Wastewater treatment with UV after chemical Treatment

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Abstract: Preminerly treatments were done using chemical additives (Chlorine, Hydrogen Peroxide, Dish cleaning liquid , Zahi and Dettol) with different concentration to wastewater then were tested. The best results of the treated wastewater had been chosen then treated by UV.

Introduction

Wastewater, which makes it an urgent imperative to develop effective and affordable technologies for wastewater treatment, which is any water that has been adversely affected in quality by anthropogenic influence. Wastewater can originate from a combination of domestic, industrial, commercial or agricultural activities, surface runoff or stormwater , and from sewer inflow or infiltration.

Population explosion, expansion of urban areas increased adverse impacts on water resources, particularly in regions in which natural resources are still limited. Currently, water use and reuse has become a major concern. Population growth leads to significant increases in default volumes of waste water, which makes it an urgent imperative to develop effective and affordable technologies for wastewater treatment.

Theory:

Water resources management exercises ever more pressing demands on wastewatertreatment technologies to reduce industrial negative impact on natural water sources. Thus,the new regulations and emission limits are imposed and industrial activities are required toseek new methods and technologies capable of

effective removal of heavy metal pollutionloads and reduction of wastewater volume, closing the water cycle, or by reusing andrecycling water waste.[1]

Sewage is a type of wastewater that comprises domestic wastewater and is therefore contaminated with feces or urine from people's toilets, but the term sewage is also used to mean any type of wastewater. Sewerage is physical infrastructure, including pipes , pumps, screens, channels etc. used to convey sewage from its origin to the point of eventual treatment or disposal.

Human exposure to wastewater dischargedinto the environment has increasedwithin the past 15 to 20 years with the risein population and the greater demand forwater resources for recreation and otherpurposes. The organisms of concern indomestic wastewater include entericbacteria, viruses, and protozoan cysts. Somecommon microorganisms found in domesticwastewater and the diseases associated withthem are presented in Table (1).[2]

[1]WasteWater Treatment Methods

Adina Elena Segneanu, Cristina Orbeci, Carmen Lazau, Paula Sfirloaga, Paulina Vlazan, Cornelia Bandas and Ioan Grozescu. Additional information is available at the end of the chapter, http://dx.doi.org/10.5772/53755

[2]Ultra Violet Disinfection, *Project funded by the U.S. Environmental Protection Agency under Assistance Agreement No. CX824652*

Table 1: Infectious Agents Potentially Present in Untreated Domestic Wastewater

Organism	*Disease Caused*
Bacteria	
Escherichia coli (enterotoxigenic)	Gastroenteritis
Leptospira (spp.)	Leptospirosis
Salmonella typhi	Typhoid fever
Salmonella (≈2,100 serotypes)	Salmonellosis
Shigella (4 spp.)	Shigellosis (bacillary dysentery)
Vibrio cholerae	Cholera
Protozoa	
Balantidium coli	Balantidiasis
Cryptosporidium parvum	Cryptosporidiosis
Entamoeba histolytica	Amebiasis (amoebic dysentery)
Giardia lamblia	Giardiasis
Helminths	
Ascaris lumbricoides	Ascariasis
T. solium	Taeniasis
Trichuris trichiura	Trichuriasis
Viruses	
Enteroviruses (72 types, e.g., polio, echo, and coxsackie viruses)	Gastroenteritis, heart anomalies, meningitis
Hepatitis A virus	Infectious hepatitis
Norwalk agent	Gastroenteritis
Rotavirus	Gastroenteritis

Adapted from: Crites and Tchobanoglous (1998) with permission fromThe McGraw-Hill Companies.[10]

Wastewater treatment is a process to convert wastewater-which is water no longer needed or suitable for its most recent use – into an effluent that can be either returned to the water cycle with minimal environmental issues or reused .the latter is called water reclamation and implies avoidance of disposal by use of treated wastewater effluent for various purposes. treatment means removing impurities from water being treated ; and some methods of treatment are applicable to both water and wastewater. The physical infrastructure used for wastewater treatment is called a "wastewater treatment plant"(WWTP).

The treatment wastewater belongs to the overarching field of public Works – Environmental, with the management of human waste, solid waste, sewage treatment, storm water (drainage) management, and water treatment.

By-products from wastewater treatment plant, such as screenings, grit and sewage sludge may also be treated in a wastewater treatment plant. If the wastewater is predominantly from municipal sources (households and small industries) it is called sewage and its treatment called sewage treatment.

Municipal wastewater (also called sewage) is usually conveyed in a combined sewer or sanitary sewer ,and treated at a wastewater treatment plant . Treated wastewater is discharged into receiving water via an effluent pipe .wastewater generated in areas without access to centralized sewer systems rely on on-site wastewater systems.

These typically comprise a septic tank, drain field, and optionally an on-site treatment unit. The management of wastewater belongs to the overarching term sanitation , just like the management of human excreta , solid waste and storm water (drainage).

Sewage is a type of wastewater that comprises domestic wastewater and is therefore contaminated with feces or urine from people's toilets, but the term sewage is also used to mean any type of wastewater. Sewerage is physical

infrastructure, including pipes , pumps, screens, channels etc. used to convey sewage from its origin to the point of eventual treatment or disposal.[3]

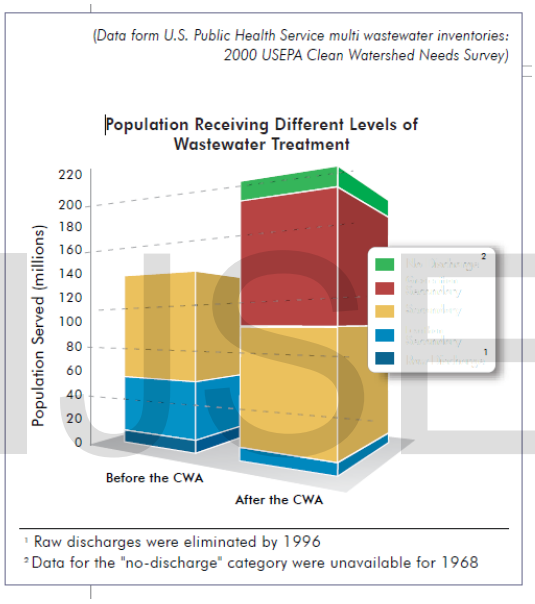
Wastewater treatment is a process to convert wastewater-which is water no longer needed or suitable for its most recent use – into an effluent that can be either returned to the water cycle with minimal environmental issues or reused .the latter is called water reclamation and implies avoidance of disposal by use of treated wastewater effluent for various purposes. treatment means removing impurities from water being treated ; and some methods of treatment are applicable to both water and wastewater. The physical infrastructure used for wastewater treatment is called a "wastewater treatment plant"(WWTP).

Numerous disinfection units are available for wastewater treatment applications, including chlorination, ultraviolet (UV) light, and ozonation systems. However, the use of disinfection for onsite and small wastewater treatment systems has not been practiced commonly because, in part, it was perceived that land disposal of small wastewater flows would not significantly effect groundwater. Unfortunately, it

[3]WHO(2006).WHO Guidelines for the safe use of wastewater, Excreta and Grey water-volume IV: Excreta and grey water use in agriculture. World Health organization (WHO),Geneva, Switzerland.

has been determined that conventional onsite treatment systems do have the potential to impact groundwater[4].

The most common formof pollution control in theUnited States consists ofa system of sewers andwastewater treatment plants.The sewers collect municipalwastewater from homes,businesses, and industriesand deliver it to facilitiesfor treatment before it isdischarged to water bodiesor land, or reused[5].



[4] *Evaluation of Disinfection Units for Onsite Wastewater Treatment Systems* Center for Environmental and Water Resources Engineering Prepared by Department of Civil and Environmental Engineering Harold Leverenz
University of California, Davis Jeannie Darby , Davis, CA George Tchobanoglous , Report No. 2006-1 January 2006

[5] Primer for MunicipalWastewater TreatmentSystems , Environmental ProtectionAgencyUnited States
Office of WaterOffice of Wastewater ManagementWashington DC 20460, EPA 832-R-04-001, September 2004

Wastewater treatment method

Physical: Sedimentation (clarification). -Screening. -Aeration. -Flotation and skimming. -Degassification. -Equalization.

Chemical:-Chlorination. -Ozonation. -Neutralization. -Coagulation. -Adsorption.-Ion Exchange.

Biological:Aerobic:

-Activated sludge treatmentmethods. -Trickling filtaration. -Oxidation pond. -Lagoons. -Aerobic digestion.

Anaerobic:-Anaerobic digestion. -Septic tanks. -Lagoons.

Physical Methods:

Physical methods include processes where no gross chemical or biological change are carried out and strictly physical phenomena are used to improve or treat the wastewater. Example would be coarse screening to remove larger entrained objects and sedimentation (or clarification).

Chemical methods

consists of using some chemical reaction or reactions to improve the water quality. Probably the most commonly used chemical process is chlorination. Chlorine, a strong oxidizing chemical, is used to kill bacteria and to slow down the rate of decomposition of the wastewater. Bacterial kill is achieved when vital biological processes are affected by the chlorine. Another strong oxidizing agent that has also been used as an oxidizing disinfectant is ozone.

A chemical process commonly used in many industrial wastewater treatment operations is neutralization. Neutralization consists of the addition of acid or base to adjust pH levels back to neutrality. Since lime is a base it is sometimes used in the neutralization of acid wastes.

Certain processes may actually be physical and chemical in nature. The use of activated carbon to "adsorb" or remove organics, for example, involves both chemical and physical processes. Processes such as ion exchange, which involves exchanging certain ions for others, are not used to any great extent in wastewater treatment[6].

Biological methods:

[6] *Wastewater Management Systems.* The McGraw-HillCompanies. New York, New York.Darby, J.; M. Heath; J. Jacangelo; F. Loge; P. Swaim; andG. Tchobanoglous. 1995. *Comparison of UV Irradiation toChlorination: Guidance for Achieving Optimal UV Performance.*

Use microorganisms, mostly bacteria, in the biochemical decomposition of wastewaters to stable end products. More microorganisms, or sludges, are formed and a portion of the waste is converted to carbon dioxide, water and other end products. Generally, biological treatment methods can be divided into aerobic and anaerobic methods, based on availability of dissolved oxygen.

The purpose of wastewater treatment is generally to remove from the wastewater enough solids to permit the remainder to be discharged to a receiving water without interfering with its best or proper use. The solids which are removed are primarily organic but may also include inorganic solids. Treatment must also be provided for the solids and liquids which are removed as sludge. Finally, treatment to control odors, to retard biological activity, or destroy pathogenic organisms may also be needed[7].

Ultraviolet (UV) rays:

Invisible solar radiation that lies just beyond the violet end of the visible spectrum in the wavelength range from 10 to 400 nanometers (just below the x-ray range) and can harm living tissue. Much of the UV radiation is absorbed by the ozone molecules in the upper atmosphere (stratosphere), but a potentially

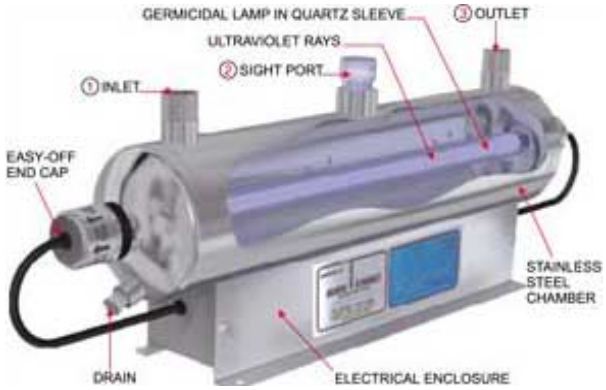
[7] *Engineering & Management.* vol. 137. no. 12. pp. 15–18.Fahey, R. J. Dec. 1990. "The UV Effect on Wastewater." *Water*Kwan, A.; J. Archer; F. Soroushian; A. Mohammed; andG. Tchobanoglous. March 17–20, 1996. "Factors for

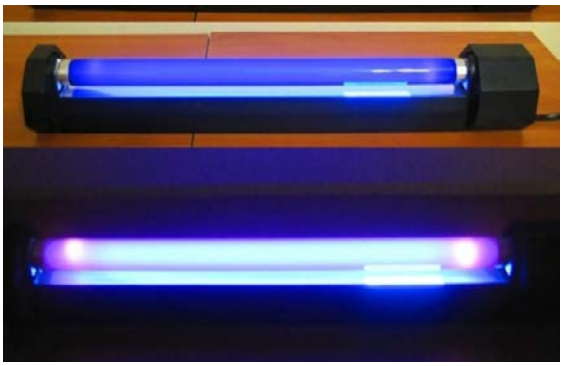
dangerous amount passes through the ozone hole to cause cataracts, skin cancer (melanoma), suppression of the immune system, leaf damage, and reduced yields in some crops. UV rays are generated also during electric (arc) welding.

2.3.1. Advantages and disadvantages of UV or ultraviolet light

The disadvantage are that it can cause skin cancer if you are exposed to sufficient amounts of UV light (in particular, UV-B and UV-C light). See the Related Questions link to the left of this answer for more information about that: "How do UV-B rays affect people?" One of the beneficial uses of UV light are that it can be used to kill bacteria and other microbes. It is commonly used to purify water for instance or clean things. UV light can also be used for a variety of other of application, such as black lights (which just look cool!). Also many compounds fluoresce (they emit light) when exposed to UV light. This is how forensic scientists can find traces of blood and other bodily fluids at crime scenes for instance. Finally exposure to some UV-B light causes the body to make Vitamin D, an important nutrient. While some exposure is important too much will cause sunburns and possibly cancer[8].

[8]Ultra Violet Disinfection methods, *Project funded by the U.S. Environmental Protection Agency under Assistance Agreement No. CX824652*





Fig(2): Schematic designe of UV System **Fig. (3) UV radiation**

Advantages

• UV disinfection is effective at inactivating most viruses, spores, and UV disinfection is a physical process rather than a chemical disinfectant; thus eliminating the need to generate, handle, transport, or store toxic/hazardous or corrosive chemicals.

• There is no residual effect that can be harmful to humans or aquatic life.

• UV disinfection is user-friendly for operators.

• UV disinfection has a shorter contact time when compared with other disinfectants (approximately 20 to 30 seconds with low-pressure lamps).

• UV disinfection equipment requires less space than other methods.

Disadvantages

• Low dosages may not effectively inactivate some viruses, spores, and cysts.

• Organisms can sometimes repair and reverse the destructive effects of UV through a “repair chanism,” known as *photoreactivation,* or in the absence of light known as “dark repair.”

• A preventive maintenance program is necessary to control fouling of tubes.

• Turbidity and total suspended solids (TSS) in the wastewater can render UV disinfection ineffective. UV disinfection with low-pressure lamps is not as effective for secondary effluent with TSS levels above 30 mg/L.

• UV disinfection is not as cost-effective as chlorination, but costs are competitive when chlorination-dechlorination is used and fire codes are met.

• There is no measurable residual to indicate the efficacy ofUV disinfection.

Method

Four samples of Contaminated water were taken with four different media dish washing liquid, H2O2, Chlorine and Dettol.

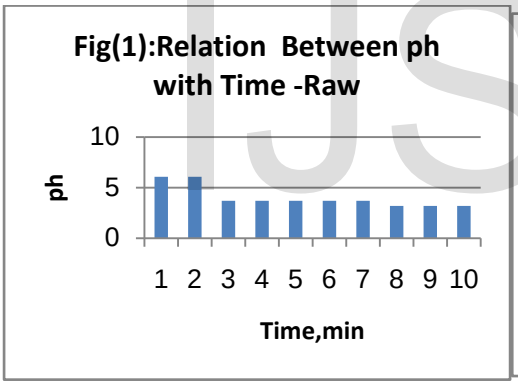
Tests (PH, COD, TDS, Turbidity, EC and temperature), were done more than one week and recorded the changes in wastewater specifications first each 15 minutes then for each hour a day then more than a week.

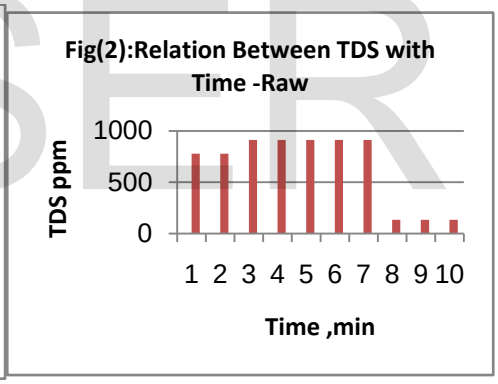
Final resulted water were treated using UV , results were recorded at final stage.

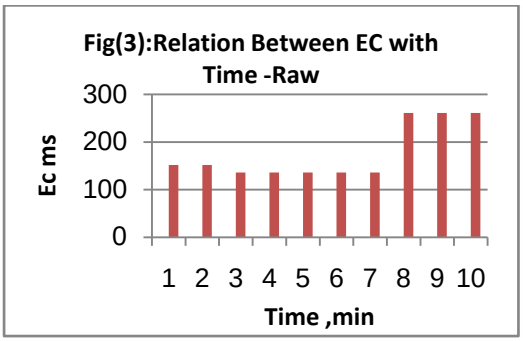
Fig (4) : UV System Fig(5): Wastewater collected & Treated

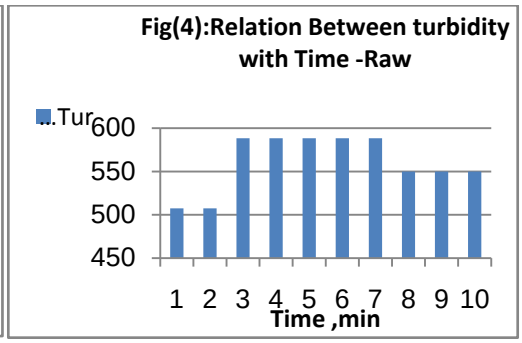
Results

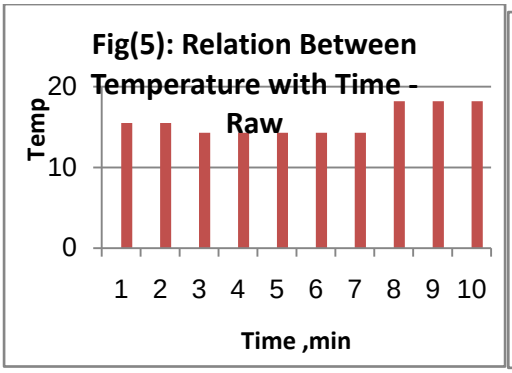
Tests (Ph, TDS, COD, Turbidity and Temperature) were done before and after primary chemical treatments also bacterial tests as shown id the figures below:

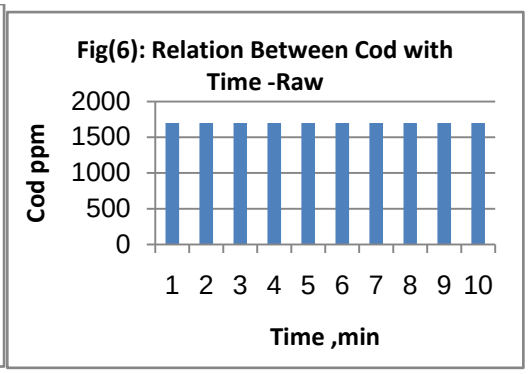




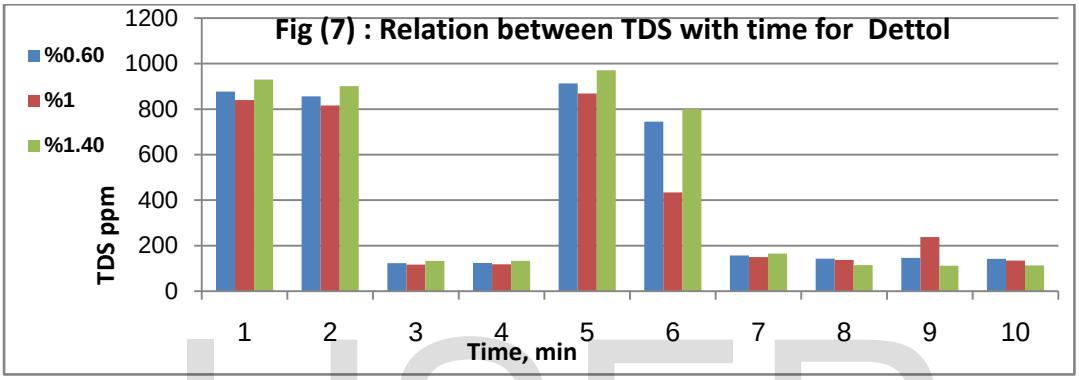


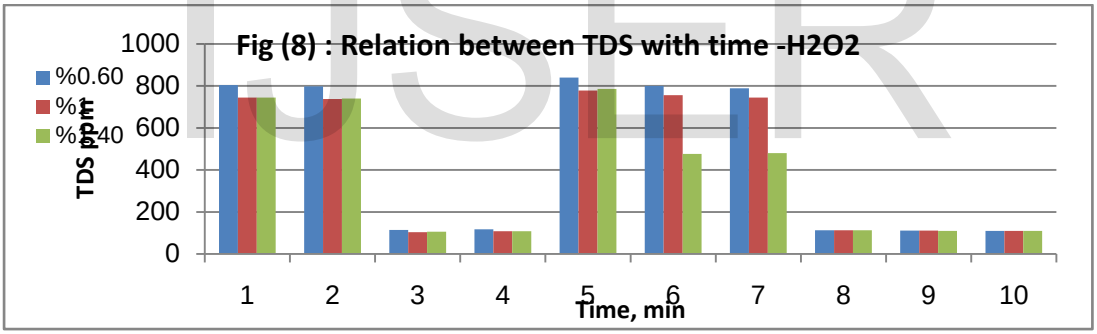


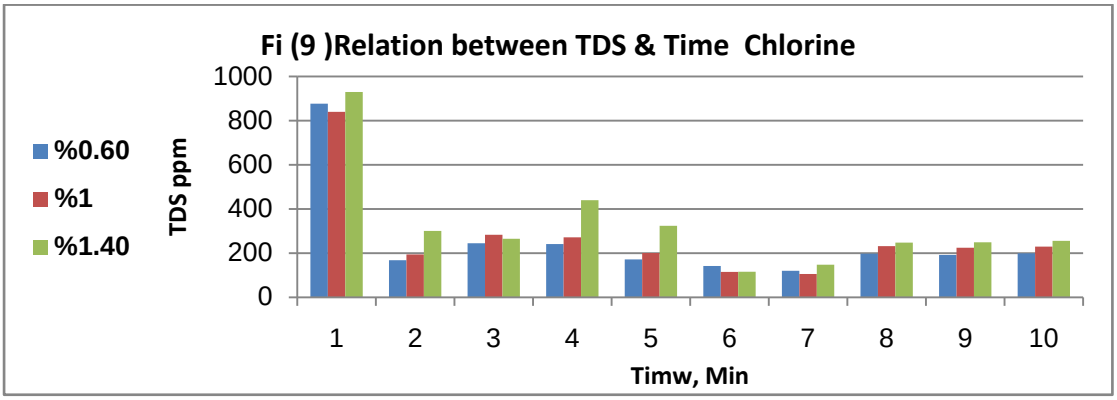




4.2. After chemical treatment







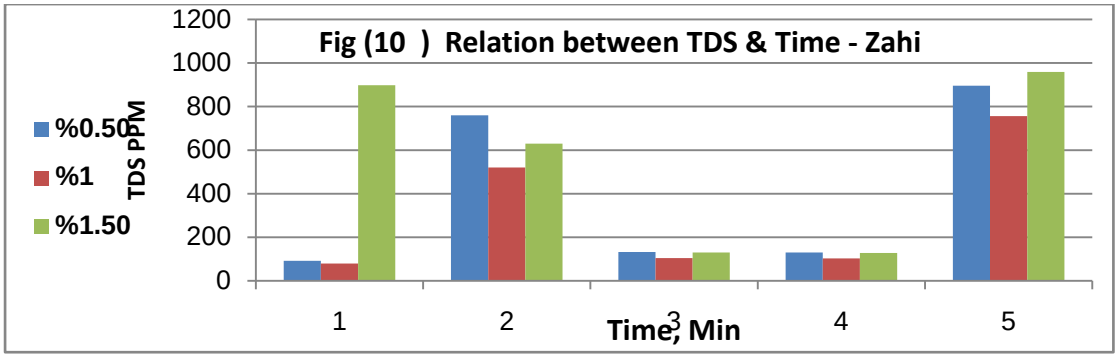
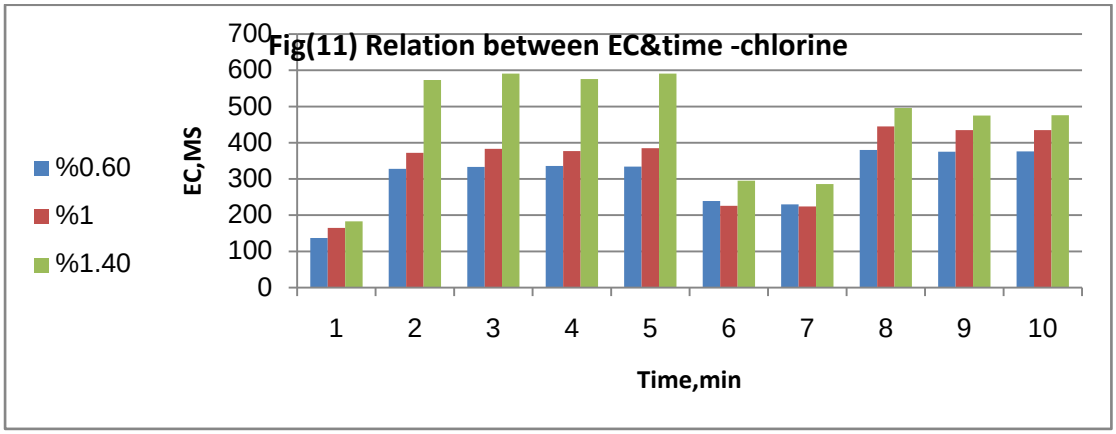


Fig (10) Relation between TDS & Time - Zahi
%0.50
%1
%1.50
TDS PPM
1200
1000
800
600
400
200
0
1
2
3
4
5
Time, Min


Fig(11) Relation between EC&time -chlorine
%0.60
%1
%1.40
EC,MS
700
600
500
400
300
200
100
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2
3
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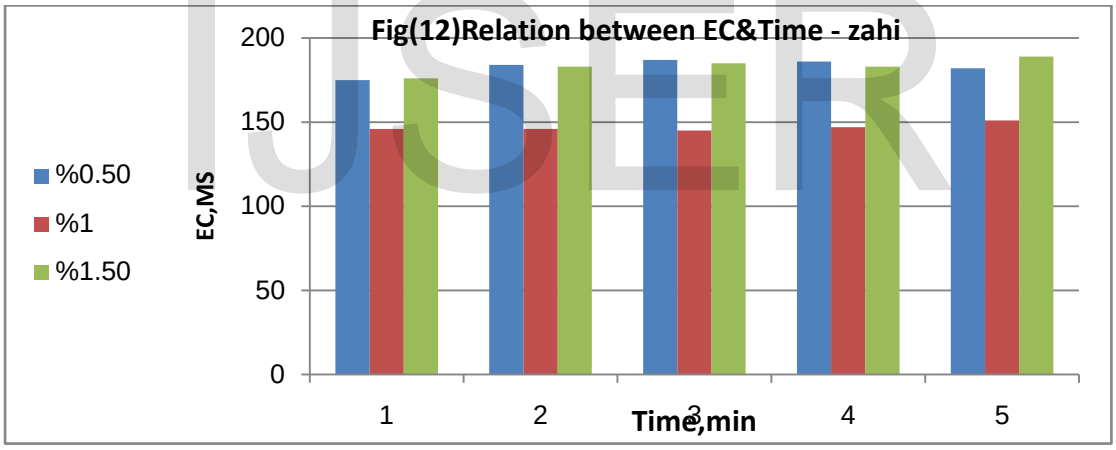
7
8
9
10
Time,min


Fig(12)Relation between EC&Time - zahi
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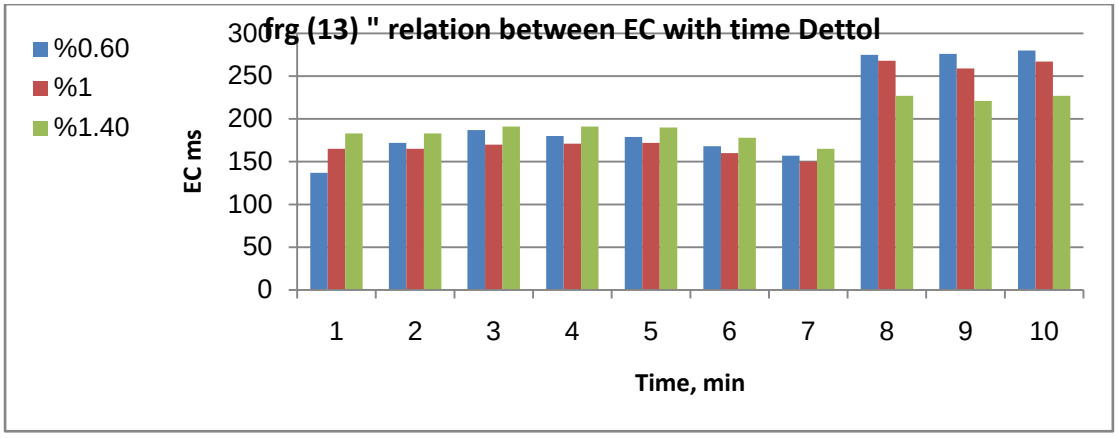
%1
%1.50
EC,MS
200
150
100
50
0
1
2
3
4
5
Time,min


frg (13) " relation between EC with time Dettol
%0.60
%1
%1.40
EC ms
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Time, min

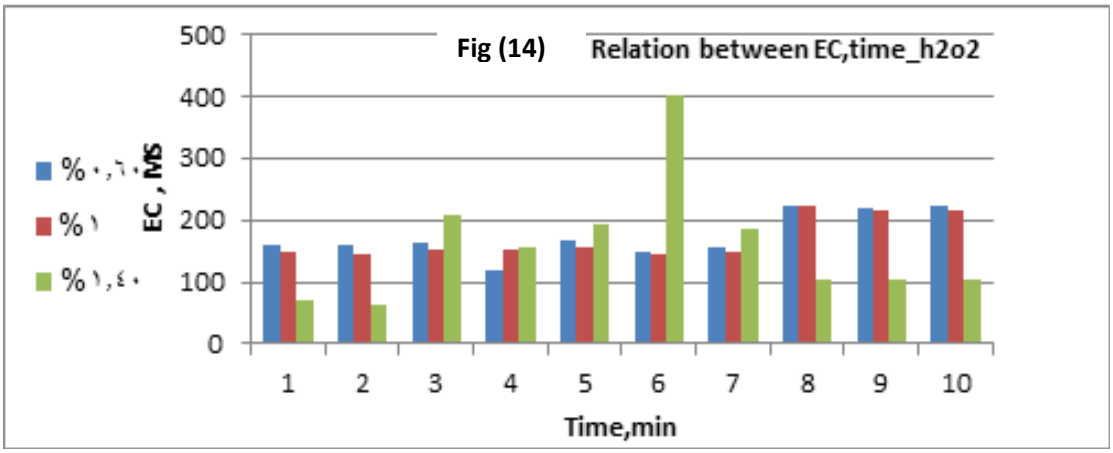
Fig (14)
Relation between EC,time_h2o2
EC , MS
Time,min
500
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100
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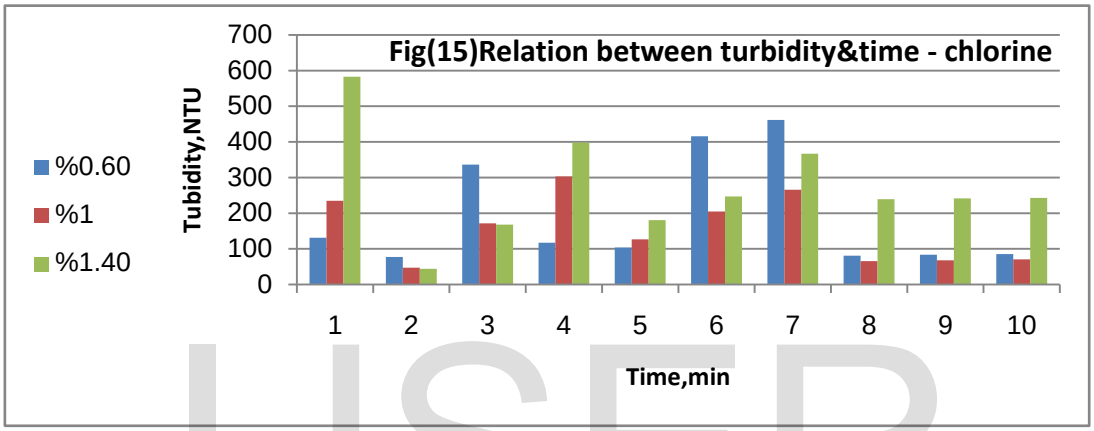
Fig(15)Relation between turbidity&time - chlorine
Tubidity,NTU
Time,min
%0.60
%1
%1.40
700
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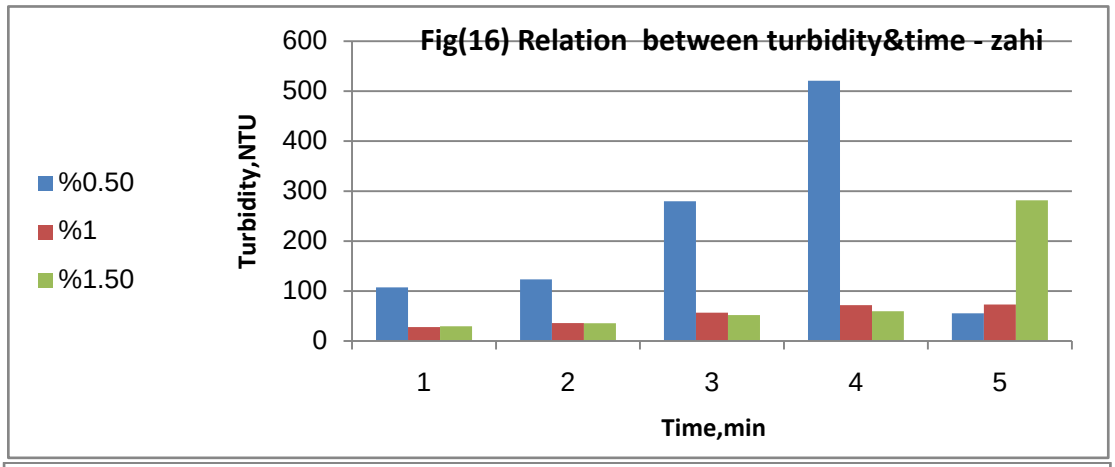
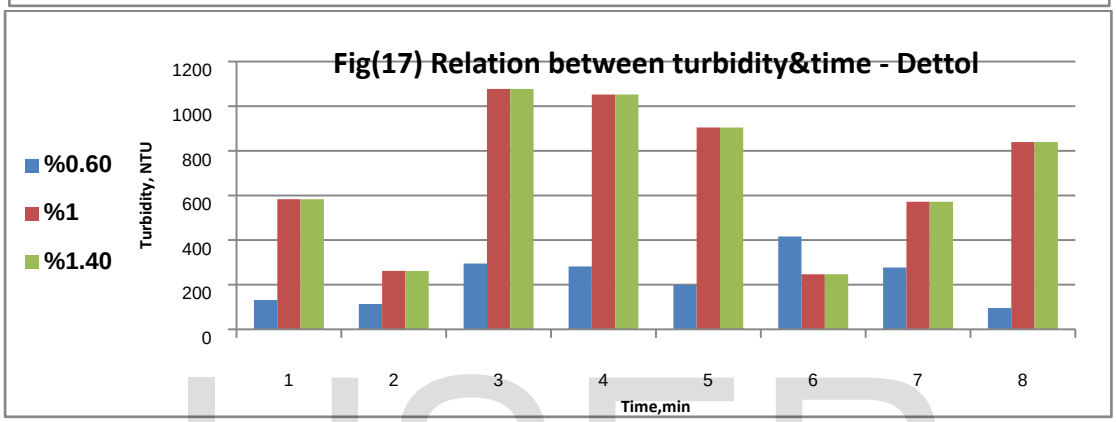

Fig(16) Relation between turbidity&time - zahi
%0.50
%1
%1.50
Turbidity,NTU
600
500
400
300
200
100
0
1
2
3
4
5
Time,min


Fig(17) Relation between turbidity&time - Dettol
%0.60
%1
%1.40
Turbidity, NTU
1200
1000
800
600
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6
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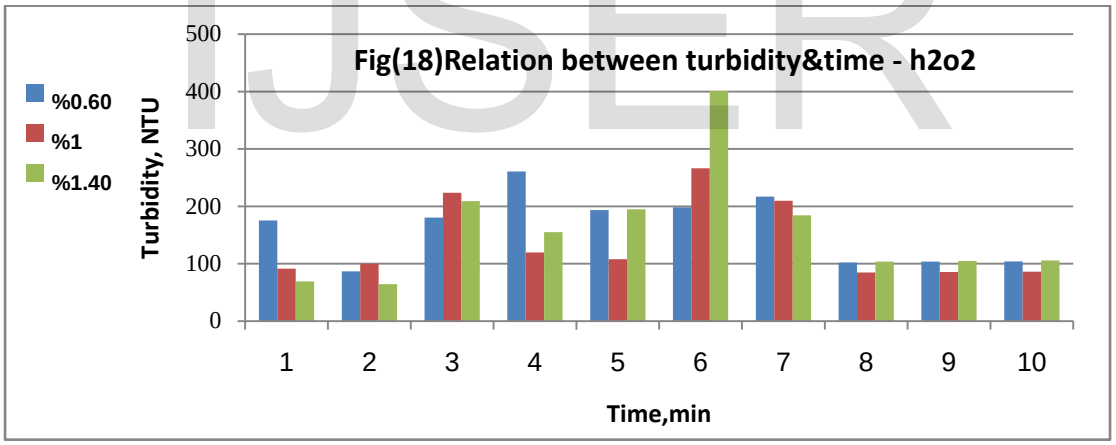
8
Time,min


Fig(18)Relation between turbidity&time - h2o2
%0.60
%1
%1.40
Turbidity, NTU
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Time,min

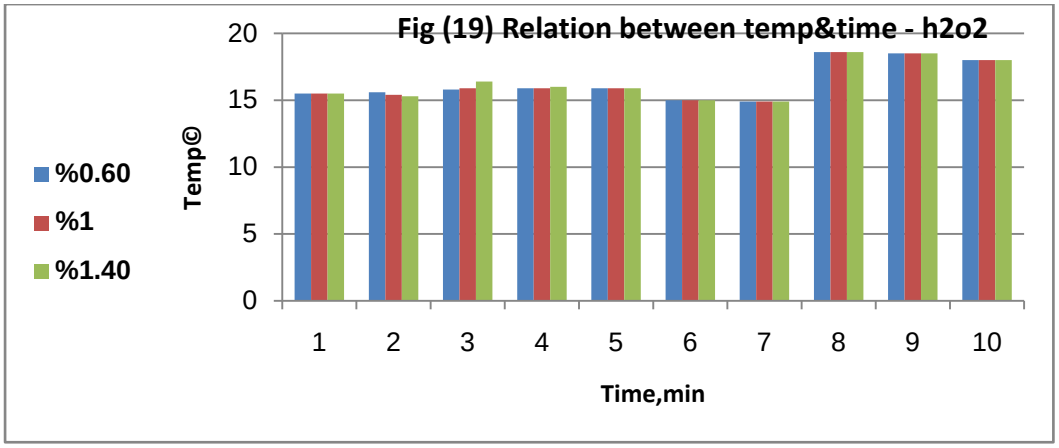
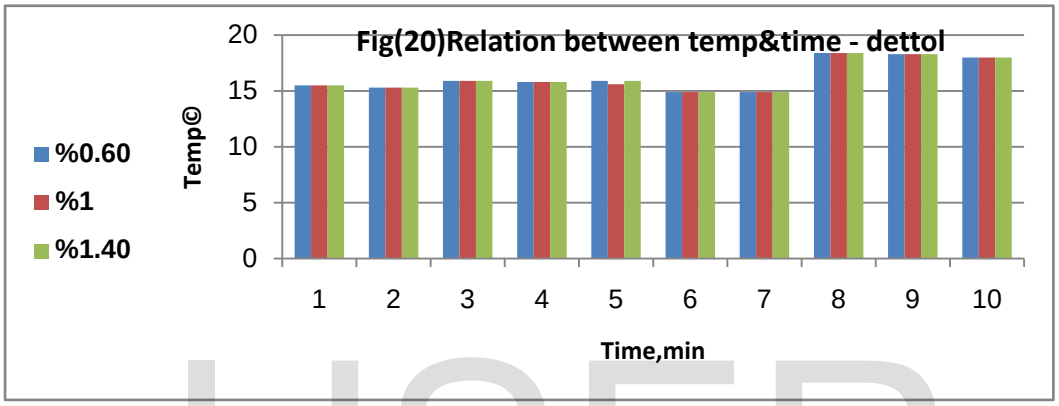


Fig (19) Relation between temp&time - h2o2
%0.60
%1
%1.40
Temp©
Time,min


Fig(20)Relation between temp&time - dettol
%0.60
%1
%1.40
Temp©
Time,min

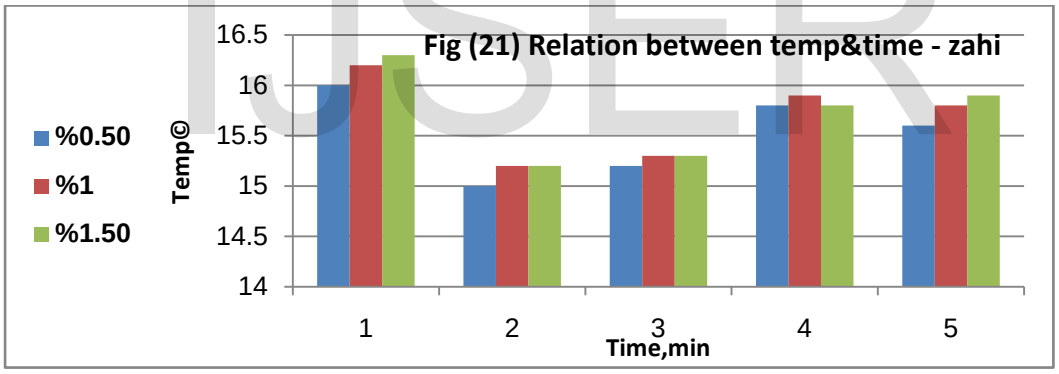


Fig (21) Relation between temp&time - zahi
%0.50
%1
%1.50
Temp©
Time,min

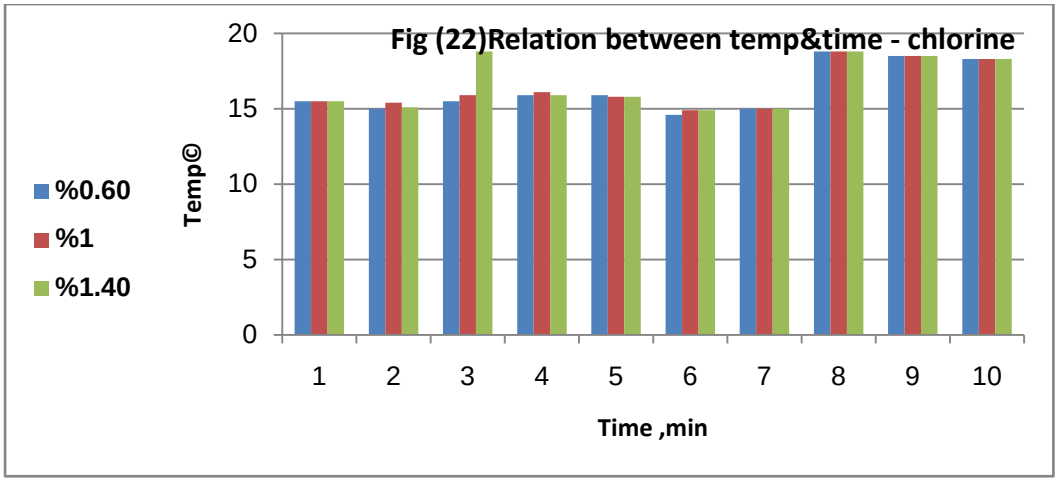
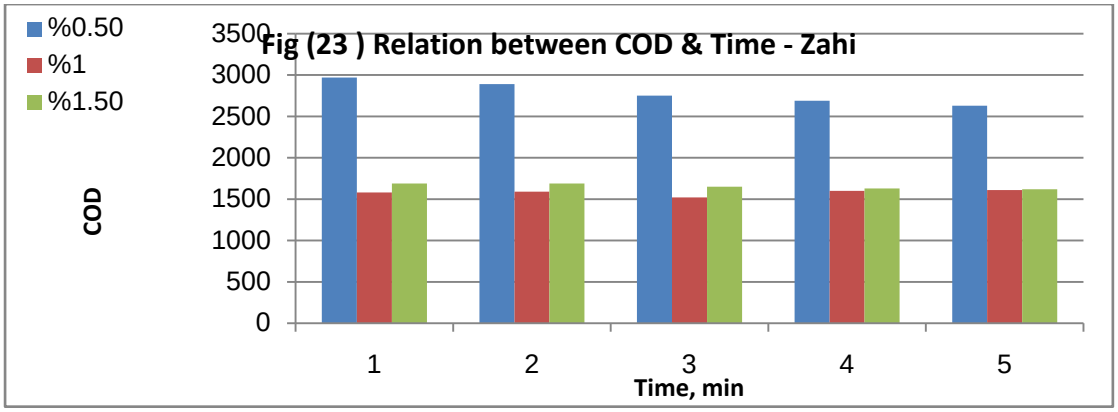
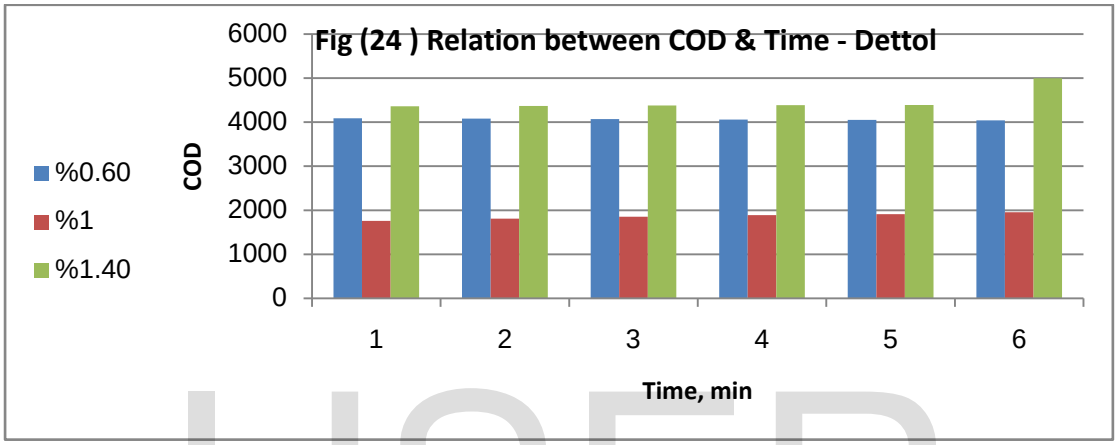
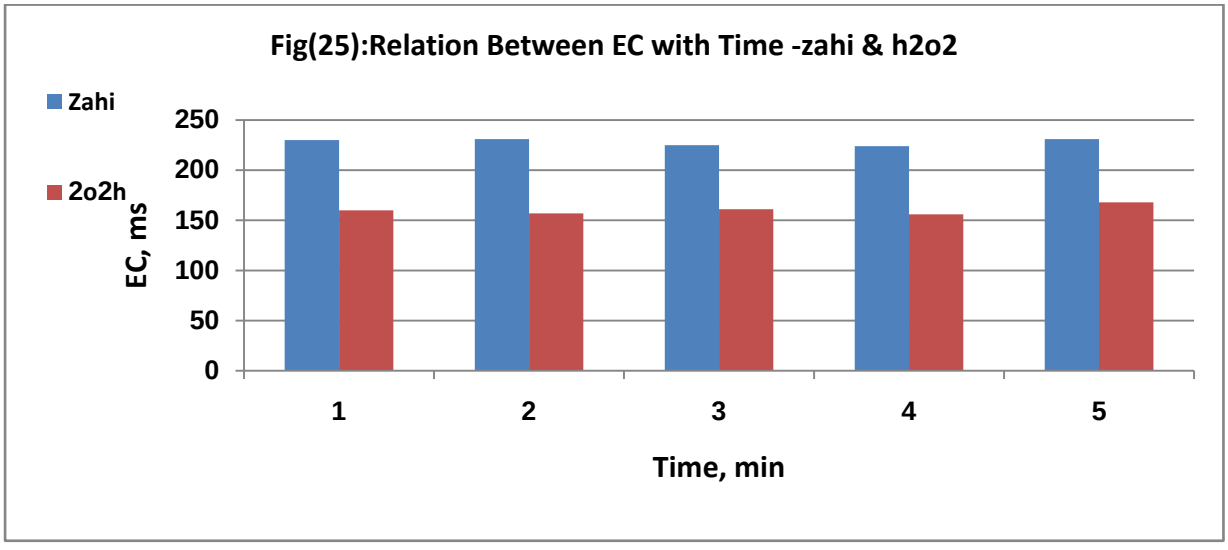


Fig (22)Relation between temp&time - chlorine
%0.60
%1
%1.40
Temp©
Time ,min

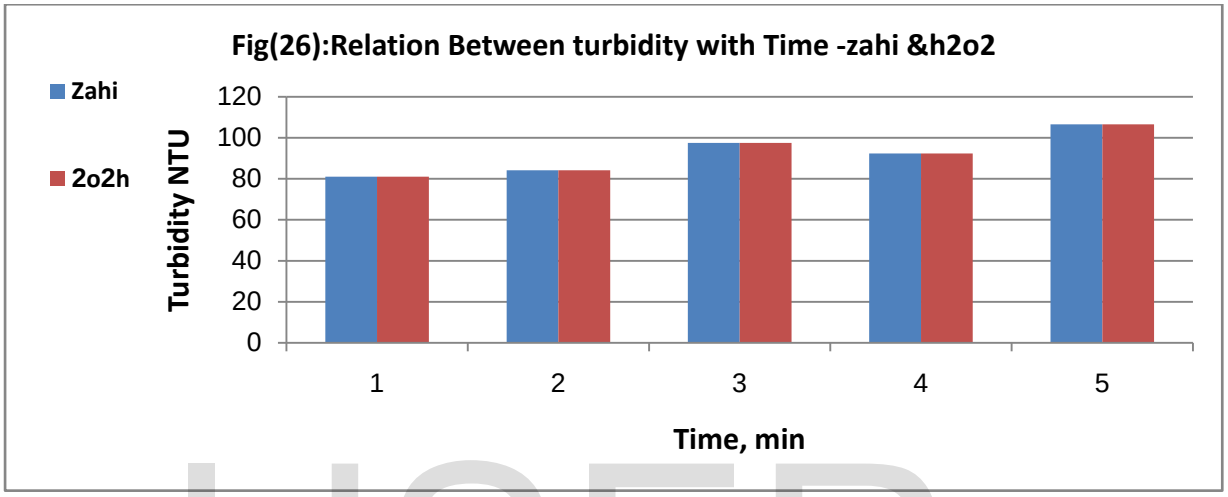


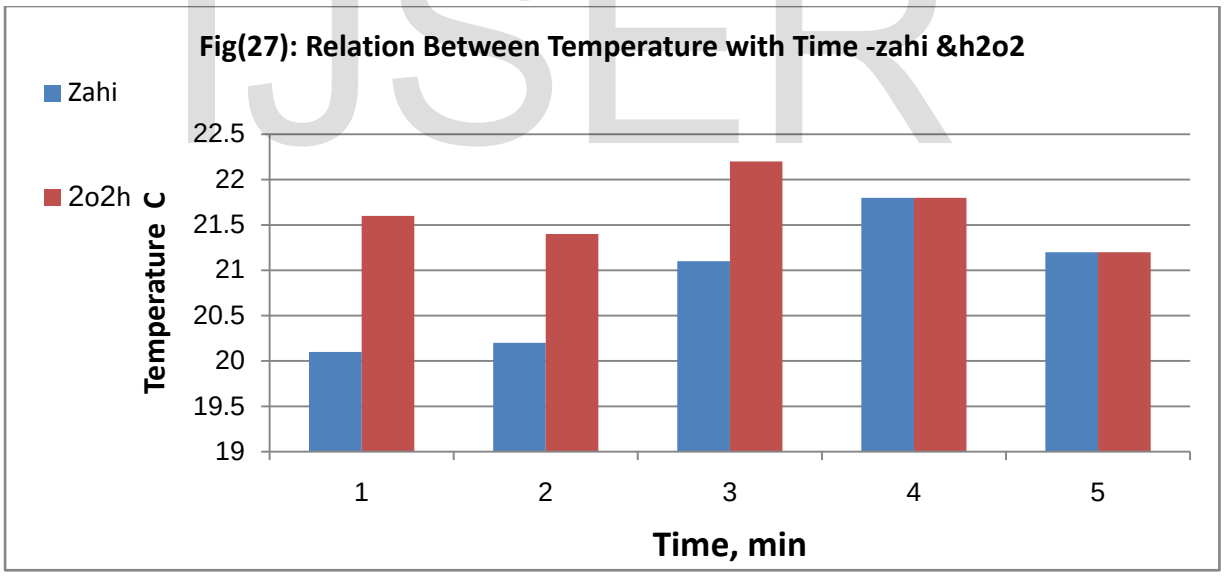


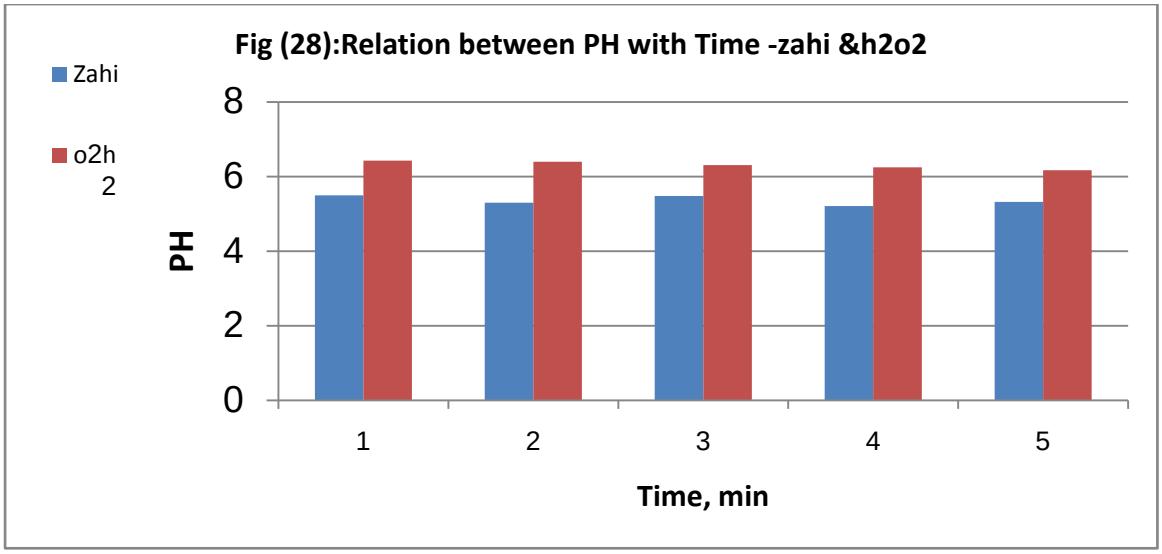
4.3. After UV Treatment

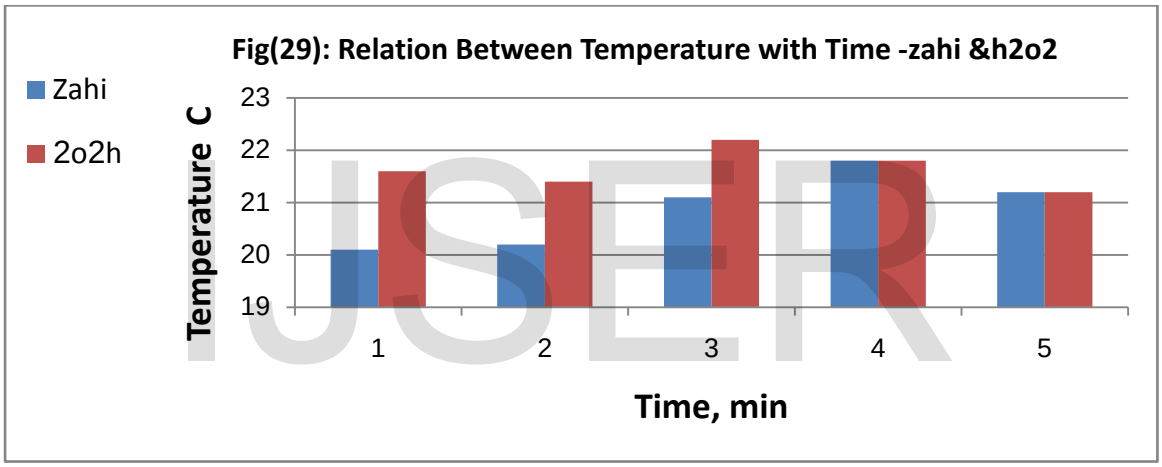


2- After UV Treatment









Discussion

Results showed relation between Tss, Tds, Ph, EC, Turbidity & COD tests to the contaminated water before and after chemical pretreatment by using different medias (H2O2, Zahi, Chlorine and Dettol) where used to treat this water before using final stage the ultra violet treatment. We found that :

1- Figure (1-6) showed the tests done on row wastewater before any treatment where PH was 3,5 – 6 with time, TDS 800-1000 ppm , EC 100-500ms turbidity 500-550NTUand COD 1550.

2- Figures (7-10) for TDS dettol and chlorine the highest value 800-990 ppm while zahi was 60-70 ppm.

3- Figures (11-14) for EC showed that zahi was the best value 140 ms specially the 1% concentration.

4- Figures(15-18) for turbidity showed that was 120-150 NTU the lowest value was by treating with zahi 100 – 40 NTU.

5- Figures (19-22) for temperature showed that temperature was almost constant 15-18 ^{o}C.

6- Figures (32-24) for COD showed that the value was between 1000-1500 specially in 1% concentration.

7- Figures (25-3-29) showed after UV treatment the comparison between the preminerly treatment by zahi and hydrogen peroxide that the specification got better and were almost same values for both materials. The water at final stage was better after using H2O2 and Zahi and hydrogen peroxide gave best results then it concluded that this media was better in dealing with infected water

Conclusions & Recommendations

Conclusions:

1- Using Chemical additives to the wastewater primery treatment used to treat this type of water is a way to improve the way of decreasing the contamination before using UV treatment.

2- The chemical liquids used in treatment were not toxic easy to handle and available

3- Best results were shown by using Hydrogen Peroxide and Cleaning liquid (Zahi)

4- Using the cleaning liquid with very small quantities is better that using Hydrogen Peroxide because it is cheaper by cost.

5- Biological test showed that using cleaning liquid (Zahi) and Hydrogen Peroxide gave the less bacterial accont.

Recommendations:

1- Use other liquids not toxic , available and not expensive.

2- The use of a new survey ways to make sure the water used specifications

3- Study the biological tests to determine the type of becteria found in the contaminated water.

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