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An Innovative Strategy and Pilot Scale Study to Achieve ZSD (Zero Solid Waste Dumping) at Genus Paper & Board Ltd applying Extrusion Technology to Convert Plastics and Rice Husk Ash into Valuable Commodity.




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Abstract

Genus Paper and Boards Ltd which has become synonymous of quality industrial packaging paper have been contemptplating to step-in into creating wealth out of waste (WOW).

Plastic waste generation is swelling day by day particularly in the case of recycled base paper mills which causes an eyesore vis-a-vis pollutes the environment. besides the RHA (rice husk ash) generated at the boiler @ 18-20% of the rice husk is also a major concern for its disposal. both wastes are augmenting land fill volume day by day and leads to the contamination of environment and air as well

By applying extrusion technology a pilot scale study has been carried out at genus paper and board ltd to make high strength bricks and paver block and artificial wood with plastics (HDPE, HM, LD, PP,PE etc), added with RHA at optimal percentage.

This is one of the best ways to circumvent the amassing of plastic waste which is a non-degradable pollutant.

Introduction

Waste is now emerging a global problem, and needs to be addressed in order to crack the world's resource and energy challenges. Plastics are made from limited resources such as petroleum, and huge advances are being made in the development of technologies to recycle plastic waste among other resources. Plastics are non-biodegradable, synthetic polymers derived primarily from petro-fossil feedstock and made-up of long chain hydrocarbons with additives and can be moulded into finished products. These polymers are broken in presence of suitable catalyst, into monomers such as ethylene, propylene, vinyl, styrene and benzene. These monomers are then chemically polymerized into different categories of plastics. Plastics are generally categorized as Thermoplastics and Thermoset Plastics. Thermoplastics can be heated up to form products and then if these end products are re-heated, the plastic will soften and melt again. These include PET, HDPE, LDPE, PP, PVC, PS etc. Thermoset plastics can be melted and formed, but once they take shape after they have solidified, they stay solid and, unlike thermoplastics cannot be re-melted. These include Multilayer and Laminated Plastics, Bakelite, Polycarbonate, Melamine, Nylon etc. [3]. Mechanical recycling methods to make plastic products and feedstock recycling methods that use plastic as a raw material in the chemical industry have been widely adopted, and awareness has also grown recently of the importance of Thermal recycling as a means of using plastics as an energy source to conserve petroleum resources [1]. The world's annual consumption of plastic materials has increased from around 5 million tons in the 1950s to nearly 100 million tons today. Plastics constitute approximately 3-7% of municipal waste. Presently, municipal garbage disposal departments burry the plastics along with other materials in landfill without even recognizing its ill effects. Municipal solid waste in India contains 1-4% by weight of plastic waste. India's rate of recycling of plastic waste is the highest (60%) in the world as compared to other countries (China 20%, Europe 20-40%, Japan 39%, South Africa 16%, England 17.7% and USA 28%). In India, there are three common ways of getting rid of plastics - by dumping them in landfills, by burning them in incinerators or by littering them. In the case of littering, plastic wastes fail to reach landfills or incinerators. It is the improper way of disposing plastics and is identified as the cause of manifold ecological problems. Extrusion plays a prominent part on the plastics industry. Plastics extrusion is a high-volume manufacturing process in which raw plastic is melted and formed into a continuous profile. Extrusion is a continuous process, as opposed to moulding, which is a cyclic process. Approximately 65% of all plastics in use today pass through an extruder [1)

At the same time, India is an agricultural country producing plenty of rice husks which is mostly used as fuel in the boilers for processing paddy, producing energy through direct combustion or by gasification, about122 million tonnes

Sr.No.	Thermoplastic	Sr.No.	Thermoset Plastic
1.	Polyethylene Tetra phthalate (PET)	1.	Bakelite
2.	Polypropylene (PP)	2.	Epoxy
3.	Poly Vinyl Acetate (PVA)	3.	Melamine
4.	Poly Vinyl Chloride (PVC)	4.	Polyester
5.	Polystyrene (PS)	5.	Polyurethane
6.	Low-Density Polyethylene (LDPE)	6.	Urea Formaldehyde
7.	High-Density Polyethylene (HDPE)		

Table 3 Typical thermoplastic and thermosetting resins
Source: Central Pollution Control Board

of paddy are produced annually by India (Jayanti Rajput et.al 2013), about 20-22% rice husk is generated from paddy and 20-25% of the total husk becomes as RICE HUSK ASH after burning, each ton of paddy produces about 40kg of rice husk ash. The Rice husk creates great environment threat causing severe damage to the land and the atmosphere.

Rice husk ash gives many advantages due to its various properties. The influence and its physic mechanical properties were studied by Mauro M. Tashima et.al. 1985), Rice husk ash was prepared under controlled incineration so that the last product formed to engineering qualities in terms of physical and chemical properties(Moayad N. Al-Khalaf et al. 1984).

PROPERTIES OF RHA :

RHA is a very fine material. The average particle size of RHA ranges from 5 to 25µm, physical properties values as reported by few authors are given below (Table-2). RHA is a very rich in silica content. Silica content in RHA is generally more than 80-85%. Chemical composition of RHA as reported by few authors is given below (Table 3), For RHA to be used as pozzolon in cement concrete, it satisfies requirements for chemical composition of pozzolons as per ASTM C618. The combined proportion of silicon dioxide, aluminium oxide and iron oxide in the ash should not be less than 70% and LOI should not exceed 12% (2).

Physical properties of RHA

Property	Unit
Mean particle size	63 micron
Specific gravity	2.1
Fineness passing 45 micron	98%

Chemical Composition of RHA

Constituents	%
SiO_2	88
Al_2O_3	2.6
Fe_2O_3	0.6
CaO	1.8
MgO	1.6
Na_2O	0.3
K_2O	1.1
LOI	5

COMPONENTS OF MACHINE (Bricks manufacturing):

Cutting of metals into different shapes and sizes as per the requirement of the machine is done using frame cutting and to join different parts of machinery drilling and welding operations are carried out.Parts used for the construction of machinery are strong enough to sustain high temperatures as well as abrasion. 38 Cr MOAL/A featuring nitrogen treatment is used for the construction of screw conveyor and barrel and the surface is treated with alloy as the possess high hardness. Uniform mixing and melting are done due to the new designs of the screw conveyor. Equipment's which are required for the regulation of machine includes temperature control box, ceramic band heaters, hear box, etc. also, the functioning of feeding is highly improved due to the spiral barrel with a longitudinal groove.

WORKING:

The operational principle for the working of the machine is given below:

1 The heater is switched on and the temperature required for heating of plastic is set. Temperature is generally beyond 220 degree Celsius.

2 A hopper with a wide mouth is used for the feeding of waste plastic into the extruder machine. Different kind of waste plastics is fed into the hopper and reaches the rotating screw conveyor via gravity.

3 As the screw is rotating, this rotation conveys the waste plastic forward through the barrel which is set at a high temperature.

4 The depth of the channel along which the waste plastic is traveling also keeps on decreasing, which forces plastic to reduce in size with the additional help of barrels high temperature.

5. This combination of compression and screw rotation causes friction which generates heat and is called as shear heating.

6. Barrels heating and shear heat together melts the plastic and the final product is collected at the end of the machine where a nozzle is situated. The nozzle is called as an outlet.

7. The end product coming through the outlet in the form of paste is poured into a mould designed for brick making and once the respective mould is completely filled it is properly cooled.

8. After adequate cooling of the brick it is de-molded and sent for quality testing.

ABOUT US:

Genus Paper and Boards Ltd established in 2001, is today one of India's leading manufacturers of industrial kraft paper in India. It is 100% recycled based paper mill situated at Moradabad, Uttar Pradesh, having a capacity 400 TPD on two paper machines. These are three wire machines that manufacture paper ranging from 120- to 450 gsm having burst factor 18 to 40.

Various types of imported and Indian wastes paper being used for paper making and generating 1-3% plastic wastes per day of the total raw material i,e 5-12 ton/ day. The plastic generation points are at dry sorting, pulper and screen rejects.

Almost 60-70% plastic sorted out manually and sold, rest 30-40% goes with waste paper into pulper and screned out in wet condition(50-60%) and general practice is dumping aside.

Plastic generation points

Dry Sorting Area

Pulper Rejects

Vibratory Screen Rejects

Board Plant Plastic Rejects

For energy, rice husk used as fuel which generate about 25-30 T/ day rice husk ash.

Power Plant

Genus Paper and Board Ltd has already accredited ZLD (Zero Liquid Discharge) is putting lots of efforts in research, innovation and consultation to achieve ZSD (Zero solid dumping) status). To achieve ZSD, We carried out an experiment by mixing various plastics and RHA at various ratio to melt together for bricks and paver blocks making.

Material and Methodology

Dry plastics from sorting area collected which are generally single used thin film plastics(HM,LD,PP ETC) having low density and put into agglomerator to fused together to enhance it bulk density. Also, wet plastics from board plant having moisture about 50% collected and sun dried. Dry rice husk ash collected from power plant.

EXPERIMENT

The agglo material of HD,LD and PP mixed with 25%, 50% and 70% Rice husk ash are fed into extruder. The extruder temperature maintained at 250-300 degree celcius. The plastics melted with rice husk ash and the melted paste is poured into a mould designed for brick making. After adequate cooling of the brick it is de-molded and sent for quality testing. Brick size, water absorbency and compressive strength were measured and listed in table-3

Extruder

Mixture

Bricks Used In Road

Pave Blocks

Agglomarator

Bricks

Table : 3

BRICKS	SIZE (Inch)	COMPOSITION	COMPRESSIVE STRENGTH(Mpa)	WATER ABSORBANCY(%)
SAMPLE-1	9 *4.5*3	PLASTIC75%+ RHA25%	50.5	0.1
SAMPLE-2	9 *4.5*3	PLASTIC50%+ RHA50%	42.2	0.16
SAMPLE-3	9 *4.5*3	PLASTIC30%+ RHA70%	40.8	0.3
SAMPLE-4	9 *4.5*3	SCREEN PLASTIC 80%+ RHA20%	16.6	0.1
MUD BRICKS	-	-	2	-
CEMENT BRICKS	-	-	8	-

OUTCOME:

It is possible to make bricks and paver blocks out of plastics and RHA by applying extrusion technology. The bricks/paver block made are very strong having its compressive strength more than 20 times as compared to mud bricks and 5 times than cement bricks. Water absorbency of these bricks are also very negligible which supports enhancing its life.

CONCLUSION:

This pilot scale work effectively converts waste plastics and rice husk ash into useful building materials like building bricks and paver blocks, also can be made many different value added products. Thus it can effectively reduce the environmental pollution and further decreases and / or eliminates the problem of waste plastics in the Paper industry. We used the made bricks on the roads inside the mill and it shows an excellent result. From the compression testing results we come to know that waste plastics material when effectively mixed with rice husk ash gives the highest compressive strength and sustains high compressive load.

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Refference:

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