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Olive Mill Waste Water Management

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Abstract

In Palestine, the problem of untreated OMW discharge is urgent .several hundred thousand cubic meters of untreated W.W is discharged into open areas and cesspools .the current project addresses this issue by relatively basic treatment scheme that can be implemented to olive mill sites for little cost with valuable end products. This study shows olive mill waste was treated in circulating pond /T.F system, with a K=0.535, or within the activated sludge system with K=0.304.this suggesting strong treatment feasibility.

Introduction

From the ancient times, people recognized the beneficial effects on health from the consumption of olives and olive oil. Throughout the years, the process of olive oil extraction has been improved towards both final product quality and production efficiency. However, the problem of the produced wastes, solid waste and liquid waste, that was very important from the beginning, still represents a major concern for the olive oil producing countries. This study highlight the environmental concerns associated with olive oil production in Palestine. Due to high organic load, pH and concentration of phytotoxic compounds that are in these wastes, these wastes are the major environmental pollutant. This study initially describes these residues and discusses their physical and chemical qualities, and their effects on the environment (positive or negative). Also the study will discuss the amount of generated olive mill waste in Palestine, as well as the Milling methods in contemporary Palestinian, and other related information. Then samples were taken from OMWW from different mills, and number of test conducted. Finally a potential OMWW treatment plant was suggested taking in consideration the economic and technical aspect.

Research task

The proposed treatment process, will consist of an initial solid-liquid separation process by sand filtration. The filter retentive (TSS) will be removed from the sand filter and added to a catabolically active compost pile to produce a nutrient rich fertilizer. The outflow (OMW liquid) will exit the sand filter enter an aerobic reactor for treatment before discharge. The treated liquid effluent can be recovered and used as nutrient enriched irrigation water.

Methodology and experimental setup

The experimental work was conducted the concrete and the sanitary laboratories at Birzeit university. First, sand filter test was conducted at December where ,average room temperatures ranged between 10°c and 18°c. The filters were built up with different size distribution, and The OMWW pumped to the filter by peristaltic pump with different flow rate for each trial. several trials were conducted to choose the most efficient configuration of the filter media.

For the secondary treatment, the performance of two different system (T.F system and activated sludge system) had been evaluated .For the T.F system, the plastic filter media was submerged in the sludge contact tank at Birzeit University T.P, for two week in order to enhance the growth of the slim layer on the plastic media. The wastewater samples were diluted to 1000mg COD /l, in 12L of distilled water and 62mg/l of OMWW. Then

the flow of 0.41 l/s is pumped from the pond (40*30*20cm) into the top of the filter by a peristaltic pump and continually re-circulated through the pond. Surface aeration pump was provided to supply air and for stirring purposes. A feed of OMWW was applied to the system after 3rd and 6th day. The test setup is as indicated in figure 2 below.

Figure 1 :T.F system and the activated sludge setup

For the activated sludge experiment, the filtered W.W was diluted to 1000mg/l COD 14.92 l of distilled water was diluted with 78.8mg of OMWW. The sludge was collected from the wastewater treatment plant at Birzeit university and added to the W.W. Oxygen is provided to the system by a two oxygen jet and an aeration pump which was installed to provide complete mixing and to prevent sedimentation of sludge. The system configuration is shown in figure 1. Samples were collected from the tank for three consecutive days, and then feed of 78mg of OMWW was applied to the system. Again samples were collected for three consecutive days. The evaporated liquor was compensated with distilled water. For color removal, three different chemical compounds were added to a treated samples, note figure 2, where the first sample from the left is the effluent W.W before color removal, and the rest samples that were mixed with few grams of Iron Nano -particles, few grams of Iron Nano-particles with zeolite, and two drops of chlorine respectively.

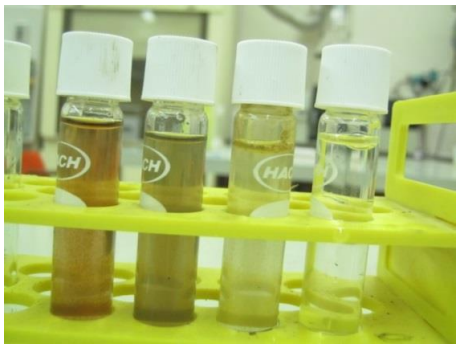

Figure 2: removal of color from effluent

While For solid waste composting, the test conducted at April 2013, where 2 kg of dry OMSW and 2.433kg of settable solids were collected and tested for C: N ratio and moisture content before composting. The solid sample from sand filter with 86.74% and 813.8gm of saw dust as bulking agent were mixed completely to reach the optimum

moisture content of 65% .Whereas the OMSW samples mixed with 30 gm of saw dust and 314.85 mg of water to obtain moisture content of 65%. both of the piles were mixed manually twice daily in the first two weeks for aeration, after two weeks mixing carried out once daily.

Sampling and analytical procedure

Samples for laboratory analysis were taken from the outflow of sand filter, every an hour interval .TSS and pH tests were made according to the standard methods .Samples from the effluent of both T.F and activated sludge systems are analyzed for pH , DO and COD were made according to the standard methods**.**

Results and discussion

To test the biodegradability of OMWW, the performance of T.F and activated sludge had been evaluated, figure 3 shows the COD vs. time for initial concentration (1000 mg/l) during a week.

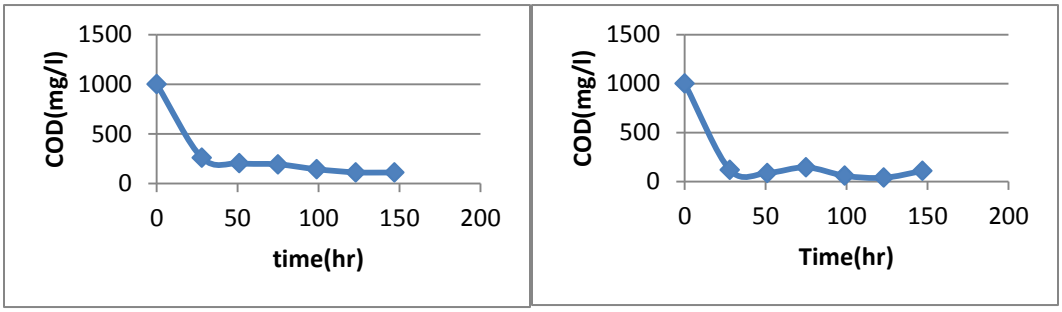

Figure 3 : A-COD removal from OMWW in the T.F system.B- COD removal from OMWW in the activated sludge system**.**

After the consecutive run established .A Kinetic model was formulated:

$$\frac{dC}{dt} = -K(C - Cnb) \ldots\ldots(1)$$

With initial condition C=C$_{\circ}$ at t=0 where C and C$_{\circ}$ represent initial COD and COD at time t (d),respectively, Cnb is the COD due to non-biodegradable substances in the W.W, and k the first -order rate constant for COD removal d-1. And a fraction factor f was used to distinguish between the non-biodegradable fraction from the biodegradable, as:

Cnb=f * C$_{\circ}$, Integration of the kinetic equation was yielded: C=C$_{\circ}$[f+(1-f)e^kt]

The curve fitting based on the nonlinear regression analysis, found the mean first order rate constant k in the trickling filter system to be 0.534696 d-1,the K values were significantly faster than the typical removal of organic from typical waste water ,and f values fitted to be 0.249, 0.223, 0.254 for the consecutive runs. For the activated sludge system , the mean first order rate constant k found to be 0.303814 d-1 ,and f values fitted to be 0.181, 0.235, 0.219for the consecutive runs.

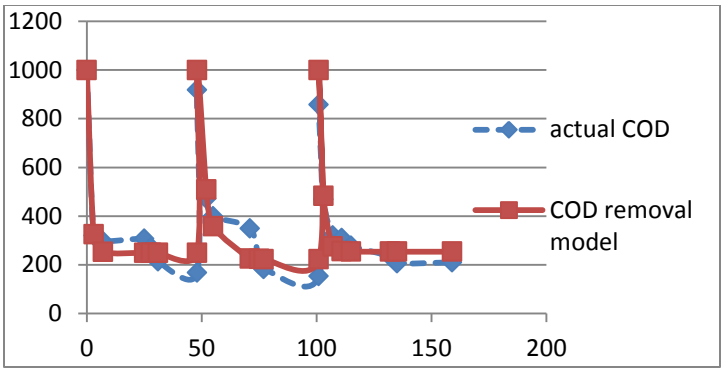

Figure 4 :COD removal kinetics using P/TF system

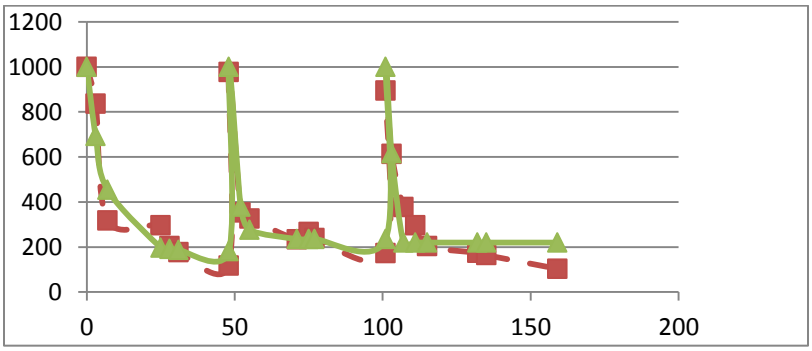

Figure 5 :COD removal kinetics using activated sludge system.

Conclusion

Because the three phase separation system the dominant method for olive oil extraction in Palestine, very large amounts of liquid wastes is producing every season, and OMWW impact on the environment. This study shows olive mill waste was treated in circulating pond /T.F system, with a rapid first-order degradation rate constant of 0.535, or within the activated sludge system with also a rapid first-order degradation rate constant of 0.304.this suggesting strong treatment feasibility.

It is anticipated that the treatment of mill waste stream can be carried out at rural site by separation of the liquid from the solid, solid is to be composted and the liquid to be treated by a recirculating pond and trickling filter system.

Acknowledgment: We can no other answer make, but, thanks, and thanks to our guide and teacher DR.OMAR ZIMMO. His constructive criticisms, suggestions, and experience added to the body of knowledge, and his example of how to take advanced science and engineering and use it in a cost effective manner to treat wastewater is a model of how we should all work in our different field .This work was supported and financed by Utah Estate University, so we give a hearty thank you to them. and special thanks goes to sanitary laboratory and concrete laboratory in Birzeit University, institute of environmental and water studies laboratory. Additional support was provided by ministry of agriculture, Der abu meshal olive mill, and Beitrema olive mill, so we thank them .Finally but not least, we thank our parents who supported us in every step.

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