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Study of the Effect of Food Oils and Grease Discharged to the Sewage Network on the Values of Pollution Indicators (BOD, COD)

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Abstract: Food Oils and Grease (FOG) which is discharged to the sewage network, increases the pollution indicators (BOD, COD). Therefore, the negative impact on sewage network systems is very important in general and in particular on water treatment systems. In this study, a laboratory and field study is conducted to determine the impact of FOG distributed to the public sewage network from a real case study in a quarter of Lattakia city-Syria. Plastic bottles were distributed on a number of houses to collect the oil usually transferred to the sewerage network. The bottles were then collected after a specified period of time. This step was accompanied by measure of some indicators of pollution of oil waste (BOD-COD-FOG) in two cases: before stopping the disposal of oils in the sewer network and after the collecting of oils by distributed bottles. It is identified, through laboratory tests of indicators of sewage pollution, the negative impact of oil and grease discharged to the public sewerage network. The analysis of the results showed that stopping the dumping of oils and grease in the sewage network reduced the rate of wastewater contamination by 17% for the BOD and 15.9% for the COD.

INTRODUCTION

There are a lot of pollutants of water, mainly food oils and grease which together represent two main sources of pollution indicators (BOD, COD), thus having a significant negative impact on sewage systems in general and on water treatment systems in particular[1].

The domestic use of food oils and grease leads to large amounts of them reaching the drainage network, which later hardens within the sewerage lines, causing a narrowing of the canalization, leading to the formation of anaerobic conditions, causing unpleasant odors and poisoning the water medium.

The main problems that occur in the treatment plant due to the presence of water contaminated by oils are: A thin layer on the surface that does not prevent gas exchange with ambient air which in turn decreases the amount of oxygen dissolved in water which will later affect the work efficiency of the treatment plant.

Lubricants and oils adhere to the surfaces of the equipment which reduces the efficiency of the work of many equipment such as pumps, pipelines and filters.

It is therefore, necessary to separate food oils and greases prior to its arrival at the sewage network and then treat them to obtain new products that can be used as raw materials in the following industries:

- Animal feed materials (feed)
- Paint and detergents
- Industrial oils mainly in steel mills
- Heating by direct burning or by mixing (where the calorific value of the oil produced is greater than 8500 kcal kg^{-1})
- Getting the biofuels
- Stabilization of sandy soils

In fact, most families use usually vegetable oil as a basis for preparing various daily meals, leading to the discharge of large amounts of oils including what goes to the sewage network directly (frying products) or indirectly (dishwashing). The collection and processing of food oils and grease achieves the following benefits:

- Improving the efficiency and longevity of the sewage network
- Improving the efficiency of treatment processes in wastewater treatment plants
- Reduce the amount of waste generated by the treatment plant
- Reduce the amount of oils dumped in the natural environment
- Economic profit of the process of reuse of oils collected in different industries

Problem description: FOG usually discharged to the sewage network and then the treatment plant affects negatively according to the following mechanisms:

Influence on pollution indicators of wastewater:

- The oil and grease floating on the surface of the water prevents the exchange of gas between the water medium and the air, resulting in the lack of oxygen dissolved in the water medium and thus, the death of life in the water and the formation of smells
- Moving from the state of aerobic reactions to the state of anaerobic interactions
- Form toxic and explosive gases (H_2S-NH_3-SO_2-CH4)
- The corrosion of the pipes and ducts is increased by the formation of the expanded sulfuric acid
- Increase the activity of sulfur and bacteria
- Increase the rate of pollution indicators for water entering the treatment plant

Effect on hydraulic indicators: Due to the change in the flow of drainage water during the day, the level of wastewater within the pipes swings permanently, which leads to the placement of a layer of oils and grease on the internal surfaces of the ducts that soon pick up some plankton and sand and then increase the roughness of the pipes and increase resistance to flow and this leads to reduce the efficiency of sewerage systems[2]. Figure 1 shows the extent of the effect of oils and grease on the sewage network.

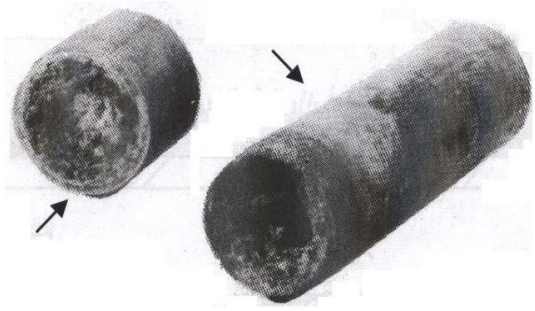

Fig. 1: A section in a sewage cistern showing the effect of oil and grease on the sewerage system

Effect on health aspects: Periodic exposure of workers to sewage pollutants as a result of frequent maintenance and repairs of the network from home to the treatment plant.

As a result of the anaerobic reactions caused by oils and grease, the possibility of spreading odors from the inspection rooms increases.

Increasing pollution indicators due to the oils coming with water reduces the efficiency of the work of the treatment plant and increases the probability of failure. This failure will create health problems in the work environment and will have a negative impact on the environment to which the inadequately treated water is evacuated (river-dam-irrigation)

The reuse of oils and grease resulted from kitchen waste, gets more to more attention especially for obtaining products that can be used in the industrial fields and aimed to reduce the consumption of natural resources. Processes include the following steps:

Filtration: With the objective of removal of hazardous materials and followed by a treatment with heating liquid and refinement of treated oil.

Sedimentation and filtration: The oil and grease are collected from the water and separated from the impurities and blots and then pumped to the outside which is subjected to secondary filtration processes followed by the new precipitation. With every precipitation the oil becomes refiner.

Refinement: The maximum flow is passed through the thermal reactor where the oil is subjected to continuous temperature and the temperature of the filter causes the water to evaporate. The water is absorbed by condensate. In these operations two parts of oil will be obtained:

- The first part (70%) of oil meets the specifications of the oils used in foodstuffs for humans and this part is used in the production of animal feed
- The second part (30%) of the oil is the waste from the process and is suitable for use as fuel

Food oils and grease can be used in many areas, for example, in the United States of America, about 180,000 tons of FOG is used in producing the soap in 1990[3]. In addition, it can be used to reduce the amount of water losses due to evaporation and to insure water needs[4].

Daniel *et al*.[5] conducted a study about the household perception waste management based on these findings from household perception, it has been argued that the solution to worsening environmental conditions in most of the towns and two cities in Botswana lies with the prioritization of urban environmental management, creation of awareness and commitment of Botswana's political leadership to sustainable urban settlement development and integrated solid waste management.

In another study achieved by Dehghani *et al*.[6], the results showed that the FOG amount in input raw sewage in the MWWTP from June 2011 to September 2011 was around 25.5 mg L^{-1} and the amount in treated wastewater was about 8.1 mg L^{-1}. The FOG removal efficiency in this refinery was about 70% and met the environmental standards for the discharge (<10 mg L^{-1}) ($p<0.05$). Taking into account the precedents points, this research aims to give:

- Statement of the negative impact of FOG on the sewage system and treatment systems
- Identifying the importance of oil recovery and reuse in various economic aspects (animal feed mixtures, detergent industry, biofuel, sandy soils, etc.)

MATERIALS AND METHODS

In order to study the effect of oils on the values of pollution indicators (BOD-COD), the following methodology was applied:

In Lattakia Governorate, the bottles for collecting oils was distributed in a quarter of 50 houses in order to monitor the indicators of sewage contamination before and after the distribution of the bottles. Figure 2 shows a satellite image of the studied quarter.

Ask citizens to avoid the direct discharge of oil into the sewerage system and replace it by collecting oil in the bottles distributed for this purpose.

BOD (COD) values of wastewater were analyzed in the laboratories of general company of water resources before the distribution of the oil collection bottles and after the distribution of the bottles by 20 days Table 1:

$$\text{BOD reduction ratio} = \frac{410-494}{494} = 17\%$$

$$\text{COD reduction ratio} = \frac{740-880}{800} = 15.6\%$$

When comparing the values of pollution indicators before and after the distribution of bottles, we found that

Table 1: The values of BOD and COD in wastewater in the quarter of seventh project

Date	Specimen number	BOD (mg L^{-1})	COD (mg L^{-1})
Before the distribution of oil packages			
Start the stud	1	500	850
11/01/2017	2	460	800
13/01/2017	1	540	950
	2	560	980
15/01/2017	1	440	880
	2	460	820
Average		494	880
Distribution of oil packages (seven days later, 18/01/2017)			
02/02/2017	1	410	720
	2	420	740
04/02/2017	1	430	760
	2	450	810
End of study			
06/02/2017	1	360	690
	2	390	720
Average		410	740
Reduction ratio (%)		17	15,9

Fig. 2: A satellite image of the studied quarter in Lattakia-Syria (Google Earth)

there is a real reduction in the values of pollution indicators due to the discontinuation of the dumping of oils in the sewage network.

This research result has been used to design oil pickers that capture oil and grease and prevent them from reaching the sewerage system.

The following paragraph shows an accurate description of the installation of the oil pump and its working mechanism.

RESULTS

Avoiding throwing FOG in the sewage system can reduce the values of pollution indicator by 16% for COD and by 17% for BOD which will increase the design age of the pipes and treatment plant.

Cost saving in the expense of treatment of plant if the oils were collected and prevented from access to the sewage treatment plant.

Possibility of reuse of FOG collected in many economic activities (soap industry-biofuels ..... etc), which will have a good economic return.

Possibility of reducing the damage of sewage networks starting from the house and the restaurant to the treatment plant.

DISCUSSION

In order to reduce the amount of food oils and grease produced by homes and restaurants, a set of recommendations and proposals should be followed:

The concerned entities should encourage and support the collection of oil remaining after consumption at source (house, restaurant ...) by asking investors who collect oil from homes at an reduced price and encourage the establishment of projects for the reuse of collected oils.

Requiring restaurants to install oil pumps and put the approval of the restaurant license in condition to the process of installing the oil pickup.

Conduct periodic monitoring by the concerned authorities on the oil pumps and ensure that they work properly.

The use of appropriate concentrations of solvents, detergents and sterilizers: the high concentrations of them cause emulsification of oils and grease and then pass through the oil pickup and access to the sewage network, in addition to the effect of sterilizers on the work of bacteria in the sewage system which in turn reduces the efficiency of wastewater treatment.

In the case of the use of hot water in the dishwashing, it is recommended that the washbasin in the kitchen is divided into two parts, the first section where the oil and grease is grated at normal temperature and without adding cleaning liquid and this part is attached to the oil picker, and the other section where the dishes are washed at high temperatures with use of cleaning liquid: this STUDY is not connected to the oil picker but is connected directly to the public network.

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