The Technology of the Municipal Solid Wastes Composting

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Abstract: Compost is one of the most important ways in China. This paper took Daqing Meishang compost plant as example, and introduced the modern municipal solid wastes composting technology, which including composting engineering flow, process indexes and disposal technology. [Nature and Science 2003;1(1):91-94].

Key words: composting; engineering flow; process indexes; pollutant

Introduction

With the increasing of population quantity as well as industry and economy developing, the output of the municipal solid wastes (MSW) has been increasing in China. At present, the output of MSW has been exceeded a hundred million tons in most cities of China. In fact, the MSW output has been increasing at 10% each year and now it has been accumulated gradually to ninety hundreds million tons in the past years. Most cities in China have been surrounded by the MSW. Because the calorific value of the MSW in China is lower than that in other countries, incineration treatment will be much expensive (Nie, 2000; Sun, 1999). On the other hand sanitation landfill would occupy a lot of lands, and lead to two-step solution by less developed technology (Zhong, 1999). In recent years, the technology of the MSW microbial composting has been accepted gradually by Chinese citizen, because the organic matter content of China MSW exceed 60%, and water content is about 50%, after the MSW was classified by machines, the residual organic matter is suitable for composting, and the composting production could be served as soil fertilizer. At present, Daqing Meishang Company in China owns unique technology in such field. This article would use this MSW composting technology to test its effect.

1. The Engineering Flow of the MSW Composting

The microbial composting technology was used to treat different and comprehensive utilization in Daqing MSW treatment plant. The MSW treatment technology include the MSW classify, composting fermentation, and late treatment system. The engineering flow chart could be seen in Figure 1.

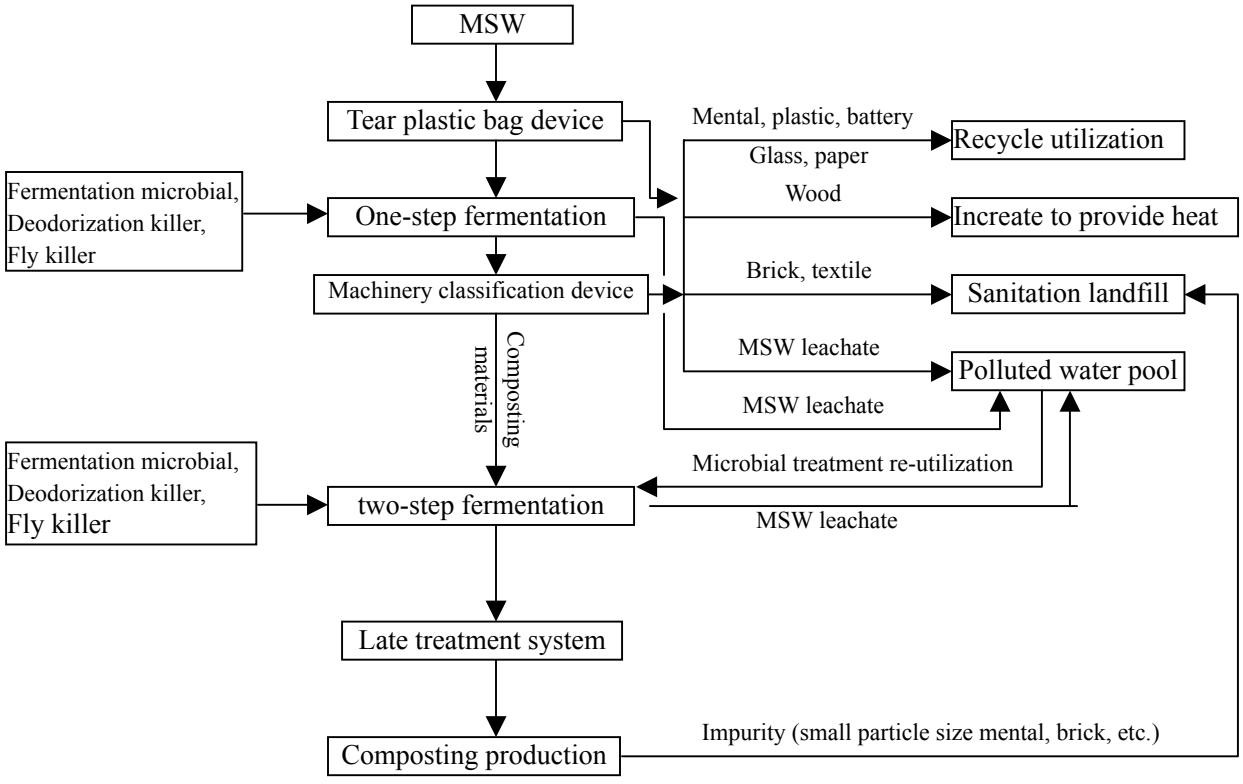

Figure 1. The MSW Composting Engineering Flow Chart

The two-step fermentation was adopted in the composting process and the fermentation period would last about 40 days. Because the water content in the MSW is high (about 55%) and the classification rate is low, the project will divide machinery classification into two steps: one-step fermentation and two-step fermentation, so the classification rate and the quality of the MSW composting could be increased.

1.1 One-step Fermentation

The purpose of one-step fermentation is to decompose carbohydrate, starch and protein, as well as reduce the water content of the MSW. This could lower the losing of organic matter when screening.

The MSW one-step fermentation was completed in 10 fermentation storerooms that were isolated from each other.

Each storeroom area: 54 m (length) × 27 m (width) = 458 m^2.

The height of the fermentation MSW pile: 3 m.

First, MSW was transported into composting plant and the plastic and paper would be removed from the MSW by wind classification and tearing plastic bag device. Then the residual matters would be transported into one-step fermentation storeroom. During the piling of the MSW, the microbial fermentation solution and deodorization killer were sprayed into it, and the oxygen in the fermentation storerooms would be forced to apply to the composting pile at regular interval. The whole period of one-step fermentation would last about 20 days. When water content of the MSW decreased to 30%, transport machinery could transport the one-step fermentation matter to classification liner.

1.2 Classification Technology

The project adopted automatic classification, gravity-wind classification and spring classification. After one-step fermentation finished, MSW was transported to classification liner： metals, plastics, papers, glasses were picked out for recycle utilization； wood and textile were incinerated to apply heat； bricks were landfilled in sanitation landfill plant; the residual organic matters were transported to two-step fermentation area.

1.3 Two-step Fermentation

The MSW was piled in bar shape in two-step fermentation area, and microbial fermentation solution was sprayed into it. Each bar compost pile was 150 m long. Its cross section was triangle, 4.5 m in width and 150 m high. At the primary period of two-step fermentation, the water content was controlled at 50%, compost temperature and pH were determined every day and machinery turned over the fermentation piles once a week. When the compost temperature decreased to 30℃, it indicated that the compost had been maturity. Two-step fermentation period would last about 20 days.

1.4 Late Treatment Technology

Late treatment technology included organic matter classification and package. After two-step fermentation finished, the samples of organic fertilizer were took from fermentation pile, and maturity indexes were tested. After organic fertilizer quality checked, it was transported to screening machinery system, and picked out the small particle size impurity (glass and stone etc), then the organic fertilizer was grinded to package. The organic fertilizer productions were transported to storeroom.

2. Process Indices (Haug, 1979; Crombie, 1982; Smith, 1992; Miller, 1985; Jimenez, 1991)

2.1 Classification Technology Indices

Water content of MSW: 30%.

Classification rate: ≥95%.

MSW volume weight: 0.6 t/m^3.

2.2 One-step Fermentation Technology Indices

Organic matter content: 40%~60%.

Fermentation period: 20 days.

Water content of input organic matter: 55%.

Water content of output organic matter: 30%.

Oxygen density: ≤10%.

C/N (the ratio carbon to nitrogen): 28:1.

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

Ventilation quantity: 0.11 m^3/min·m^3 MSW (adjust according to production).

Fermentation pile high: 3.0 m.

Volume weight of input organic matter: 0.5 t/m^3.

Volume weight of output organic matter: 0.6 t/m^3.

2.3 Two-step Fermentation Technology Indices

Fermentation period: 20 days.

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%.

pH of output organic matter: 7.5.

Oxygen density: ≤10%.

C/N: 20:1.

Ventilation quantity: 0.05 m^3/min·m^3 MSW (adjust according to production).

Fermentation pile high: 2.2 m.

Volume weight of input organic matter: 0.5 t/m^3.

Volume weight of output organic matter: 0.6 t/m^3.

Turn over the fermentation piles: once a week.

2.4 Compost Maturity Indices

Water content: 25%~30%.

C/N: ≤20:1.
Compost temperature: <30℃.
Aerobic rate: gradually stable.

2.5 Organic Fertilizer Production Quantity Indices
Smell: without malodorous.
pH: 6.5~7.
Organic matter content: 25%~35%.
Water content: 25%.
Color: brown.
C/N: 15:1~20:1.

3. Pollutant Disposal Technology
The pollutant source came from malodorous gases, MSW leachate and noise.

3.1 Malodorous Gases (Xie, 1997; Brauet, 1981)
MSW was collected from citizen, then transported to the MSW treatment plant the following day. In this period, the simple organic matter would be anaerobic fermentation, rot and decompose. As a result, the malodorous gases (NH_3, H_2S, CH_3SH, etc) were produced and discharged during one-step fermentation and classification process.

The project adopted physics and microbial method to deal with the malodorous gases. The gases collection device was installed in the main compost workroom. Collected the malodorous gases, then passed them through two step water membrane to get rid of dust, wood scraps, activate carbon, furthermore, passed them through microbial membrane to get rid of malodorous (Figure 2). The depurated malodorous gases were discharged to atmosphere through chimney (30 m high). At last, the discharged malodorous gases density were: H_2S, 2.54 mg/m^3; NH_3, 18.8 mg/m^3; CH_3SH, 0.268 mg/m^3. The ejected rates were: H_2S, 0.87 kg/h; NH_3, 9.40 kg/h; CH_3SH, 0.134 kg/h. All of the parameters conform to China malodorous ejection standard (H_2S, 1.3 kg/h; NH_3, 20 kg/h,; CH_3SH, 0.17 kg/h).

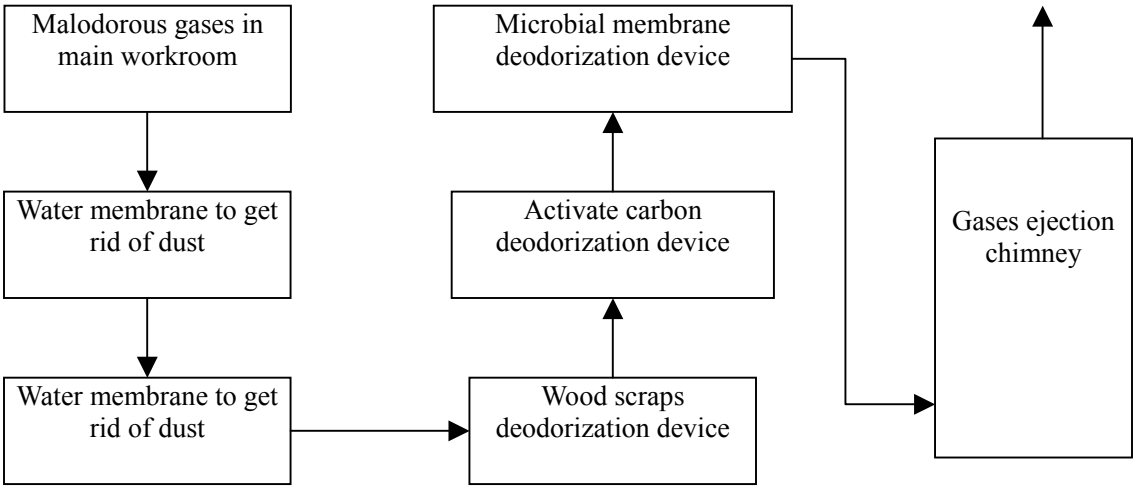

Figure 2. Malodorous Gases Deodorization Technology

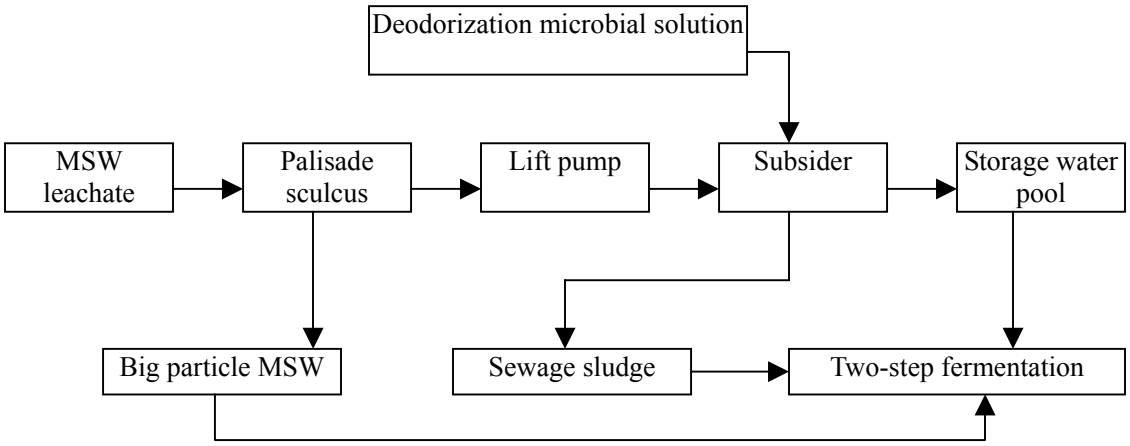

Figure 3. MSW Leachate Disposal System

3.2 MSW Leachate

The MSW leachate main come from one-step fermentation and machinery classification process. As pollution substance solution was very high in MSW leachate, to get rid of pollution substance and drift them to river will cost much. The project adopted physics and microbial method to deal with it (Figure 3). The MSW leachate was collected through drainage ditch, then passed through palisade sculcus to pick out big particle MSW, and deposit to get rid of sedimentation particle substance at the same time, deodorization microbial solution was sprayed into it, finally the treated MSW leachate was sprayed into two-step fermentation.

3.3 Solid Wastes

Solid wastes were picked out by classification process, which including plastic, metal, wood, textile, paper, brick, glass, battery etc. Its disposal ways were shown in Table 1.

Table 1. The Solid Wastes Disposal Ways

Solid waste types	Yield （t/d）	Disposal methods
Plastic	55	Recycle
Metal	8.3	Recycle
Wood	13.5	Incineration
Textile	28.5	Incineration
Paper	7	Recycle
Brick	12	Sanitation landfill
Glass	40	Recycle
Battery	0.1	Storage

4. Discussions and Conclusions

Daqing Meishang plant has composted the MSW for three years. It has produced organic fertilizer 115 tons per day and recycled plastic 64 tons and paper 22 tons per day, and gained enormous economic and environment results. At the same time, many questions have risen in MSW organic fertilizer sale and utilization. As the nutrient of the MSW organic fertilizer is lower (N, 1.23%, P_2O_5, 0.98%, K_2O, 1.34%) and the fertilizer application quantity is higher in soil than that of chemical fertilizer, that would waste a large number of labors. At present, not all farmers in China accept the MSW organic fertilizer. Therefore, how to increase the MSW nutrient and decrease the fertilizer application in soil is the main work for environment protection and fertilizer worker in the future.

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