Effects of Inoculating Microbes on Nitrogen Form During the Municipal Solid Waste Compost

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Abstract: Inoculating two kinds of microbes (MS compound strains and ZHJ fermentation), study on the effect of the MSW compost on the nitrogen and maturity, the results showed, comparing with that of compost primary, the content of total nitrogen obviously declined at the end of the MSW compost. The two kinds of microbes could accelerate the transform of water-soluble NH_4^+-N and the formation of the water-soluble organic nitrogen, and could advance the compost maturity comparing with the treatment without inoculating microbes. [Nature and Science, 2004,2(2):73-76]

Key words: compost; inoculating microbes; nitrogen form

1 Introduction

Compost is one of the main ways of the municipal solid waste (MSW) treatments (He, 1992). The compost process is, the materials (metal, plastic, glass alt), which can't decomposition, are picked out to recovery, then the residual organic matter are composted, during compost period, the pathogenic bacterium and weed seed are killed by the high temperature produced by the organic matter decomposition. After the MSW compost complete, the decompost manure would be save use as soil fertilizer (Riffaldi, 1986; Ciavatta, 1993; Levi-Minzi, 1986). In fact the MSW compost is a process of organic matter decomposition, and the organic nitrogen is the main form of the nitrogen element in the MSW, therefore, how to control the nitrogen loss and raise the nutrient content are the key to the MSW compost research. The paper would examine the effects of two kinds of inoculating microbes on nitrogen form and compost efficiency with the same compost factors.

2 Materials and Methods

2.1 Compost materials

MSW: the residual matter after the decompositions (metal, plastic and glass *et al*) were picked out.

The MSW nutrient elements content: C, 323.24 g/kg; N, 14,88 g/kg; P_2O_5, 10,02 g/kg; K_2O, 12.80 g/kg. H_2O, 56%.

MS compound strains (MS): provided by Daqing Meishang Company. Strains content: 1×10^9/mL.

ZHJ fermentation strains (ZHJ): provided by Zhongjia Biological Technique Limit Company.

Strains content: 1×10^9/mL.

2.2 Experiment method

Experiment site: Daqing Meishang MSW compost plant.

Experiment date: March 15 to May 18, 2003.

The experiment included 3 treatments; each treatment was replicated 3 times. Experiment treatment materials composition was showed in Table 1.

Table 1 Ratio of different composting materials

	Treatment	MSW (kg)	MS (mL)	ZHJ (mL)	Water content %
1	MSW	10			60
2	MSW+MS	10	100		60
3	MSW+ZHJ	10		100	60

10 kg MSW was put into nylon mesh sack in each treatment, and the nylon mesh sacks were random buried at same depth into the bar MSW fermentation pile, bar compost pile was 150 m long. Its cross section

was triangle, 4.5 m in width and 1.50 m high. Compost process adopted two-step fermentation.

2.2.1 One-step fermentation indices

Water content of input organic matter: 60%.

Water content of output organic matter: 30%.

Oxygen density: ≤10%.

Compost temperature: 55℃≤T≤75℃, lasted more than 5 days.

Turn over the fermentation piles: once a week.

Fermentation period: 28 days.

2.2.2 Two-step Fermentation Technology Indices

Water content of input organic matter: 30%.

Control water content at two-step compost primary period: 50%.

Water content of output organic matter: 25%~30%.

Oxygen density: ≤10%.

C/N: ≤20:1.

Fermentation pile high: 2.2 m.

Turn over the fermentation piles: once a week.

Fermentation period: 35 days.

2.3 Sampling

When the MSW fermentation piles were turned over, the nylon mesh sacks were taken out and ventilated, at same time, MSW samples were respectively taken from each nylon mesh sacks on 7, 14, 21, 28, 35, 49, 63 days, each sample weigh 500 g, 200 g fresh MSW sample was measured water content and water-soluble matter, the rest air dry, and grinded to sieve (the sieve aperture is 1 mm), measured total N and organic C.

2.4 Measuring item and methods

Water-soluble matter measure method:

To 100 g MSW fresh sample and 200 mL of distilled water were added. And the solution was shaken for 30 min. The centrifugate of the suspension was filtered and stored at 4℃.

Water-soluble organic N: H_2SO_4 digestion, steam-distilled.

Water-soluble NH_4^+-N: steam-distilled.

Total N: H_2SO_4, Se-K_2SO_4-$CuSO_4$, digestion, steam-distilled.

Organic C: $K_2Cr_2O_7$, H_2SO_4 capacity method.

3 Results and Analysis

3.1 The effect on total N

The Figure 1 showed, at the end of MSW compost, the total N contents of all the treatments decreased comparing with those of compost primary period, which indicated, during the MSW compost, nitrogen could lose to certain extend when decomposing of organic matter. The declination characteristics varied owing to the different treatments. The total N content declined continuously in treatment 1 without inoculating microbes during the whole compost period, while those treated with inoculation microbes reached to the minimum value at 5 and 4 weeks after composting. Comparing to the minimum value, the total N contents of treatments 2 (MS and 3 (ZHJ) decreased 32.97% and 29.67% respectively, then raised little. The results showed that the inoculating microbes accelerated the decomposing of the organic matter in MSW, furthermore, accelerated the loss of nitrogen at the primary period of the compost, comparing to the end of compost period, the total N content of the treatment 1, 2 and 3 declined 29.77%, 26.49% and 28.74% respectively. The results showed the inoculating microbes didn't accelerate the loss of the total N, on the contrary, the total N accumulated to certain extend comparing with that of treatment without inoculating microbes.

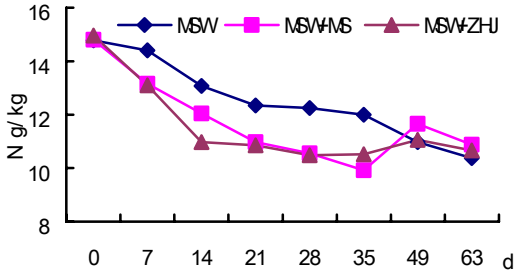

Figure 1 Effect on total N of the compost

3.2 The effect on water-soluble organic nitrogen

The water-soluble organic N was increased at each treatment (Figure 2). The water-soluble organic nitrogen in the treatment without inoculating microbes could increase from 0.035 g/kg at the beginning of compost to 0.186 g/kg at the 63rd day, which increased 4.31 times, that of treatment with inoculating MS microbes increased from 0.038 g/kg to 0.412 g/kg (9.84 times), while that of treatment inoculating ZHJ microbes increased from 0.042 g/kg to 0.398 g/kg (8.48 times). The water-soluble organic N without inoculating microbes raised slowly at the whole compost period, while those with MS raised between 0~35 days, then trended to stable. At the same time, those with ZHJ were always raised between 0~49 days, then trend to stable. The results showed that the inoculating microbes could

benefit for the formation of water-soluble organic N.

3.3 The effect on water-soluble NH_4^+-N

The Figure 3 showed, the water-soluble NH_4^+-N in all treatments during compost period, the NH_4^+-N content in the treatment 1 without inoculating microbes declined from 1.52 g/kg at the beginning of compost to 0.35 g/kg, declined 76.97%; that of the treatment inoculating MS microbes declined from 1.48 g/kg to 0.21 g/kg (85.81%); while that of the treatment inoculating ZHJ microbes declined from1.52 g/kg to 0.30 g/kg (80.26%). The declination trends owing to the different treatments, the NH_4^+-N content in the treatment 1 without inoculating microbes declined continuously between 0~63 days, while that of inoculating microbes treatment declined continuously between 0~35 days, then the content trended to stable. The results indicated inoculating microbes in compost would advance the stable period of water-soluble NH_4^+-N.

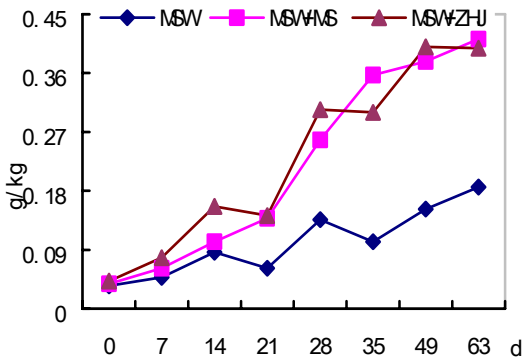

Fig. 2 Effect on water-soluble N of the compost

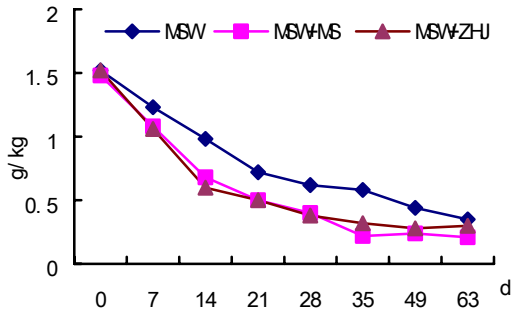

Fig 3 Effect on water-soluble NH_4^+-N of the compost

3.4 The effect on compost maturity of the carbon/ organic nitrogen ratio in water extract

The ratio of the C/N doesn't be taken as the index of the MSW compost maturity, but the ratio of the water-soluble organic carbon (WSC) to water-soluble organic nitrogen (WS org-N) would value the compost maturity (Chanyasak, 1981;Garcia, 1990; Garcia, 1992), at general, if the ratio of WSC/WS org-N reached between 4 and 6, we can regard the compost as maturity. The Figure 4 showed, the ratio of WSC/WS org-N in different treatments increased in the whole compost period, and the ratio of the WSC/WS org-N of the treatment 1 without inoculating microbes exceed 4 after 7th week (WSC/WS org-N, 4.02), while that of treatment 2 inoculating MS microbes and treatment 3 inoculating ZHJ microbes exceed 4 at 5th week (treatment 2 WSC/WS org-N, 4.12; treatment 3 WSC/WS org-N, 4.82), the result showed, inoculating microbes would advance the compost maturity, and the treatment 3 was the best.

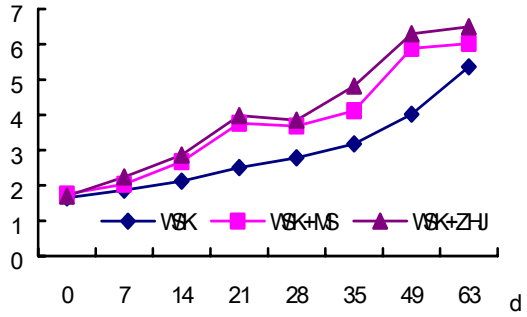

Figure 4 The ratio of WSC/WS org-N during the compost

4 Conclusions

a. During the MSW compost, the total nitrogen of all the treatments declined, but the total N content of inoculating microbes increased at the compost mature period comparing with the lowest value, the result showed, at the moment, the nitrogen fixation of the inoculating microbes treatments is active during nitrogen transformation comparing with that of the treatment without inoculating microbes.

b. Water-soluble nitrogen content increased contin-uously during the MSW compost, while that of inoculating microbes treatments could benefit the formation of water-soluble nitrogen comparing that of the treatment without inoculating microbes. On the contrary, water-soluble NH_4^+-N content declined continuously during the MSW compost, and inoculating microbes in compost would advance the stable period of water-soluble NH_4^+-N.

c. According to the ratio of WSC/WS org-N, the compost maturity of the inoculating microbes treatments could advance two weeks comparing

with that of the treatment without inoculating microbes.

Acknowledgement

The financial supported by Harbin City Technology Item 2002AA3CN109.

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