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Plastic Extrusion Machine

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Abstract: *This machine is concerned with recycling of waste plastic by method of Extrusion. This is done by melting of plastic with the help of barrel and screw. Plastic extrusion machine utilizes the waste plastics such as PET, HDPE etc., and converts them into something effective such as plastic lumber, plastic granulates, filament, etc. In this project, PID controller is used for Temperature control of barrel in which the plastic is melted. Solid State Relay is used as a switch which responds to the input signal by PID controller. J-type Thermocouple is used for temperature sensing. This circuit is build and tested on Polyethylene terephthalate (PET).*
Keywords: *Extrusion, Plastic, Temperature Control, Temperature Sensing, PID Controller, PET.*

I. Introduction

Plastic has been a major cause for incredible damage and reasons to various pollution. Recently government of India has banned plastic but even after this movement, Plastic is still present in the ecosystem. Therefore, this project is concerned with, recycling the plastic in effective way as it can be used for small scale industries or by individual. But, Plastic extrusion has been a crucial process for several manufacturers and researchers to produce products meeting requirements at the lowest cost. The complexity of extrusion process and the enormous amount of process parameters involved make it complex to keep the process in control. The extruder typically consists of large barrel divided into several constant temperature zones, with a hopper at one end and die at another end. The extrusion process control system had to be based upon the use of timers, counters, individual temperature controllers and speed controllers. [1]The screw is the key component of an extrusion machine and has been divided into three main functional/geometrical zones (i.e., solids conveying or feed, melting or compression, and metering or pumping) based on the primary operations of the machine.

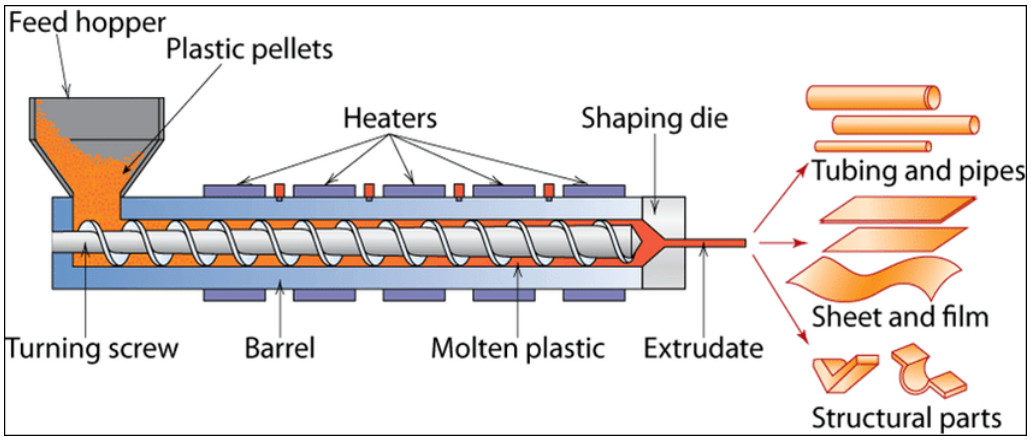

Fig.1 Plastic extrusion machine

II. Methodology

The extrusion machine is a very powerful machine of the Precious Plastic arsenal as it can create unique products and can run continuously. Technically, if one has enough plastic and a well-streamlined process you could be recycling 24/7. With the extrusion machine we can obtain filament, granulate or get creative working with moulds. Plastic is inserted from the hopper, gets transported along the barrel by a big screw towards the end where heating bands are placed. The material is gradually melted by the mechanical energy generated by rotating screws. PID controller is used for controlling the temperature of barrel in which the plastic

is melted. Solid State Relay is used as a switch which responds to the input signal by PID controller. J-type Thermocouple is used for sensing the temperature and the band heater is used for heating of plastic in the barrel and by band heaters arranged along the barrel. The melted chemical compound is then forced into a die, which shapes the polymer into a shape that hardens during cooling.

The heat from the bands and the mounting pressure inside of the barrel bring the plastic to a melting state. Once sufficiently melted, the plastic can eventually pass out through the nozzle in the form of a continuous thread. The plastic thread is then treated according to required outcome.

III. Circuit Diagram

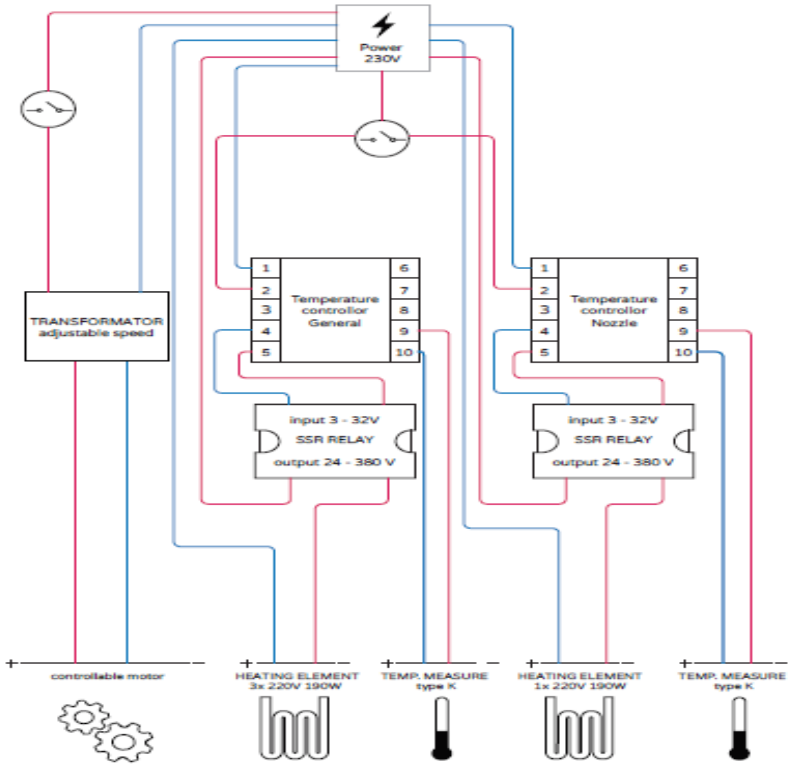

Fig.2 Circuit diagram of plastic extrusion machine

IV. Types Of Plastic

Table no.1: properties of different types of plastic

SYMBOL	TYPES	PROPERTIES
1 PETE	**Polyethylene Terephthalate**	Clear, tough, solvent resistant, barrier to gas and moisture, softens at 80 degrees.
2 HDPE	**High-Density Polyethylene**	Hard to semi-flexible, resistant to chemicals and moisture, waxy surface softens at 75 degrees.
3	**Polyvinyl Chloride**	Strong, tough, can be clear and solvent softens at 60 degrees.
4 LDPE	**Low-Density Polyethylene**	Soft, flexible, waxy surface, scratches easily, softens at 70 degrees.
5 PP	**Polypropylene**	Hard but still flexible, waxy surface, translucent, softens at 140 degrees
6 PS	**Polystyrene**	Clear, glassy, opaque, semi tough, softens at 95 degrees.
7 OTHER	**All other plastics**	Properties depend on the type of plastic.

Type of Plastic to start with: PET may also be referred to by the brand names Terylene in the UK, [3] Lavsan in Russia and the former Soviet Union, and Dacron in the US. The majority of the world's PET production is for synthetic fibers (in excess of 60%), with bottle production accounting for about 30% of global demand.[2] In the context of textile applications, PET is referred to by its common name, polyester, whereas the acronym PET is generally used in relation to packaging. Polyester makes up about 18% of world polymer production and is the fourth-most-produced polymer; polyethylene (PE), polypropylene (PP) and polyvinyl chloride (PVC) are first, second and third, respectively.

PET consists of polymerized units of the monomer ethylene terephthalate, with repeating (C10H8O4) units. PET is commonly recycled, and has the number "1" as its resin identification code (RIC). Depending on its processing and thermal history, polyethylene terephthalate may exist both as an amorphous (transparent) and as a semi-crystalline polymer. The monomer bis (2-hydroxyethyl) terephthalate can be synthesized by the esterification reaction between terephthalic acid and ethylene glycol with water as a byproduct, or by transesterification reaction between ethylene glycol and di methyl terephthalate (DMT) with methanol as a byproduct. Polymerization is through a polycondensation reaction of the monomers (done immediately after etherification/transesterification) with water as the byproduct.

V. Conclusion

Use of this machine is to do a social cause by recycling the waste plastic littered around us into something useful. By this machine, we want to show the world the incredible opportunities of plastic waste so as to cut down the plastic pollution, reducing the demand for new virgin plastic while creating better livelihoods for people around the world. As it works on single phase ac input, it can be used by any individual. It can also works with dc supply by adding few modifications. The products from the Extruder can be used as Start Up ideas. Example: 3D Printer Filament, Plastic Lumber or various Plastic molded products.

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