RECYCLING OF WASTE WATER PACKETS USING CRYOGENIC PROCESS

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ABSTRACT

Recycling of plastics is a big issue in terms of environmental sustainability and of waste management. The development of proper technologies for plastic recycling is recognised as a priority. Cryogenic grinding is one of the means to a useful and cost-effective solution for recycling of plastics. Powdering the products at sub-zero temperatures ranging from 0°C to -196°C is done by cryogenic grinding process. The products are cooled down with liquid nitrogen before they are ground. This process does not damage or alter the chemical composition of the products in any way.While cooling the material to below the glass transition point; thus embrittling the material before grinding. Cryogenic grinding is suitable for materials such as thermoplastics, elastomers, waxes, paint additives and even some metals.In this project we going to deal about sub-zero treated plastic waste pocket and epoxy resin composite rod and to analysis the mechanical property and behaviour of the composite. The main goals of the research are to establish mechanical properties of plastic composites and to identify attractive applications for the composites by involving the plastic resin composite to cryogenic environment. The sub-zero treatment was done by liquid nitrogen gas. *In this project recycling of waste water packets by using cryogenic process. Now a days, we are using plastics in all over the world. On behalf of that we are planned to recycle the plastics. The plastics can be recycled in many ways among those we have chosen to make as a plastic pipe instead of PVC (polyvinyl chloride) pipes by using cryogenic process. In this project waste water packets are mixed with epoxy resins and made into a semi-solid. Then the semisolid is poured into the die making and then the cryogenic process with liquid nitrogen is implemented to the specimen obtained. After that the following tests are taken (i.e, tensile test, hardness test, impact test). The main scope of our project is to improve the solid waste management by recycling of plastics.*

KEYWORDS: *Waste Water Packets, epoxy resin, Cryogenic Process, Liquid Nitrogen Gas.*

1. INTRODUCTION

With an increased in environmental problems, especially those materials that are non – biodegradable caused too much predicament on the ecological sector. The primary material among this waste product is the plastic substance. Plastic with its exclusive qualities of being light yet storing and economical, had invaded every aspect of our day to- day life. It has many advantages; it is durable, light, easy to mold and can be adapted to different user requirements. Once hailed as a "wonder material", plastic is now a serious environmental and health concern, here in our country and around the world, essentially due to its non-biodegradable nature. Although people know that plastics have a remarkable impact, it has become increasingly obvious that there is a price to be paid for their use. Plastics are durable and can degrade slowly. In some instance, burning it can cause toxic fumes on our air. Plastics are used in a wide range of applications and some plastics items, such as food packaging, become waste only a short time after purchase. Other plastic items lend themselves to be reused many times over. Reusing plastic is preferable to recycling as it uses less energy and fewer resources. Long life, multi-trip plastics packaging has become more widespread in recent years, replacing less durable and single-trip alternatives, so reducing waste. For example, the major supermarkets have increased their use of returnable plastic crates for transport and display purposes four-fold from 8.5 million in 1992 to an estimated 55.8 million in 2012. They usually last up to 30 years and can be recycled at the end of their useful life.

According to a 2012 Environment Agency report, 80% of post-consumer plastic waste is sent to landfill, 8% is incinerated and only 7% is recycled.

In addition to reducing the amount of plastics waste requiring disposal, recycling plastic can have several other advantages: A.) Conservation of non-renewable fossil fuels – Plastic production uses 8% of the world's oil production, 4% as feedstock and 4% during manufacture. B.) Reduced consumption of energy. C.) Reduced amounts of solid waste going to landfill. D.) Reduced emissions of carbon dioxide (CO_2), nitrogen-oxide (NO) and sulphur-dioxide (SO_2). Currently most plastic recycling is of 'process scrap' from industry, i.e. polymers left over from the production of plastics. This is relatively simple and economical to recycle, as there is a regular and reliable source and the material described as reprocessing rather than recycling. The creation of non-decaying materials, combined with a growing consumer population, has resulted in a waste disposal crisis. One solution to this crisis lies in recycling waste plastic into useful products.

Research into new and innovative uses of soild waste plastic materials is continually advancing. Many agencies, private organizations, and individuals have completed or are in the process of completing a wide variety of studies and research projects concerning the feasibility, environmental suitability, and performance of using recycled products in PVC pipe construction. These studies try to match society’s need for safe and economic disposal of waste plastic materials with the PVC pipe construction industry’s need for better and more cost effective PVC pipe construction materials.

2. SELECTION OF MATERIALS

- Wasted plastic water packets
- Cryogenic grinding
- Epoxy resin

3. METHODS AND WORKING PROCESS

3.1 Cryogenic treatment procedure

The liquid nitrogen as generated from the nitrogen plant is stored in storage vessels. With help of transfer lines, it is directed to a closed vacuum evacuated chamber called cryogenic freezer through a nozzle. The supply of liquid nitrogen into the cryo freezer is operated with the help of solenoid valves. Inside the chamber gradual cooling occurs at a rate of 2º C /min from the room temperature to a temperature of -80º C. Once the sub-zero temperature is reached, specimens are transferred to the nitrogen chamber or soaking chamber wherein they are stored for 24 hours with continuous supply of liquid nitrogen. **Fig no: 1** illustrates the **entire set up for cryogenic treatment**. The entire process is schematically.

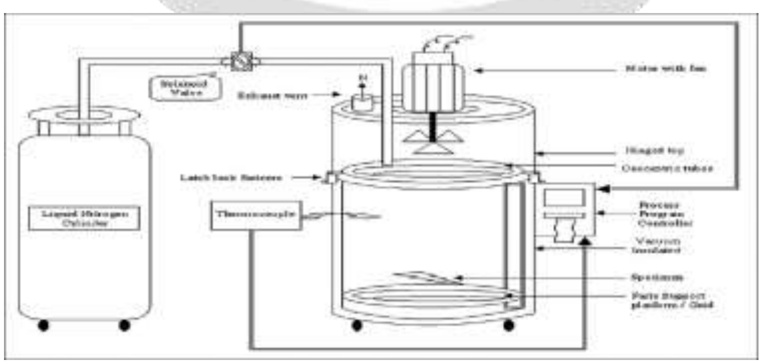

Fig no: 1 Cryogenic treatment

3.2 Mixing process

Wasted water pocket, which is taken as reinforcement in this study is collected from local sources. The epoxy resin and the hardener are supplied. Wooden mould having been first manufactured for WPC fabrication. The Wasted water packets are mixed epoxy resin by simple mechanical stirring and the mixture was poured into various mould, keeping in view the requirement of various testing conditions and characterization standard. The composite sample of different composition are prepared .the composite of mixing ratio Wasted water pocket 45% with mixing of epoxy resin 55%. The detailed composition and designation of composite materials. A releasing agent is used on the mould release sheets to facilitate easy removal of the composite from the mould after curing. The mould is closed for curing at a temperature Of 30 degree C for 24 hours at a constant load of 50kg .after curing the specimen of suitable dimension is cut using a diamond cutter for mechanical test as per the ASTM standards.

Wasted water pocket and epoxy resins are used in this study. Hardener used is polyamide hardener. The epoxy resin and hardener are mixed in the ratio of 2:1 and stirred thoroughly. Release agent used was mansion polish.

Two part epoxy compounds are normally supplied in separate A - B containers, either both full or in a pre-measured kit. Under the Resin lab designation; Part A is the epoxy resin and the Part B is the polyamine hardener, with some systems the Part B may be an anhydride. Epoxy resins are normally clear to slightly amber, high viscosity liquids which may be filled with mineral fillers to improve performance and lower cost. These sometimes can settle to the bottom of the container and must be stirred to a homogeneous consistency before adding the hardener. Epoxy resins can cause mild skin irritation and a form of dermatitis upon repeated contact. It is important to limit skin contact with any epoxy resin or hardener. Therefore, we recommend that you wear rubber gloves when mixing and using the epoxy compounds.

3.3 Die making

The tooling involved moulding is quite similar to that of stamping dies. The principal difference is that stamping requires force, while molding does not. In molding, two units are required whose design is such that, when brought together, they make up a system of closed cavities linked to a central orifice. Liquid is forced through the orifice and into the cavities, or molds, and when the solidifies, the molds open and the finished parts are ejected.

4. MECHANICAL PROPERTIES

4.1 Tensile test

- **Tensile test:** Tensile testing is conducted on recycled plastic rod according to ASTM standard D3039 and properties are determined tabulated.
- **Tensile Test Value:**

CSA mm^2	YL KN	YS N/mm^2	TL KN	TS N/mm^2	IGL mm	FGL mm	%E
490.87	**2.11**	**22.37**	**3.02**	**54.76**	**130.82**	**137.83**	**7.01**

Table no: 1, Tensile test value

4.2 Hardness test

- **Hardness test:** The resistance to indentation, and it is determined by measuring the permanent depth of the indentation. This test was conducted in brinell hardness testing machine.
- **Hardness value:** 89.1,89.8 & 90.3 HBW

4.3 Impact test

- **Impact test:** The charpy impact test is also known as charpy v-notch test, is a standardized high-rate test which determines the amount of energy absorbed by a material during fracture. This test was conducted in charpy impact testing machine.
- **Impact test value:** 20 joules.

5. COMPARISON OF PVC AND RECYCLED PLASTIC

Tests	PVC material	Recycled plastic material
Tensile strength (N/mm^2)	52	54.76
Hardness test (HBW)	80	90.3
Impact test (Joules)	For 20ºC -20 Joules For 0ºC – 8 Joules	20

Table No: 2, Comparison of PVC and recycled plastic

6. CONCLUSION

From the research it can be concluded that the cryogenic grinding process produces fairly smooth fracture surfaces. Little or no heat is generated in the process. This results in less degradation of the material. Apart from this Fineness and uniform distribution of particular sized particle is met in this process according to requirement; it can be adjusted using suitable configuration of Cryogenic grinders. As the production is in inert atmosphere the material is protected from oxidation and rancidity. Comparatively the cost of Cryogenic grinding process is less and energy consumption is reduced. Production rate is also improved. In this project the tensile test, hardness test and impact test have been taken after the plastic composite is cryogenically treated using the cryogenic process. This project is made to improve the solid waste management and also to make a better product like plastic pipe instead of using PVC pipes. Also the comparison between this project and the PVC pipes have been taken. Hence, in this project we obtained the test values more over similar to PVC mechanical properties. The scope of this project is to recycling of waste water packets into a hollow pipe by cryogenic process and to make solid waste management.

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