# *Biological Evaporation by Composting for Alcohol Industries WasteWater*

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**Introduction**

Alcohol production from molasses can lead to large amounts of wastewater that cause serious environmental concern. It is characterized with extremely high chemical oxygen demand (COD), biochemical oxygen demand (BOD) and dark brown color. This wastewater is poorly decolorized by the normal biological treatments such as activated sludge systems, aerated lagoons and anaerobic ponds.

Various physicochemical treatments are also explored, such as activated carbon absorption process. But the high cast makes these methods hard to be applied. Therefore, it is significant to find a suitable way to treat this wastewater.

Other providers are looking for other methods to convert this kind of dense wastewater into fertilizers with higher economic and social value.

Composting this kind of wastewater is a biothermal aerobic process. During composting heat generated by the composition of the organic materials reduces the moisture content of the pile.

Generally, the higher the organic contents, the greater the quantity of heat released during composting. This greater quantity of heat results in thermophilic phase (55 to 65°C) which has been started earlier in the composting process. The greater release results in more moisture evaporation.

For the most efficient operation, the temperature of composting process should be 50 to 65°C, but not above 70°C .for best results, temperature should be maintained between 50 and 55°C for the first few days and between 55 and 60°C for the remainder of the composting process. Temperatures above 65 to 70°C for a significant period of time are detrimental to microbial activity. Moisture content, aeration rate, size and shape of pile, atmosphere condition, and nutrients influence the distribution of temperature in a composting pile.

A bulking agent is added to the sludge for porosity and moisture control. This bulking agent can be a wide variety of materials, such as woodchips, sawdust, wood ash, agricultural residues such as rice bran, and composted sludge.

The objective of this study is to investigate the effect of periodically changing alcohol wastewater to compost pile on decreasing bulking agent and increasing wastewater evaporation using a pilot scale compost pile.

**Materials and Methods**

Two identical mixtures of bulking agent, wastewater from alcohol industry and compost fertilizer were thoroughly mixed in small piles. There was a match factory near the composting site. Waste wood chips and saw dust from the factory were used as bulking agent. Wastewater was added to the pile until it became saturated. In saturated condition the pile could not absorb any additional amount of wastewater, so it surpassed .Table No.1, summarizes the volume of wastewater, bulking agents and produced compost that was used in the mixture. Both piles were made as follows. A perforated polyethylene pipe, rounded with a diameter of two meters was placed on top of a concrete pad. Mixtures were evenly distributed on top of the pipes to a height of 1.5 meters. 10 centimeters of wood chips cover was placed on the top and sides of the pile to act as an isolation blanket and to contain odors.

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The Pipes were then connected to a 30-cm axial fan. Figure 1 illustrates the pile layout. The fan originally operated in the negative mode, pulling air through the pile. The Piles temperature was monitored daily in the middle of the pile.

The First pile had a conventional composting process and no wastewater was added during the composting period.

The second pile temperature and moisture content were controlled daily. When temperature was reaching above 55°C and moisture was rising to %40, wastewater was added to the pile through a nuzzle, until it became saturated again. The addition of wastewater was interrupted when reaching to 55°C took more than 12 days. In fact we allowed its natural composting process to continue.

Samples were taken daily from the depth of 30 cm through the piles. The samples were weighed and dried for 72 hours at 70°C. Then they were weighed again to obtain the water content.

Salinity was measured for wastewater saturated samples taken from both composting piles and from the second pile before adding any wastewater, using an electrical conductivity meter unit.

In order to compare the quality of produced composts, pH, total carbon, total nitrogen, total potash and total phosphorus were examined using the following procedures. Total nitrogen was examined using a kjeldahl procedure, total carbon with dry combustion method, total potash with flame photometry and total phosphorus with the molybdate –blue method. The surrounding temperature was also tested daily.

**Results**

Figure 2 shows the results of temperature and moisture variations in both piles .figure 3 shows that the rate of evaporation in the conventional compost. As it can be seen, the evaporation rate is at its maximum during five days after the start up, and then it decreases in the remainder days of the composting process. In the second pile saturated moisture in each phase has increased in comparison with the previous phase. According to the figure 2 it is obvious that the temperature and moisture contents graph has four phases and each phase has begun with the addition of wastewater to the pile. The duration of the 4 phases were respectively 5, 4, 7and 12 days. Salt concentrations (expressed as electrical conductivity) in the waste water, in wood chips after composting, and in both of the produced composts in the end of each phase are shown in table 2. The results of the quality of both produced composts are presented in table 3. According to the data in this table, it is obvious that in the second pile, organic carbon, organic nitrogen and total phosphate were less than the first pile. But the amount of potash in the second pile was more than the first one.

**Discussion and Conclusion**

Using biodegradable wood chips and recycled compost, the temperature in the compost pile increases with a faster rate since these materials are already in a state of biodegradation. This was the reason for increase in the temperature and moisture in the first five days after start up. As it is shown in figure 2 the duration of the third and the forth phases are longer than that of the first and the second ones. Such time expansion is due to rising salt concentration in the pile. The evaporation of saline wastewater results in salt concentration increase and bacterial activity decrease due to high osmosis pressure. It seems that using quick lime in compost in order to reduce the moisture of compost pile is not effective to evaporate saline wastewater like alcohol industries' wastewater.

Due to increase in bacterial mass content during the composting process, and high bacterial mass capacity of absorbing water, the saturated moisture content is increasing from the first to the forth phase.

According to table 3, producing compost using alcohol industries wastewater has acceptable quality for agricultural uses. There is no need to increase the temperature up to 60°C, as there are no pathogenic microorganisms in this kind of composting materials. Increasing temperature higher than 60°C for a long time decreases the activities of mesophilic bacteria. Adding periodical wastewater to the pile can evaporate a pile moisture content of about %72 the total weight of it in 10 days, while in the conventional system, only 28% of the total weight of the pile is evaporated in 14 days. The increasing rate of evaporation in the second pile compared to that of the first one show that the second method needs less bulking materials and sieving costs.

**Table 1: the volume of initial mixed material in both piles**

| Mixed materials | Volume(liters) |
|---|---|
| wastewater | 800 |
| bulking agents:<br>saw dust<br>woodchips | <br>550<br>1400 |
| produced compost | 200 |

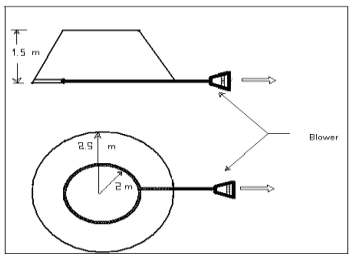


**Fig. 1: Layout of the composting pile**

**Table 2: Salt concentration (expressed as electrical conductivity)**

| Sample from | Salt concentration (expressed as electrical conductivity)(millimhos/cm) |
|---|---|
| waste water | 26.5 |
| wood chips after composting | 9.47 |
| produced composts from the first pile | 10.88 |
| produced composts from the second pile | 25.2 |
| End of the first phase | 10.90 |
| End of the second phase | 15.89 |
| End of the third phase | 20.5 |

**Table 3: the results of the quality of both produced composts**

| produced composts | pH | OC% | N% | P(ppm) | K(ppm) |
|---|---|---|---|---|---|
| from the first pile | 7.74 | 12.48 | 1.24 | 67 | 2062 |
| from the first pile | 7.5 | 4.87 | .48 | 75 | 5000 |

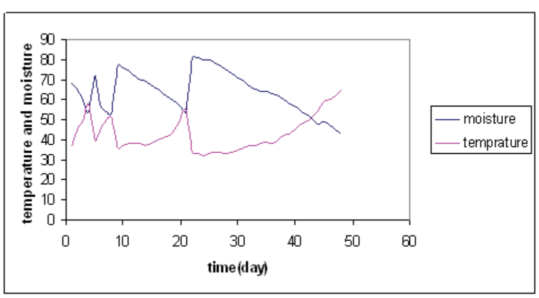


**Fig. 2: moisture and temperature variation**

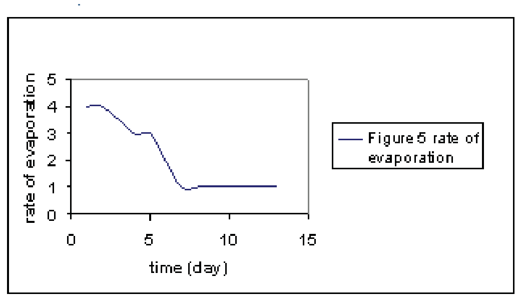


**Fig. 3: variation in rate of evaporation**

**Key words**
Evaporation, Compost, Alcohol Industries, Wastewater