International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 12, Issue 10 (November 2016), PP.15-17

Characteristic of the Vegetable water Produced from Elaboration of Olive Oil in Area of Tirana, Albania.

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Abstract:- The aim of this study was to evaluate the characteristics of the vegetable water (olive mill waste water), produced during elaboration of the olive oil from three-phase system. Study was realized during October 2012- February 2013. Water samples were taken in the exit of decanter and are analyzed the following indicators: pH, temperature, COD, DBO5, CE, turbidity, density, NO3, oil and grease, total dissolved solids, salinity. These analyses were conducted at the laboratory at the Department of Environmental and Ecology, Agricultural University of Tirana. The results demonstrated a very high value of COD, BOD, density, oil and grease, total dissolved solids. Based on these results, we conclude that vegetable water (olive mill waste water) have different characteristics, depending on the technology and cultivars used for the oil elaboration.

Keywords:- Olive oil, vegetable water, three-phase system, cultivars olive of Tirana

I. INTRODUCTION

Environmental pollution comes as a result of human activity that has become a universal problem for the society. The activities which cause a negative impact to the environment are the technologies that produce olive oil. Olive oil production constitutes one of the most important agricultural–industrial activities for the Mediterranean region in which over 95% of the world's olive oil is produced, reaching 3x106 tons per year (International Olive Oil Council, 2009). Many study report that OMW is a major pollutant to surface and ground water resources because it is one of the least biodegradable natural compounds due to its high phytotoxic component, high organic matter concentration, high chemical oxygen demand (COD), low pH, oil and grease (O&G) (Paredes et al, 1986, Saez et al, 1992, Al Khudari, et al, 2004, Mekki et al. 2007). The disposal and treatment of OMW has been a serious problem for the countries which produce olive oil.

In Albania are 38 mills that produce olive oil with 3 phase system. Average oil production per year is around 6-8 thousand tones. According the data from Ministry of Agriculture, Albania has about 40000 ha of land with 6 million plants. In Albania from the statistic of 2006 result around 4.497 000 olive trees, from which the output is about 3,603,000 root, with an average production 14 kg per tree, or over 40 thousand tonnes average production. The total installed capacity is about 88 tons / hour of work. During the olive oil production a large volumes of the waste are generated that vary in what type of technology is used and what cultivar is used. The olive oil extraction industry produces liquid effluents termed olive mill wastewaters (OMW). Solid and liquid OMW are dark-colored and contain high amounts of organic materials, high chemical oxygen demand (COD), low pH, and the presence of phytotoxic and antimicrobial compounds (Mekki et al. 2007). This system is called three-phase because the centrifugal decanter allows for the separation of three flows of matter; the olive oil, solid waste and wastewater. The major environmental problem is caused in a short period of time during October - February. After the elaborating of olive oil the solid waste are about 50-60%. The aim of this study was to evaluate the characteristics of the vegetable water (olive mill waste water), produced during elaboration of the olive oil from three-phase system. The quantity of the waste produced is still much smaller than other types of waste and its production is seasonal, the contribution of OMW to environmental pollution is important. In terms of pollution effect, 1 m3 of OMW is reported to be equivalent to 200 m3 of domestic sewage (Tsagaraki, Lazarides, &Petrotos, 2007).

During the elaboration of the olive oil the final components of the waste are 20% liquid oil, 30% solid waste and 50% olive mill waste water. Vegetable water is a result of water entering washing olive during the production process, which known as "alpchine" (olive mill waste water).This includes soft tissue pulp of olive. This composition is variable and depends from the elaboration of olive system (press or centrifuge), the cultivar produced, harvesting time, climatic conditions, (Lopez & Ramos-Cormenzana, 1996). Waste production causes negative environmental impacts during the period of the elaboration of oil also and behind it. It is characterized by a dark colour. The process described above requires hot water to be added to the olive paste, in order to reduce the antioxidant in oil and increase them to vegetable water.

Table 1. Olive oil and wastes production per 1000 Kg of olives

PRODUCTION PROCESS	INPUT	AMOUNT OF INPUT	OUTPUT	AMOUNT OF OUTPUT
Traditional pressing process	Olives Washing water Energy	1000 kg 0.1 – 0.12 m³ 40 – 63 kWh	oil solid waste (c. 25 % water + 6 % oil) waste water (c. 88 % water)	c. 200 kg c. 400 kg c. 600 kg
Three-phase decanter	Olives Washing water Fresh water for decanter Water to polish the impure oil Energy	1000 kg 0.1– 0.12 m³ 0.5 – 1 m³ c. 10 kg 90 – 117 kWh	oil solid waste (c. 50 % water + 4 % oil) waste water (c. 94 % water + 1 % oil)	c. 200 kg c. 500 – 600 kg c. 1000- 1200 kg
Two-phase decanter	Olives Washing water Energy	1000 kg 0.1 – 0.12 m³ < 90 - 117 kWh	oil solid waste (c. 60 % water + 3 % oil)	200 kg 800 – 950 kg

II. MATERIALS AND METHODS

Sampling of olive mill wastewater (OMW) was carried out from a three phase system. Study was realized during October 2012 - February 2013. Samples were transferred to storage conditions according to the methodology defined by EPA, to the Agricultural University of Tirana, Laboratory of the soil and water analyses. Water samples were taken in the exit of decanter and are analyzed the following indicators: pH, temperature, COD, DBO5, CE, turbidity, density, NO3, oil and grease, total dissolved solids, salinity. Samples that are taken from 3 phase system during this period are 5, with only one cultivar that is olive of Tirana. Based on these samples we determined the general characteristics waste water. The following physicochemical characteristics of OMWWs were determined according to "Standard Methods for the Examination of Water and Wastewater 20th Edition, 1999".

pH with pH-meter Multi 340i/SET.

Conductivity: Conductivity measurements were performed using conductivity meter.

COD (Chemical Oxygen Demand): COD is defined with the kit test. The method determines the oxygen consumed during the oxidation of the sample with a strong oxidative substance.

Nitrates (-NO3-), Phosphates (-PO4 -): Measured with Spectrophotometer.

Oil and grease: Partition-Gravimetric Method according to the Standard Methods for Examination of Water and Wastewater

III. RESULTS AND DISCUSSIONS

Results of the study are presented in Table 2. Results have demonstrated very high values of BOD and COD. The highest values were observed during January-February. Their values demonstrate high industrial pollution which negatively affects the quality of surface waters of the Erzeni River.

The observation results show that pH has moved to very low values to the acidity 5.5 minimum up to 5 maximum values. Very high content of nitrates, several times higher than the rates allowed by the Albanian Industrial Emissions (K.S.SH. 2010), associated with high values of BOD and COD's, this coincide with the results obtained by (Kapellakis I.E., Tsagarakis K.P. & Crowther J.C. 2008).

This results obtained from analysis have demonstrated very high content of organic pollution, which negatively affect the environment that changes the characteristics of surface water (Erzen River) and characteristics of soil.

Table 2. Results of the analysis for the wastewater in district of Tirana

Values	Units	min value	max value	Average	Discharge rates by VKM Nr 177 Albania
pH		5	5.31	5.15	6--9
Temperature	˚C	11.8	16.8	14.3	3
CE	ms/cm	6.66	11.94	9.3	

Salinity		3.6	6.8	5.2	
Apparent density	g/ml	1.012	1.05	1.031	
COD	mg/l	59700	148000	103850	250
BOD	mg/l	28500	74000	38425	50
TDS	g/l	43.58	112.88	78.23	50
Oil & grease	g/l	2.26	4.58	3.42	10
N-NO_3	mg/l	350	760	555	10
P-PO4	mg/l	172.5	163.2	167.85	
Total chlorine		1985	2127	2056	
Color	intensive violet-dark brown up to black				
Odor	strong specific olive oil smell				

IV. CONCLUSIONS

This study concluded that the physic-chemical parameters, such as BOD, COD, chloride, alkalinity and phosphate were relatively higher in olive mill waste water. COD varies from 59700-148000mg/l, pH 5-5.3, N-NO3 760-350 mg/l, P-PO4 172.5-163.2mg/l. The chemical composition of olives, which is the raw material for olive oil extraction, is very variable and depends on factors such as the olive variety, soil type and climatic conditions, but in general it consists of 18-28% oil, 40-50% vegetation water and stone (pit) and 30-35% of olive pulp (Niaounakis and Halvadakis 2004). From an environmental point of view, OMWW is considered the most critical waste emitted by olive mills in terms of both quantity and quality (Niaounakis and Halvadakis 2004). On previous studies (Tsagaraki, Lazarides, & Petrotos, 2007), it was determined that the effect of pollution than, 1 m3 of OMW is reported to be equivalent to 200 m3 of wastewater family. Based on the results found in this study shows that vegetable waters have very high pollution, and in the future should be viewed their ability to be used as fertilizer and at the same time can also be purified before their discharge into surface waters. Typically, the COD level varies from 80,000 to 200,000 mg/l (Robles, 2000), while typical sewage water has a COD value of 400 mg/l (Lyberatos et al., 1997).

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