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STUDY OF EFFECT OF SOME SURFACTANTS ON WATER QUALITY OF AL-HILLA RIVER, IRAQ

Saja Emad Latef and Atheer Saieb Naji AL-Azawey
Environmental pollution Department, College of Environmental Science, AL-Qasim Green University, Iraq

Abstract

This study has found that: water temperature values varied from 14-42 °C respectively, the total dissolved solid 733–900 mg / L, pH ranged between 7.03 - 8.3 with a reasonable ventilation as the dissolved oxygen values recorded varied monthly 4-12.1 mg / L. The study results Also showed that the surfactant (cyclopentasiloxane decamethyl, hexadecane acid methyl ester, cyclononosilxane octadecamethel, cyclic octamic sulfur, cycloheptasilxane tetradecamethyl, phathalic acid, benzoic acid,benzendicarboxylic acid, cyclotetrasilone octamethyl, thiocyanic acid, diethylphthalate, phenol, cyclodecasiloxanee icosamethyl, cyclohexasiloxanedodecamethyl). Concentrations of this surfactant of Al-hilla River showed seasonal variations during the study period and they are exceeding permissible limits for Iraqi standard.
Keywords: Surfactants, Al-Hilla, River

Introduction

A diverse group of chemicals consisting of a polar, water soluble head group and a nonpolar hydrocarbon tail group soluble in water (ying GG2006). Wetting agent detergent (surfactant) (such as soap powder, laundry soap, detergent, laundry paste, and laundry tablets), home improvement provides (such as detergent, floor cleaner, bathroom fine and clean appliances cleaning), and private toiletries (such as shampoo, shower gel, hand liquid and cleanser) (Yuan *et al.,* 2014). Large quantities of surfactants are being employed in households and business each day, and most find yourself distributed in several environmental compartments (soil, water, sediment). Quite 4.2 million tons of detergent merchandise and 1.2 million tonnes of chemical merchandise were used annually in Western Europe 10 years past (Tomislav2009). The main classification of surfactant is depending on the charge of hydrophilic part of there molecule: anionic,non-ioic and cationic compounds (Olkowska *et al*., 2011). Surfactant are draining into the river or the municipal sewage, than into waste water treatment plans. Surfactant types have different performance in the ecosystem (Lechuga *et al*., 2016).

Classification and application of surfactants

There are many kinds of surfactants, and they are classified by use, properties and chemical structure. The surfactant classification depends on water dissociation and the structure of hydrophilic group. According to the water-soluble, surfactants can be classified into ionic surfactants and nonionic surfactants. Ionic surfactants can be divided into anionic surfactants, cationic surfactants and amphoteric surfactant. Special features or new type surfactant is as special surfactant (WB Wang *et al*., 2003).

Anionic surfactants

The anionic surfactants are dissolved in water with generating the negatively charged surface active group, whose aqueous solution is neutral or alkaline (Schmitt, 2001). Hydrophilic groups according to the type of anionic surfactants can be divided into five peptide condensates: carboxylic acid salt type, sulfate salt type, sulfonate, phosphate ester and fatty acid salt type (Zhao, 2005). Anionic surfactants are the earliest development, the biggest production and the largest species in various types of surfactants. They can be widely used as detergents, foaming agents, emulsifiers, antistatic agents, dispersants and stabilizers in the family and chemical aspects of life.

Cationic surfactants

Cationic surfactants are dissolved in water with generating the surface activity positive ions (Yuan, 2014). They have good surface activity in an acidic medium and are likely to precipitate and lose activity in alkaline medium. Cationic surfactants are classified into open-chain cationic surfactants, heterocyclic group cationic surfactants and bonded intermediate connection cationic surfactants according to the chain structure. Cationic surfactants are widely used for sterilization, rust, corrosion, breaking, corrosion and mineral flotation.

Amphoteric surfactants

Amphoteric surfactants which take with both positive and negative ions can be divided into imidazoline, betaine, lecithin, and amino acid-type type according to the anion type (Wang, 2007). The toxicity of amphoteric surfactants is very low. It is gentle to the skin, and has good biodegradability. Amphoteric surfactants have wide application in the personal protective equipment such as shampoo, shower gel, cosmetics, etc. and also can be used in industrial softeners and antistatic agents.

Non-ionic surfactants

Nonionic surfactants did not ionize any form of ions in an aqueous solution, and a number of oxygen-containing groups form hydrophilic, achieving dissolution by hydrogen bonding with water (SH 1M *et al.*; 2008). Most of non-ionic surfactants are in liquid and slurry form, their solubility in water decrease with the increasing temperature. Non-ionic surfactants have different physicochemical properties from ionic surfactants due to their structural features. Hydrophilic groups are divided into four categories such as polyethylene glycol type, polyhydric alcohols, polyether type and glycosidic type (LI *et al.,* 2008). Non-ionic surfactants are widely used in the textile, paper, food, plastic, glass, fiber, medicines, pesticides, dyes and other industries. They are a lot better performance than ionic surfactants, the production is second to the anionic surfactants.

The Effects of surfactant:

Surfactants are widely employed in numerous field of the national economy, will continue to expand its scope of application and the consumption is also increasing. . In use, the waste water containing surfactants inevitably is discharged into water bodies, and cause serious dangerous damage on ecosystems (Yuan *et al.,* 2014).

The effect of surfactants on aquatic plants

The damage degree of surfactants to aquatic plants relate to the concentration. Once the content of surfactants is high within the water, it'll have an effect on the expansion of alga and alternative microorganisms in water, leading to decreased primary productivity of water bodies, thereby undermining the food chain of aquatic organisms in water bodies. The reason that surfactants inflicting acute poisoning will cause membrane permeability increase, so the substance exosmose and cell structure step by step disintegrate. The content of superoxide dismutase, catalase peroxidase activity and chlorophyll decrease (Liu *et al.,* 1997).

The accumulation of surfactants increase with time. From the chemical structure, the connection between the chemical structure of surfactants and the toxicity of water to aquatic organisms are often because of the following 3 points:

(1) Compared with non-ionic surfactants, the toxicity of anionic surfactants decreases.

(2) The lot of ethoxylate group, the lower toxicity of aquatic organisms.

(3) The greater hydrophobicity (HLB value is smaller) of surfactants, the greater the aquatic toxicity (Chen *et al.,* 2001).

The effect of surfactants on aquatic animals

A particular toxicity of surfactant can pass into the animal through animal feeding and skin penetration means. Once the wetter concentration in water is too high, surfactants will enter the gills, blood, kidney, pancreas gall bladder and liver, and manufacture aquatic toxicity effect (Yuan *et al.,* 2013).

Fish is very easy to absorb surfactants by the body surface and gills, and with the blood circulation they distribute to body tissues and organs. When the fish expose to the surfactants, serum transaminases and alkaline acid phosphate activity increase, it indicates that fish produce inhibition to various enzymes in the human body this reducing the body's immunity. The toxicity of surfactants on bacteria and algae can expressed in ECO50, which means the suppression degree of surfactants on the movement of aquatic bacteria and algae with in 24 hours (Zhang *et al.,* 2008).

The effects of surfactants on the water environment

Surfactants-containing waste water discharged into the surroundings will cause pollution issues. Once the concentration of the surfactant to 0.1mg/L, the water may appear persistent foams. A lot of bubbles aren't straightforward to disappear within the water, forming foam insulating layer. The insulating layer weakens exchange between the water body and gas atmosphere, resulting in reduction of dissolved oxygen. A large variety of micro-organisms are dead due to hypoxia, resulting in deterioration of water bodies. Below the critical micelle concentration (CMC), with the rise of surfactants concentration, and physical phenomenon decrease apace. Once the surfactant concentration exceeds CMC within the water column, it will increase the concentration of insoluble or soluble-water pollutants within the water. They take substances which have no original adsorption energy into adsorption layer material; this solubilization behavior can lead to indirect pollution and change the properties of water (Michael *et al.,* 1991).

Surfactants can even kill microorganisms in the environment and inhibit the degradation of alternative toxic substances. Since most detergents contain massive am ounts of poly phosphate as net agent, the waste contains massive amounts of phosphorus that may simply result in eutrophication. In waste treatment of plant waste, once the concentration of surfactants exceeds a particular concentration, it will have an effect on aeration, deposit, sludge nitrification and lots of different processes and increase the problem of waste matter treatment. Surfactants promote emulsification and dispersion in water-insoluble oil and poly-chlorinated organics, reducing the potency of waste material treatment (Yuan, 2014).

The effects of surfactants on the human body:

The effects of surfactants on the human body divided into effects on the skin and into the body. The main ingredients of modern life detergents surfactants, long- term use cause skin irritation effect and lead to some degree of harm. Once the surfactants enter into the human body, they damage the enzyme activity and so disrupt the body's normal physiological function. Surfactants have some toxicity and may accumulate within the human body, thus it's difficult to degrade (Stepanents *et al.,* 2001). In general, nonionic surfactants aren't electrically charged, not combined with protein. They have minimal irritation to the skin. The toxicity of cationic surfactants is the biggest, and also the toxicity of anionic surfactants is between that of nonionic surfactants and cationic surfactants. There have the reports that SDBS (sodium dodecyl benzene sulfonate) is absorbed through the skin, they damage to the liver and cause narrowing and alternative chronic symptoms, in addition as agent and carcinogenic (Lewis, 1990).

Material and Methods

Study area

Al-Hilla River or Shat Al-Hilla, one of the most famous rivers in Iraq and the most important in terms of water resources length of more than 101 km^2, the Euphrates River is the main source of it where the river originates from the northern border of the province of Babylon to the province of Diwaniyah, the river is used for agriculture and drinking as well as a tourist attraction. But in recent years the river has been neglected and heavily polluted by waste leading to disease and cancer.

Procedure:

Add 15 mL of hexane to 100 ml of sample and shaker for 30 minutes and then process the extraction or separation by separation fennel for the purpose of separating the aqueous phase from the organic phase. This process is repeated more than once for obtaining more accurate results and better quantity of organic matter with a concentration change Hexane to 10 mL and shaker to 10 minutes and takes this sample to testing on Gc/mss (Srinivasarao Chitikela 1995).

Result and Discussion

The study results showed that the surfactant in all sites along river (cyclopentasiloxane decamethyl, hexadecane acid methyl ester ,cyclononosilxane octadecamethel, cyclic octamic sulfur, cycloheptasilxane tetradecamethyl,phathalic acid, benzoic acid, benzendicarboxylic acid, cyclotetrasilone octamethyl, thiocyanic acid, diethyl phthalate, phenol, cyclodecasiloxanee icosamethyl, cyclohexasiloxanedodecamethyl) all these surfactant used in(laundry detergent , pesticides, medical products) because of some station is near of agriculture area used a lot of pesticides and near medical clinics also used cleaning product with out treatment of these product but draining directly to the river and absent the treatment of waste water lead to accumulate these surfactant in the river.

Cyclopentasiloxane decametheyl:

Is widely used in cosmetic products due to its unique functions as antistatic, emollient, humectant, solvent, viscosity controlling and hair conditioning agent and have low surface tension which allow to spread rapidly on skin and hair its hydrophobicity its volatility and its stability note the LSD Value in station1 between two months in Jul 7. and Feb2 0,00013M because of this station considered as agricultural area and a lot of pesticide used and in station 2 a pair of in Nov and Feb. In a similar rates owing to this space is found close to casinos and Olympic pool and also the hospital all of them use cleanup and cosmetic products.

Hexadecanoic acid methyl group:

This compound used manufacture soaps, cosmetic, and industrial mould. This compound seem only in station1 in July 7 owing to this station close to agriculture

cyclononasiloxne octadecamethyl:

This compound was appear in all station in station 1 appear in (Aug, Jan, Feb, March) station 2 (Aug, Nov, Jan, Feb, March) station 3 (Dec, Jan) station 4 (Dec) in station 5 (Oct, Dec, Jan, Feb, March) as a result of this compound wide utilized in cleanup laundry product and in several industrial material. In station one the LSD 0.00026 M.

cyclic octa-atomic sulfur:

Is granulated to affine powder to be used as a pesticide(control for mites, insect, fungi and rodent) this compound is found solely in station one in Aug month because of this station is near of agriculture area and used a great deal of pesticides.

Cycloheptasiloxne tetradec-amethyl:

It is found altogether station like in S1(Oct) S2 (Aug,Feb) S3(Aug, Jan, Feb) S4(Aug, Oct, March) S5(Feb) because of this compound utilized in cosmetic product and this surfactant enter in many structure of fertilizer and the station 1 is near to the agriculture area also using a lot of pesticides and fertilizers and transfer to the river by irrigation of land and this compound found in leaf of some medical plant.

Phthalic acid:

Are being employed widely for the production of perfume, cosmetics, hairsprays and another personal/cosmetic uses. This compound was found in four station s1(Nov) s2(July) s3(March) s4(Jan) because to phthalates enter within the production of the many cleansing product and also the exposure to the this product will pain in the skin irritant and secretion membranes of human.

Benzoic acid

used in cosmetic product and in cleansing product such as soaps and laundry and industrial plastics this compound found in station1 (Dec) and in station2 (Dec) and located another compound similar in structure ((benzendicaboxylic acid diissootyl ester)) this compound found solely in station3 in(11m) attributable to throwing industrial waste directly to the river.

cyclotetrasiloxne, octamethyl:

Found in several station like S1(Jan, Feb, March) S2 (Feb) S3 (Oct, Nov) S4 (Feb) S5 (Jan) is high spread attributable to this surface-active agent persistent in air and have the potential to be transported over long distance within the atmosphere.

Thiocyanic acid

This compound found in only station1 in (Jan) as a result of this station being near to the bedonnes once generation large quantity of resulting in hypothyroidism.

Diethyl phthalate:

found only in station 2 (July, March) because of this station is extremely near to casino and also the toxicity of phthalates Little is thought concerning the chronic toxicity of diethyl phthalate, however existing information suggests only low toxic potential

Phenol:

It is found in only station3 in (Oct) attributable to this station is extremely close to clinics and the use of this acid is wide to sterilization.

cyclohexasiloane, dodecamethyl

is additionally found in paints, lacquers, varnishes, and surface treatments. it's can jointly utilized in the assembly of bound food products this compound is found in 3 station (S3 (Nov, Feb) (S4 (Nov, Feb)) S2 (Aug)) as a result of the over loaded waste product throw away to the watercourse and absent health management.

cyclodecasiloxne, eicosamethyl:

This compound uses in cleansing and private product, and this surface-active agent found solely in station 5 in (July, Aug) attributable to this space. Because of this station lie near of agriculture land also using fertilizer and pesticide that added of area and transfer to the river by irrigation and dusty storms.

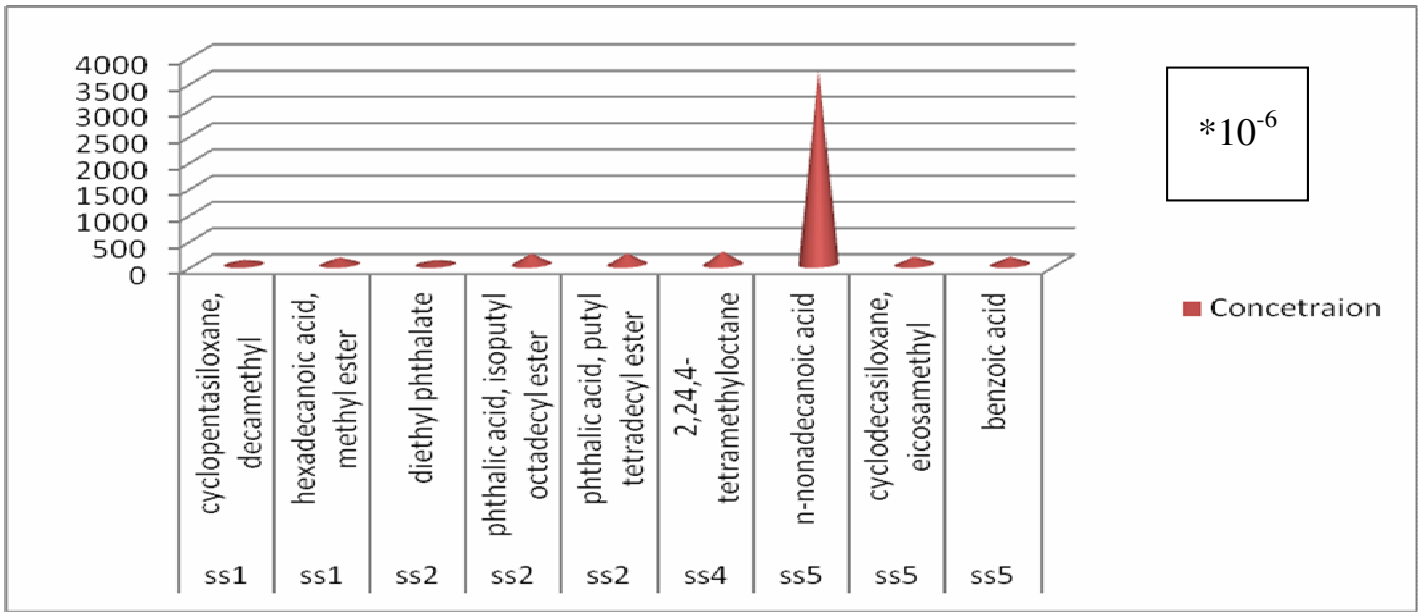

Fig. 1 : Surfactant concentration in different station in august

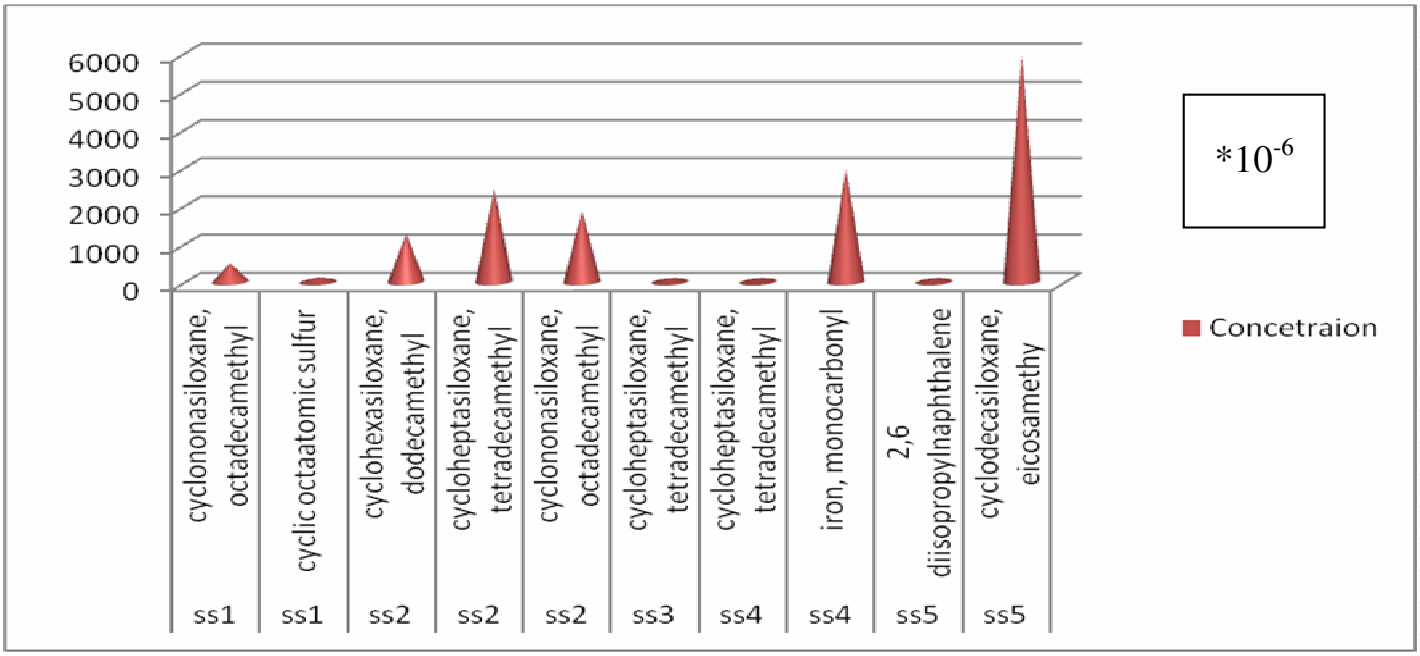

Fig. 2 : Surfactant concentration in different station in September

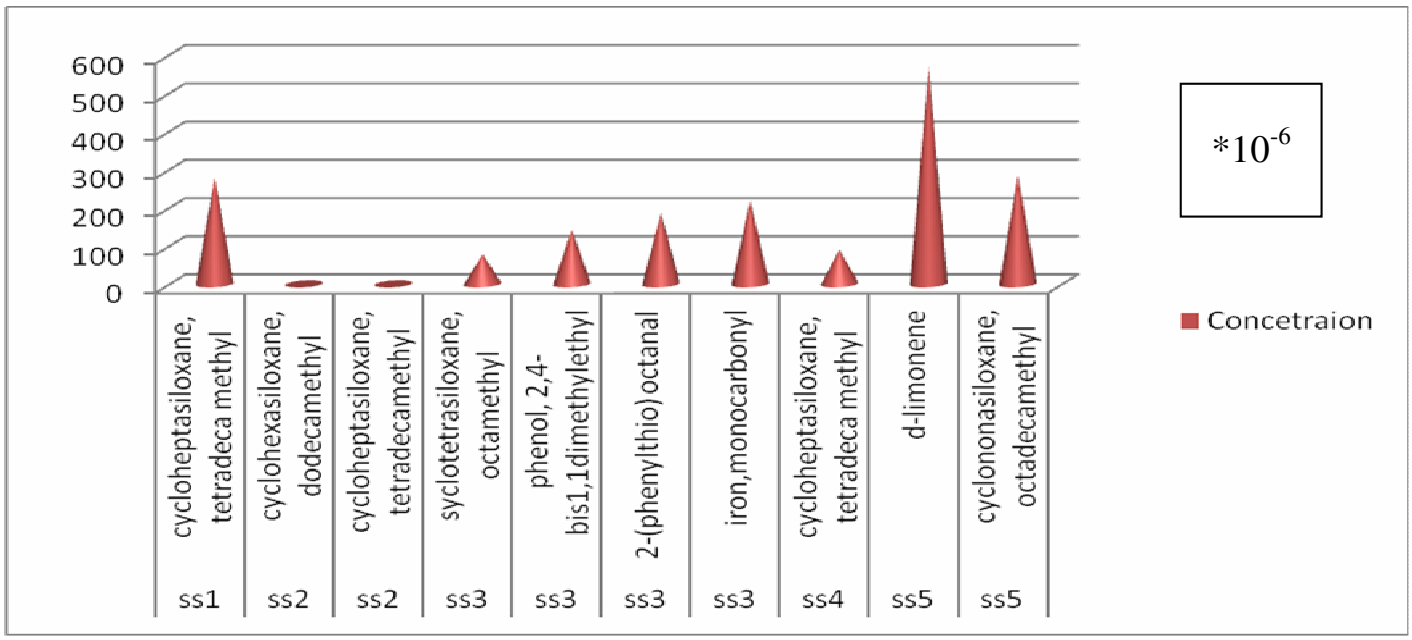

Fig. 3 : Surfactant concentration in different station in October

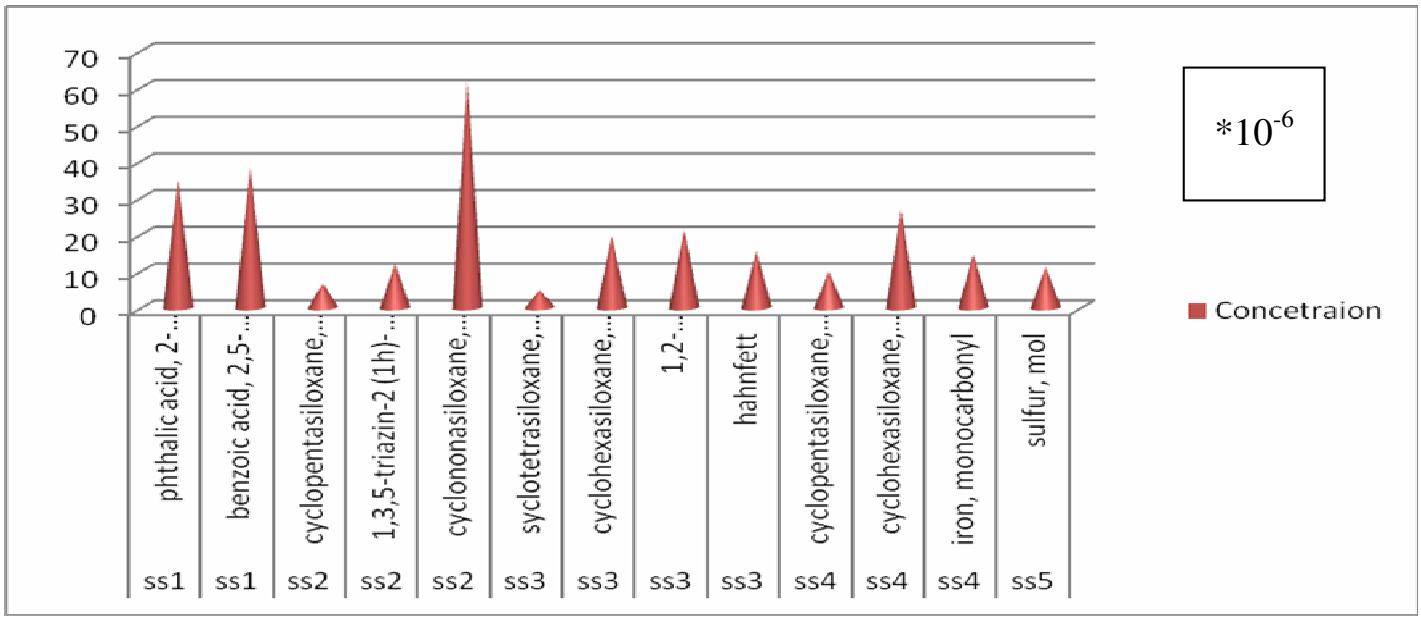

Fig. 4 : Surfactant concentration in different station in November

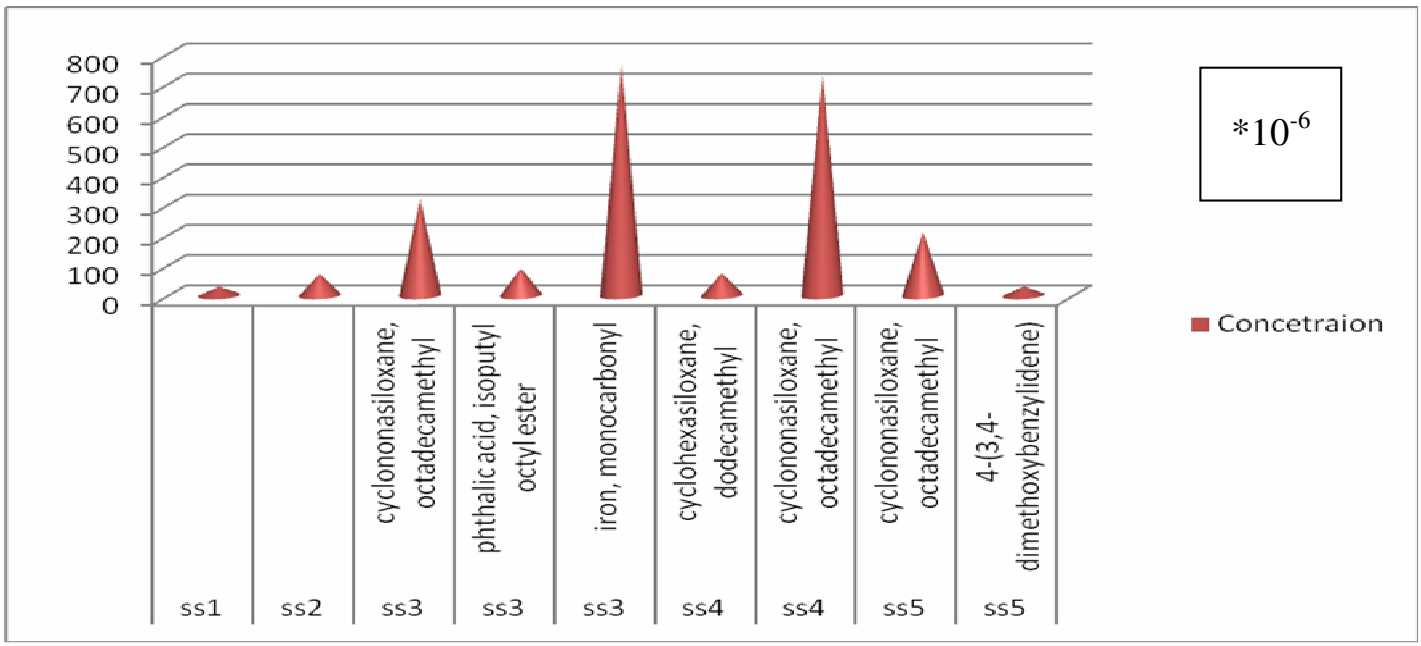

Fig. 5 : Surfactant concentration in different station in December

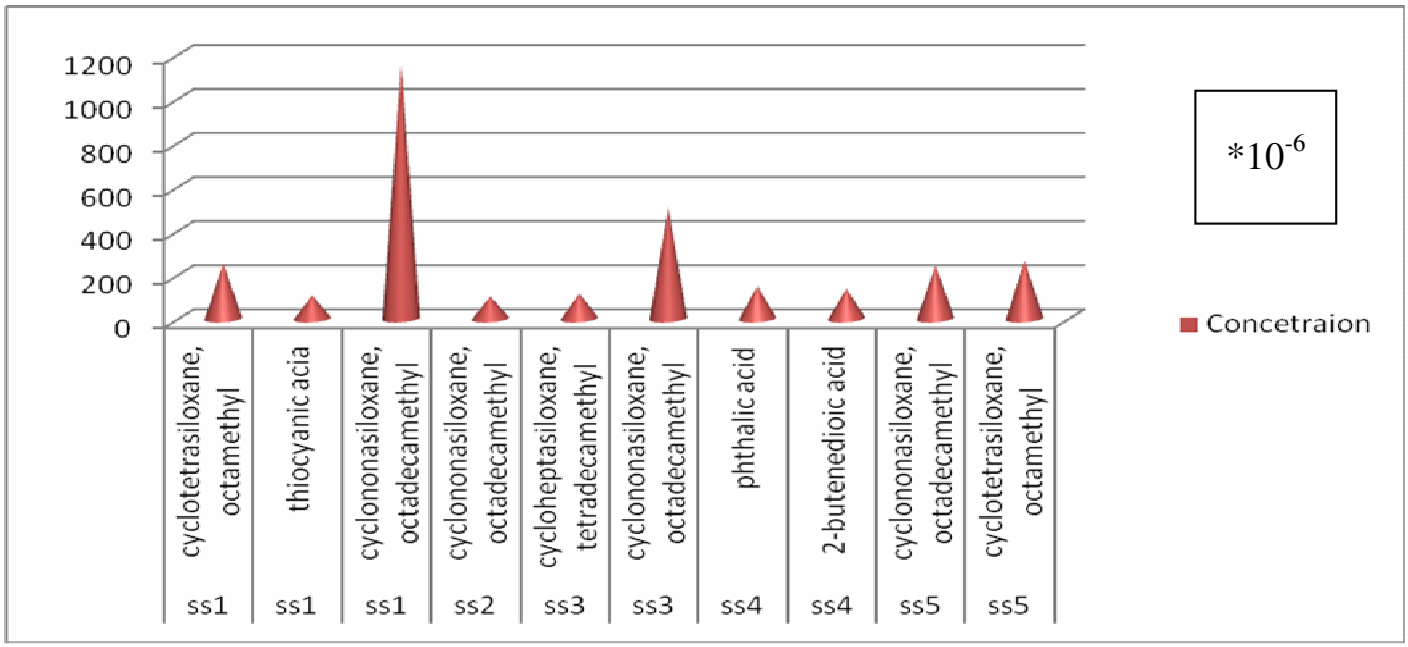

Fig. 6 : Surfactant concentration in different station in January

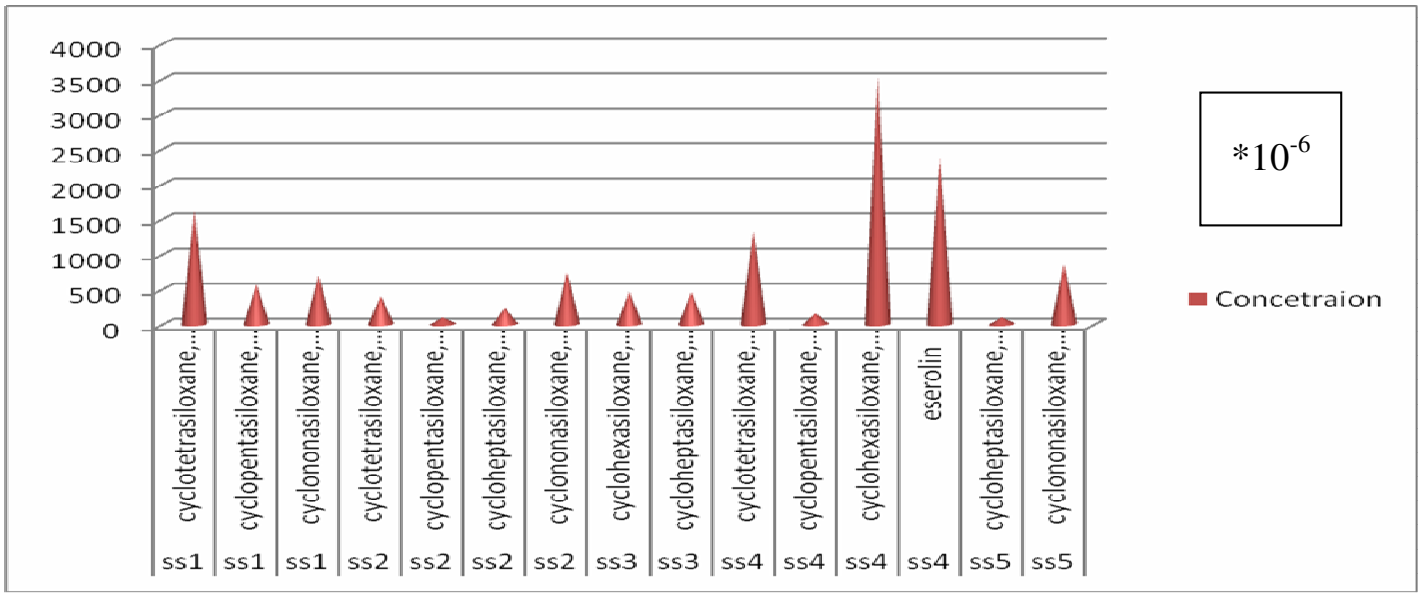

Fig. 7 : Surfactant concentration in different station in February

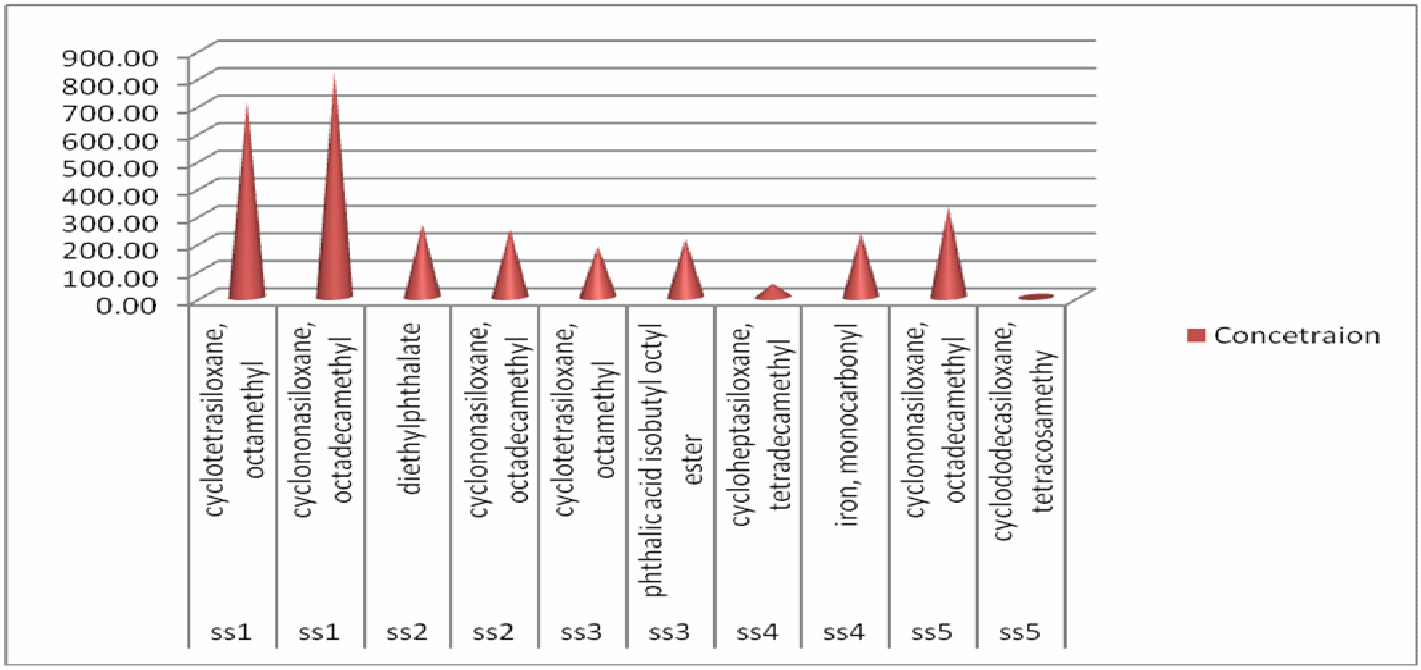

Fig. 8 : Surfactant concentration in different station in March

Conclusions

- It seems clearly AL-Hilla river was contamination by domestic and waste water.
- Increasing level of surfactant in AL-Hilla river where exceed the permissible limit.
- The high pollution levels were high at the center of city and the adopted measure to control is weak and almost non-existent.
- The seasonally study is more effective than monthly study where changes is in physical and chemical properties of water appear clearly throng the seasons of the year .
- The station four is most polluted site because of the site of her station in the mid of city and river and near of vegetable market and medical clinic.

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