

Sustainable Waste Management Approach: Use of Plastic and Unrecycled Paper Waste to form Plastic Paper Aggregators, which can be used as a Substitute to Traditional Gravels used in Switchyard

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Abstract— With the Rapid urbanization, economic growth, and higher rate of urban consumption, Solid Waste is increasing rapidly. According to the survey report by The Energy and Resources Institute (TERI), India generates over 62 Million Tons of MSW in a year from this around 5.6 MT come from Plastic waste (12-15 %) and Paper waste around 3 MT (6-7%). However sustainable waste management planning helps in addressing the Solid Waste management. This paper covers the sustainable management for handling of Plastic and paper waste. With the Use of Plastic waste and paper waste to form gravels blocks which can be used in place of traditional gravel blocks in switchyard which results in greener environment.

Index Terms— Sustainable waste management, Switchyard gravels, Plastic and paper waste, Step and Touch Potential

I. INTRODUCTION

Generally, gravels were used to cover the surface of Switchyard and Substations. These gravels form a high resistivity layer, which increases the allowable step and touch voltages, thereby reducing the risk of humans in the vicinity of the grounding system, during an earth faults.

Step Potential and Touch Potentials are very important in substations because during ground faults all the ground current returns to the substation transformer (as the substation transformer is grounded). The current that returns through the earth can create a significant voltage gradient along the ground and between ground and conducting objects. A **step potential** in substation creates a path through the legs from one foot to the other. A **touch potential** in substation is normally considered a hand-to-foot or hand-to-hand contact.

Step potential and touch potentials are of concern during normal conditions and during ground fault. Step potential and Touch potentials during faults are more dangerous. Therefore, it is important to reduce the step potential and touch potential to be within limits during the substation design this can be achieved by creating an insulation layer with the help of Gravels. Across India approx. **121030.1 Tons** of gravels presently filled in substations. Taking into consideration of Huge requirement of Gravel which can be substitute by Municipal solid waste, which forms a sustainable waste management. Plastic Bottles make up approximately 11% of the content landfills, causing serious environmental consequences.

II. LITERATURE REVIEW

Handling of Municipal Solid Waste

Solid waste management is a major concern for many urban local bodies in India, where urbanization, industrialization and economic growth growth have resulted in increased municipal solid waste generation per person. Achieving sustainable development within a country experiencing rapid population growth and improvements in living standards is made more difficult in India because it is a diverse country with many different religious groups, cultures, and traditions. Despite development in social, economic and environmental areas, SWM systems in India have remained relatively unchanged. The informal sector has a key role in extracting value from waste, with approximately 90% of residual waste currently dumped rather than properly landfilled. There is an urgent need to move to more sustainable SWM, which requires new management systems and waste management facilities. As per TERI publication India generate around 62 million tons of municipal solid waste(MSW) out of which Plastic and Paper solid waste corresponds to 5.6 MT and 3 MT per annum It is estimated by Indian central pollution control Board that by 2030 approx. 165 Million Tons of MSW will generate out of which around paper and plastic waste contribute to 30 Million Tons, from which we can use the PET plastic waste and untreated paper waste can be used to form gravel/ aggregator blocks.

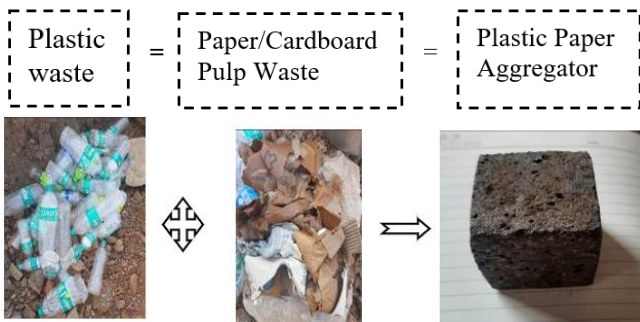
III. METHOD

A Plastic paper aggregator block made from mixture of plastic waste and unrecycled paper waste. Firstly, **Plastic bottles of PET** type taken as one of the raw material and unrecycled waste paper, like tissue paper, cardboards waste taken as secondary raw material for innovative block.

Proportioning and casting: Plastic waste and paper/cardboard waste taken in **2:1 proportionate**.

Secondly unrecycled paper and cardboard firstly made as pulp mixture. Thirdly Plastic waste is melted and subsequent to this paper/cardboard pulp is added and continued for melting up to 150 deg centigrade temperature.

During the melting process continuous stirring carried so as to avoid lump formation.



The Molten material placed in mold and cooled to reach ambient temperature. After reaching ambient temperature it is cleaned with water thoroughly and kept under sunlight for 12 hours. Final product formed which is tested for insulation value and mechanical strength.

Specimen Block Dimensions

Length (mm)	Width (mm)	A. Breadth (mm)	B. Weight (g)
45	45	45	79.5

IV. TESTING RESULTS

The Prepared Plastic Paper aggregator block tested for Electrical Insulation and Mechanical strength

Electrical Test: Insulation resistance test carried for block by injecting 5000 V DC, for 1 minute duration and observed the resistance value across the testing leads. More than 1 Tera ohms recorded.

Resistivity of the block comes greater than 4.5 x10¹²-ohm meter.



Electrical Insulation Resistance Measurement

Mechanical Strength Test:

A Plastic paper aggregator cube has been prepared with the dimensions of 45mm x 45 mm x 45 mm, and the Block is tested to determine the compressive strength of the specimen



Compression Strength Measurement

Compressive strength starts from 1 KN is applied initially and gradually increased with the incremental of 1 KN compression force on the specimen cube. Till 9 KN of force the cube able to withstand without any cracks.

Test Result Comparison		
	Traditional Gravel	Plastic paper Aggregator
Electrical Resistivity	5x10 ⁴ ohm meter	4.5 x10 ¹² ohm meter
Compressive Strength	25 Mpa	4.44 Mpa
Density	2600 Kg/m ³	870 Kg/m ³

V. CONCLUSION

This Study attempts to give a contribution to the effective use of domestic waste (plastic and unrecycled paper) to make plastic paper aggregators in order to prevent the environmental strain caused by them and also to limit the consumption of traditional gravels which were used in switchyards. The Plastic paper aggregator can reduce the disposal of plastic and Unrecycled paper waste; it also makes the effective utilization of waste plastic that are hazardous to environment.

As per the Lab test results following conclusion can be drawn that the electrical resistivity of the Plastic paper aggregator is very much increased which is a best suitable material that can be used as a surface layer in switchyard. In India total switchyard area corresponds to 4655007 m², to cover this entire switchyard with traditional gravels it requires 121030.1 Tons, whereas by use of plastic paper aggregator needs only 406223 Tons, which means there is reduction of 2/3rd of the material, which result in overall cost reduction.

If all the switchyard gravels replace by Plastic Paper aggregators, then it takes **13540766666 Nos** of PET bottles to be used. It is concluded that the use of Plastic paper aggregators provides advantages such as reduction in the use

of conventional aggregate, disposal of wastes, prevention of environmental pollution, and energy saving.

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