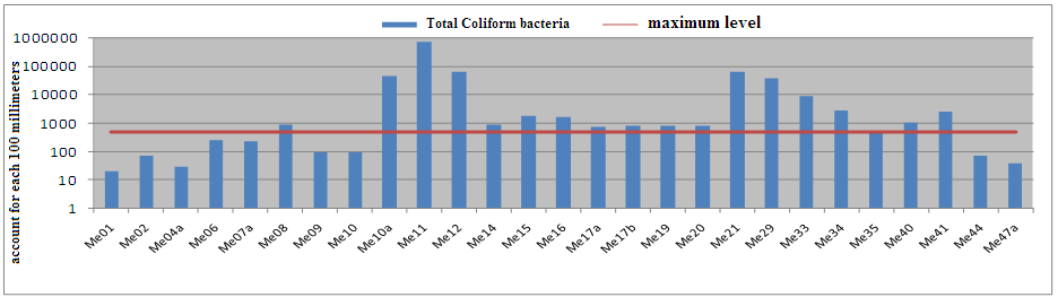

Fig.10 Total Coliform bacteria

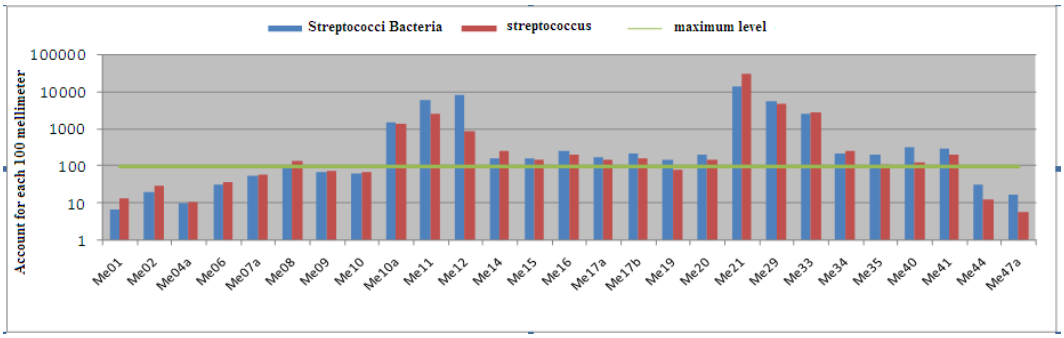

Fig.11 Streptococci Bacteria

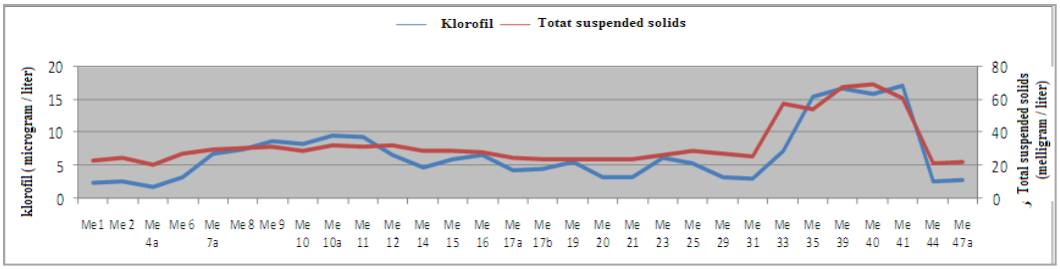

Fig.12 Total suspended solids

5. Relations between labor harbor efforts and water pollution

Relations between labor harbor efforts and water pollution elements during 1/1/2014 to 1/12/2014 can be shown from fig (13) to fig (26).

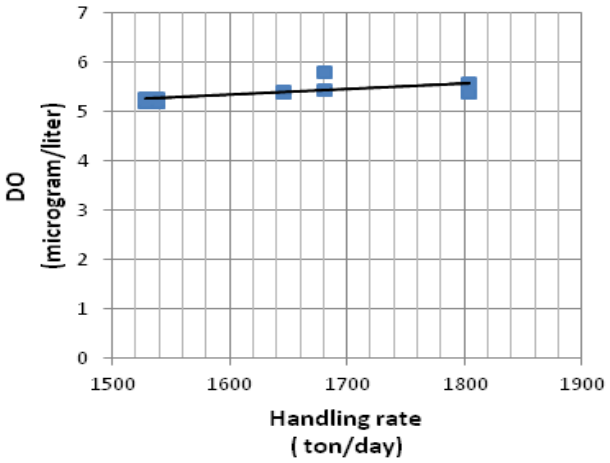

Fig.13 Relation between DO and daily handling rate in Alex port

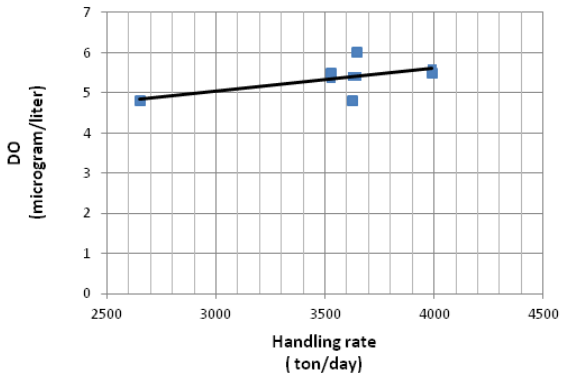

Fig.14 Relation between DO and daily handling rate in Dekhila port

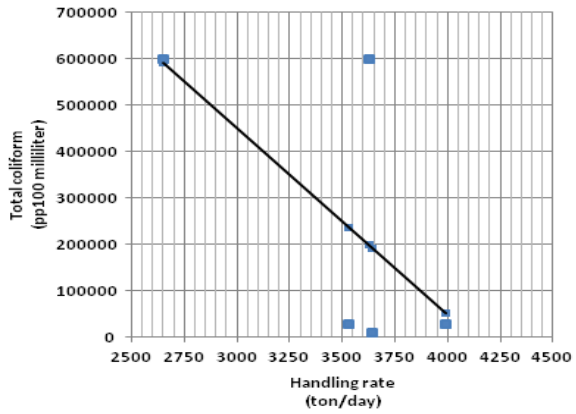

Fig.15 Relation between Total Coliform bacteria and daily handling rate in Alex port

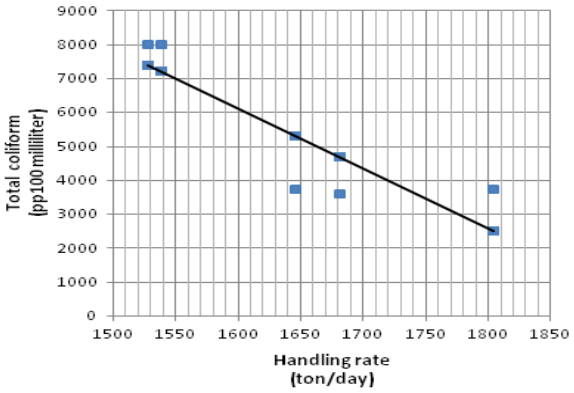

Fig.16 Relation between Total Coliform bacteria and daily handling rate in Dekhila port

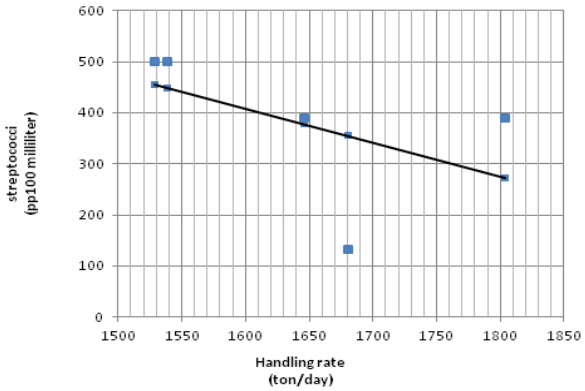

Fig.17 Relation between Streptococci Bacteria and daily handling rate in Alex port

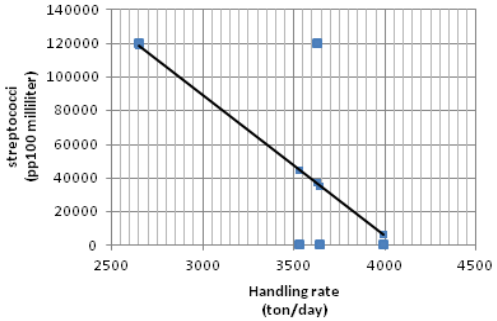

Fig.18 Relation between Streptococci Bacteria and daily handling rate in Dekhila port

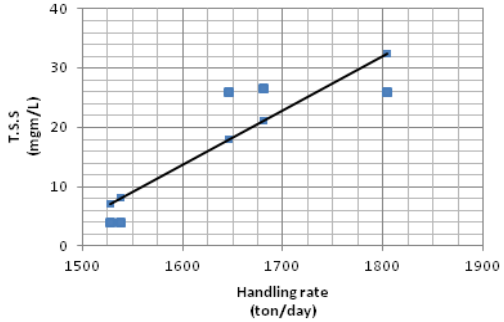

Fig.19 Relation between Total suspended solids and daily handling rate in Alex port

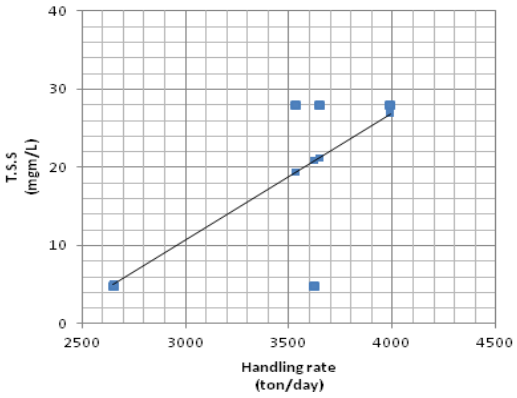

Fig.20 Relation between Total suspended solids and daily handling rate in Dekhila port

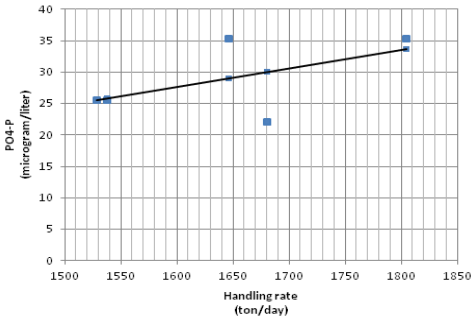

Fig.21 Relation between Phosphate phosphorusand (PO_4-P) daily handling rate in Alex port

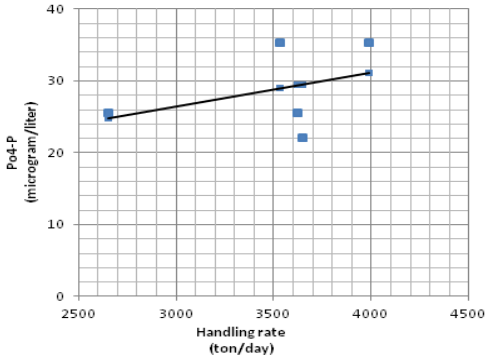

Fig.22 Relation between Phosphate phosphorus (PO_4-P) and daily handling rate in Dekhila port

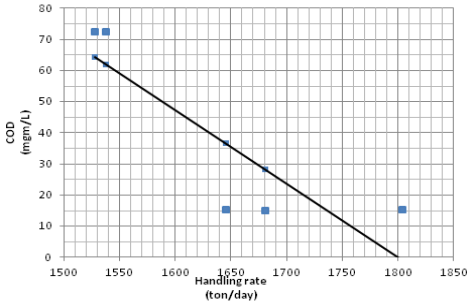

Fig.23 Relation between COD and daily handling rate in Alex port

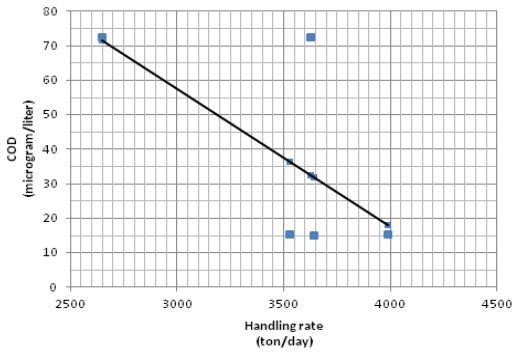

Fig.24 Relation between COD and daily handling rate in Dekhila port

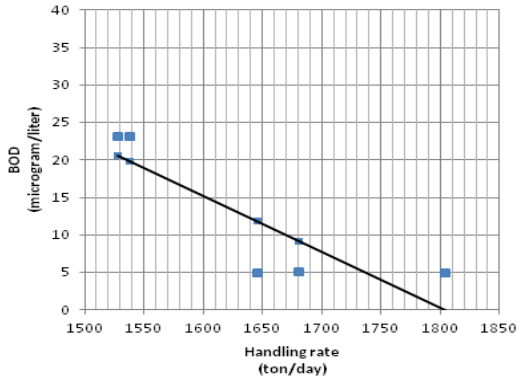

Fig.25 Relation between BOD and daily handling rate in Alex port

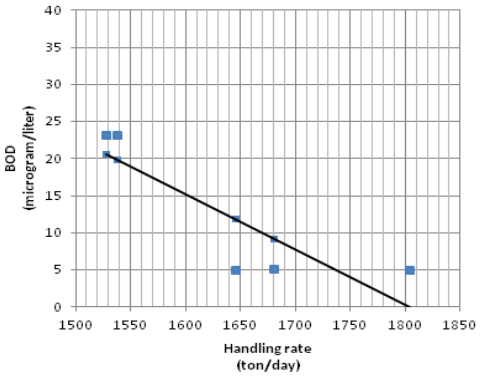

Fig.26 Relation between BOD and daily handling rate in Dekhila port

6. Results Analysis

1) As shown from fig (13) to fig (14) the rate of handling for both Alexandria and Dekhila harbor is increasing with the increasing of DO due the reason that the dissolved oxygen is within the acceptable marginal which will cause fish population to be increased as other aquatic species and will contribute food supply for coastal urban area, fish meat is protein source for human muscles building.
2) As shown from fig (15) to fig (18) the rate of handling for both Alexandria and Dekhila harbor is decreasing

with the increasing of both Total Coliform bacteria and Streptococci Bacteria due the fact that sea foods is infected with viruses, viruses are capable of producing a wide variety of syndromes, including rashes, fever, gastroenteritis, meningitis, respiratory disease which eventually effect on labor health.

3) As shown from fig (19) to fig (20) the rate of MP10 for both Alexandria and Dekhila harbor is increasing with the increasing of total suspended solids rate due the reason that organic suspended solids could be a source of food to fish different species in conditioned to not valid from contaminated source such as sewage disposal. But pathogens and toxic metals can be attached to total suspended solids and cause unhealthy environment for aquatic marine organism and that will be reflected on human health by negative impact after period of time which will reverse the relation between handling rate and total suspended solids.
4) As shown from fig (21) to fig (22) the rate of handling for both Alexandria and Dekhila harbor is increasing with the increasing of Phosphate phosphorus (PO_4-P) due the reason that Phosphorus (po4-p) in sea water will increase the growth rate of phytoplankton and aquatic plants which is major food supply or aquatic organisms, Also aquatic organisms population will be increased as a result of that.
5) As shown from fig (23) to fig (26) the rate of handling for both Alexandria and Dekhila harbor is decreasing with the increasing of both COD and BOD because both of them reduce the dissolved oxygen in water which is needed for aquatic organism life also it will reduce its population.

Conclusions

It was noticed that in both Alexandria port and Dekhila port the following facts:

1) The daily handling rate is increasing with the dissolved oxygen (DO) in sea water and that because the dissolved oxygen cause fish population to be increased which is a protein source for human muscles building.
2) Daily handling rate is decreased with the increasing of both Total Coliform bacteria and Streptococci Bacteria because that sea food is infected with viruses which effect by negative impact on labor health.
3) Daily handling rate is increasing with the increasing of Phosphate phosphorus (PO_4-P) due the reason that Phosphorus (po4-p) in sea water will increase the growth rate of phytoplankton and aquatic plants which is major food supply or aquatic organisms
4) Daily handling rate is decreased with the increasing of both COD and BOD because both of them reduce the dissolved oxygen in water which is needed for aquatic organism life.

Recommendations

1) Preventing the sewage treatment effluent or factories sewage disposal in sea water.
2) Constructing monitoring system inside both Alexandria port and Dekhila port to detect any water composition changes and to give recommendations to avoid such problem.
3) Establishing especial legislations and rules for ports to give more control of ship fuel leakage.
4) Activate the environmental Law no.4 for Egypt (1994) to control surrounding urban and industrial area emissions which contribute in ports water pollution.
5) Create strong medical insurance system in order to cover all labors in all port sectors to provide annual a comprehensive health examination which will give good a alert for any common Epidemiological phenomena.
6) A study of drinking water pollution effect on labor health and also on cargo handling operation inside Alexandria port.
7) A study of soil pollution effect on food chain and on labor health which will give significant reflect on cargo handling operation inside Alexandria port.

References

[1] EEAA, Egyptian environmental affairs Mediterranean water Quality campaign Reports, (2014).
[2] FAQ, Fishery Harbor Manual on the Prevention of Pollution, Chapter (1) Potential pollutants, their sources and their impacts, http://www.fao.org/docrep/X5624E/x5624e04.htm..
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[4] Alexandria Port Authority website-www.apa.gov.eg .
[5] Alexandria Port Authority – General Department of Information Center report-operation status report 2014.