WASTEWATER CHARACTERISTICS FROM TOFU PROCESSING FACILITIES IN BANDA ACEH

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Abstract

Tofu is a very favorite food in Asian countries such Indonesia, and is gaining popularity among west countries as well, due to the associated health benefits and its acceptable price. Tofu which is produced by grinding of soy bean produces high of amount wastewater, and is considered as one of the most polluting food-industrial effluent due to its high values of organic pollutants. This paper analyzed some pollutants parameter discharged from tofu industries in Banda Aceh. The parameter of BOD, COD, MLSS, PO4-P NH3-N, Turbidity and pH were analyzed based on the standard method for the examination of water and wastewater, approved by the EPA. The COD and BOD of wastewater from tofu processing facilities in Banda Aceh is ranging from 5000-8500 and 3500-4500 mg/L, respectively. Site investigation showed that in Banda aceh city, the tofu waste has been disposed into the environment without any treatment, causing bad odours and pollution of the surface, ground water and river.

Keywords: Wastewater; Tofu; Characteristic; Biochemical oxygen demand; Chemical oxygen demand

Introduction

The management of wastes producing from food industries such as tofu industry is currently one of the most serious and controversial issues faced by local goverment. The goverment are required to proposed the waste management systems that fullfill the hierarchy of option (i.e. prevention, reduce, reuse, recycling, recovery and disposal). The good waste management system will protect the environmental health by reducing the negative impact of the waste and finding environmentally friendly reuse for it. Improved environmental protection through the optimization of waste management practices is the typical focus of waste management policies and technologies in countries where strong legislation has been well established and immediate health concerns have been controlled.[1-3]

Tofu is a very popular food in Indonesia, because of its associated health benefits and acceptable price. Tofu is produce by grinding of soy bean, cooking (boiling), filtration, protein coagulation, preservation, and packaging. Although the tofu industries discharge a lot of wastes, only a small percentage of tofu waste has been utilized as nutritious feed for livestock, the remainder being incinerated and/or reclaimed as industrial waste, thereby contributing to serious pollution problems.[4]

Many factors have been considered in order to select the treatment process of the wastes. One of them is waste characterization. Characterization of the waste has proven to helpfull in order to determine the treatment process to be selected. The characterization is fundamental in order to improve the waste treatment system. This paper discussed the characterization of tofu waste from some tofu industries in Banda Aceh city, Indonesia.

Methods

The tofu wastes were obtained from local tofu factories in Banda Aceh city. Five representative samples of tofu wastes) from local tofu industries (e.i. Tahu Lampaseh Aceh, Tahu Lampaseh Aceh, Tahu MKS, Tahu Sumedang and Tahu Meurah Jaya) were analyzed by using various methods. All examinations are made in accordance with the procedure given in Standard Methods for the Examination of Water and Wastewater, approved by the EPA (Environmental Protection Agency).

Results and Discussion

Tofu manufacturing is one of the traditional oriental food processes using soy bean as the raw material. A typical process consists of soy bean grinding, cooking and boiling, first filtering, protein coagulating, second filtering, preserving, washing, drying and packaging. The wastewater is obtained from filtering that requires further treatment before discharging. The wastewater from soybean processing is characterized by its high chemical oxygen demand (COD) and biochemical oxygen demand (BOD) values derived from the high protein content. Table 1-5 shows the characteristic of wastewater from local tofu industries in Banda Aceh (e.i. Tahu Lampaseh Aceh, Tahu Lampaseh Aceh, Tahu MKS, Tahu Sumedang and Tahu Meurah Jaya).

MLSS (Mixed liquor Suspended solid)

The MLSS measures the total concentration of mixed liquor suspended (non-soluble) solids in the wastewater. The data is important in for examination of the operational behavior and solids inventory of the system and it is used to determine when the waste is discharge or for recycle. The value of MLSS from the tofu wastewaters in Banda Aceh are ranging from 1,050-3,130 mg/l. As can be seen from Table 4, the highest value of MLSS is at wastewater from Tahu Sumedang.

Table 1. Characteristic of wastewater from Tahu Lampaseh Aceh

Parameter	Unit	Results
MLSS	mg/L	1,177
BOD	mg/L	3,575.5
NH_3-N	mg/L	36.1
PO_4-P	mg/L	1.81
COD	mg/L	6,500
Turbidity	NTU	387
pH	-	4.9 (28.6^{o}C)

Table 2. Characteristic of wastewater from Tahu Solo

Parameter	Unit	Results
MLSS	mg/L	1,150
BOD	mg/L	4,415.5
NH_3-N	mg/L	**33.5**
PO_4-P	mg/L	0.97
COD	mg/L	8,500
Turbidity	NTU	841
pH	-	4.85 (28.9^{o}C)

Table 3. Characteristic of wastewater from Tahu MKS

Parameter	Unit	Results
MLSS	mg/L	1,050
BOD	mg/L	4,390.5
NH_3-N	mg/L	39.9
PO_4-P	mg/L	1.57
COD	mg/L	7,300
Turbidity	NTU	902
pH	-	4.82 (28.2^{o}C)

Table 4. Characteristic of wastewater from Tahu Sumedang

Parameter	Unit	Results
MLSS	mg/L	3,130
BOD	mg/L	3,810.2
NH_3-N	mg/L	129.3
PO_4-P	mg/L	95.5
COD	mg/L	5000
Turbidity	NTU	730
pH	-	5.5 (28.5^{o}C)

Table 5. Characteristic of wastewater from Meurah Jaya

Parameter	Unit	Results
MLSS	mg/L	1,600
BOD	mg/L	4,520.5
NH_3-N	mg/L	64.0
PO_4-P	mg/L	2.56
COD	mg/L	6400
Turbidity	NTU	921
pH	-	5.08 (28.4°C)

BOD (Biochemixal Oxygen Demand) and COD (Chemical Oxygen Demand)

The BOD measures the quantity of oxygen required by bacteria to biologically oxidize organic material under aerobic conditions. The BOD test involves the value of dissolved oxygen (DO) at initial and after five days of incubation at 20°C. The measurement method attempts to replicate the oxidation found in the environment. The BOD value can be in mg/L or in lbs/day. While in the COD analyses, the sample is reacting with excess oxidizing agent under acidic conditions, and nearly all organic compounds can be fully oxidized to carbon dioxide. The value of BOD and COD are critical in the wastewater analyses, since the can show the amount of polluted organic materials in the water system. Usually there is a good correlation betwen COD and BOD value. Its ratio can give the information wether the waste could be treated biologically or not.

The COD and BOD of wastewater from tofu processing facilities in Banda Aceh is ranging from 5000-8500 and 3500-4500 mg/L, respectively. Those high value of organic compounds could cause bad odours, pollution of the surface, ground water and river. Other parameters such as MLSS, PO4-P NH3-N, Turbidity and pH are also above the standard for wastewater. Site investigation showed that in Banda aceh city, the tofu waste has been disposed into the environment without any treatment. Tofu-processing waste is acidic (pH about 4-5) since during the tofu preparation acetic acid as added for coagulation. There are no hazardous chemical added to tofu during the production process make the tofu waste basically is non toxic, thus can be effective treated biologically. However, without any treatment, bad smell will appear after 2 days, due to the degradation of ammonia compounds.[4] The management of tofu waste is very important to be socialized for tofu manufacturing owner. Government involvement is also very necessary to encourage the owner to treat their waste and keep the environment clean.

Ammonia (NH3-N)

Ammonia from tofu wastewater in Banda Aceh is ranging from 33-129 mg/l. The highest concentration of NH3-N is at Tahu Sumedang (i.e 129.3 ppm). High amount of ammonia would be responsible for eutrophication in the waterways or river. The nitrogen contained in ammonia will serve as a nutrient that stimulates the productivity of algae and other water plants. The eutrophication is responsble in accelerating the extrem growth of alga, which is impact to the bad taste and odour of water. Moreover, ammonia is also consuming oxygen from the water system during its oxidation to nitrite and nitrate, thus will reduce the oxygen in the water, causing problem for fish and other animals in cusuming of oxygen.

Treatment of Tofu Processing Waste

Usually, the treatment method of tofu processing waste is by biological degradation. Most probably because the waste is high degradability since the high value of BOD and COD ratio. It is, however, often prohibitively expensive in densely populated areas due to the high space requirement of this method. Chemical coagulation is an option to remove most of the organics from the water colloids.[5] The treatment of tofu waste using supersonic irradiation of the substrate suspension on the methane fermentation performance has been studied, and found that the supersonic wave irradiation is effective to enhancing the methane yield.[6]

Anaerobic digestion is a well-known technique that has been widely applied to the organic waste treatment since it transforms organic carbon in the waste into biogas (methane and hydrogen) and reduces the amount of biosolids to be disposed of.[7-9] The process is is gaining attention in the effective treatment of low quality food waste and its competent biogas yield which can be used directly for electric power generation. However, it has a

complex process and does not exist independently, and requires additional equipments, such as pre-treatment, wastewater treatment, and composting process.[10]

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