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Design and Fabrication of Paver block manufacturing machine with waste plastic and casting sand.

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Abstract: Plastic waste management is a prominent issue in consideration of land and Ocean pollution. Every year 5.58 billion tons of single use plastic is produced in India and only 60% is been recycled. The plastic recycling is not affordable because of the need of segregation of various plastics from the waste and cleaning of the plastic waste is not economical. Considering this problem the project proposes a solution of converting these plastic to a paver block in specifically design machine without cleaning and segregation. In this machine the plastic waste and casting sand waste will be converted to a paver block. The machine works on simple principle of heating the plastic, mixing it with the sand and solidifying into a solid paver block. The paver block prepared from plastic are durable and affordable in cost.

Keywords: Paver block, Plastic waste management, Single use plastic.

I.INTRODUCTION

Plastic pollution is deposition of plastic objects and particles in the land and ocean that adversely affect the environment, wildlife and their habitat, and humans. Plastic has various applications as they are durable and inexpensive because of which manufacturing industries prefer plastic for packaging of their product. Plastic is non-biodegradable material or slowly degradable due to its chemical structure. Due to these two factors large quantity of plastic enters the environment as a result of improper management of waste and this waste lasts long into environment. It is appraised that 1.1 to 8.8 million tons of plastic waste dumped into the ocean from coastal communities each year. It is seen that there is a stock of 86 million tons of plastic marine debris in Ocean as end of 2013. According to some researchers by 2050 there could be more plastic than fishes in ocean by weight.

Plastic is classified into two categories namely thermoplastic and thermosetting plastic. Out of the total waste produced, 78% is thermoplastic. Thermoplastic can be recycled without hampering its properties. LDPE contributes 17% of volume of total plastic produces in the world. Considering the plastic pollution into account various research have been done non converting plastic waste into paver blocks, pathways, roads etc. But it is seen that there is no specific manufacturing equipment for making such blocks. The propose project will be semi-automatic machine for converting this plastic waste to paver blocks.

II.OBJECTIVE

To design and fabricate effective machine for manufacturing paver blocks from waste plastic and casting sand. The machine should reach the require temperature and evenly mixed the plastic and sand incorrect proportion. Machine should be easy to operate and economical. This standard size of paver block of 200x100x60 produced with help of machine. The machine can easily disassemble an assembled in case of maintenance. The machine should be capable of producing 10 blocks per cycle. Different shape and size of paver blocks can be produced. The produced paver blocks should be of accurate dimensions and having good strength and durability.

III.METHODOLOGY

3.1 Sample paper block producing and testing.

Various samples were produced in a smithy furnace manually for understanding and designing the machine accordingly. We have also figured out the best proportion of plastic and sand according to the samples produce. The sample block having proportion of 2:1 was having the highest compressive strength ie. 8.63 N.mm^2. The figure 1 shows the Sample block produced and figure 2 shows testing of block under compression test rig.

Fig 1. Sample Block

Fig 2. Testing of block under Compression Test

Table 1: Results of compression Test on sample blocks

Sample No.	Composition (Sand:Plastic)	Compressive Stress (In N/mm^2)
1	1:1	6.23
2	1:1.5	7.82
3	1:2	8.63

3.2. Overview of Machine Components.

3.2.1 Heating and Mixing chamber.

The heating and mixing chamber is made with 304 stainless steels. The chamber is provided with 2 peripheral induction heaters of 2000 watt each. The chamber is provided with an internal mixing blade. The 4 blades are welded on a shaft which is supported by 2 ball bearings with solid cage to avoid leakage. The side plate is fastened to the chamber, so that cleaning and maintenance of the machine could be done easily. The chamber is so designed that it can consolidate 10 block material into it. 3 mm thickness of the chamber is provided considering constant wear due to chances of sand indentation and wear. Fig 3. shows a 3d model of machine.

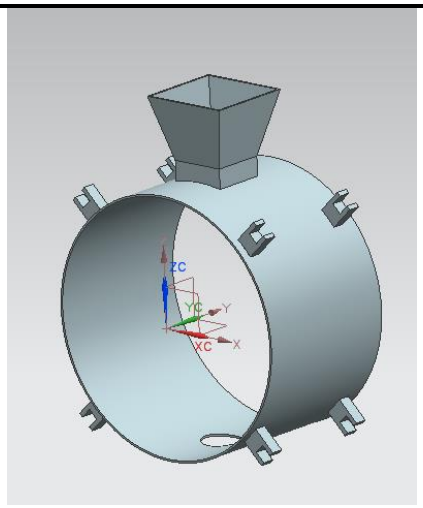

Fig 3. 3D Model of heating and mixing chamber

3.2.2 Hopper

Hopper is provided to feed in the sand into the heating and machine chamber.85 mm opening is provided to accommodate plastic pieces into it. Here the hopper is provided with the lead so that gases produced in the chamber while processing should not come out. Hopper is also made up of 304 stainless steel and welded directly to the hitting and mixing chamber. Figure 3 shows 3D Model of heating and mixing chamber.

3.2.3 Support Stand.

Support stand is provided for structural support to the machine. The stand absorbs vibrations produced while the processing and provides a rigid support while operating. This stand is made up of mild steel angle sections welded together. The stand gives elevation to machine up to 1000 mm, so that it's easy to operate, to feed and take off the material. On the support stand control panel of the machine is provided. The 3D Model of sand is shown in figure.

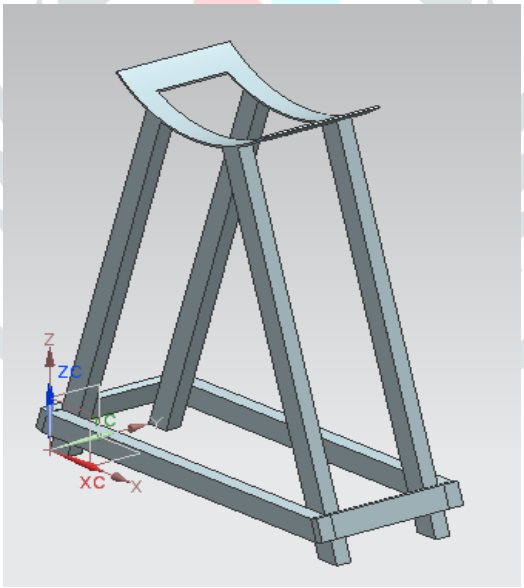

Fig 4. 3D Model of stand

3.2.4 Gate Valve

63 mm standard gate valve is provided at the bottom to extract the material from the chamber and solidified into a wooden mould. The Gate valve is having valve seat and valve made of brass and other components are of mild steel. The actual image of GATE valve is shown in figure 5.

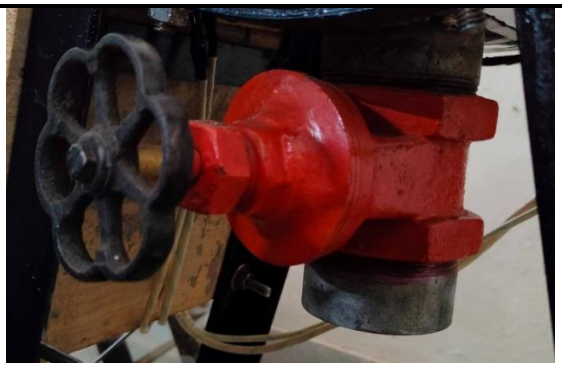

Fig 5. Image of GATE valve

3.3 Assembly of Machine

The machine is Assembled as in figure 6. The whole weight is supported by stand. The stand has holes on which the Heating and mixing chamber is fastened. The side plates are fastened to the heating and mixing chamber. The mixing blade shaft is supported on ball bearings of the side plate. The handle is attached to the shaft to provide a motion. The Electrical panel is made of wood and provided on the stand of the machine.

Fig 6. Assembled Model of Machine

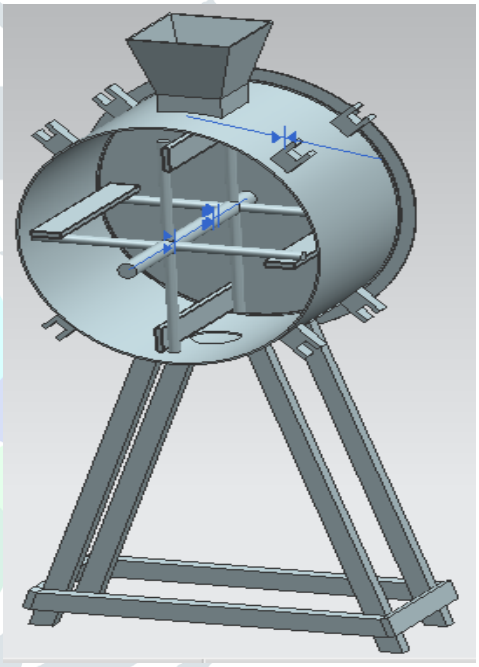

Fig 7. 3D Model of machine internal structure

IV. CONCLUSION

The Fabricated machine works effectively and produces durable and affordable paver blocks with use of plastic and casting sand. The minimum energy is required to operate this machine. The cycle time of 20 minutes is achieved to produce 10 standard sized paver blocks. The blocks are cost effective and competent of sustaining higher loads. The machine is easier to operate and an unskilled labour can operate this machine. The paver block produced on the machine costs around 30 rupees whereas the concrete block cost around 55 rupees. The produced blocks are efficient concerned with both strength, economy and environment.

V. ACKNOWLEDGEMENT

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