

Discussion of Current Resource Recycling Policy in Taiwan

Shiao-Shing Chen¹⁾, Tien-Chin Chang²⁾ and Cheng-Yi Huang³⁾

¹⁾Assistant Professor, Department of Civil Engineering, National Taipei University of Technology

²⁾Associate Professor, Department of Civil Engineering, National Taipei University of Technology

³⁾Professor, Department of Civil Engineering, National Taipei University of Technology

The research is to discuss the current resource recycling and recovery policy, which was enacted by Environmental Protection Administrative (EPA) in Taiwan. For the past few years, the solid waste generated in Taiwan has greatly increased about 5 % per year. In addition to the construction of landfill sites and incineration plants, 4 R techniques (Reduction, Reuse, Recycle and Recovery) were also publicized among the citizens and then promulgated to furthermore manage these increased solid waste. Although the regulations have been carried out to a great success, they still need to be revised and updated since solid waste contains varieties of different materials. Therefore, this research discusses the current regulation and makes suggestion for future regulation revision. From the results of this study, energy recovery was suggested to be emphasized in the regulation. Energy could be recovered from materials such as waste tires, and all kinds of plastic containers. Waste tires and most of the plastic containers made of hydrocarbon species, which contains great heating values, should be considered as one of the alternatives for the resource recycling.

Keywords: recycling, reuse, material recovery, energy recovery.

Introduction

Handling of municipal solid waste (MSW) is a problem for all industrialized nations around the world, including Taiwan. Taiwan is a small but highly populated area with a booming economy, which include industrial and commercial industries. The discharge volume of solid waste from these industries is enormous. However, the building of landfills and incineration plants are often confronted by protests from local residents. Moreover, solid waste usually contains materials that can be recycled and reused. Hence environmental protection and the costs of waste disposal can both be reduced if waste is properly categorized, collected, recycled and reused. Currently, according to the government information in Taiwan, about 60% of the typical solid waste can be recycled and reuse. If these recyclable materials can be well-recovered, the usage of the landfills will be prolonged and the overall economics effects will be increased.

The general policy for the waste recycling should include 4 R techniques: reduction, reuse, recycle, recovery. According to these schemes, the latest revision of "Waste Disposal Act" was promulgated and effective by EPA in Taiwan on March 28, 1997. Based on the characteristics of resource recycling, the solid wastes have been classified into four categories:

- (1) Is not easily cleared away or disposed of ;
- (2) Contains components that are not readily biodegradable;
- (3) Contains hazardous substances;
- (4) Possesses high recycling or reuse value

Over the past year, recycling regulations have gradually been established; the amount of recycling has steadily grown. This research, supported by the EPA in Taiwan,

examined the policy and made suggestion to obtain the success in the future.

Characteristics of the mandatory recycle items

The mandatory recycling items of the solid waste are listed in Table 1. All the recycled materials can be listed into these four categories which solid wastes were classified:

- (1) Is not easily cleared away or disposed of :
For the solid waste with large volume or heavy weight and is difficult to handle, is listed in this category. For examples, vehicles, tires, household appliance, computers are heavy and difficult to move. Also, although lubricant is light, but is liquid. Waste glass and fluorescent light bulb, which are fragile, are also in this category.
- (2) Contains components that are not readily biodegradable;
Almost all the listed items are not biodegradable. If these materials are not properly recycled, non biodegradable item will enter landfills and shorten the usage of the site.
- (3) Contains hazardous substances;
This category means the discharge of such waste will directly danger the environment or human body, but the hazardous materials released after chemical reaction are not included in this category (such as combustion). Fluorescent light bulb contain mercury, or others such as mercury battery or lithium battery all contain heavy metals, need to be recycled to protect the environment or human body.
- (4) Possesses high recycling or reuse value

This category indicates such item possess high market price, such as steel containers and aluminous containers.

The other examples are waste tires and most of the plastic containers. They are made of hydrocarbon species, which contains great heating values, could be used as alternative fuel supply.

From Table 1, papers are not currently listed in the regulation and are suggested to be included. The papers here will include xerox paper, paper box, newsprints, etc.

Comparison of the price for the mandatory recycle item to the raw material

The price of the recycled items comparing to the raw material is crucial. Combined with the market price, cost of the recycling, and the characteristics of the recycled items itself, a reasonable recycling fee can be determined for the manufacturers which originally produce this material. The followings discuss the three possible scenarios:

(1) Recycling material price is more or less equal to the raw material:

Because of the fluctuation of the market price, the price of the recycling materials can be sometimes higher or lower than the raw materials. When the raw material price is lower, the manufacturers will go for the raw material. But when the raw material is high, then the manufacturers will purchase the recycling material, unless the government enforces the manufacturers to purchase certain percentage of the recycling material. In this case, the recycling fee rate committee, the organization determining the fair recycling fee, should establish the recycling fee rate according to the raw material price.

(2) Recycling material price is higher than raw material:

In this case, the recycled material is not competitive at all to the new raw material. The only way to work out is to charge the recycling fee from the manufacturer to make the recycling material competitive in the market.

(3) Recycling material price is less than the raw material:

Solid waste possessing high recycling and reuse value belongs to this category. Even the government does not imply any policy for the materials in this category, the market itself will work out for the benefit. Aluminous container and steel container are other examples in this category.

Suggestion for the new mandatory items

From Table 2 and Figure 1, the materials should be recovered for reuse can be classified into two parts: material recovery and energy recovery. The followings state the differences for these two categories.

(1) Material recovery

Material recycling should be the typical way to recover resource because of longer life cycle. Based on the

recovery price, the solid waste recovered as materials can be divided into two categories: higher reuse value and lower reuse value.

(a) Higher reuse value

For the material with high recovery value, even without the recycling policy, the market price will keep the system working and the government does not need to intervene because the materials will be recovered eventually.

(b) Lower reuse value

Most of the mandatory recycled items are lower reuse value items. The critical point for the success of these materials is to find the market for these recycling items. In this case, the resource recycling fund management committees, which is the organization who handle all the recycling fee from the manufacturers, have the responsibility to set up the recycling market by providing economic benefits. Also, such as waste vehicle, waste household electrics and water computer, they are heavy but difficult to dismantle for reuse. The resource recycling fund management committee has to provide the operational technique to help the treatment facilities to recover the useful materials.

(2) Energy recovery

Energy recovery is applied to the materials which are difficult to recycle, difficult to treat after recovery but with high heating value. Waste paper is not in this category, since papers are high price recoverable materials. However, some of the paper container with plastic interior is listed in this category. Also, such as waste tire, containing most of hydrocarbon, energy recovery is also one of the alternatives to handle.

Conclusions

The general policy for the waste recycling should include 4 R techniques: reduction, reuse, recycle, recovery. This research was focused on this scheme. According to the previous discussions, there are several conclusions to be made in the followings: (1) Energy recovery is not currently listed in the regulations for treatment facilities to apply for permitting, except for waste tire. However, it is one of the good alternatives to be considered. (2) Papers, including paper box, Xerox paper, newsprint, are suggested to be listed in the mandatory recycling items.

Acknowledgement

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References

(1) Study of the policy for recycling of the waste container, EPA Taiwan, 1999 (in Chinese)

- (2) Taiwan EPA web site, <http://www.epa.gov.tw/>
- (3) Taiwan EPA web site, recycling network,
<http://recycle.epa.gov.tw/>

Table 1. The characteristics for the solid waste should be recovered by regulation

Items should be recycled	Is not easily cleared away or disposed of ;	Contains components that are not readily biodegradable;	Contains hazardous substances;	Possesses recycling or reuse value
steel container		√		√
Aluminous container		√		√
Glass container	√	√		√
Paper container		√		
PET container		√		
Styrofoam	√	√		
PVC container		√		
PE container		√		√
PP container		√		√
Vehicle	√	√		√
Light bulb	√			√
Lubricant	√			√
Tire	√	√		√
Battery	√	√	√	√
Refrigerator	√	√		√
Washer/dryer	√	√		√
Air conditioner	√	√		√
Notebook	√	√		√
Mother board	√	√		√
Hard disc		√		
Power supply		√		
Computer case	√	√		
Computer monitor	√	√		√

Table 2. Measures of recoveries for the recycled material

Material recovery material		Energy recovery material
High recovery value	General recovery value	
Aluminous containers	Glass containers	Paper container with plastic interior
Steel containers	Plastic containers	Plastic cup, plates
Papers	Batteries	Tires
	Vehicles	
	Lubricant	
	Household electronics	
	Computer, notebooks	

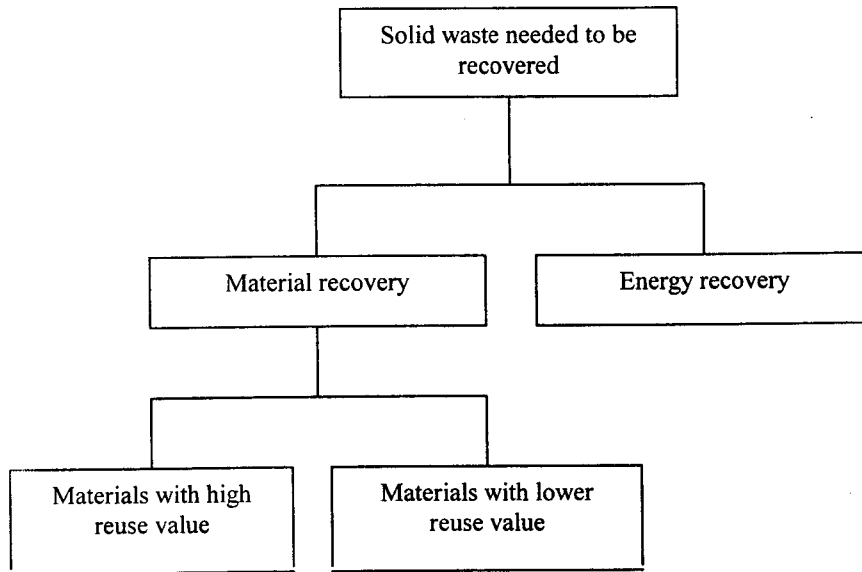


Figure 1. Flow diagram for the suggested recycled systems