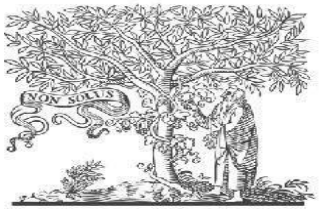
International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

COPY RIGHT



ELSEVIER SSRN

Link : https://ijiemr.org/downloads/Volume-12/Issue-04

10.48047/IJIEMR/V12/ISSUE04/191

Title FABRICATION AND ANALYSIS OF RECYCLED ABS WIRE BLENDED WITH BAKELITE

Pages: 1480-1486

Paper Authors
Dr. M. KEDAR MALLIK, B. ADITHYA, D. BALA KRISHNA, D. BHARGAV, A. SANTHOSH

USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

To Secure Your Paper As Per UGC Guidelines We Are Providing A Electronic Bar Code

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

FABRICATION AND ANALYSIS OF RECYCLED ABS WIRE BLENDED WITH BAKELITE

Dr. M. KEDAR MALLIK, Professor, Department of MECH,
Vasireddy Venkatadri Institute of Technology, Nambur, Guntur Dt., Andhra Pradesh.

B. ADITHYA, D. BALA KRISHNA, D. BHARGAV, A. SANTHOSH
UG Students, Department of MECH,
Vasireddy Venkatadri Institute of Technology, Nambur, Guntur Dt., Andhra Pradesh.
E-Mail ID: adithyabhagavatham@gmail.com

Abstract

Phenol-formaldehyde resin, commonly known as Bakelite (C16H26O2)n[7], is a versatile material that can be molded quickly into a wide range of vibrant colors. When heated, Bakelite becomes pliable and liquefiable, but once cooled, it becomes permanently rigid, making it an ideal choice for thermosetting plastic applications. This type of plastic is commonly used in the manufacturing of non-conducting parts for electronic devices such as sockets, wire insulation, switches, and automobile distribution caps.

Fused Deposition Modelling (FDM) or Fused Filament Fabrication (FFF) is a 3D printing process that utilizes the same plastic materials found in everyday products, including industrial-grade thermoplastics. ABS, which is composed of Acrylonitrile, Butadiene, and Styrene polymers, is a commonly used material in personal or household 3D printing, primarily through FDM or FFF 3D printers.

The goal of the project is to combine ABS and Bakelite in various compositions to print 3D components and analyze the results.

1. Introduction

Introduction to material:

- The primary material used in this entire procedure is the BAKELITE. Chemically Bakelite is termed as Phenol formaldehyde resin (C16H26O2).
- The secondary material is ACRYLONITRILE BUTADIENE STYRENE in the form of a wire which is most important material in 3D printing applications.
- The main reason to choose Bakelite as a primary material in this procedure is to analyse the properties of the components which are 3D printed along with ABS.
- Also, Bakelite possess some important properties such as, quickly molded, heat resistance up to 120º on continuous operating, heat capacity up to 0.92KJ/kg K, being a thermosetting polymer Bakelite has high strength to retain its own form even after extensive molding.

- ABS is the basic material which is commonly used in 3D FDM or FFF printing applications.
- ABS strand is guided into an extrusion head or extruder that heats the ABS plastic fluids melting point in order to liquefy it.
- The entire procedure is done in 3 steps:

i. Heat treatment ii. Wire draw iii. 3-D Printing

The main reason of using ABS is its desirable properties such as, melting temperature around 200 deg C, recyclable, good weldability, good impact resistance temperature around -20 deg C to 80 deg C.

Fig 1: Bakelite granules

Fig 2 : ABS

Bakelite:

The thermosetting phenol formaldehyde resin known as Polyoxybenzyl methyleng lycolan hydride is produced through the condensation reaction of phenol with formaldehyde.

Waste Bakelite is generated from various sources such as machine parts of electrical systems, automobile components, and telecommunication workshops.

Properties:

- This material is a cross-linked polymer.
- It is characterized by its strength, rigidity, and lightweight nature.
- It can be easily molded into various shapes.
- It cannot be melted and reshaped once set.
- It has excellent resistance to heat, electricity, and chemical corrosion.

HEAT TREATMENT:

Heat treating, also known as heat treatment, encompasses a set of thermal and metalworking processes utilized in industries to modify the physical and sometimes chemical properties of a material, with metallurgy being the most common application. The process typically involves heating or cooling the material to extreme temperatures to achieve the desired outcome, such as hardening or softening the material.

Fig 3: Process of Heat treatment

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Wire draw:

Drawing dies are commonly crafted from tool steel, tungsten carbide, or diamond materials, with tungsten carbide and manufactured diamond being the most prevalent options. In cases where extremely fine wire is required, a single crystal diamond die is utilized.

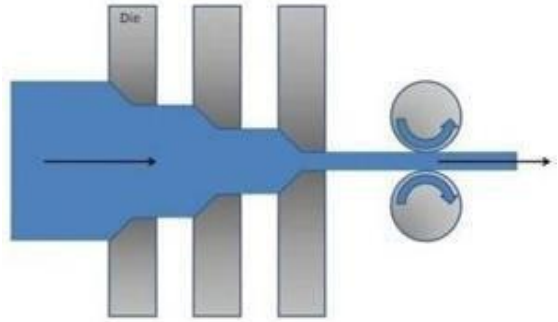
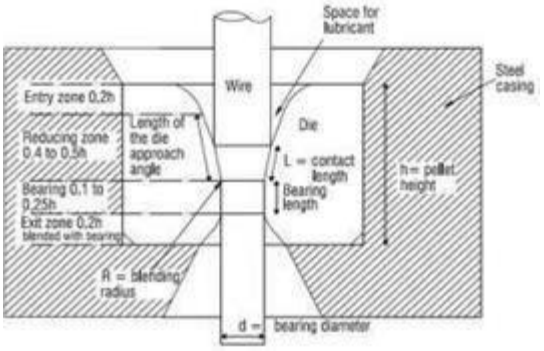


Fig 4: 2-D view of wire drawing

In hot drawing processes, cast steel dies are typically utilized, while tungsten carbide dies are commonly used for steel wire drawing. The process of wire drawing can have a significant impact on the strength of the material. In fact, some of the highest strengths ever recorded for steel have been achieved through small-diameter cold-drawn austenitic stainless wire.



To prepare the wire for drawing through the die, the initial end of the wire is compressed through a process of hammering, filing, rolling, or swaging to reduce its diameter, enabling it to fit through the die. The wire is then drawn through the die.

Injection moulding

Phenolic injection molding has been utilized in the industry for almost four decades. While it requires equipment that is somewhat distinct from that used in conventional thermoplastic molding, the basic concept is quite similar. The process does necessitate a specialized screw and jacketed barrel, but with the appropriate modifications to these components, the same basic machine can be used for phenolic injection molding

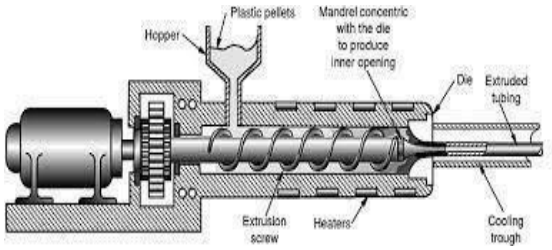


Fig-5: Extrusion

Procedure:

• Initial step of whole procedure is to prepare a fine powder of Bakelite from its granules along with cutting the required amount of Acrylonitrile Butadiene and Styrene (ABS) wire into small pieces.

• Second step involves the heat treatment of Bakelite and ABS together along with

charcoal and added materials in a furnace.

• When Bakelite starts liquefying, pieces of ABS wire are added on continuous heat treatment up to the maximum temperature where they both are mixed.

• Being a thermosetting polymer, Bakelite starts solidifying easily. So, the solution should be added to a pre-prepared die to draw a wire.

• This immediate action should be done very quickly and carefully in order to draw a fine wire to get 3D printed of desired shape.

• On further steps the procedure involves the rolling of wire to a rod like material not to get dismantled before its application.

• Entire procedure will be done in Fused Deposition Modelling technique to get the printed components up to their maximum level of accuracy.

Initilization Material Selection

Taking our project theme as a main consideration we have gone through various properties and examined the result and finalized ABS and BAKELITE POWDER as our main material.

Inorder to do the procedure accurately and safely we took 2kg of Bakelite and 1kg of ABS granules at the same time.

The main course follows as the procedure of blending of Bakelite powder with ABS granules to fabricate a wire.

Procedure as Follows Procedure1:

BLENDING OF BAKELITE AND ABS IN A OPEN FIRE PLACE FURNACE

Initially we have taken 200gms of Bakelite Powder (approx..80%) and 50gms of Acrylo nitrile butadiene styrene wire (approx..20%) and started the procedure. As a result, Bakelite didn't get change its state and settled stable and ABS got partially melted.

For a second time we have changed the composition of Bakelite as 150gms (approx..60%) and ABS as 100gms (approx..40%) and began the same with some more added heat resistant as shown in fig 6.

As a result, Bakelite turned into a solid form and ABS got completely melted.

The final step includes the equal composition of both Bakelite and ABS as 100gms (approx..50%) each.

Bakelite turns out to a rigid solid form and got mixed with ABS wire. The obtained outcome cannot be utilized as a result.

Fig-6: OPEN FIRE PLACE FURNACE

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Procedure2: BLENDING OF BAKELITE POWDER AND ABS IN A MUFFLE FURNACE

Change of equipment gives a little progress and the initial composition are 150gms of Bakelite (approx..80%) and 50gms of ABS (approx..20%). As a result, Bakelite turned out to solid and mixed with ABS granules at the following three temperatures: 250deg C, 350deg C, 400deg C in the machine as shown below.

The following step include the composition of 100gms of Bakelite (approx..50%) and 100gms of ABS (approx..50%).

Obtained outcome of above composition is ABS got mixed with Bakelite and Bakelite turned into solid.

Coming to the final step, 50gms of Bakelite (approx..20%) and 150gms of ABS (approx..80%) got heat treated at the above mentioned three temperatures and obtained outcome doesn't suitable for wire drawing.

Fig-7: Muffle Furnace machine

Procedure 3: INJECTION MOULDING

The fundamental principle of phenolic injection molding is analogous to that of thermoplastic injection molding, and the same basic machine can be adapted for phenolic molding by modifying the screw and barrel appropriately.

Here, the initial composition of 150gms of Bakelite and 50gms of ABS wire are injected into the barrel of injection moulding machine.

Observing the outcome, material was not coming out of the nozzle. It just deposited inside the barrel.

The second step in the above procedure includes the equal composition of both ABS and Bakelite and added to machine as shown in fig 8.

As a result, materials slightly came out of the nozzle but doesn't form a continuous wire suitable for the further procedure.

Coming to the last step of the procedure, 25gms of Bakelite and 175gms of ABS were introduced into the machine.

A fine wire of ABS and Bakelite composition is drawn with the diameter approximately 2mm.

Fig 8: Injection moulding machine

Problem Statement: Objectives:

- To prepare a wire using Bakelite and ABS.
- To identify the best combination which is suitable for 3-D printing.
- To fabricate and analyse the 3D printed components using Bakelite as a wire along with ABS.
- To draw a conclusion of properties exhibited by the components and to compare them with the standard ones.

Outcomes:

- Bakelite is pretty stiff and hard compared to most 3D printed materials, more like hard acrylic resins or amber.
- ABS is a good filament for general-purpose 3D printing. Common applications for the material include functional prototyping, concept modelling, and production of tooling as well as some end-use parts.
- Most common uses for ABS plastic sheets include, Refrigeration industry, 3-D Building Materials, Machine prototype construction and Bakelite in door, utensil handles, sockets etc…
- A fine wire of ABS and Bakelite composition is drawn with the diameter approximately 2mm.

Limitations:

- Melting of raw Bakelite powder is impossible directly instead of adding few additives for melting procedure.
- In order to gain suitable composition of Bakelite and abs, percentage of abs should be more than compare to Bakelite.
- Melted Bakelite mixture should be inserted immediately into the machine unless it will be turn out into hard solid form.

Future Scope:

- If the procedure is up to the mark, it reduces the cost of usage of abs percentage. Also, Bakelite being a thermoplastic material, the outcome product contains maximum stability to withstand higher loads and temperature.

REFERENCES

1) Nopagon Usahanunth, Seree Tuprakay, Waranon Kongsong.

2) Sirawan Ruangchuay Tuprakay. “Study of mechanical properties and recommendations for the application of Waste Bakelite Aggregate Concrete”, Case Studies in Construction Materials 8 (2018) 299-314.

3) Ronak Shah, Himanshu Garg, Parth Gandhi, Rashmi Patel, Anand Daftardar. “Study of Plastic Dust Brick made from Waste Plastic”, International Journal of Mechanical and Production Engineering,

ISSN: 2320- 2092, Volume- 5, Issue-10, Oct.-2017.

4) Dinesh. S, Dinesh. A, Kirubakaran. K. "Utilization of Waste Plastic in manufacturing of Bricks and Paver Blocks", International Journal of Applied Engineering Research, ISSN 0973- 4562 Vol. 11 No.3 (2016).