

Use of potassium dihydrogen phosphate and sawdust as adsorbents of ammoniacal nitrogen in aerobic composting process

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Abstract

Three kinds of adsorbents—potassium dihydrogen phosphate, sawdust and mixture of potassium dihydrogen phosphate and sawdust were added respectively into composting to investigate their adsorption effect on ammonia. The experimental results showed that all the adsorbents could restrain ammonia volatilizing, with the sorption of potassium dihydrogen phosphate adsorbents being the best of all, the sorption of mixture adsorbent with potassium dihydrogen phosphate and sawdust being the second and the sorption of sawdust adsorbent being the last. Therefore, the total nitrogen loss ratios respectively reduced from 38% to 13%, 15% and 21% after adding these three kinds of adsorbents into composting. However, potassium dihydrogen phosphate produced negative influence on composting properties as its supplemented amount exceeded a quantity basis equivalent to 18% of total nitrogen in the composting, for example: pH value had been lessened, microorganism activity reduced, which finally resulted in the reduction of biodegradation ratio of organic matter. But it did not result in these problems when using the mixture of potassium dihydrogen phosphate and sawdust as adsorbent, in which the amount of potassium dihydrogen phosphate was under a quantity basis equivalent to 6% of total nitrogen in the composting. Moreover, the mixture adsorbent produced better adsorption effect on ammonia, and raised biodegradation ratio of organic matter from 26% to 33%.

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1. Introduction

Composting is one of the fittest methods that can treat municipal solid waste, increase soil organic fertilizer quantity and protect environment. However, in order to get the compost products with good quality, we must improve composting techniques effectively. Therefore, the manipulative measures of the nutrient element used in the composting is an important way to improve the agronomical compost value.

During the last decades, one research object which received much concern was the loss of the nitrogen element as the nutrient element during the aerobic composting process [1–6]. As

one of the major parts that constitutes the cells of microbial biomass in the composting, most nitrides are important nutrient elements, such as amino acid, protein and nucleic acid, etc., as well as the headspring of energy sources or metabolized nitrogen production to microorganisms, and the key factor to keep the compost quality [7,8]. However, there is always some nitrogen loss during the composting process. The major form of the loss is volatilization of some gaseous nitrogen compound, such as ammonia gas, nitrous oxide and nitrogen [9–11]. Another loss is with the leakage of water-soluble ammonia in leachate. The ammonia is the most dominating in all loss, consisting of more than 98% NH₃-N and less than 2% N₂O-N. There are 24–33% of the initial amount of N in the self-heated organic household wastes composts [10].

Ammonia is generated from decomposition of organonitrogen material during the composting process [12], because the part of organonitrogen material can be converted to ammonia by deamination action with the help of enzyme which is a kind

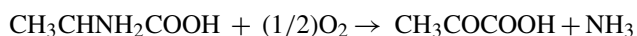
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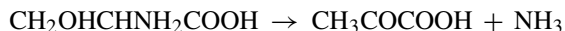
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of process removing amido from aminophenol. So some ammonia is released as gaseous form and is dissolved in liquid to flow out, which result in the loss of nitrogenous substance. In the compost, the organic materials containing nitrogen are mainly protein, aminophenol, signal peptide, uric acid and chitinase. Many kinds of bacteria, actinomycete and fungus have strong aminate ability, which we call them amination bacteria, including *Bacillus subtilis*, *Clostridium*, *Chromobacterium*, *Troteus*, *Pseudomonas*, *Actinomyces* and *Aspergillus*, *Penicillium*, *Mucor* and so on. During the composting process, the protein in plant body should be decomposed into aminophenol, or else other microorganism that could not “eat” it directly. So microorganism produced a kind of deaminase that accelerated all sorts of aminophenol to be decomposed to volatile ammonia when decomposing protein [7,13]. The deamination ways contain:

- (1) *Oxygenation deamination*: It depends on aerobic microorganisms to deaminate, catalysed by deaminase, aminophenol-oxidase and aminophenol-dehydrogenase. The products contain keto-acid and ammonia



- (2) *Dehydration and deamination*: It mainly exists in aminophenol which contains hydroxyl. It can be catalysed by deaminase and dehydration enzyme. The product contain keto-acid and ammonia



- (3) *Hydrolysis deamination*: It exists in deamination action of some kinds of epiphyte and bacteria. Different aminophenol produces different hydrolysate. For example, tryptophan could be hydrolyzed by bacteria and the hydrolysates contain indole, pyruvic acid and ammonia.

So deamination action is the immanent reason for nitrogen-loss in the composting process. Ammonia emission frequently occurs during the thermophilic stage of aerobic decomposition and tends to be high under low C/N ratio.

Previous researches showed that the composting temperature is an important effect factor to volatilization of ammonia [14]. During composting process, if temperature is different, the volatilization output of ammonia will be different. But in fact it is related with microorganism's activity. Martins and Dewes [15] proved that the decomposing of organic mass was so intense, and much ammonia was produced. In the initial composting phase, there was the largest output of ammonia. And ammonia production in per mass unit of critter's dejecta compost reached peak. Besides, the intense decomposing of organic compounds by microorganism promoted the rise of temperature in compost. Thereby the volatilization output of ammonia was enhanced. Dewes [5] also proved it. His research indicated that in three different temperature phase (22.9, 34.3, and 69.5 °C), the production of ammonium (NH_4^+ -N) gradually increased along with temperature rising in compost and ammonia's volatilization was also enhanced.

Li et al. [16] compared the output of ammonia in aerobic compost using different plants materials. The results indicated that the output varied with the different plants. Brink [17] also compared the influence of straw and other carbon resources on nitrogen compounds' losses in compost. His results also proved that the different composting material was the intrinsical reason of ammonia's output. These confirmed that the character of different plants having different ammonia's output in the same conditions is related with the constitutes of biology.

The nitrogen losses result in negative effects on the composting because they not only slow down the speed of organic matter biodegradation by microorganisms in the composting process, but also worsen the quality of compost products. Simultaneously, gaseous nitride such as volatile ammonia in the composting produces bad smell and does harm to the environmental atmosphere. Therefore, many environmental researchers have focused on studying the fittest manipulative measure to avoid the loss of nitrogen matters in the last few years. Presently there are three methods to control the loss of nitrogen matters: the first method is utilizing the property of composting itself to decrease the volatilization of nitride [6,18]. The study showed carbon-containing matter in the composting such as sawdust and straw, etc. can reduce the volatile loss of nitride. The second method is using adsorbents in the composting to reduce the volatile loss of nitride [19,20]. Some common adsorbents are clay, zeolite, moorbad mud and basalt, which have good physical adsorption property for ammonia gas and N_2O gas released from composting. The third method was stated by Yeon-Koo and Jin-Soo [21], etc., which showed that hydrogen phosphate was added into the composting to adjust the pH value, adsorb ammonia through chemical ways, and reduce the volatilization of ammonia. His research results showed that the loss of ammoniacal nitrogen was obviously reduced and nitrogen content increased to 1.4% if the hydrogen phosphate was added into the composting, being three to five times more than that of common composting, and besides, phosphate produced in this process could exist in the nature stably. But the amount of the hydrogen phosphate added into composting was inaptitude, excessive potassium dihydrogen phosphate (KH_2PO_4) will produce negative effects on composting property, for example: the initial pH value was lowered down, the microorganism activity was reduced, and the biodegradation ratio of organic matter decreased.

To reduce the negative effects when only using hydrogen phosphate in aerobic composting, this work was conducted to investigate systematically the effect of a mixture of carbon-containing matter and appropriate hydrogen phosphate on the adsorption of ammonia in aerobic composting and the adsorption mechanism of ammonia.

2. Materials and methods

2.1. Composting materials and reactor

2.1.1. Materials

Some municipal organic solid wastes were adopted in this experiment, including garden plant wastes, edible plant wastes

Table 1
Physiochemical properties and content of the composting materials

Number	Adsorbent	Adsorbent quantity (%)	Organic matter (%)	Ash (%)	Moisture ratio (%)	TC	TN	C/N ratio	Initial pH
1#	Empty	0	71	29	63	39.44	1.23	32:1	7.5
2#	Sawdust	30	42	34	60	36.67	1.11	33:1	6.8
3#	K ₂ HPO ₄	0.18	70	30	61	38.59	1.21	32:1	5.9
4#	K ₂ HPO ₄ + sawdust	0.06 + 15	55	32	62	37.78	1.22	31:1	6.5

and humus soil, which were full of microbe in the refuse dump. The physiochemical properties and content of those composting material at the beginning were shown in Table 1. Adsorbents were composed of sawdust and potassium dihydrogen phosphate (KH₂PO₄ chemical pure reagent) (compositions of the composting organic materials shown in Table 2 [22–25]).

2.1.2. Apparatus

PHS-25 acid meter; LZB-6 rator flow meter; micro-N/C analysis meter; PGM-2000 & 2020 complex gas measure.

2.1.3. Equipments

The experimental compost reactor was set up by ourselves. Its inner diameter and height are 0.60 and 0.40 m, respectively, and height of composting mass is about 0.25–0.30 m in the reactor (the structure design of compost reactor was described in Ref. [26]).

2.2. Composting methods

The composting materials were chipped to 10–15 mm before mixed with adsorbents—sawdust, potassium dihydrogen phosphate, mixture of sawdust and potassium dihydrogen phosphate, respectively (potassium dihydrogen phosphate dissolved in the water then sprayed into the composting), and then added into the reactor to incubate. Urea was used to adjust the C/N ratio in the composting if it could not meet the composting requirement. The composting needed aeration supplied by a compressor and the aeration amount was controlled by air flow meter. The conditions of the ferment were that the temperature was ranged from 21 to 38 °C, the pile was aerated twice in the morning and evening, in which the air flow was controlled at the level of 0.3 m³ h⁻¹ and each time lasted for 30 min (the composting tester was shown in Fig. 1).

Table 2
Major compositions of the composting plants (ω , %)

	Moisture	Protein	Fatty	Fiber	Lignin	Water-solubility carbohydrate	Ash	Rest
Little cabbage leaves	94.2	1.5	0.3	1.1	–	1.6	1.0	0.30
Bud cabbage leaves	93.4	1.7	0.2	0.6	–	3.1	0.8	0.21
Cabbages leaves	93.2	1.5	0.2	1.0	–	3.6	0.5	0.15
Asparagus lettuce leaves	94.2	1.5	0.2	1.0	–	2.6	0.6	0.17
Potato leaves	86.4	2.0	0.3	2.8	–	6.8	1.4	0.30
Sweet potato leaves	87.5	2.0	0.5	2.5	–	6.0	1.5	0.24
Watermelon leaves	90.0	1.5	0.3	2.6	–	4.0	1.5	0.20
Haricot leaves	84.2	1.8	0.4	3.0	–	8.6	1.7	0.32
Leaves	13.0	1.3	2.6	32	3.5	41.4	4.0	2.2
Dry grass	32.0	3.8	1.6	33	9.2	15.4	3.7	1.3
Sawdust	12.0	5.0	2.5	37	25	13.5	4.0	1.0

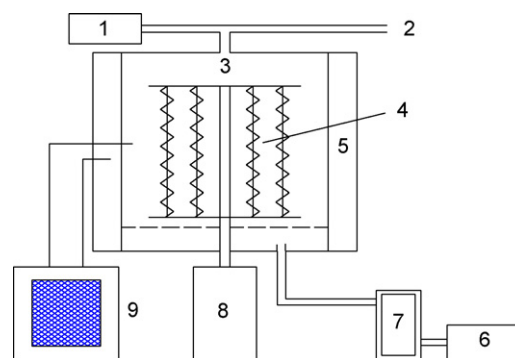


Fig. 1. Compost tester. (1) Gas measurer; (2) gas discharging mouth; (3) reactor; (4) blender; (5) heat preservation layer; (6) air compressor; (7) gas flowmeter; (8) power; (9) heat preservation apparatus.

After the beginning of composting, the composting pile was turned over every 3 days in order to diffuse oxygen and mix the materials.

2.3. Chemical and biological analyses

Total organic matter (TOM) content: samples were dried at 105 °C for 8–10 h in desiccator, then burned at 550 °C for 5–6 h in muffle. The total organic matter content was gained by the weight difference with content of ash [27].

Total nitrogen (TN) content: 1 g samples were dissolved in certain amount of distilled water in addition with 1.2 g K₂SO₄, 0.4 ml 1 M CuSO₄ and 5 ml 98% H₂SO₄, and the total nitrogen content was measured by Kjeldahl method [28]:

$$\text{TN} = \text{percent of nitrogen} \times \text{composting quantity}$$

Water-solubility ammonia (WSA) concentration, water-solubility nitrogen (WSN) concentration and water-solubility

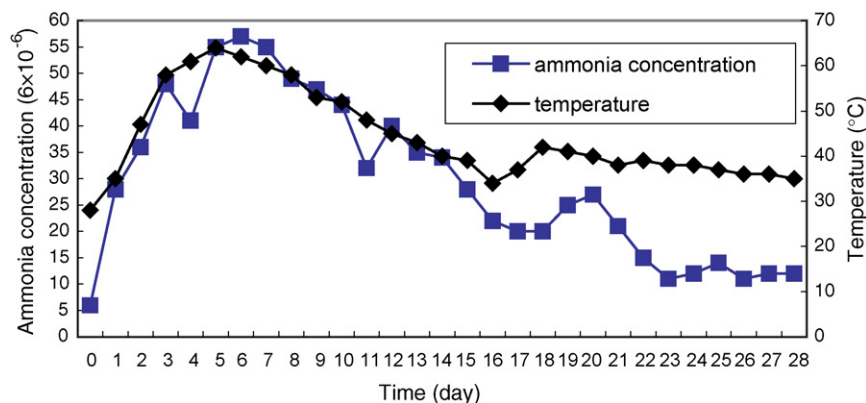


Fig. 2. Change of gaseous ammonia concentration and temperature.

carbon (WSC) concentration: samples were dissolved in 1 mol L^{-1} KCl acid solution (pH 4–5) and shaken for 1 h, and then filtered through filter paper and $0.45 \mu\text{m}$ screen [29]. WSN, WSC was measured by micro-N/C analysis meter, WSA was determined by method of MgO distillation [30].

Ammonia gas released during the composting was analysed with PGM-2000 & 2020 equipment.

3. Results and discussions

3.1. Absorption of ammonia in aerobic composting by different adsorbent materials

3.1.1. The principle of ammonia-nitrogen producing and loss in composting

As described in Section 1, because of the deamination action during the composting process, a great deal of ammonia will produce and be volatile gas in appropriate condition. The composting temperature and WSA concentration are two main affecting factors of ammonia volatilization. Fig. 2 shows the change of temperature and the ammonia volatility in different process of composting 1#. From the diagram, at the beginning

of composting, because the ammonia could not be produced without the help of microorganism even if containing abundant organic-nitrogen in the composting materials, the concentration of gaseous ammonia was very low, only 6×10^{-6} . After 1 day, organism began to be decomposed and fermented in the composting, and ammonia was also generated. With the degradation of organism and with the composting temperature rising rapidly, the ammonia generated in large amount and released quickly. At the third day, the composting went into a high-temperature period, all kinds of biodegradable organism accelerated decomposing speed, a great deal of ammonia were produced to release into air or dissolve into liquid to form WSA (shown in Fig. 3). To the fifth day, the temperature reached the top temperature (64 , 62°C), the amount of gaseous ammonia increased quickly in high temperature, and the highest concentration was as 10 times as the initial one. Meanwhile, the concentration of WSA also reached 1.8707 mg g^{-1} , but the concentration of WSA was not the peak value yet, and it just reached top value of 2.258 mg g^{-1} at the eighth day.

The WSA concentration was the other affecting factor of ammonia volatilization. It was the main limit to the ammonia volatility. From Fig. 3, the changes of volatilization ammonia

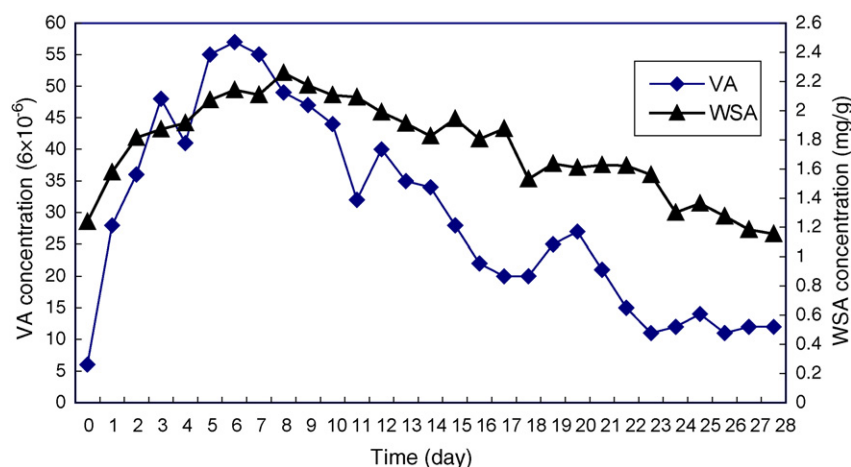


Fig. 3. Comparison between concentrations of water-solubility ammonia and volatile ammonia.

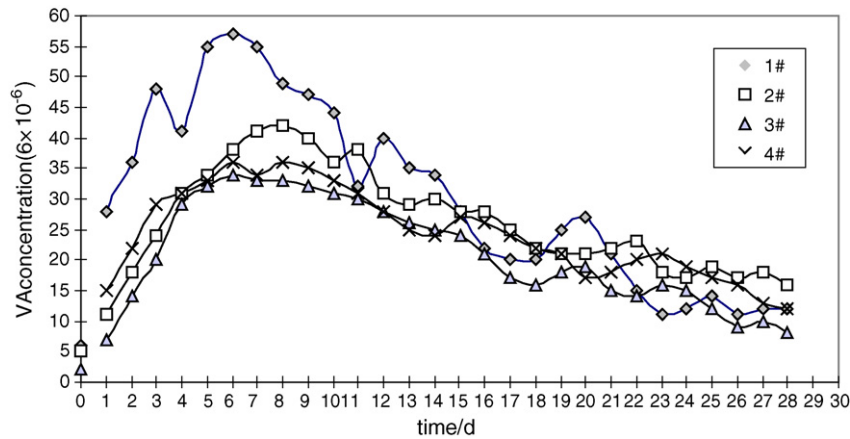
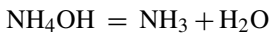


Fig. 4. Volatilization ratio of ammonia with different sorbents added.

concentration and WSA concentration indicated to be irregular parabola change. That is, their concentrations increased rapidly and then decreased slowly after the culmination of the composting process occurred in the whole process, the change of volatilization ammonia concentration had the similar trend with change of WSA concentration. There is an equilibrium relation between them shown as chemical equation:



The reaction equilibrium could be expressed by a formula:

$$K_C^\ominus = \frac{C_{\text{NH}_3}}{C_{\text{NH}_4\text{OH}}}$$

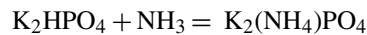
where K_C^\ominus is the equilibrium constant, C_{NH_3} the equilibrium concentration of ammonia and $C_{\text{NH}_4\text{OH}}$ is the equilibrium concentration of WSA. So on the basis of reaction equilibrium principle, we could draw the same conclusion that the volatilization of ammonia was influenced by the change of the WSA concentration.

The above conclusions agreed with Dewes and Martins' studies [5,15]. They found that ammonia would be produced greatly with composting temperature increasing because of biodegrading action of microorganism. It resulted in the increase of ammonia volatilization amount and the gradual increase of the WSA concentration.

3.1.2. The effect of different adsorbents on ammonia

As shown in Fig. 4, the ammonia volatilization decreased greatly after adding different adsorbents in composting 2#, 3#, 4#. The concentration of volatilization ammonia in composting 1# was the highest one in all composts during the first 15 days of the composting process, whose peak value was 57×10^{-6} . The result indicated the adsorbents had very strong sorption or absorbing effect to ammonia. However, the three adsorbents had different sorption or absorption ability. The ammonia volatilization in composting 3# was the lowest, indicating that potassium dihydrogen phosphate had the best absorption ability. The mixture of potassium dihydrogen phosphate and sawdust in composting 4# was the second and sawdust was the weakest.

According to the former (see Section 3.1.1) description, we know that the potassium dihydrogen phosphate absorbed ammonia by chemical reaction, resulting in its strong absorption ability and stability at high temperature. The reaction equation was shown as:



However, the amount of the potassium dihydrogen phosphate added into the composting 3#, which a quantity basis equivalent to 0.18% of total nitrogen, was inaptitude. The excessive potassium dihydrogen phosphate produced negative influence on composting property, for example: initial pH value has been lowered down (Fig. 6), microorganism activity reduced and biodegradation ratio of organic matter decreased (Table 4).

The sorption of ammonia in sawdust mainly depended on physical sorption action and biological effect. The former is because of its high surface porosity and the latter is because sawdust has high carbon content, which may result in the increase of aqueous phase C/N ratio and the intense microorganisms attachment and their ability to use Brink [17] and Eklind [6] also had the report that the addition of high carbon content material in low carbon content composting could reduce the loss of ammonia, such as the hard sawdust or carbon powder added into sludge composting and the straw or sawdust added into food waste composting. However, generally the biological effect and physical sorption action of sawdust are not as strong as chemical sorption action, and they are affected by temperature. As a result, the sorption ability of potassium dihydrogen phosphate on ammonia is stronger than that of sawdust.

Absorbing ammonia with the mixture of potassium dihydrogen phosphate and sawdust in composting 4# utilized the virtue of potassium dihydrogen phosphate, namely, strong chemical absorption action. While the amount of the potassium dihydrogen phosphate added into the composting 4# was appropriate, but not resulting in negative influence on composting property. In the composting, the sawdust made up for insufficiency of the absorption ability on ammonia.

Additionally, we found by the research that there was difference among the losses of total nitrogen produced using different adsorbent materials. The lowest was the 3# (with mixture of

Table 3
Loss ratio of total nitrogen in each composting after 28 days

Number	Nitrogen loss (%)
1#	38
2#	21
3#	13
4#	15

Table 4
Biodegradation ratio of organic matter in those composting after 28 days

Number	Biodegradation ratio (%)
1#	26
2#	29
3#	22
4#	33

potassium dihydrogen phosphate and sawdust), in which the loss ratio was only 13%. The next was 4# (with potassium dihydrogen phosphate and sawdust), in which the loss ratio was 15%. The highest was 2# (with sawdust), and the ratio was 21% (shown in Table 3). The loss of total nitrogen using control adsorbent 1# was 38% (shown in Table 3). It is consistent with the conclusion as above. It indicates that lower volatilization of ammonia produces lower loss of total nitrogen.

3.2. Effect on aerobic composting property using different adsorbents

3.2.1. Effect on degradation ratio of organic matters in composting using different adsorbents

Three kinds of adsorbents had influence on degradation of organic matters. As shown in Table 4, the degradation ratio of organic matters in composting 2# and 4# was higher than composting 1# and 3# by 28 days' composting. There were about 70% organic matters in the initial compost materials (shown in Table 1). After 28 days, the organic matters in four composts were 26%, 29%, 22% and 33%, respectively. So degradation ratios of 2# and 4# were improved to 3% and 7%, respectively, comparing with composting 1#. This indicated that the absorption and sorption of ammonia benefited composting pro-

cess. Because during the composting process organic matters and nitrogen are very important for growth and reproduction of microorganism, the growth of nitrogen concentration can promote composting speed. Hence, although there was lots of sawdust in composting 2# and 4#, their degradation ratios were still higher than that of composting 1#. In addition, with negative effect on composting property because of inaptitude amount, the degradation ratio of organic matters in composting 3# was the lowest in all composting (shown in Table 4).

3.2.2. Effect on temperature of composting using different adsorbents

As shown in Fig. 5, the tendency of temperature changes in all composting was almost the same. At the beginning of composting, the change of temperature was rising gradually. It began to fall down gradually from top value after 3 days. About 10 days later, the change of temperature was not obvious and started to vibrate with small breadth. However, the temperature of composting with different adsorbents had obvious change in different composting stage. The highest temperature was 66 °C in composting 4# and higher than 64 °C in composting 1#. The stage of high temperature lasted 4 days. These indicated that the activity of microorganism in composting 4# was the highest and the biochemical reaction was the most acute in all compostings. It is consistent with its highest degradation ratio of organic matters. On the contrary, the highest temperature was only 58 °C in composting 3#, in which the temperature increase was lower than that of composting 1# by 6 °C. It indicated that the bio-chemical reaction in composting 3# was moderate. The temperature change in composting 2# was between in composting 3# and 4#. Its highest temperature was near to that of composting 1#. The temperature in composting 2# was a little lower than that of composting 1# on the later phase. To sum up, the temperature change was different in composting using different adsorbents in the normal range.

3.2.3. Effect on change of pH value of composting using different adsorbents

Usually, the best range of pH value of composting is 6.5–7.5 and the pH value is change during the composting, but there is a low pH value controlled by the composting materials at the initial composting phase. The range is fit for the composting microorganism growth and too high or too low pH will affect the

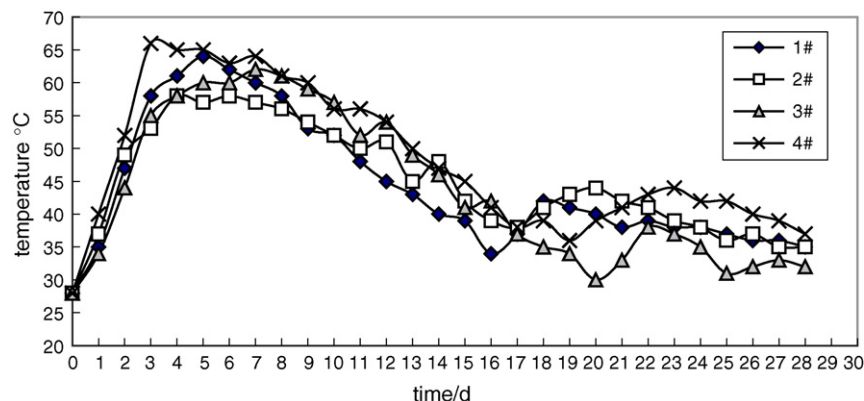


Fig. 5. Temperature variation.

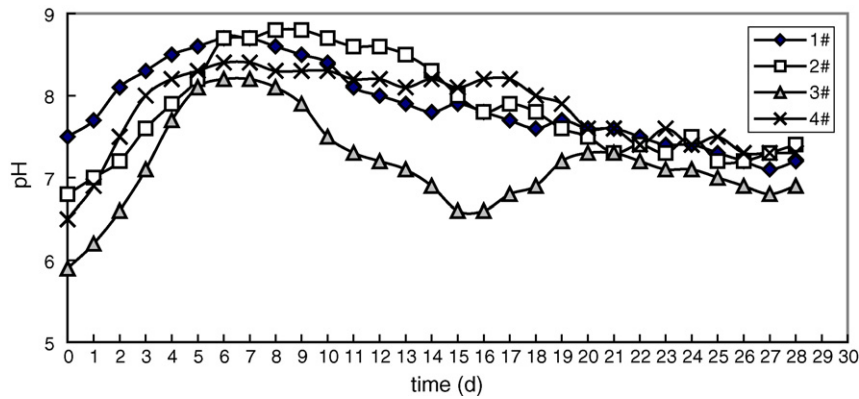


Fig. 6. Variation of pH value.

activity of the microorganisms or kill them. But the pH value of composting 1# varied from 7.5 to 8.7 during composting process because of a lot of ammonia volatilizing. The pH variation range leaned alkalinescence range.

Adding different adsorbents into composting altered variation range of pH value of composting. As shown in Fig. 6, we saw the initial pH value of composting 3# was lower than 6.0, also the lowest one in all compostings. After 6 days of composting, the pH value reached 8.2, its top value, and then lasted 4 days in the high pH value phase. The pH value varied at 6.9–7.5 in later composting days. It indicated that the ammonia concentration in composting was controlled in appropriate range. The initial pH value of composting 4# was 6.5, being the appropriate initial value. After 6 days of composting, the pH value reached its top value (8.4). Then its value varied from 7.3 to 8.2 in later composting days. The pH variation range leaned little alkalinescence range. The pH value of composting 2# which was similar to that of composting 1# was the initial high value (6.8). After 8 days of composting, the pH value reached 8.8, the maximal value in all that of compostings. The pH value turned above 7.0 in later composting days. The pH variation range leaned alkalinescence range.

Thus, in general, these three kinds of pH values of compostings with different adsorbents added were small pH value variation range and more fit for microorganism growth. However, though the pH value was controlled in appropriate range in most time of composting 3#, because of using excessive potas-

sium dihydrogen phosphate as adsorbents, its lower initial pH value was not very fit for microorganism growth.

3.2.4. Effect on change of C/N ratio in aqueous phase of compostings using different adsorbents

C/N ratio in aqueous phase was investigated in the experiment. The variations of C/N ratios in aqueous phase of the four compostings were shown in Fig. 7. There was the same variation trend for C/N ratios. But the initial C/N ratio of composting 2# had been a little different and was 18.3 which was very high value. It was due to the high carbon content in the initial materials using sawdust. In addition, the C/N ratio of composting 3# was higher than that of other composting at end of composting, which indicated its lower degradation ratio of organic matters in composting. But their C/N ratio always decreased gradually in the whole composting process. The C/N ratios of all compostings were under 5 after 28 days except for composting 3#. It indicated the end of composting [22].

However, this conclusion seemed to be contrary with the former theoretical analysis, because the ammonia volatilization should improve the C/N ratio and should reduce C/N ratio after adding the adsorbents to adsorb ammonia. In fact, the aqueous ammonia concentration was determined not only by the volatilization of ammonia but also by the decomposition of organics nitrogen [31]. When the ammonia concentration in the aqueous phase varied too quickly, the microorganisms would regulate the decomposition of organics nitrogen in composting.

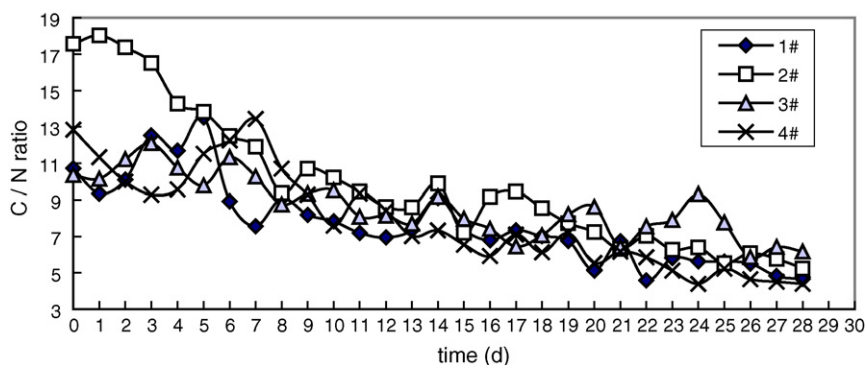


Fig. 7. Variation of water-solubility C/N.

As a result, the C/N ratio in the composting would not change significantly in the whole process and only decrease gradually. In addition, based on our experiment we found that the value of organic carbon and value of organic nitrogen in the composting was comparatively small so as to have little effect on C/N ratio variation.

4. Conclusions

In aerobic composting, the organic nitrogen compounds in frond were decomposed and absorbed by microorganism by their enzymatic action, but parts of the organic nitrogen compounds could not be absorbed to transform ammonia to dissolve in compost liquid or volatilize. The volatility ammonia concentration changed during the composting process, which commonly presented the change of irregular parabola, but the volatility ammonia concentration gets to a peak in the composting seventh day, ten times of initial value. This is major source of N losses. Of course, the migratory losses of water-soluble ammonia are a part of total N losses.

For controlling the ammonia volatility loss, the adsorption capability of three kinds of adsorbents—potassium dihydrogen phosphate, sawdust and mixture of potassium dihydrogen phosphate and sawdust on ammonia was investigated. The adsorption mechanisms of those adsorbents on ammonia are analysed. The research results showed potassium dihydrogen phosphate “adsorbing” ammonia is chemical absorption, sawdust “adsorbing” ammonia is physical sorption. The experimental results also showed that all the adsorbents could restrain ammonia volatilizing well. But absorbing capability of potassium dihydrogen phosphate on ammonia was the largest of all, one of the mixtures of potassium dihydrogen phosphate and sawdust was the next, one of sawdust was the smallest of all. So the total nitrogen loss ratios were reduced from 38% to 13%, 15% and 21%, respectively, after adding the three kinds of adsorbents into composting.

However, excess potassium dihydrogen phosphate in the composting would produce negative influence on composting property, for example: the initial pH value had been lowered down, microorganism activity reduced and biodegradation ratio of organic matter decreased. However, there were no such problems when using the mixture of potassium dihydrogen phosphate and sawdust as adsorbent in the composting. The mixture adsorbent could not only reduce ammonia volatilization, but also improve biodegradation ratio of organic matter in composting, and improve the quality of the composting products.

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Teachers in Higher Education Institutions of MOE, PR China (TRAPOYT) in 2000.

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