



Selection of suitable plastic waste disposal strategy in Madurai municipal solid waste management corporation using AHP method

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General Note



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ABSTRACT

The plastic wastes are growing rapidly. This wastes polluting the environment and produce many diseases to living things. Now-a-days many researches are going on to reduce the plastic waste impact on environment. In Tamilnadu Madurai Municipal Corporation is the second largest corporation next to Chennai Corporation. Municipal solid waste management is the challengeable one in the Madurai Corporation. Among these municipal wastes plastic waste disposal is the challengeable one because plastic wastes are non-biodegradable. There are many strategies available to dispose the wastes. The objective of this thesis is to reduce the plastic waste impact on the earth. The survey was taken in the Madurai to identify the non-biodegradable disposing techniques available. A survey questionnaire was prepared and circulated among the medium to higher priority faculty of municipal solid wastes corporation Madurai to identify the factors for disposing wastes. The analytical hierarchy process is a multi criteria decision making tool is used to determine the best strategy among the strategies. Based on the ranking order the best strategy was selected.

Key words - plastics wastes, surveying, data collection, analytical hierarchy process (AHP)

1. INTRODUCTION

In present world the people are using the plastics for their daily purpose. Plastics are used for packaging, automobile parts production, toys production, soft drink bottle production and in some home appliances etc. The plastic products are produced by some potentially harmful chemicals. Plastics are non-biodegradable. The usages of plastics are increasing day to day. We cannot control the usage of plastics but we can moderate it by some disposing strategy. The plastic wastes are produced from households, market, commercial establishments, hotels, hospitals and industries. In Tamilnadu Madurai Municipal Corporation is the old and second largest corporation next to Chennai, because the population in Madurai exceed above 1,017,865. So the municipal wastes created by the people are very high. In Madurai municipal corporation the municipal solid waste management facing a huge challenge to dispose the municipal solid wastes. Because the municipal solid wastes contains biodegradable and non-biodegradable wastes. The biodegradable wastes can be easily disposed. But the non-biodegradable wastes are very difficult to dispose. The non-biodegradable wastes such as plastics, rubber etc are the challengeable one to dispose. In Madurai city the garbage produced by each head at the rate of 406 gram per day. Therefore 548 metric ton of wastes created per day. In this thesis the plastic waste is considered as a major problem because the plastic waste provide many disadvantages like health problems to living things and it prevent the absorption of water into ground. The plastic contains many potentially harmful chemicals. These chemicals have the potential to be absorbed by human beings and cause dermatitis (Boualla Nabila, 2015). The municipal solid waste corporation trying to dispose the plastic waste by some techniques. There are many strategies to dispose the plastic wastes. Among the strategies the best one is selected by using analytical hierarchy process. The analytical hierarchy process is a multi criteria decision making tool. It is used to select the best one among the alternatives.

2. LITERATURE RIVIEW

The amount of plastics consumed annually has been growing steadily (Rafat siddique 2007). The plastics are used for packaging purposes and production purposes. Plastic production also involves the use of potentially harmful chemicals. When living things being contact with the plastics then the chemicals present in the plastics can harm the skin of living things.

The plastics have many advantages and have become a part and parcel of routine life of humans. Plastic waste has grown up to very dangerous level (J.S. kushawaha 2013). Because the plastics are used for many applications without the plastics the world cannot run. But the usage of plastics is growing rapidly. The high usage of plastics can form a accumulation of plastics called plastic wastes.

Solid wastes are one of the most challenging issues in India (M. Balasubramanian 2012). According to central pollution control board of India the india facing a big challenge to manage the municipal solid waste. CPCB reports that india generates 56 lakhs tonnesof plastic waste annually, with Delhi accounting for a staggering 689.5 tonnes a day. It also said that total plastic waste which is collected and recycled in the country is estimated to be 9,205 tonnes per day (approximately 60% of total plastic waste) and 6,137 tonnes remain uncollected and littered"

Plastic recycling is a legal requirement and can yield environmental benefits (Xiaoyun Bing 2012). Because the usage of plastics are growing rapdly. These may led to the accumulation of plastics called plastic wastes. So we must reduce the plastic waste by some techniques. So recycling is a technique which reduce the plastic wastes and preserve the resources from our earth. So every country needs a plastic recycling program.

Plastic disposing methods have many alternatives (Carlos F. Simoes Gomes 2006). Plastic disposing must be carried out in each and every city, town and villages. Because the disposing of plastics reduce the plastic wastes in the municipal solid wastes. There are many alternatives available to dispose the plastic wastes. So choose the best one to do the dispose effective and economic.

Analytical hierarchy process is a multi criteria decision making process (saaty 1977). It is a tool used to select the best one among the alternatives. The AHP tool is used in the paper to select the best dispose method.

3. PROBLEM DESCRIPTION

Municipal solid wastes is a challenging problem in the developing countries. The biodegradable wastes can be easily disposed but the non-biodegradable waste is difficult to dispose due to their properties. Plastic is a non-biodegradable wastes and are growing rapidly. Madurai municipal corporation is the old and second largest corporation next to Chennai. In Madurai the people population is rush. So due to rush population plenty of wastes created daily. Only minimum amount of wastes are collected and the remaining wastes are kept littered. The disposing methods of non-biodegradable wastes kike plastics are quite improper. There are several disposing strategies are available. But in Madurai only landfill technique is in high priority. Then the other techniques are not in same priority like landfill. So we took survey in Madurai municipal corporation to identify the non-biodegradable disposing techniques available. A survey questionnaire was prepared and circulated among the medium to higher priority faculty of municipal solid wastes corporation Madurai to identify the factors for disposing wastes. Then the analytical hierarchy process tool is used to select the best disposing strategy. Based on the ranking order the best dispose strategy is selected.

4. SOLUTION METHODOLOGY

The solid waste management is a challenging problem in the Madurai municipal solid waste management. Because the people density in Madurai is rush. So plenty of wastes are created accounting 500-800 ton per day. The disposing method of municipal solid waste is improper in Madurai. The biodegradable waste can be easily disposed. But the non-biodegradable waste is a

challenging problem in the Madurai Corporation. So a survey was taken in Madurai Municipal Corporation to identify the non-biodegradable disposing techniques available. A survey questionnaire was prepared and circulated among the medium to higher priority faculty of municipal solid wastes corporation Madurai to identify the factors for disposing wastes. AHP tool is used to identify the best disposing strategy among the available strategy.

4.1. Analytical hierarchy process

The analytical hierarchy process is a multi criteria decision making process. This process was originally developed by prof. Thomas L. Saaty. This method is very useful for choosing the best one among the alternatives. Here I am using this process to select the best plastic waste disposing technique. The following are the steps used in the problem.

Step 1: Construct hierarchical structure.

The hierarchical structure should be construct using the decision elements. It is a graphical representation of the problem then go for the next step.

Step 2: Pairwise comparison and pairwise comparison matrix.

The pairwise comparison should do and the pairwise comparison matrix also should done.

Step 3: Eigen vector and Eigen value.

The Eigen vector can be calculated by simplify the pairwise comparison matrix and then the Eigen value should be calculate.

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^n \frac{i\text{th entry in } Aw^T}{i\text{th entry in } w^T}$$

Step 4: Consistency index and consistency ratio.

The consistency index (C.I) and the consistency ratio (C.R) should be calculate by using these formulas.

$$CR = CI/RI$$

$$CI = \frac{(\lambda_{\max} - n)}{(n-1)}$$

RI value should be taken in the following table

Table 1

Random index value

size	RI
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

Step 5: Final priority ranking.

The final priority ranking should be calculate and then the high range value should taken as the final priority rank.

5. SCOPE OF WORK

In Tamilnadu Madurai Municipal Corporation is the second largest corporation next to Chennai Corporation. The survey was taken in the Madurai to identify the non-biodegradable disposing technique. The objective of this thesis is to select the best disposal technique among the alternatives. We went to Madurai municipal solid Waste Corporation to gather information about the non-

biodegradable techniques. According to Madurai municipal solid Waste Corporation in Madurai nearly 500 tons of wastes created daily. These wastes contains bio-degradable and non-biodegradable. In these wastes the half of the MSW was non-biodegradable. So the disposing of non-biodegradable wastes is a challengeable one. So we took a survey in MSW to identify the non-biodegradable disposing techniques. The disposing techniques using in Madurai MSW corporation is landfill, incineration, recycle. The survey questionnaire was prepared and circulated among the medium to higher priority faculty of Madurai MSW Corporation to identify the factors of disposing wastes.

Madurai municipal solid waste corporation disposing strategies.

- Landfill
- Incineration
- Recycling

Factors for disposing wastes.

- Human health
- Waste reduction
- Environmental benefits

Analytical hierarchy process was used to select the best disposing strategy among the other disposing strategies.

Applying AHP method

Pairwise comparison matrix for alternatives.

Table 2

Matrix for alternatives

Alternatives	Human health	Waste reduction	Environmental benefits
Human health	5/21	5/13	7/13
Waste reduction	1/21	1/13	3/31
Environmental benefits	5/7	7/13	21/31

Eigen vector $w = \{0.282, 0.073, 0.643\}$

Eigen value = 3.08

Consistency index (C.I) = 0.04

Consistency ratio (C.R) = 0.068

Then do the matrix with respect to the human health

Table 3

Matrix for human health

Human health	L	I	R
L	3/19	3/11	7/47
I	1/19	7/11	5/47
R	15/19	7/11	35/47

Eigen vector $w = \{0.1929, 0.0832, 0.7234\}$

Eigen value = 3.1076

Consistency index (C.I) = 0.0538

Consistency ratio (C.R) = 0.092

Matrix with respect to waste reduction

Table 4

Matrix for waste reduction

Waste reduction	L	I	R
L	1/11	1/19	5/47
I	3/11	3/19	7/47
R	7/11	15/19	35/47

Eigen vector $w = \{0.0829, 0.1929, 0.7233\}$

Eigen value = 3.104

Consistency index (C.I) = 0.052

Consistency ratio (C.R) = 0.089

Matrix with respect to environmental benefits

Table 5

Matrix for environmental benefits

Environmental benefits	L	I	R
L	3/25	1/3	5/47
I	1/25	1/9	7/47
R	21/25	5/9	35/47

Eigen vector $w = \{0.186, 0.099, 0.713\}$

Eigen value = 2.46

Consistency index (C.I) = 0.27

Consistency ratio (C.R) = 0.46

Then all the other criteria are compared with the alternatives and then we get the final priority ranking.

Table 6

Final priorities

	Human health	Waste reduction	Environmental benefits	Final priorities
landfill	0.4749	0.0060	0.119	0.5999
incineration	0.0234	0.0140	0.0636	0.1016
recycling	0.2039	0.0528	0.458	0.7147

6. RESULT

The overall priorities of criteria and the alternatives for non-biodegradable disposing strategy are shown in table 6. The result indicates that the recycling is the best disposing strategy among the others and we can achieve environmental benefits if we do recycling as a disposing strategy. So recycling score (0.7147) and incineration score (0.1016) and landfill score (0.5999).

7. CONCLUSION

Plastic waste is increasing day-by-day. Madurai Corporation is the second largest corporation in Tamilnadu next to Chennai. So the people using the plastics and create plastic wastes. So Madurai Municipal Corporation is struggling to handle the plastic wastes. In Madurai non-biodegradable wastes is disposing in three ways i.e. landfill, incineration, recycling. If plastic wastes go to incineration

process the gasses from the process produce many harmful diseases to living things. If the plastic waste goes to landfill the ground water might pollute due to the chemicals present in the plastics absorbed by the soil. So the recycling is the best disposing strategy. Madurai Corporation should give importance to the recycling process than the landfill and incineration. So the environmental benefits also increase by increasing the recycling dispose strategy.

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