Demonstration of Plastic Waste Management by Knapsack Algorithm

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Abstract - We will make use of the **knapsack problem** to find the optimal solution of **Plastic Waste Management** problem. Knapsack Algorithm will help us give an **optimized** outcome of both problem and solution vividly. We will give out statistics and a knapsack optimal solution in which we will get to know how recycling of plastic from plastic waste will less than generating new one from its raw material cost. From this a clear picture mindset of **recycling** the plastics rather than generating new will come out which will help to **prevent Plastic Pollution** thereby helping in contribution to Plastic Waste Management

Key Words: knapsack, plastic, optimized, prevent plastic pollution.

1. INTRODUCTION

1.1 Knapsack Algorithm

Knapsack algorithm which is also known as rucksack algorithm. It gives an optimized outcome of both problem and solution vividly. Having the feature of fixed size is very useful as an example by setting a fixed weight of element and then taking specific weight, value and the total number of elements after that by total summation and comparing fixed value we can get the optimized result. Its time complexity is N Log N. It has two more types in this too: 0/1 knapsack and Fractional knapsack. 0/1 knapsack uses the concept of dynamic programming and fractional knapsack uses the notion of greedy approach. For getting the best optimized result of specific elements with their weight and value knapsack is very benign.

1.2 Waste

Waste are the entities which have been abdicated after their primitive use. They are found in a very gigantic proportion all over the world and the majority are in a very contaminated form which is very harmful to their surrounding and to the atmosphere. Waste management does the work of accurately managing the waste .Contaminated and unhygienic waste which needs to be dumped is done by properly managing their dumping .The waste which can be recycled without harming the environment and be propitious to all humans is taken care of by properly managing the waste. According to their properties of waste they are mainly split into 3 ways such as liquid, solid and organic waste. It almost covers all types of waste which is needed to be administered.

1.3 Plastic Waste

A major part of the solid waste dumped into the environment consists of waste plastics, and its quantity is rapidly increasing with increasing widespread use of plastics [1]. Plastic is a non-bio-degradable substance which takes thousands of years to decompose that creates land as well as water pollution to the environment [2].

1.4 Types of Plastics

Plastics which are also in one form of waste and have some benign uses. There are primarily 4 types of plastic such as PET, LDPE, HDPE and PP. PET stands for polyethylene terephthalate which is a general-purpose thermoplastic polymer. PET is prominent for its thermal, mechanical and chemical resistance. It is the topmost recycled polymer among all. LDPE stands for low density polyethylene which is semi rigid translucent polymer .It has many short branches poised if 4000 to 40,000 carbon atoms. Used mainly in plastic bags, containers and bottles. HDPE stands for high density polyethylene which is cost effective thermoplastic with linear structure. At a very low pressure and a given specific pressure it can be only prepared. It is used mainly in trays and drums. PP stands for polypropylene which is rigid and crystalline thermoplastic. It's also known as linear hydrocarbon resin. Its cost is very cheap overall. It's mostly used in automotive and industrial applications. Discussing all the plastics it clearly demonstrated PET plastic is very propitious among all.

2. LITERATURE REVIEW

Plastic is a synthetic material which is widely used in a variety of different sectors. The word plastic is derived from a Greek word plastikos which means to be formed in different shapes [3]. Plastic is a synthetic polymeric material with a high molecular weight[4], made from a wide range of organic compounds such as ethylene, vinyl chloride, vinyl acetate, vinyl alcohol and so on. Plastics can be molded into different shapes in its soft form and then it coal sets into a rigid or slightly elastic form. The basic precursors for the production of plastic materials are obtained from natural gas, and petroleum [5]. Owing to the unique properties of plastics such as: light weight, low cost, durability, robust, strength, corrosion resistance, thermal and electrical insulation, versatile fabrication and design

capabilities which can easily be molded into assorted products; plastic finds a wide range of applications[6].

The Knapsack Problem was Chosen keeping in mind the problem of plastic Pollution. The agenda is to solve the plastic problem by recycling it and getting it done with minimal cost. Previously the usage and production was done on the basis of demand and sales. Now it's the time to change it environmentally friendly by recycling plastic and making use of it.

The Knapsack problem is used to find out the optimal solution of the problem such that it satisfies the given problem and constraints. Knapsack can be considered one of the best for finding solutions to decision-making processes, finding the least wasteful way to cut raw materials, selection of investments, etc. The aim is to fill the knapsack, the total weight of each item does not exceed the capacity of the knapsack, and maximizes the total profit of the contained objects [7].

The Main Motivation is to extend the classical knapsack to real time situations like capital budgeting, network planning, etc. where data is not so accurate [8]. Best Example for this could be variable budgeting in a developing firm.

Plastics being lightweight, easy to carry and its usability in day to day life helps develop the economy of the nation. Alongside being present for over 60 years and due to lack of its disposal techniques and lower amount of recycling it's affecting the environment. The Lack of plastic waste management has led plastic to be omnipresent with marine plastic leading. This paper would help to lower this global challenge and make use of it to the development of the economy with plastic waste management.

3. ANALYSIS BETWEEN RECYCLED PLASTIC AND FRESH PLASTIC

When it comes to comparison between recycled material and fresh material, there are some advantages and disadvantages in each of them. Fresh materials are easily available in the market and can be processed easily. But somehow using fresh material creates more plastic pollution and in terms harms the environment. Also Plastic Waste Management is turning out to be one of the leading issues in each country. Using Recycled material provides few advantages over fresh. Recycled material is easily available if a proper channel is maintained. It also helps reduce Plastic Waste. It can be comparatively cheaper than the fresh material. Also, it makes increasing sense economically as well as environmentally and recent trends demonstrate a substantial increase in the rate of recovery and recycling of plastic wastes [9].

4. CALCULATION

We did research and got the average price for Recycled and New Raw Plastic. Below is the Database and Knapsack output for Recycled Plastic:

Table - 1: Cost of different Raw/New Plastics

	LDPE	PP	PET
Price	2.08	2.15	2
Weight	500	500	500
Unit Value	15	10	5

We then carried out the calculation using Knapsack algorithm. Knapsack Output of Raw/New Plastic:

Table - 2: Knapsack Output

Price	Unit volume	N	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1.05	15	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.05	1.05	1.05	1.05	1.05	1.05
2.12	10	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12
0.83	5	3.00	0.00	0.00	0.00	0.00	0.00	0.83	0.83	0.83	0.83	0.83	2.12	2.12	2.12	2.12	2.12	2.95	2.95	2.95	2.95	2.95	2.95

Below is the Database and Knapsack Output for Recycled Plastic:

Table - 3: Cost of different Recycled Plastics

	LDPE	PP	PET
Price	1.05	2.12	0.83
Weight	500	500	500
Unit Value	15	10	5

Knapsack Output of Recycled Plastic:

Table -4: Knapsack Output

Price	Unit volume	N	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2.08	15	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.08	2.08	2.08	2.08	2.08	2.08
2.85	10	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
2	5	3.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00	2.00	2.85	2.85	2.85	2.85	2.85	4.85	4.85	4.85	4.85	4.85	4.85

It is clearly visible from the knapsack output obtained that the effective Cost comes out to be greater for new/raw material used in plastic as compared to recycled one.

5. CHALLENGECE AND FUTURE SCOPE

Various challenges are being faced in it when it comes to using recycled material. It isn't easily available if the proper channel isn't available. For achieving recycled plastic in large scale, a proper channel needs to be maintained and the supply chain has to be formed right from ground level to the head. Also, the challenge of investing in machinery is also a big deal when it comes to recycling them. Generally these machineries aren't easily available and also if we find it, the cost of it turns out to be

costly. Somehow, there is a future scope in the recycled plastic industry as plastic pollution is turning out to be a major concern everywhere. There are chances of price hike in Fresh material of plastic by the government due to plastic waste management issues. Machineries and equipment required for recycling could certainly be available at subsidized cost by the government to encourage recycling plastic. Various Technical advancements in technology may lead to developing machinery which could be available comparatively at cheaper cost.

6. CONCLUSION

We carried out some problems using the knapsack algorithm and compared fresh plastic and recycled plastic to achieve results. We compared the prices by keeping the same weights of each of them and solved it using Knapsack Algorithm. We concluded that compared to fresh plastic, recycled ones are comparatively cheaper and could help beat plastic problems. In order to reduce the waste plastic problem what we can do is to adopt the principles of waste prevention. Waste prevention undoubtedly needs to be a central theme of social responsibility [10]. Plastic Waste management is turning out to be major concerns for everyone and this methodology can be useful to control the usage of plastic and beat the plastic pollution

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