

Technology of comprehensive disposal and utilization of municipal solid waste (MSW) *

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Abstract—The project for treating MSW of 200 tons each day was built in Yibin, Sichuan Province of China. The disposal processes are: separation and selection of usable resources; compost and fermentation of “heavy” organic waste (kitchen, garden composting rubbish); incineration of “light” waste (plastic, paper, wood and bamboo etc.) and landfill of inorganic waste. The thermal energy generated in the process can be used as 1/3 of the whole energy for drying fertilizers. In the process, there is no wastewater drainage, and air emissions can be effectively controlled by a series of measures. The sanitary and environmental indicators of disposal site meet the national standards. This project has worked well for two years. It not only disposes of and reduces the MSW, but also retrieves the resource effectively. The organic fertilizer has been applied in the ten thousand acres of fields, with productivity increase by more than 10%.

Keywords: municipal solid waste (MSW), comprehensive utilization, composted fertilizer.

1 Introduction

Municipal solid wastes (MSWs) pollute environment, occupy lots of land and cost much money for disposal. To protect the environment, it is urgent to search for a good way of MSW disposal. At present, there are many methods such as landfill, incineration, compost, high-temperature liquefaction and gasification, but no one is perfect.

The aim of this research was to treat and dispose the wastes, rendering it harmless, utilizing it as a resource and reducing volume. Its emphasis is to use different ways to treat different kinds of MSW to make full use of waste resource and completely solve the problem of MSW pollution. MSW treatment facility (capacity 200 tons per day) has been constructed successfully in Yibin City, Sichuan Province and has been in normal operation for two years.

2 Technical process and production line

The separation system includes shatter, winnowing machine, sieve, magnetic separator and manual sorting component. The selected usable materials (plastic, metal, paper etc.) were retrieved. The inorganic waste was landfilled. “Heavy” organic waste (kitchen, garden rubbish) was composted and fermented in a fermentation tank. After drying and pulverizing, the composted waste was turned into organic powder fertilizer, which was then mixed with chemical fertilizer for the production of organic compound fertilizer. After granulating, the granular fertilizer was produced. “Light” organic waste (plastic, paper, wood, bamboo etc.) was burned in furnace. The thermal energy released by incineration can be used as complementary energy for desiccation of the fertilizer. And the residue was landfilled. Plastics will be turned into gasoline and diesel oil by pyrolysis method at next step. With this technology, waste was not only disposed and reduced harmlessly but also fully utilized as a resource.

The technology process is shown in Fig. 1.

The major equipment includes pre-selection mechanical production line, solid waste powder mechanical production line and organic compound fertilizer production line. Most of the equipment is automatically controlled.

The results of the practical tests are as follows: (1) the treatment capacity: 200 tons per day; (2) the capacity for producing powder of wastes: 25—30 tons per day; (3) the capacity for

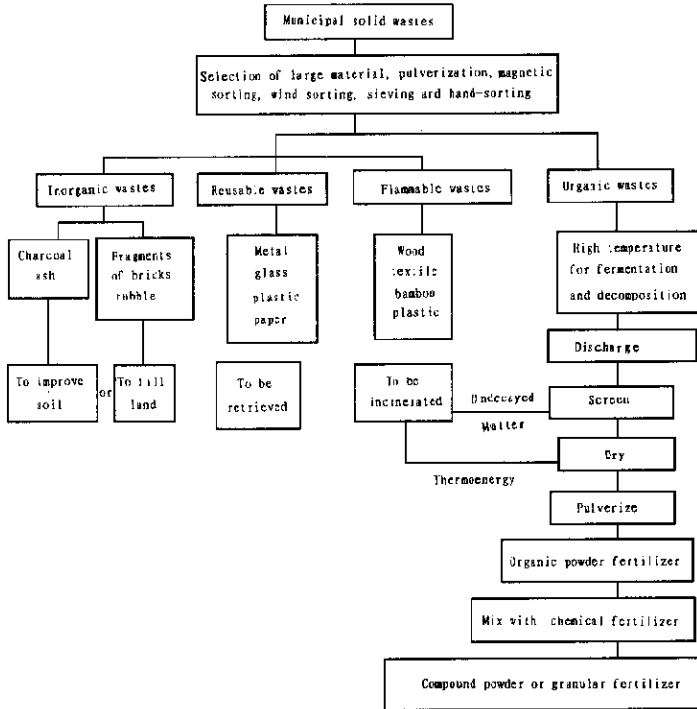


Fig.1 The MSW treatment technology

producing organic compound fertilizer: 43—55 tons per day; (4) the power for combined operation; 295kW.

3 Environmental and sanitary monitoring and analysis

In the course of refuse, the environmental and sanitary indicators were monitored, including noise, treatment concentration of dust and NH₃. The results are shown in Table 1 and 2.

The results showed that:

(1) The noise from the equipment does not exceed the national standard except that of the ball mill.

(2) The concentrations of dust in the production process are within the range of workroom standard except that at the outlet of ball mill.

Table 1 Noise intensity in the workshop

Location	Intensity, dBA
Load plat	74—78
The front of the conveyer belt	77—80
Vibrosieve	83—84
Ball mill	83—87
Center of plant	66—68

Table 2 Concentration of dust and NH₃ in the workshop

Location	Concentration of dust		NH ₃ , mg/m ³
	Range, mg/m ³	Average value, mg/m ³	
Load pla.	1.80—2.88	2.33	<0.2
Front of conveyer belt	1.78—2.49	2.14	<0.2
Middle of conveyer belt	0.18—2.88	1.56	<0.2
Rear of conveyer belt	0.54—1.08	0.81	<0.2
Outlet of ball mill	17.35—19.86	18.61	<0.2
Vibrosieve	6.90—9.01	7.96	<0.2

(3) The concentration of ammonia is less than 0.2 mg/m^3 and does not exceed the standard.

(4) The wastewater generated in the process of fermentation can be reused. That is, there is not wastewater in the process.

Note: Because of the over-standard noise and dust concentration and high energy exhausted at the ball mill the project is being improved. Precise pulverizer will be used instead of ball mill and a dust absorption device will be installed in the system of dust treatment.

4 Quality and applicability of the composting products

As shown in Table 3, the quality of the composting products is very good, better than the composting standard.

Table 3 The quality of composting products

Item	Unit	Concentration or amount	Composting standard
Mortality of parasite	%	100	95—100
Value of bacterium coil		10^{-2}	10^{-1} — 10^{-2}
Cd	mg/kg	0.037	< 3
Cr	mg/kg	56.0	< 300
Pb	mg/kg	19.0	< 100
As	mg/kg	6.39	< 30
Hg	mg/kg	2.3×10^{-3}	< 5
Granule size	mm	0.03	12
Organic matter content	%	> 20	10
N, P, K	%	3—4	0.9

The organic compound fertilizer produced from powder organic fertilizer contains more than 10% of organic matter. The compound fertilizer has the main nutritious ingredients and many elements essential to plants. According to the applications in Yibin County, Pingshan County and Changning County etc., the compound fertilizer has obvious effect of increasing the production and improving soil quality. In the grain plants, the tests showed

that the increasing rice production by 13.3%, corn by 11.4% and wheat by 10.1% on average. According to the tests on more than ten kinds of general vegetables such as lettuce, spinach, cabbage and cauliflower etc., the average production increase is 6.56%—21.4%. Besides that, manuring the fertilizer on the fruits, tea and tobacco has obviously improved the quality of products, i. e. fruit tree turning green, stabling fruits and fruit growing sweeter, crisp and watery. It is also showed from testing on ten thousands acres of fields that the fertilizer not only increase the quantity and quality of product but also has an effect on reducing or wiping out plant discards and insect pest.

5 Conclusions

This technology comprehensively treats MSW and utilizes it as a kind of resource. It contains a complete set of equipment and combined operation of machines. With this technology, secondary pollution is reduced to a minimum. The dust in the process of production, the fly ash in the process of incineration and the stink gas emitted in the process of fermentation can be effectively controlled through a series of measures. The wastewater can be reused. Therefore, there is not wastewater drainage. This technology shortens fermentation time and reduces construction area and operation costs. Organic fertilizer produced with this technology can be returned to land to realize the sustainable development of environment and agriculture. Moreover, it can bring about social, environmental and economic benefits.

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