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Effect of Aeration Rates and Mechanical Stirring System on Compost Production from some Farm Wastes

Abdellatif, S. M.; Y. M. El-Hadidi and Sahar W. A. El-Kasemy*

Agricultural Engineering Department, Faculty of Agriculture, Mansoura University.

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ABSTRACT

The experimental work was carried out in the wastes treatment laboratory of the Agricultural Engineering Department, Mansoura University to assess the optimal aeration rate and mechanical stirring to produce compost. C/N ratio of the examined raw materials was calculated to find out the mixing ratios of the correct ingredients. The composting of digested buffalo dung and maize stover has been investigated in a forced-aeration composting system at three different aeration rates (0.0003, 0.0005 and 0.0007 m^3/s) and two different levels of mechanical stirring (Once and twice a week) to specify the optimal aeration rate and mechanical stirring system and used them with fresh buffalo dung and maize stover at moisture content of 65% w.b. Two control (traditional system) experiments were performed, the first ($control_1$) was digested buffalo dung and the second ($control_2$) was fresh buffalo dung. Temperatures of ambient air, bioreactor vessel, $control_1$ and $control_2$ were measured and recorded. Chemical analysis for the raw materials and the final compost was also carried out. The obtained results indicated that, the buffalo dung (digested or fresh) can be mixed with shredded maize stover together at a ratio of 2 part of buffalo dung to 1 part of maize stover (by weight) to produce compost. It is recommended to use aeration rate of 0.0005 m^3/s at once a week mechanical stirring to produce compost with good properties inside the bio-reactor. According to the biological analysis, the produced compost from the digested buffalo dung is better than that from the fresh buffalo dung.

Keywords: aerobic digestion, compost, aeration rates, mechanical stirring, buffalo dung.

INTRODUCTION

The problem of agricultural wastes appears after the harvest because of its low in protein and fat content, high lignin and cellulose contents, and it is very clear especially after summer crops, due to the farmer's desire to evacuate the field quickly to re-cultivate it by burning agricultural waste, which leaves harmful effects on the environment. These harmful effects are represented in reducing microbial activities in the soil and air pollution with toxic gases. Meanwhile, these agricultural wastes cannot be stored in the field because it becomes an appropriate environment for the activity and growth of pathogens and harmful pests that affect new crops (Abou Hussein and Sawan, 2010).

Biomass recycling by different technologies reduces the amount of waste and gets rid of it, reduces waste odors, and gets a valuable product called compost. The composting process kills most of the pathogenic microorganisms and provides the soil with the necessary nutrients, increases water retention and improves physical properties of the soil (Hargreaves *et al.*, 2008 and Martinez-Blanco *et al.*, 2009). Therefore, agricultural wastes must be recycled in a safe, appropriate and environmentally friendly manner (Abou Hussein and Sawan, 2010).

Composting defined as a process in which mesophilic and thermophilic microorganisms are used to treat organic substances and produce a healthy, stable substance that is free of pathogens, seeds, unpleasant odors and rich in humic substances (Mbuligwe *et al.*, 2002 and Marhuenda-Egea *et al.*, 2007).

Temperature is one of the most important factors during the composting process (Chen *et al.*, (2015) and Xiu-lan *et al.*, (2016)). The composting process depends on the ability of the substrates to dissolve in addition to the initial temperature and is considered an exothermic process (Kulikowska, 2016). The temperature rises as a result of the decomposition of organic materials during the composting process by microorganisms. On the other hand, the efficiency of the composting process decreases when the temperature rises above the permissible limit (Ryckeboer *et al.*, 2003 and Raut *et al.*, 2008).

Huang *et al.*, (2004) reported that temperature during the composting process should be ranged from 60 °C to 65 °C and it must not exceed these limits. Care must be taken that the temperature does not increase during the composting process and does not exceed 71 °C because increasing the temperature during the composting process more than 71 °C stops the process as a result of killing all microorganisms.

The decomposition of organic wastes during aerobic composting in the presence of oxygen is more efficient when the C/N ratio ranges from 30:1 to 40:1 (Agnew and Leonard, 2003). During the composting process, microbes need nutrients such as nitrogen, potassium and phosphorous for the metabolism process, so the microbes break down the organic compounds and decompose them Chen *et al.*, (2011). The elements carbon and nitrogen are among the most important elements, as the element carbon is a source of energy and nitrogen is also an important element in building the structure of cells (Iqbal *et al.*, 2015). Chai *et al.*, (2005) specified that the optimum ratio of C/N ratio ranges from 25: 1 to 35: 1 during the aerobic fermentation process.

Ahn *et al.*, (2008), McLaurin and Wade (2009), Iqbal *et al.*, (2010) and Makan *et al.*, (2013) stated that the moisture content is very important when producing compost, it affects the microbial activity and the growth of microorganisms, as the lack of moisture content prevents the compost from decomposing

* **Corresponding author.**
E-mail address: Sahar.wahed.2020@gmail.com
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efficiently and the increase in moisture content leads to anaerobic conditions and slow the decomposition process. It also causes unpleasant odors. Thus, the moisture content affects the physical structure and transport of oxygen to the composting area.

Shilev *et al*., (2007) and Shammas and Wang (2009) added that the initial moisture content of the raw materials "feedstocks" should be in the range from 55 to 65% w.b in order to provide optimal conditions for the development of microorganisms.

Ogunwande *et al*., (2008) and Getahun *et al*., (2012) reported that there is a very strong relationship between the stirring process and some chemical and physical analyses of compost through its effect on some elements such as pH, C / N ratio, dry materials, moisture content, temperature, total nitrogen and total carbon which can be used as indicators of compost maturity.

Many researchers dealt with different periods of stirring through various compost production processes and stated that the process of stirring compost ranges from once a day until it reaches once a week in order to produce good compost. During the production of compost, Li *et al*., (2015) used stirring once a day to ensure that the aerobic conditions of the compost environment were preserved, while Ros *et al*., (2006) used stirring once every 4 to 5 days, while Mohee *et al*., (2015) used stirring once a week to ensure that the compost is supplied with the necessary oxygen. Petric *et al*., (2015) recommended using the stirring process for 30 minutes daily in order to improve the composting process. Awasthi *et al*., (2014) studied the effect of different periods of stirring on the activity of the bacterial population and found that daily stirring does not affect the bacterial population and stirring once every three days and once every week led to a significant increase in the bacterial population in the compost environment.

Chang *et al*., (2005)., Lin (2008)., Iqbal *et al*., (2010)., Jiang *et al*., (2011) and Guo *et al*., (2012) reported that, aeration is an important process for both microbial growth and the emission of gases during compost decomposition and McLaurin and Wade (2009) added that oxygen is an important factor when carrying out the decomposition process of organic waste and in the absence of oxygen, the decomposition process slows down and results in unpleasant odors.

Kalemelawa *et al*., (2012) and Chan *et al*., (2016) stated that the pH of initial raw materials affects the microbial activity during composting, so the pH is an important factor when performing the composting process, as the pH decreases in the first stage of composting and rises in the advanced stages during the composting process. They also found that the optimal pH for composting ranges from 7 to 8.

The current study was carried out to investigate the effect of different aeration rates and mechanical stirring interval times on compost production from some farm wastes.

MATERIALS AND METHODS

A stainless-steel horizontal vessel Fig. (1) was designed, manufactured, and installed in the wastes treatment laboratory of the Agricultural Engineering Department, Mansoura University. The gross dimensions of the vessel are 60.0 cm diameter, 150.0 cm length and 0.2 cm thickness with a net volume of 0.417 m^3. The horizontal unit is insulated by using 2.5 cm thick glass wool insulation to reduce the heat losses from the curved surface area and protect the unit from changes in the ambient air temperature.

The aeration unit:

To supply an adequate amount of air for providing and maintaining the presence of oxygen in the composting materials, two holes were drilled on the sides of the unit at 6.0 cm above the bottom of it. Air was supplied from a blower (368.0 W) and moves through two holes by 2.54 cm diameter plastic PVC pipe and rubber hoses through two control valves. Three aeration rates (0.0003, 0.0005 and 0.0007 m^3/s) were used during the experimental work.

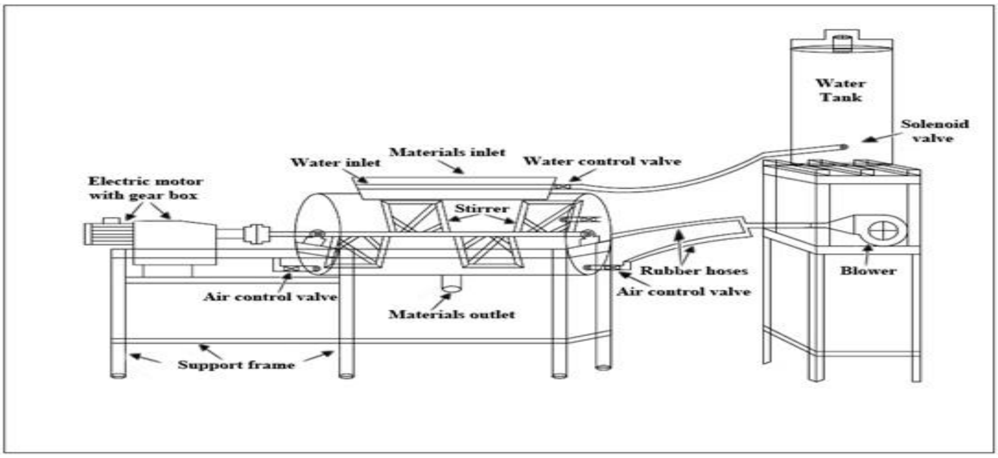


Fig. 1. Schematic diagram of the horizontal production unit (Experimental unit).

The humidification unit:

The compost production unit is also supplied with the water needed for the humidification process through a water tank (84.5 cm high and 55.0 cm diameter) with a volume of 200.8 liters. The water is connected and transferred from the tank to the unit by means of rubber hoses installed on the upper right side of the unit. The amount of water flow to the unit is controlled by the solenoid valve. The moisture content of the mixed materials during these experiments was about 65 % w.b ± 1%.

The Stirring system:

The horizontal unit is provided with a metal steel stirrer in order to carry out the stirring process and homogenizing the components of the wastes. It is a column 150.0 cm long and 5.0 cm in diameter and equipped with four blades whose dimensions are as follows: The length of the feather is 27.0 cm, its width is 33.0 cm, and its thickness is 1.0 cm. The stirrer was operated using an electrical motor with gear box of 3 hp (2.2 kW) and output speed of 25 rpm. Two levels of mechanical stirring (Once and twice a week) for 30 minutes each time were used to specify the optimal mechanical stirring system.

Raw materials:

The buffalo digested slurry was obtained from the biogas unit of the laboratory of the Agricultural Engineering

Department, Mansoura University while the fresh buffalo dung was collected from the animal farm of Faculty of Agriculture, Mansoura University.

The buffalo dung (digested or fresh) was mixed with chopped maize stover and at the beginning of each experiment, the mixture of raw materials is weighed, and the resulting compost is also weighed at the end of each experiment. The resulting compost is stored at room temperature (natural conditions for the curing stage).

Maize stover was collected from the field after harvesting operation at moisture content of 10 - 13 % w.b. Chopping machine (figure 3.3) was employed to break and shred the maize stover. One level of particles size of maize stover was used (2.0 ≤ particles size ≤ 10.0 mm).

The raw materials (shredded maize stover and buffalo dung) were mixed together by weight as the following:

Mixture (1): 1 part of digested buffalo dung +1 part of maize stover.
Mixture (2): 2 part of digested buffalo dung +1 part of maize stover.
Mixture (3): 3 part of digested buffalo dung +1 part of maize stover.

Data tabulated in table (1) shows the chemical analysis of different mixtures.

Table 1. Chemical analysis of different mixtures.

Chemical analysis	Compost mixtures			
	Mixture (1)	Mixture (2)		Mixture (3)
		Digested	Fresh	
Dry Matter (DM, %)	49.25	34.62	35.65	28.42
Moisture content, (MC,%)	50.75	65.38	64.35	71.58
Total Nitrogen (TN, %)	1.115	1.280	1.042	1.355
Phosphor (P), %	0.265	0.271	0.213	0.285
Potassium (K), %	1.628	1.558	1.125	1.471
Sodium, %	0.314	0.317	0.310	0.356
Total Carbon (TC, %)	46.569	44.533	37.151	43.920
Ash %	19.710	23.222	35.949	24.279
Organic Matter (OM, %)	80.290	76.779	64.051	75.721
pH	7.09	7.04	7.12	7.20
Electrical Conductivity (EC, S/m)	0.332	0.339	0.361	0.352
C/N ratio	41.785	34.802	35.653	32.425

The mixture (2) was chosen to test it in the experimental work because of its suitable moisture content (65% w.b) and C/N ratio (35:1) as recommended by Chai *et al.*, (2005) , Shilev *et al.*, (2007) and Shammas and Wang (2009).

The moisture content was determined using the equation of Cornell University (1996).

The total organic carbon was calculated using the equation of (Chang *et al.*, 1980):

$$\text{Organic carbon} = \frac{100 - ash\ (\%)}{1.7241} * 100 \quad ,\% \qquad \ldots..(1)$$

Major nutrients [nitrogen (N), phosphor (P) and potassium (K)] of the raw materials and the cured compost were analyzed and determined in the Central Laboratories of the Faculty of Agriculture, Mansoura University by C/N analyzer (Model Thermo Scientific Flash 2000 Elemental Analyzer).

Carbon to Nitrogen ratio (C/N) was calculated for the raw materials to find out the mixing ratios of the correct ingredients using the following equation according to Cornell University (1996). It was also appreciated for mixed materials and cured compost.

$$R = \frac{Q_1(C_1 \times (100 - M_1) + Q_2(C_2 \times (100 - M_2) + \ldots}{Q_1(N_1 \times (100 - M_1) + Q_2(N_2 \times (100 - M_2) + \ldots} \ldots..(2)$$

Where:
R = C/N ratio Q = Quantity of material to be added, (Kg)
C = Carbon, (%) N = Nitrogen, (%)
M = Moisture content of material, (%) w.b.

Pathogenic bacteria such as *Escherichia coli and Salmonella spp.* for the examined raw materials and final compost were analyzed and determined in the Microbiology Department, Faculty of Agriculture, Mansoura University according to APHA, (1989) and Islam *et al.*, (2004).

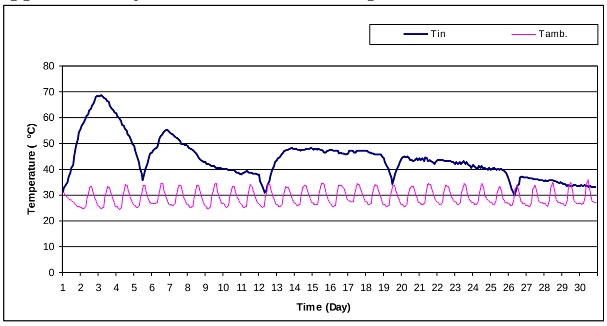
Excel spreadsheet was used to calculate the moisture content, dry matter, organic matter, ash content and organic carbon of the raw materials, mixed materials and cured compost during the experimental work.

RESULTS AND DISCUSSION

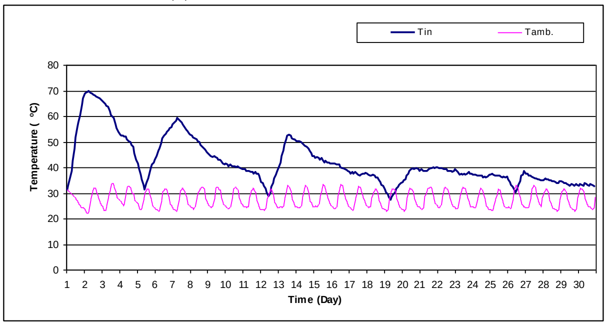
Effect of mechanical stirring at different aeration rates using digested buffalo dung and maize stover on fermentation temperature:

- **Once a week mechanical stirring:**

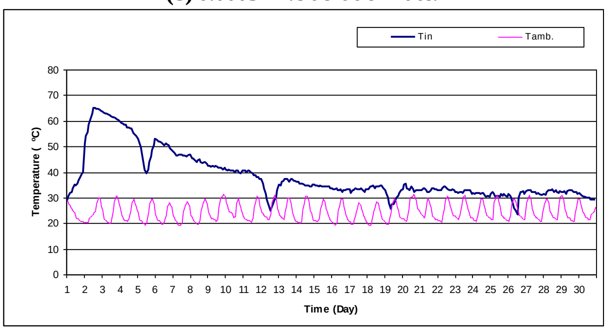
Data in Fig. (2 a, b and c) revealed the temperatures of mixed composting materials inside inside the production unit and the ambient air under once a week mechanical stirring system for 30 minutes and 25 rpm, and three different aeration rates. The obtained results showed that, the peak temperature levels of the composting materials were 68.4, 69.8 and 65.1 ºC at aeration rates of 0.0003, 0.0005 and 0.0007 m^3/s, respectively. During mechanical stirring time at all experiments, the temperature of the compost materials was reduced to about the ambient air temperature and then started to increase inside the production unit. This continuously occurs until the temperature of the composting materials stabilizes approximately with the ambient temperature.



(a) 0.0003 m^3/s aeration rate.



(b) 0.0005 m^3/s aeration rate.

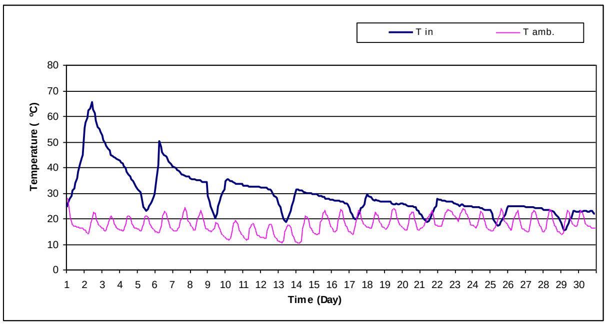


(c) 0.0007 m^3/s aeration rate.

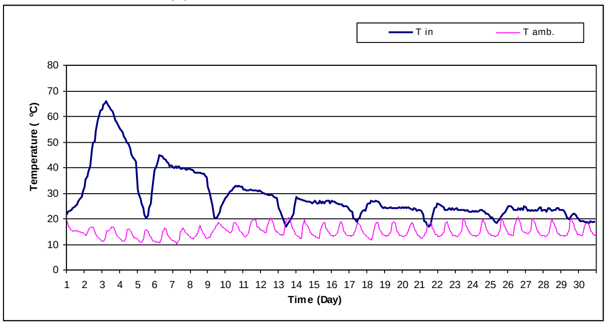
Fig. 2. Temperatures of the mixed composting materials and the ambient air under once a week mechanical stirring system and three aeration rates.

- **Twice a week mechanical stirring:**

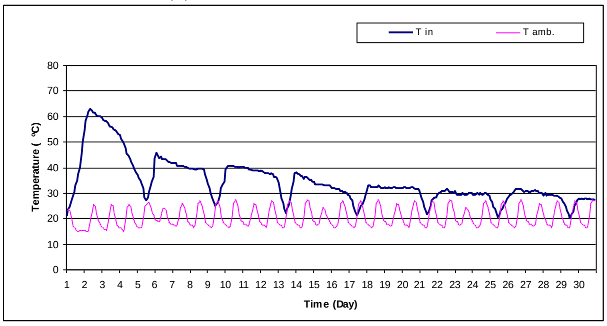
Figs. (3 a, b and c) showed the obtained results for the temperatures of the mixed composting materials inside inside the production unit and the ambient air under twice a week mechanical stirring system for 30 minutes and 25 rpm, and three different aeration rates. The peak temperature levels of the composting materials were 65.5, 65.7 and 62.7 ºC at aeration rates of 0.0003, 0.0005 and 0.0007 m^3/s, respectively. During mechanical stirring time at all experiments, the temperature of the compost materials was reduced to about the ambient air temperature and then started to increase inside the production unit. This continuously occurs until the temperature of the composting materials stabilizes approximately with the ambient temperature.



(a) 0.0003 m^3/s aeration rate.



(b) 0.0005 m^3/s aeration rate.



(c) 0.0007 m^3/s aeration rate.

Fig. 3. Temperatures of the mixed composting materials and the ambient air under twice a week mechanical stirring system and three aeration rates.

In general, the obtained results revealed that the highest peak temperature of composting materials (Biogas digested buffalo dung (effluent) and maize stover) at aeration rate of 0.0005 m^3/s and once-a-week mechanical stirring was 69.8 ºC. While it was 65.7 ºC at the same aeration rate and twice-a-week mechanical stirring. These results revealed that the highest microbial activity of microorganisms was at aeration rate of 0.0005 m^3/s. Some laboratory analyses for the produced compost were carried out to verify some of its physical and chemical properties. Macronutrients contents were also determined, such as the content of N, P and K elements from the produced compost. The results showed that, the aeration rate of 0.0005 m^3/s with once-a-week mechanical stirring was considered as an optimal for the composting process. Thus, it has been used and applied to the fresh buffalo dung and maize stover.

Effect of the optimal mechanical stirring and aeration rates using fresh buffalo dung and maize stover on fermentation temperature:

Data in Fig. (4) presents temperatures of the mixed composting materials inside the production unit and the ambient air under once a week mechanical stirring and aeration rate of 0.0005 m^3/s. The peak temperature of the composting materials was 69.9 ºC. During mechanical stirring time, the temperature of the compost materials was reduced to about the ambient air temperature and then started to increase inside the production unit. This continuously occurs until the temperature of the composting materials stabilizes approximately with the ambient temperature.

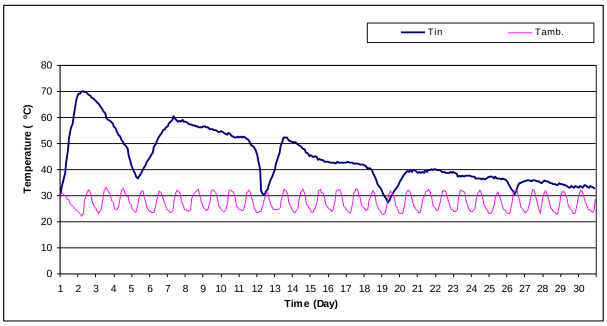


Fig. 4. Temperatures of the mixed composting materials (fresh buffalo dung and maize stover) and the ambient air under once a week mechanical stirring and aeration rate of 0.0005 m^3/s.

Effect of the traditional (open) system on the fermentation temperature:

- **Control $_1$ (digested buffalo dung and maize stover):**

The results in Fig. (5) show temperatures of the mixed composting materials and the ambient air for control$_1$ experiment. The peak temperature of composting materials was 41.6 ºC. The disadvantage of this method is the long period of aerobic digestion. So this experiment took 120 days until the temperature of the composting materials was nearly stabilized with the ambient air temperature and the compost maturity was completed.

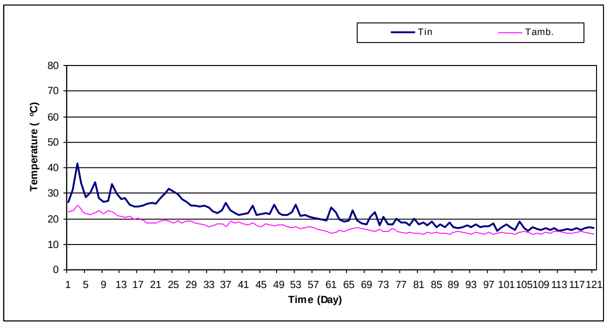


Fig. 5. Temperatures of the mixed composting materials and the ambient air for the control$_1$ experiment.

- **Control$_2$ (fresh buffalo dung and maize stover):**

The data illustrated in Fig. (6) revealed the temperature of the mixed composting materials and the ambient air for the control$_2$ experiment. The peak temperature of the composting materials was 48.2 ºC. The disadvantage of this method also is the long period of aerobic digestion, so this experiment also took 120 days to compost maturity and until the temperature of the composting materials was nearly stabilized with the ambient air temperature.

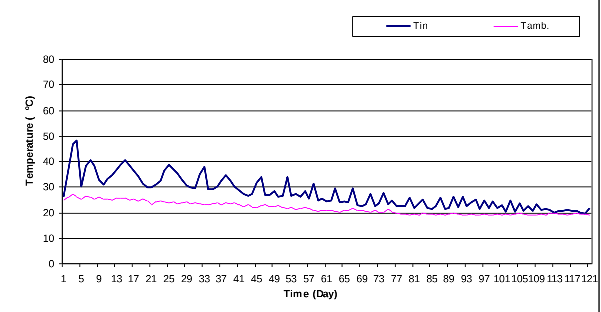


Fig. 6. Temperatures of the mixed composting materials and the ambient air for the control$_2$ experiment.

Moisture content during the composting process:

The results illustrated in in Figs. (7) show the moisture content during the composting process at all experiments. The moisture contents of raw materials were 65.38 and 64.35% w.b for the mixed maize stover with digested buffalo dung and fresh buffalo dung, respectively. The final moisture contents for the cured compost (mixed of digested buffalo dung and maize stover) at once a week mechanical stirring were 33.34, 31.25 and 33.14% with aeration rates of 0.0003, 0.0005 and 0.0007 m^3/s, respectively. While the corresponding values were 37.21, 36.17 and 34.1% w.b at twice a week mechanical stirring and the same aeration rates. The final moisture contents for the cured compost were 23.46, 29.79 and 35.25% w.b for Control$_1$, Control$_2$, and fresh dung with maize stover at 0.0005 m^3/s aeration rate and once a week mechanical stirring in the experimental unit, respectively.

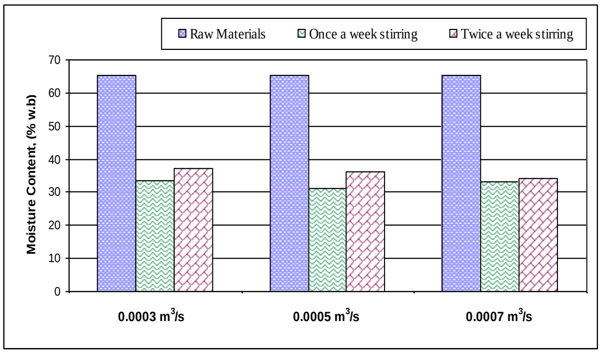


Fig. 7. Moisture content of the mixed composting materials (digested buffalo dung and maize stover) and cured compost at different aeration rates and stirring time.

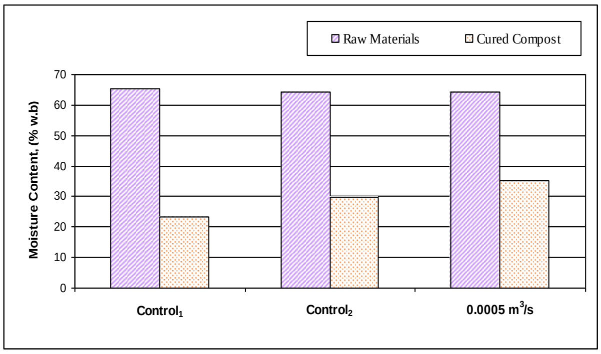


Fig. 8. Moisture content of the mixed composting materials (Control$_1$, Control$_2$ and fresh dung with maize stover) and cured compost.

Organic carbon during the composting process:

The results illustrated in Figs. (9 and 10) show the organic carbon during the composting process at all experiments. The organic carbon of raw materials was 44.53 and 37.15% for the mixed maize stover with digested buffalo dung and fresh buffalo dung, respectively. The final organic carbon for the cured compost (mixed of digested buffalo dung and maize stover) at once a week mechanical stirring was 35.05, 37.29 and 36.33% with aeration rates of 0.0003, 0.0005 and 0.0007 m^3/s, respectively. While the corresponding values were 37.79, 38.26 and 36.61% at twice a week mechanical stirring and the same aeration rates. The final organic carbon for cured compost was 36.36, 32.44 and 34.72 % for Control$_1$, Control$_2$, and fresh dung with maize stover at 0.0005 m^3/s aeration rate and once a week mechanical stirring in the experimental unit, respectively.

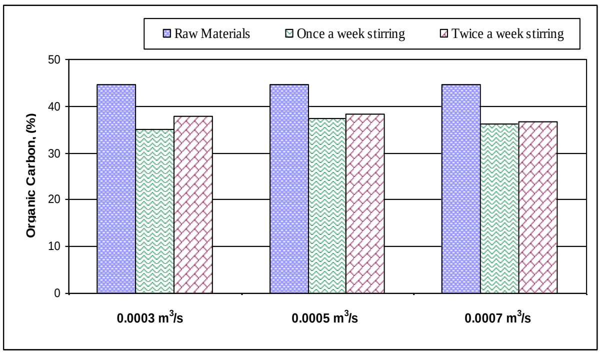


Fig. 9. Organic carbon of the mixed composting materials (digested buffalo dung and maize stover) and cured compost at different aeration rates and stirring time.

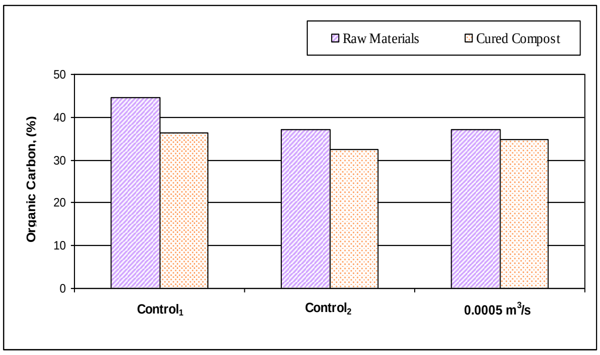


Fig. 10. Organic carbon of the mixed composting materials (Control$_1$, Control$_2$ and fresh dung with maize stover) and cured compost.

Nitrogen content (N) during the composting process:

The results illustrated in Figs. (11 and 12) show the total nitrogen content during the composting process at all experiments. The total nitrogen contents of raw materials were 1.28 and 1.04% for the mixed maize stover with digested buffalo dung and fresh buffalo dung, respectively. The final total nitrogen contents for the cured compost (mixed of digested buffalo dung and maize stover) at once a week mechanical stirring were 2.94, 3.14 and 2.43% with aeration rates of 0.0003, 0.0005 and 0.0007 m^3/s, respectively. While the corresponding values were 2.60, 2.88 and 2.25% at twice a week mechanical stirring and the same aeration rates. The final total nitrogen contents for the cured compost were 2.50, 2.59 and 2.66 % for Control$_1$, Control$_2$, and fresh dung with maize stover at 0.0005 m^3/s aeration rate and once a week mechanical stirring in the experimental unit, respectively.

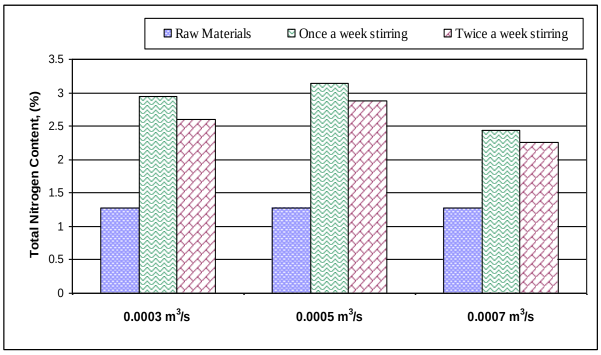


Fig. 11. Total nitrogen content of the mixed composting materials (digested buffalo dung and maize stover) and cured compost at different aeration rates and stirring time.

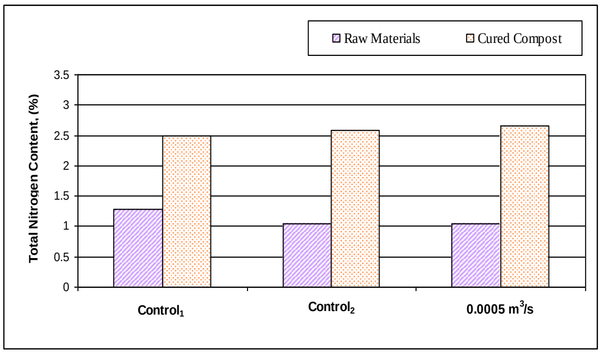


Fig. 12. Total nitrogen content of the mixed composting materials ($Control_1$, $Control_2$ and fresh dung with maize stover) and cured compost.

Phosphorus content (P) during the composting process:

The results illustrated in Figs. (13 and 14) show phosphorus content during the composting process at all experiments. Phosphorus contents of raw materials were 0.271 and 0.213% for the mixed maize stover with digested buffalo dung and fresh buffalo dung, respectively. Final phosphorus contents for the cured compost (mixed of digested buffalo dung and maize stover) at once a week mechanical stirring were 0.688, 0.765 and 0.515% with aeration rates of 0.0003, 0.0005 and 0.0007 m^3/s, respectively. While the corresponding values were 0.545, 0.547 and 0.511% at twice a week mechanical stirring and the same aeration rates. Final phosphorus content for the cured compost were 0.523, 0.542 and 0.553 % for $Control_1$, $Control_2$, and fresh dung with maize stover at 0.0005 m^3/s aeration rate and once a week mechanical stirring in the experimental unit, respectively.

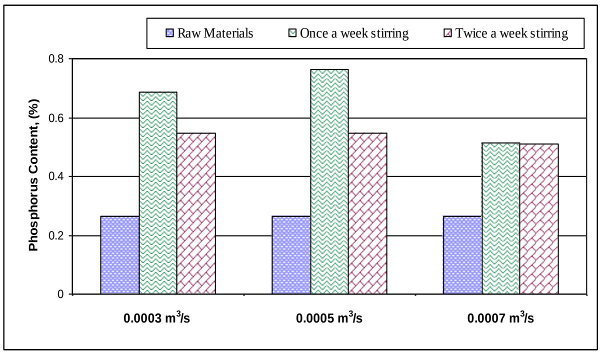


Fig. 13. Phosphorus content of the mixed composting materials (digested buffalo dung and maize stover) and cured compost at different aeration rates and stirring time.

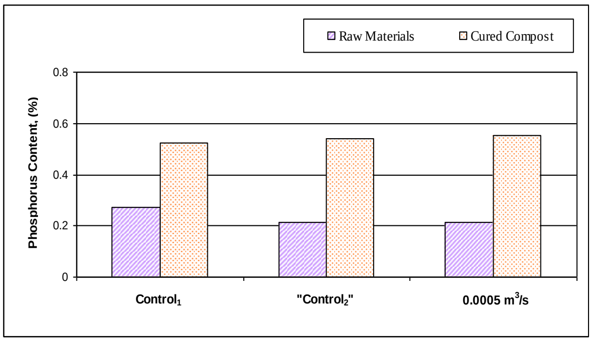


Fig. 14. Phosphorus content of the mixed composting materials ($Control_1$, $Control_2$ and fresh dung with maize stover) and cured compost.

Potassium content (K) during the composting process:

The results illustrated in Figs. (15 and 16) show potassium content during the composting process at all experiments. Potassium contents of raw materials were 1.558 and 1.125% for the mixed maize stover with digested buffalo dung and fresh buffalo dung, respectively. Final potassium contents for the cured compost (mixed of digested buffalo dung and maize stover) at once a week mechanical stirring were 4.281, 4.409 and 4.032% with aeration rates of 0.0003, 0.0005 and 0.0007 m^3/s, respectively. While the corresponding values were 4.259, 4.278 and 4.011% at twice a week mechanical stirring and the same aeration rates. Final potassium content for the cured compost were 3.585, 3.753 and 3.806 % for $Control_1$, $Control_2$, and fresh dung with maize stover at 0.0005 m^3/s aeration rate and once a week mechanical stirring in the experimental unit, respectively.

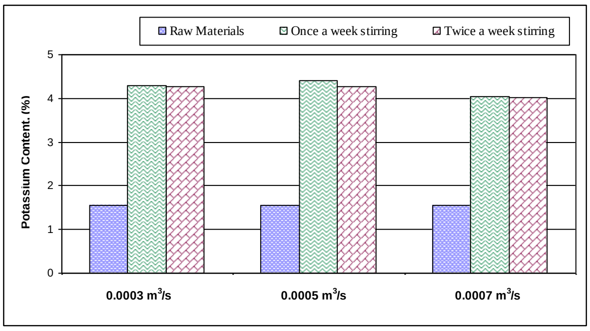


Fig. 15. Potassium content of the mixed composting materials (digested buffalo dung and maize stover) and cured compost at different aeration rates and stirring time.

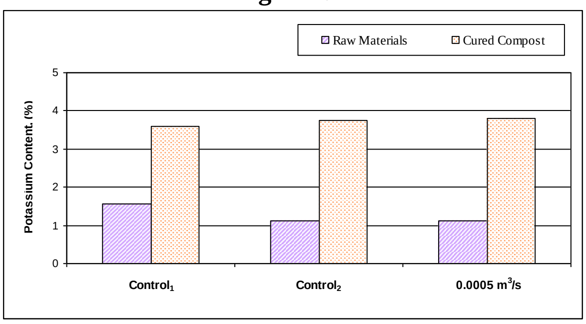


Fig. 16. Potassium content of the mixed composting materials ($Control_1$, $Control_2$ and fresh dung with maize stover) and cured compost.

Pathogenic bacterial counts during the composting process:

Data in table (2) present the count of pathogenic bacterial counts such as *Escherichia coli and Salmonella spp.* For the raw materials and final compost. *Escherichia coli* counts were 2000 and 200 CFU/g for the raw materials fresh buffalo dung and digested dung, respectively. While the corresponding counts were 1010 and 0 CFU/g for the cured compost from mixed maize stover with fresh buffalo dung and digested dung at optimal aeration rate and mechanical stirring (once a week mechanical stirring and aeration rate of 0.0005 m^3/s), respectively. *Salmonella spp.* Counts were 1100 and 20 CFU/g for the raw materials fresh buffalo dung and the digested dung, respectively. While it was 560 and 0 CFU/g for the cured compost from the mixed of maize stover with fresh buffalo dung and the digested dung ", respectively, at optimal aeration rate and mechanical stirring "once a week mechanical stirring with aeration rate of 0.0005 m^3/s".

Data in table (2) also revealed that the pathogenic bacterial counts such as *Escherichia coli and Salmonella spp.* for the biogas digested buffalo dung (Effluent) were 200 and 20 CFU/g, respectively and when the mixture was exposed to the highest peak temperature of 69.8°C the pathogenic bacterial counts such as *Escherichia coli and Salmonella spp.* dropped to 0 CFU/g. for the cured compost from the mixed of maize stover with digested dung at optimal aeration rate and mechanical stirring (once a week mechanical stirring and aeration rate of 0.0005 m^3/s).

Table 2. Pathogenic bacterial counts for raw materials and final compost.

Materials	Pathogenic bacterial counts, CFU/g	
	Escherichia coli	*Salmonella spp.*
Fresh buffalo dung	2000	1100
Digested buffalo dung	200	20
Fresh dung and maize stover (0.0005 m^3/s and once a week stirring)	1010	560
Digested dung and maize stover (0.0005 m^3/s and once a week stirring)	Absent	Absent

CONCLUSION

1. The buffalo dung (digested or fresh) can be mixed with shredded maize stover together at a ratio of 2 part of buffalo dung to 1 part of maize stover (by weight) in order to produce high quality compost.
2. It is recommended to use aeration rate of 0.0005 m^3/s at once a week mechanical stirring to produce compost with good properties inside the experimental unit.
3. According to the physical and chemical analysis, the produced compost from different studied waste mixtures could be used as a good soil conditioner. It contains high concentration of plant nutrient elements (N, P and K) and it has tendency to give higher crop yield, positive soil microbial activities and increase soil fertility. However, according to the biological analysis, the produced compost from the mixture of digested buffalo dung and maize stover is better than that from the mixed maize stover and fresh buffalo dung in that it does not contains pathogenic bacteria such as *Escherichia coli and Salmonella spp.*

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تأثير معدلات التهوية ونظام التقليب الميكانيكي على إنتاج السماد العضوي المصنع (الكمبوست) من بعض مخلفات المزرعة.

صلاح مصطفى عبد اللطيف، ياسر مختار الحديدي وسحر وحيد عبد الغفار القاسمي
قسم الهندسة الزراعية - كلية الزراعة - جامعة المنصورة

تم تنفيذ هذه الدراسة بهدف الوصول للمعدلات المثلى من التهوية والتقليب الميكانيكي لإنتاج السماد العضوي المصنع (الكمبوست) من بعض مخلفات المزرعة في معمل معالجة المخلفات بقسم الهندسة الزراعية بكلية الزراعة - جامعة المنصورة. تم حساب نسبة الكربون إلى النيتروجين (C / N) للمواد الخام موضوع الدراسة (روث الجاموس وحطب الذرة المفروم) لمعرفة نسب الخلط للمكونات الصحيحة. وتم تغذية وحدة من النوع الاسطواني الأفقي بمخلوط من المخلف الحيوانى والنباتى وتسجيل درجات الحرارة للهواء المحيط و المخلوط. حيث تم استخدام روث الجاموس المهضوم (الملاط) وحطب الذرة المفروم مع ثلاث معدلات تهوية مختلفة (0.0003 و 0.0005 و 0.0007 متر مكعب / ثانية) ومستويين مختلفين من التقليب الميكانيكي (مرة ومرتين في الأسبوع) لتحديد المعدلات المثلى من التهوية والتقليب الميكانيكي. وبناءاً على نتائج هذه التجارب تم الوصول إلى المعدل الأمثل للتهوية (0.0005 متر مكعب / ثانية) والتقليب الميكانيكي (مرة في الأسبوع) كنظام أمثل. كما تم إجراء تجربتين كنترول (النظام التقليدي) ، التجربة الأولى تم استخدام روث الجاموس المهضوم (الملاط) وحطب الذرة المفروم (كنترول 1) والتجربة الثانية تم استخدام روث الجاموس الطازج وحطب الذرة المفروم (كنترول 2). وبلغ المحتوى الرطوبي للمخلوط خلال هذا العمل التجريبي حوالي 65٪ على الأساس الرطب. تم ايضاً إجراء بعض التحاليل المعملية للتحقق من بعض الخصائص الفيزيائية والكيميائية والبيولوجية للمخاليط المكونة من المخلفات موضوع الدراسة، والسماد العضوي المصنع الناتج (الكمبوست). وأوضحت أهم النتائج المتحصل عليها من الدراسة الآتي:1- يمكن خلط روث الجاموس (المهضوم أو الطازج) مع حطب الذرة المفروم معا بنسبة 2 جزء من روث الجاموس إلى 1 جزء من حطب الذرة المفروم (بالوزن) لإنتاج السماد العضوى المصنع (الكمبوست) من بعض مخلفات المزرعة.2- يوصى باستخدام معدلات تهوية 0.0005 متر مكعب / ثانية وتقليب ميكانيكي مرة واحدة في الأسبوع لإنتاج كمبوست تتوافر فيه الخصائص الجيدة.3- يوصي بإستخدام الكمبوست الناتج من المخاليط المذكورة كمحسن جيد للتربة حيث إحتوى على تركيز عالٍ من المغذيات النباتية (تركيز N و P و K) ويساعد على زيادة الأنشطة الميكروبية الإيجابية للتربة بالإضافة إلى انه يعمل على زيادة خصوبة التربة، بينما أوضح التحليل البيولوجي أن الكمبوست الناتج من مخلوط روث الجاموس المهضوم مع حطب الذرة أفضل من الناتج من مخلوط روث الجاموس الطازج مع حطب الذرة حيث أنه لا يحتوي على البكتيريا المسببة للأمراض مثل الإيكولاى والسالمونيلا.