International Journal of Research in Engineering, Science and Management
Volume-2, Issue-4, April-2019
www.ijresm.com | ISSN (Online): 2581-5792

Compression of Plastic Carry Bags

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***Abstract*: Plastics are inexpensive, lightweight and durable materials, which can readily be molded into a variety of products that find use in a wide range of applications. As a consequence, the production of plastics has increased markedly over the last 60 years. However, current levels of their usage and disposal generate several environmental problems. Around 4 per cent of world oil and gas production, a non-renewable resource, is used as feedstock for plastics and a further 3–4% is expended to provide energy for their manufacture. A major portion of plastic produced each year is used to make disposable items of packaging or other short-lived products that are discarded within a year of manufacture. These two observations alone indicate that our current use of plastics is not sustainable. In addition, because of the durability of the polymers involved, substantial quantities of discarded end-of-life plastics are accumulating as debris in landfills and in natural habitats worldwide. Recycling is one of the most important actions currently available to reduce these impacts and represents one of the most dynamic areas in the plastics industry today. Recycling provides opportunities to reduce oil usage, carbon dioxide emissions and the quantities of waste requiring disposal. Here, we briefly set recycling into context against other waste-reduction strategies, namely reduction in material use through down gauging or product reuse, the use of alternative biodegradable materials and energy recovery as fuel.**

***Keywords*: Carry Bags Compressing Machine**

1. Introduction

Approximately 50 per cent of plastics are used for single-use disposable applications, such as packaging, agricultural films and disposable consumer items The plastics industry has developed considerably since the invention of various routes for the production of polymers from petrochemical sources. Plastics have substantial benefits in terms of their low weight, durability and lower cost relative to many other material types. Worldwide polymer production was estimated to be 260 million metric tonnes per annum in the year 2007 for all polymers including thermoplastics, thermosetting plastics, adhesives and coatings, but not synthetic fiber. This indicates a historical growth rate of about 9 per cent p.a. Thermoplastic resins constitute around two-thirds of this production and their usage is growing at about 5 per cent p.a. globally. Today, plastics are almost completely derived from petrochemicals produced from fossil oil and gas. Around 4 per cent of annual petroleum production is converted directly into plastics from petrochemical feedstock. As the manufacture of plastics also requires energy, its production is responsible for the consumption of a similar additional quantity of fossil fuels. However, it can also be argued that use of lightweight plastics can reduce usage of fossil fuels, for example in transport applications when plastics replace heavier conventional materials such as steel.

2. Problem Statements

We often observe that in the village areas most of the plastic carry bags after being used are thrown away by the people on the roadside, also there is no proper arrangement for garbage disposal in the villages. Since these plastic carry bags are light in weight, these carry bags are easily blown away with air and gets accumulated in the surrounding. This can cause harm to the animals as some of the animals consume the carry bags considering it as their food which may cause death of the animals.

So as to avoid all this, collection of the accumulated plastic should be done periodically and transported to the main plastic re-cycling plant in the nearby city. Also, plastic re-cycling can be harmful to the environment, when the material is melted down, VOCs are released into the atmosphere. They are harmful to the nearby plants and animal life. Volatile Organic Compounds released from plastic recycling harm the environment. They present health risks to the people who use the recycled plastic. The heat is required to melt the plastic, the process generates carbon emissions. The harmful greenhouse gases contribute to the global warming and they are already taking an effect on our planet's climate.

3. Objectives

The main aim of this project is to develop a machine which will compress or reduce the size of the plastic carry bags at greater extent so that it will be easier to transport the waste plastic carry bags from remote villages to the main re-cycling plant in the nearby city.

The main objectives of this project are:

- To reduce the size of carry bags by compressing them and without actually melting the plastic carry bags.
- To reduce the transportation cost incurred while transporting the plastic carry bags to the main re-cycling plant.
- More amount of compressed plastic carry bags to be transported to main re-cycling plant in a single trip.
- Develop efficient and low-cost machine which is easy

to operate and which can be installed in the remote villages.

- To improve the eco-efficiency by reducing the pollution which is caused during melting and during transportation.

4. Working

This machine works on the simple principle of heating and flat rolling the material. As the plastic is a very delicate material, it shrinks in size when heat is provided to it through different means. Once the plastic gets shrinked, it is very easy to compress the plastic by passing it through the roller assembly. The various parts and components which are used in making of this machine are briefly discussed in the previous chapter of this report.

This machine is very easy to operate and can be operated by semi-skilled labour or person. There is a roller arrangement provided inside the machine (say compression chamber), these rollers are driven with help of a wiper motor used in cars. This motor provides a very high torque with low speed. Out of the 2 rollers, only one roller receives power from the motor while the other roller gets its power through the gears. The rear side of this machine has a gear arrangement which transmits the power from the motor to the rollers. As the gears are meshed with each other, the two rollers rotate in opposite sense thus making it easy to pass the material through the gap between the two rollers.

Inside the compression chamber, 2 halogen lamps of 500 watt each are fitted which works as the heating element. These lamps provide heat to the plastic carry bags as well as to the rollers. The rollers being made up of stainless steel, gets heated up very rapidly. This heating causes the plastic to shrink thus giving higher efficiency during compression and size reduction. During the initial stage of working, this chamber needs to be heated up for around half an hour so as to attain the required temperature limit. For this the halogen lamps remain lit for the required time period thus maintaining the temperature. Once the temperature limit is reached, the rollers are provided with the initial torque by starting the motor. Then finally the plastic bags are put into the chamber and passed through the rollers by varying the speed of the rollers. Thus, we get the desired results without actually melting the plastic and preventing the pollution. The objective is fulfilled.

Fig. 1. Internal roller arrangement

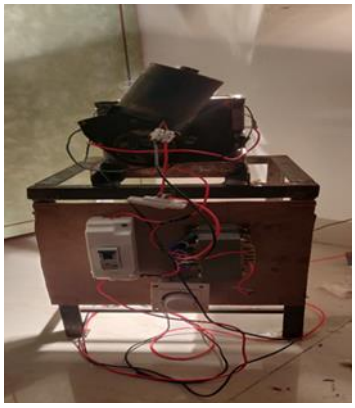

Fig. 2. Front view without Hopper

Fig. 3. Rear view, Gearing Arrangement

5. Calculations

A. Determination of plastic carry bags compressed per hour (capacity of the machine)

Average weight of a LDPE carry bag = 5.5 grams

Number of carry bags can be compressed in one cycle = 3 bags

Therefore,

Total weight compressed in one cycle= 3×5.5

= 16.5 grams

Time taken for one cycle = 5 secs

Therefore, plastic compression rate = 16.5/5

= 3.3 grams/sec

Plastic compressed per hour = 3.3×3600

= 11880 grams/hour

= 11.88 kg/hour

B. Heat energy produced

Amount of light energy converted into heat energy = 85%

Halogens rating = 1000 watts

Therefore,

Amount of heat energy obtained = 850 watts

C. Reduction in volume

Dimensions of a plastic carry bag in space without any external force applied

= 40 × 25 × 0.3 (dimensions are in cm)

Volume = L×B×H

= 40×25×0.3

= 300 cm^3

Dimensions of a plastic carry bag after compression

= 11×9×0.3 (dimensions are in cm)

Volume = L×B×H

=11×9×0.3

= 29.7 cm^3

% Reduction in volume = [(300-29.7) / 300] ×100

=90.1%

D. Energy consumption

Energy consumed by Halogen lamps = 1000 W

Energy consumed by Wiper motor = 120 W

Total energy consumption = 1120 W

So, running the machine for 1 hour may consume 1.12 unit of electricity

Cost of running the machine = ₹ 7 × 1.12

= ₹ 7.84 / hr.

6. Conclusion

Plastic is one of the artificial materials that we greatly depend on. During this project we have learned what plastics are, what types of plastics exist, how the plastic waste impacts our environment and how plastic can be recycled. Before, we just used some products made of plastic without thinking about how it is treated and how the impacts of plastic waste affect our life and environment. In our opinion, most people rarely consider the real impact of plastic, whichever it is - good or harmful - when they enjoy the convenience of plastic goods. Now there is a growing awareness that plastic waste is creating pollution in our life. It not only negatively influences our environment, but it also pollutes our natural resources that we depend on; soil, farmlands, water and animals. Human health is affected as well. But all this is only one side of the story. According to the research, the other side is that plastic pollution is included in social life, while recycling and disposal methods are not as optimal as we believe they should be. Recycling of plastic waste can provide great benefits for our environment. Our group strongly suggests doing our best to avoid plastic products that are single use and asks to be aware of the environmental impact and to try to recycle plastic if possible.

7. Future scope

The goal of this project work purposely kept within what was believed to be attainable within the allotted time and resources. As such, many improvements can be made upon this initial design. That being said, it is felt that this design represents a functioning in miniature scale model which could be replicated to a much large scale. The following recommendations are provided as ideas for future expansion of this project:

- In the initial design of prototype, manual feeding of carry bags is carried out, whereas in future in actual working machine it can be replaced by automatic feeding by another roller arrangement at the entry of machine channel.
- Another DC motor can be employed instead of wiper motor of high torque, due to high torque and big roller arrangement capacity will be increased.
- A proper cuboidal channel can be provided at the top for proper guiding of the plastic waste.
- By increasing the torque and heating effect of the machine different types of plastic waste can also be recycled rather than only plastic carry bags.
- The end product can be further worked upon by pressing it into plunger and die arrangement to give a particular shape to the product example: The product can be converted into small cubes.
- The heating element i.e. halogens can be replaced by heating coil arrangement with blower.
- Gear box can be employed for varying the torque and speed of the rollers.

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