

MODIFICATION AND FABRICATION OF PLASTIC RECYCLING SYSTEM

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Abstract – This paper proposes a system to modify and fabrication of plastic recycling system. In this system extraction process is used to recycle the waste plastic. Plastics are made from non-renewable natural resources like crude oil, coal and gas, also post consumed plastics are wastes going to landfill and are not degradable. This project was aimed to recycle plastics and to reduce unnecessary wastes and to increase our economic growth. Large contaminants from the collected plastic were removed before shredded and then washed to remove small contaminants. In extraction process single screw extruder is the main parts of the machine. Various parts of machine were screw, hopper, barrel, heater, bearings, handle & voltage regulator. Screw was the main parts of the machine for successful outflow of the melted plastic material from the barrel. The barrel was hollow pipe inside of which the screw was fitted and an electrical heater was wrapped around the outside of the barrel. Hopper was used for feeding the plastic material. Finally we can find the plastic into new form which we like to form.

Keywords: Recycling, Removing waste, Extraction process, Economical growth.

1. INTRODUCTION:

Environmental pollution is any discharge of material or energy into water, land, or air that causes or may cause acute (short-term) or chronic (long-term) detriment to the Earth's ecological balance or that lowers the quality of life. Pollutants may cause primary damage, with direct identifiable impact on the environment, or secondary damage in the form of minor perturbations in the delicate balance of the biological food web that are detectable only over long time periods[1]. This includes mainly land, water, and air. Pollution can come in various forms including the lesser-known noise, light, and thermal pollution [2].

Environment can be polluted by various kinds of ways. One of the major causes by environment pollution occurs by plastic waste. Plastic is one of our necessary things in human life. Plastic is everywhere either in the form of food containers, financial transactions (Debit/Credit cards, plastic money), storage, baggage, stationary items, electronic and electrical products and every foreseeable item that a human being can think of. Plastic is made up of various chemical elements and therefore is regarded as a highly contagious material that does not easily degrade in the natural environment after its usage or utility period. In that cause waste plastic create pollution in environment.[3]

Plastic pollution involves the accumulation of plastic products in the environment that adversely affects wildlife, wildlife habitat, or humans [4]. Many types and forms of plastic pollution exist. Plastic pollution can adversely affect lands, waterways and oceans. The prominence of plastic pollution is correlated with plastics being inexpensive and durable, which lends to high levels of plastics used by humans [5]. As the

plastic is produced by non-degradable material in that cause if we want to keep our environment pollution free we need to recycle the plastic.

Recycling is the process of taking scrap or waste plastics and recovering the material for re-use in manufacturing. Conventional recycling processes consist of melting down polyester soft drink bottles, and spinning the polymer into fibers. [6]

Plastic recycling prevents damage to the environment via excessive landfilling and use of non-renewable resources. The process is also largely environmentally safe, with the only effluent being from the wash water. This is recycled in the plant as much as possible to minimize water use and when it is finished with it is still sufficiently clean to be dumped into the sewers.[7] If we reduce the plastic waste by recycling we just not to keep our environment pollution free clean but also grow our economy.

2 .Extraction molding process:

In plastic manufacturing various processes is used. Such as: Extrusion molding process, Co-Extrusion, Injection Molding, Blow molding, Film blowing, Sinter molding, Thermal paralysis, Catalytic Pyrolysis, Microwave Pyrolysis, Hydrogenation, Gasification etc.[7]

In this project single extruder extrusion process is used. Extrusion is a process that involves continuous drawing, forcing or pushing the molten plastics in a heated barrel through one or more dies by the turning screw aided with pressure to produce the required shape. The extruded product is cooled with the help of either air or water in a drum to solidify and then cut into units. The extruded end product could be solid or hollow form such as pipes, plastic profiles, plastic films and sheets. Extrusion process is the best plastic manufacturing process used in turning recycled plastic flakes into

pellets for making other plastic products. It is a continuous process for the production of components such as pipes or sheets. It can also be used to produce compounds, which are mixtures of polymers of plastics and further additives.

3. The plastic recycling process:

Recycling of waste plastic completed by five step processes. These five steps processes were:

1. Plastics collection
2. Manual sorting
3. Chipping
4. Washing
5. Pelleting

3.1 Plastics collection:

Used plastic such as water, juice, Soda bottles, Shampoo and laundry detergent and cleaning product bottles etc. could have been collected but only water bottles were collected.

3.2 Manual Sorting:

Collected plastics were then sorted according to their Resin identification code such as 1, 2, 3, 4, 5, 6, and 7. This identification code was given In 1988, the Society of Plastics Industries (SPI) to differentiate the six major resins suitable for recycling as well as a seventh “catchall” code.

Table: 1 Resin code, polymer name & uses are shown in the following table [8]:

Code	Name	Description	Example
 PET	Polyethylene terephthalate	Usually clear or green, sinks in water, rigid, glossy	soft drink bottles biscuit trays
 HDPE	High density polyethylene	Slightly opaque, low gloss, crackly film	milk bottles supermarket bags
 PVC	Polyvinyl chloride	Semi-rigid, glossy, sinks in water	detergent bottles pipes raincoats
 LDPE	Low density polyethylene	Flexible, not crinkly	bread bags rings shrink wrap
 PP	Polypropylene	Semi-rigid, low gloss	straws screw-on lids
 PS	Polystyrene	Often brittle, glossy	polystyrene foam
 Other	Including acrylic, fiberglass, and Bio plastic.	-	Containers and sauce bottle.

In this project mainly number 1 or PET was be recycled. With the same Identification code the plastics were then sorted into different color fractions: transparent or uncolored, blue, green colored etc.

3.3 Chipping:

Sorted plastics then shredded into small chips manually using blades. The size of the chips was 10-15 mm enough to pass through the hopper and can move with the feed screw.

3.4 Washing:

The chips were then washed to remove glue, paper labels, dirt and any remnants of the product once contained. Hot water was used for washing purpose. For PET plastic water temperature kept around 90°C. After washing these plastic chips was then allowed to dry in sun light.

3.5 Pelleting:

Dried Chips was melted in the recycling machine and extruded. During the extrusion it was cooled in the atmospheric air and cut into small pieces manually.

4. Schematic of Plastic Recycling Machine:

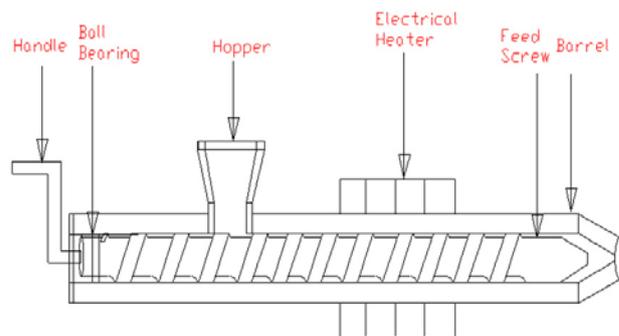


Figure: Schematic of Plastic Recycling Machine.(Autocad drawing)

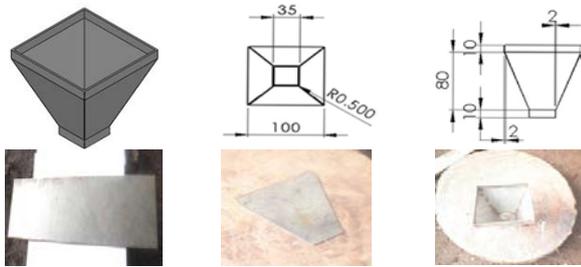
5. Fabrication of plastic recycling machine:

The plastic recycling machine was essentially a single screw extruder. It had many parts and components. These were:

1. Hopper
2. Barrel
3. A Screw
4. Bearing and Bearing Housing
5. Handle
6. Heater
7. Voltage regulator
8. Support

5.1. Hopper:

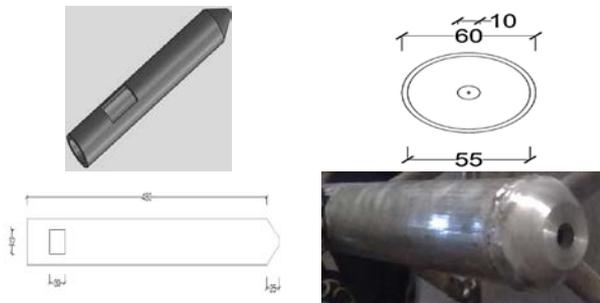
A conical shaped vessel was made from 1 mm thick mild steel sheet. The dimension of the vessel was 100x 100 x 100 mm. This hopper was mounted on the barrel by welding it on the barrel.



(Dimensions are in mm)
Figure: Drawing and making of hopper

5.2 Barrel:

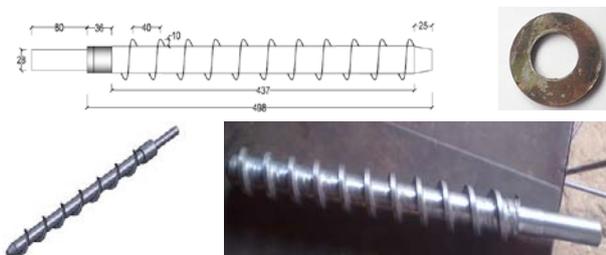
The barrel was a cylindrical pipe. Material used for this was stainless steel because it essential to prevent the corrosion of the barrel. This cylindrical pipe had the inner diameter of 55 mm for the bearing having 54 mm and the total length of 505mm. A hole of 30mm diameter which the feed hopper will be welded. After the 480mm length a draft for 25mm length was given and at the end of the draft it was given an opening of 20mm, here thickness was 5mm.



(Dimensions are in mm)
Figure: Drawing and making of barrel.

5.3 Screw:

The screw was made from Nickel stainless steel rod. The diameter of the rod was 25 mm and total length of 578 mm. Then the screw was cut by lathe machine into helical shape. The length of the teeth was 436 mm. The taper length of the screw was 25 mm. The space between the thread & Handle their two ball bearings were fitted i.e. 37 mm. The length of the handle was 80 mm. The depth of the thread was 9 mm in front side & 10 mm in backside.



(Dimensions are in mm)
Figure: Drawing and making of Feed screw

5.4 Bearing:

The feed screw was fitted inside the ball bearing and the bearing was fitted inside the barrel. A 6004-ZZ ball bearing was used, which has two non-contact metal shields one on each side of the ball bearing.

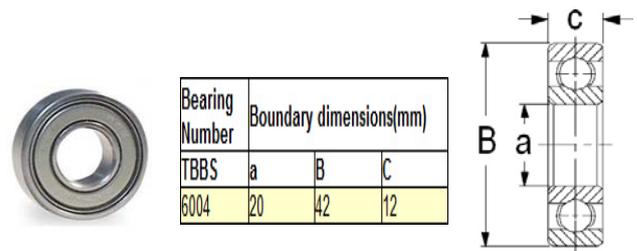


Figure: 6004-ZZ Radial Ball Bearing with cross sectional view and detailed dimensions

5.5 Handle:

A handle was welded at the one end of the shaft. The material used for making the handle was Stainless steel plate & a nickel steel bar. The length of the plate was 5 cm & the length of the rod was 6 cm. Electrical heater was placed at the other end of the barrel.

5.6 Heater:

A heater of 1500W was placed outside of the barrel. The heater produces a temperature around 280°C to melt the plastic material. To make the heater I was used mica, nicrom wire, glassull, insulation clothe & wire to connect the heater.

5.7 Voltage regulator:

A voltage regulator was used to regulate the voltage for preventing the sudden flow of high voltage current.

5.8 Support :

Two triangle shape supports were welded at the two ends of the machine. These supports were made from mild steel rod & nickel steel plate. The length of the plate was 78 mm. The rod was heated and turned into triangle shape. A 610 mm long, 205 mm wide, 25 mm height wood was used to hold the triangle & machine.

6. Operating the plastic recycling machine:

After putting the plug into the socket the electrical heater was allowed to get hot for 15 minutes to reach the melting temperature of the plastic. Plastic chip was then poured through the hopper. The feeds screw was rotated manually. With the rotation of the feed screw the plastic chip was moved to the heater. There it was melted and came out of the barrel. The melted plastic was cooled in the atmospheric air. These plastic was then collected and stored.



Figure: Plastic is melting & pouring into the dies

7. Final product:



Collecting waste plastic bottle



Collected plastic bottle are cutting into small pieces, washing, drying.



Two shape plastic form

Figure: Plastic chips & recycle plastic by forming new plastic

8. RESULT AND DISCUSSION:

After completing the project we got a new raw plastic shape, which we can use to make plastic cheeps commercially. We can also give any kind of shape what we need to use dies. Compare to other plastic recycling machine, this machine has several advantages, like:

- 1) Here, Extrusion process has been applied which is the only process to produce continuous products.
- 2) There is no bubble formation in the products, so the performance is higher than the other.
- 3) Eco-friendly equipment.
- 4) Here, Stainless steel and Nickel steel was used which are corrosive resisting that is have a longer life time and reasonable cost.
- 5) Higher heating capacity.

The machine was designed and fabricated to recycle the waste plastic of the university area to save the environment in an economic way and to reuse the raw plastic.

9. CONCLUSION:

This project was done to reduce plastic wastes considering its economic aspects as well as environmental aspects. At the same time it also kept in mind about the environmental pollution during the recycling process.

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