DESIGN AND FABRICATION OF A PLASTIC REINFORCED BRICK MANUFACTURING MACHINE

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Abstract - *This paper aims at design and fabrication of a Plastic Reinforced Brick Manufacturing Machine which brings down the plastic wastes in landfills which is primarily responsible for environmental pollution. Most common recyclable plastic products are beverage packaging widely used for water, soda, cool-drinks and juice, plastic bags and plastic containers used for packing food products. These recyclable plastic products are reinforced with the bricks. At this time of energy crisis and fast depleting resources, availability of conventional building materials perennially in terms of quantity and quality, pose a hectic task for builders. Demand for building materials is going up tremendously day-by-day in view of the ever increasing requirement of housing and habitat sectors. Such a crisis prompted the researchers to re-orient themselves so as to evolve a new technology to manufacture appropriate masonry products, using locally available low cost materials. The concept of construction using green materials was aptly conceived in research realms so as to employ marginal materials and deploy unskilled laborers in massive production schemes. At the same time, considering earth as a sustainable material, there is a growing interest in the maximum use of its resources as modern ingredients in the construction sector. The major environmental challenge confronting our country in the modern times, is Solid Waste Management. Plastic is one of the materials mostly used in the modern world. Being light weight and durable plastic is being widely used for various purposes and it has now become an integral part of our daily life. The plastic products that we mostly use are non-bio degradable and hence after use, these are ultimately used for filling our landfills.*

Keywords—design, fabrication, plastic, reinforced bricks, energy crisis, resource depletion, solid waste management, masonry units.

1. PLASTIC WASTE & PROBLEMS

Attempting to reduce the quantum of plastic wastes that fill our landfills, we decided to fabricate a Plastic Recycling Machine. In this connection, we also took into consideration the fact that the demand for bricks for housing and general construction purposes is on the rise. Thus it was felt that fabrication of a machine for manufacturing bricks by using plastic wastes as one of its components will reduce plastic waste menace to a great extent and at the same time we will also get a novel building material for construction purpose. The machine essentially consists of a cutting unit, recycling unit and a mixing unit. The machine parts are made of mild steel, because of its availability and versatile machinability. The efficiency of the machine was established using plastic wastes, cement and other aggregates. Plastic waste, after chipping into finer granules, was added to cement and aggregates in definite proportion. Then the mixture is allowed to pass through recycling unit to form a mix, and then packed into mold box, before manually rammed and compacted with machine-molded envelope. This process allows the formation of required shape, which is sent for curing to obtain stronger bricks.

1.1 Definition of Plastic

Plastic is a synthetic material made from a wide range of organic polymers such as polyethylene, PVC, nylon, etc., that can be molded into shape while soft, and then set into a rigid or slightly elastic form. Looking seriously at the global issue of environmental pollution posed by post-consumer plastic wastes, research is being focused in-depth on finding out more ways and means to consume this waste material on a massive scale in an efficient and environment friendly manner.

1.2 Sources of Plastic Waste

There are many sources for plastic wastes municipalities is one among them. The term municipal solid waste (MSW) describes those waste materials that are collected by the municipality itself or by the authorized

organizations. MSW comes out from residential, commercial, institutional and industrial sources. MSW consists of waste materials such as newspaper, cans and bottles, food waste, food packaging, clothing, appliances, yard wastes, household hazardous waste, corrugated boxes, office papers and plastics film etc. MSW normally does not include processing residuals from the industry as this material has residual value and most of the industries will know the commercial method to dispose of this material which is having some value also. The respective part of each category in the MSW stream differs in various communities.

1.3 Properties of Plastic

Polymers have a number of vital properties, which when exploited alone or together, make a significant and outstanding contribution to constructional needs. Some of the properties are:

- Durable and corrosion resistant.
- Good Insulation for cold, heat and sound saving energy.
- It is economical and has a longer life.
- Maintenance free (such as painting is minimized)
- Hygienic and clean
- Ease of processing / installation
- Light weight

1.4 Defining the Problem

Disposal of plastic waste in an environment is considered to be a major concern due to its very low bio-degradability and presence in large quantities. Used plastic consumer bags thrown out from human dwelling has become a major constraint to the agencies in the town and cities. Used plastic bags, which are a primary constituent of the domestic wastes, mainly consist of low density polyethylene (LDPE). Plastic bags dumped in the dustbins find their way into the drainage system and clog them. Often, these are burnt along wayside, producing hazardous toxic fumes causing stringent air pollution. Worldwide, technology is facing the great challenge which is termed as “environmental destruction” by means of various factors. One among them is the high consumption of some natural resources. Aggregates such as red earth for the manufacture of bricks are one of the environmental destruction that happens in present scenario.

2. PLASTIC REINFORCED BRICK MANUFACTURING MACHINE

A Plastic Reinforced Brick Manufacturing Machine was fabricated within the limitations. It essentially consists of a cutting unit, mixing unit, extruding unit or recycling unit and a mold box. The components and working is explained as follows.

2.1 Cutting Unit

This unit is ideal equipment for cutting plastics, e.g. Polypropylene, Polyethylene film scrap, High Density Polyethylene and Low Density Polyethylene. The criteria for selection of materials for various components of the machine is based on the type of force that will be acting on them, the work they are expected to perform, the environmental condition in which they will function, their useful physical and mechanical properties, the cost, toxicity of materials and their availability in the local market or the environment. The main important components of the unit are: frame, blades, hopper and cover plate. The main function of the machine frame is to support, guide and hold in accurate alignment all the moving members of the operating machine. The outlet is located at the end of the unit where the conditioned materials are compressed and the cut out through the outlet slots. The machine is powered by an electric motor via chain drive connected to the main shaft that turns the blade. The hopper into which the plastic material is fed is located at the top of the housing. The bulk of the parts of the unit is fabricated using mild steel, this is because it is the easiest to be joined among all other metals. Mild steel is a very versatile metal, necessitating its use by many industries for fabrication of process unit equipment. Apart from its versatility, it is also very cheap and readily available compared to other metals. In the first step of cutting operation, plastic waste is collected from various sources followed by separation. After separation, the method to be followed for cutting is decided. Fig-1 shows a typical CUTTING UNIT.

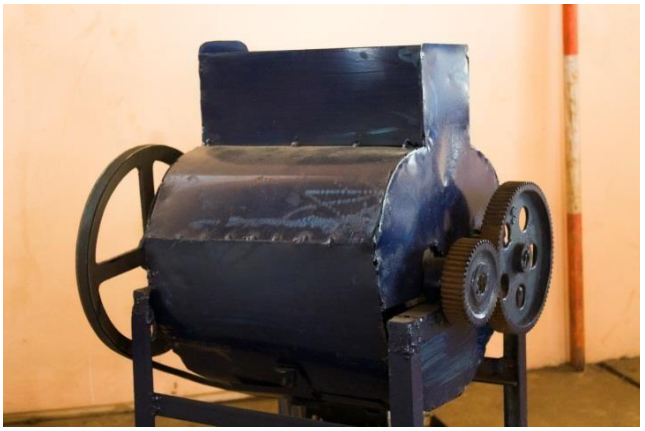

Fig -1: Cutting Unit

2.2 Mixing Unit

It is a device that homogeneously combines cement and aggregates such as sand or gravel, and plastic to form a

mixture. A typical mixer uses revolving pipes of protruding parts to mix the components. The sieved M sand along with cement and crushed stones are added together in mixing unit along with the plastic chips from the cutting unit. The cement is added to act as a binder. Mixing is to be carried out for about 15 minutes in the unit. Fig - 2 shows a typical MIXING UNIT.

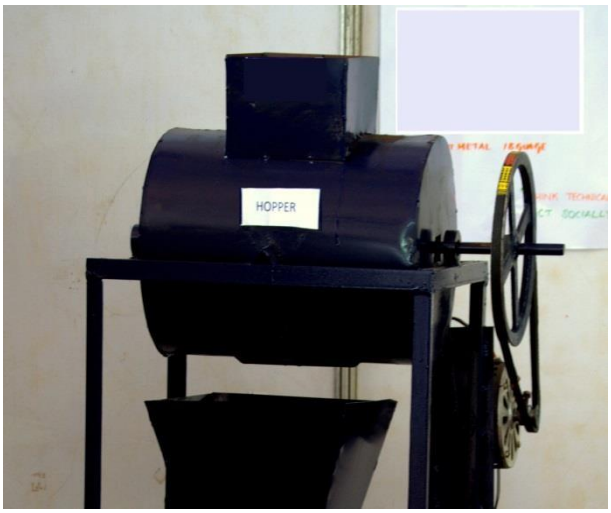

Fig -2: Mixing Unit

2.3 Extruding Unit

This type of device is capable of melting out and pumping a polymeric material with good control of the heating and of the pumping speed. When the material enters through the feed throat (an opening near the rear of the barrel) comes into contact with the screw. The rotating screw forces the mix forward into the barrel which is heated to the desired melt temperature of the molten plastic.

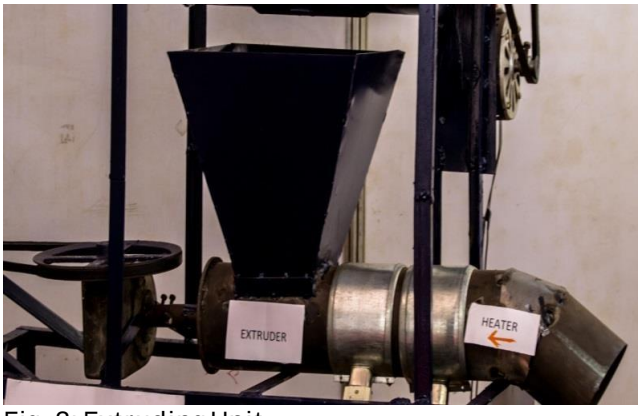

Fig -3: Extruding Unit

A heating profile is set for the barrel in which two independent controlled heater zones gradually increase the temperature of the barrel from the rear (where the mix enters) to the front. This allows the plastic chips in the mix to melt gradually as they are pushed through the barrel and lowers the risk of overheating which may cause degradation in the polymer. If the extrusion line is running a certain material fast enough, the heaters can be shut off by the thermocouple and the melt temperature maintained by pressure and friction alone inside the barrel.Fig-3 shows EXTRUDING UNIT.

2.4 Heaters & Control Knobs

The heaters are provided in Extruder. It is provided in the model in order to provide sufficient heat so that the plastic waste in the mix gets melted. And further mixes it with aggregates and comes out. The heating in the model ranges from 0 to 100^{0}C. The temperature is controlled with two knobs.Fig-4 shows HEATERS and Fig– 5 shows KNOBS to control the temperature.

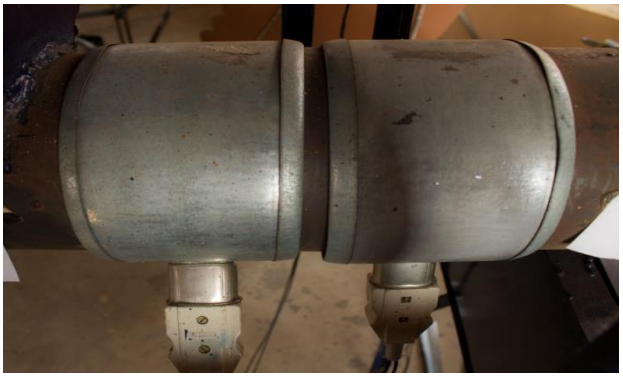

Fig -4: Heaters

Fig -5: Control Knobs

2.5 Mold Box

Shape of the bricks is molded using Brick molding box. It creates an attractive transition. Brick molding not only creates an attractive transition, but also covers the gap between the adjacent materials. Brick molding typically has a block-like profile, with decorative routing running along its exposed face or edge; shapes and exact dimensions vary according to manufacturer. Wood is the

most common brick molding material. Rot and pest resistant species such as redwood, are a classic choice for exterior trim. Alternatively, manufacturers offer pine brick molding. Plastic moldings are a common substitute for natural materials. Although relatively expensive, plastic moldings are immune to rot and pest infestation. The mixture is packed into the mold boxes compartment using mold cover and rammed to obtain it in compact size. After proper ramming, bricks are ejected and laid out in the sun for about 24 hours. Fig– 6 shows the MOULD BOX.

Fig -5: Mold Box

The following figure shows the PLASTIC REINFORCED BRICK MANUFACTURING MACHINE.

3. RESULT AND DISCUSSIONS

Fabrication of Plastic Reinforced Brick Manufacturing Machine was completed successfully. The Machine was tested and a set of both reinforced and non-reinforced bricks were manufactured. Plastic recycling is taking place in a significant pace in India. As much as 60 % of both industrial and urban plastic wastes obtained from various sources, is recycled. Thus by successful fabrication of the Plastic Reinforced Brick Manufacturing Machine, the problem of piling up of waste plastics can be controlled to a great extent. Also, by the process, we get a novel alternative building material for constructional purpose. This machine also minimizes the filling of landfill by plastic wastes. Filling of landfill is minimized by mixing the plastic wastes as an aggregate in brick manufacturing process. Recycling of plastic in brick manufacturing process has advantages as it is widely used and has a long service life, which means that the waste is removed from the waste stream for a long period. The amount of mineral aggregates required in brick is large. The environmental benefits accrued are not only related to the safe disposal of large amounts of plastic wastes, but is also resulted in reduction of environmental impacts arising from the extraction of natural aggregates.

Staying within the limitations, the prototype of the designed model was completed and the same was tested for its successful performance.

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BIOGRAPHIES

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