iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** II **Month of publication:** February 2020

DOI: http://doi.org/10.22214/ijraset.2020.2090

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

Tribological Behavior of Polyamide66 Blend with GF, PTFE and CNT in Journal Bearing Application

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Abstract: ***Polymer has important in tribological applications because of his self-lubricating property under sliding wear condition and low friction against steel counterpart. Polymer composite used in any application without any external lubricant such as sugar cane conveyor bearing application. Polyamide 66 has good strength, stiffness as well as good wear resistance and self- lubricating property these property make this component thermoplastic promising candidate in bearing application where two different body in contact under sliding condition. This property can improve with adding composites which causes increasing in load carrying capacity and strength of a material. Carbon nanotube and glass fiber has good strength, stiffness weathering property so it reduces coefficient of friction. PTFE is solid lubricant used in thermoplastic. Carbon nanotube has important effect on the mechanical property compared with traditional graphitic fiber. Perhaps most striking effect is the opportunity to associated high flexibility and high strength with high stiffness, a property that is absent in graphite fiber.***
Keywords: Polyamide 66, glass fiber, carbon nanotube, polytetrafluoroethylene.

I. INTRODUCTION

The mechanical industries are always under constant pressure to develop a creative material which is good for both mechanical strength and tribo-performance. Polymer and their composites are finding ever increasing uses for numbours industrial application such as bearing material, rollers, gears, cam, wheels and clutches. The use of polymers and polymers based composites which has having combination of good mechanical and tribological properties can only prove themselves as worthy. It is often found that such a property are not attainable with a homopolymer.

This has led to development of polymer blend. Polymer blends are mixture of at least two macromolecular species, polymers and copolymer. Polyamide 66 is a semi crystalline thermoplastic commodity polymer that finds widespread use in application that required considerable strength but low toughness. PTFE is a linear polymer with a high crystallinity, strong, stiff and tough engineering material with a lower coefficient of friction.

Polymeric composite fill with inorganic filler are the important material today. Incorporating filler and fiber is a base of polymer material provides substantial improvement in term of mechanical properties. Attempts to understand the modification in mechanical behavior of the polymer with the addition of filler have been mead by many researches. It is Founds that incorporation of fillers as a reinforcement effectively changes the various properties of thermoplastics. Thermoplastic material have been widely used in industries. There is lot of reasons to use the polymeric material as provide lower weight alternatives and self-lubrication instead of traditional metallic material.

The main adventures of this Polymer is self-lubrication and corrosion resistance. However, the polymer material have low mechanical property, such as low mechanical strength, low thermal conductivity and low thermal expansion. Therefore polymeric bearing have limited the application.

In order to turn the disadvantages to advantages. Reinforcement fiber is usually embedded in polymers to make the composites. Glass fiber and carbon fiber which are short fiber reinforcement have been successfully used to improve the strength to high pressure. In additional glass fiber improve the load carrying capacity and the thermal conductivity.

II. LITERATURE REVIEW

A. *R. Franke et el. [1]*

This pepper detect the injection molding process for the production of composite parts is gaining increasing important. The investigation we are done with PA66 and four different PTFE-PA66 composite with PA66 injection type matrix. The test is done at room temperature. The glass fiber reinforced core give a better stiffness effect of the part with even at a higher pressure. On the other hand the addition of bronze powder a filler or aramid fiber as a reinforcement material in the compound PTFE-PA66 material result in the compound with a high mechanical strength and low wear.

B. *Dr. S. H. Thakre et el. [2]*

This pepper presented a review of tribological properties of composite material with PTFE. Where, PTFE have lower wear resistance, especially abrasion, the wear resistance of PTFE is increased by addition of reinforcement material. Among the most common filler material are GF, graphite, carbon, bronze. In this pepper we have studied 85% PTFE +10% carbon + 5% graphite; 80% PTFE +20% GF. Is shows that the PTFE composite have reduction in wear. Increase in bearing pressure and velocity the wear is increase in journal bearing.

C. *Mehment Turan Demirci et el [3]-*

this pepper studied the effect of sliding velocity, bearing pressure, temperature and wear loss of a journal bearing composite which is mead up of PA66 +30% GF and PA66 +25% GF +3% MOS2 we are examined at room temperature condition. The best wear at PA66+30% GF +3 % MOS2 on the journal bearing specification. With high velocity and high pressure MOS2 reinforcement provide lower wear loss.

D. *Du.Xin Li Et El [4]*

The aim of the pepper is to optimize the tribological property of GF reinforced PA6 for high performance friction material by using and multi solid lubricant such as PTFE and UHMWPE and there composition. Different polymer composition blend we are prepared such as GF/PA6. The GF/PA6 act as polymer matrix and solid lubricant were prepared by injection molding. The optimum wear resistance property is obtained by PTFE contain 20 wt. %.

E. *B M. Rudresh et el [4]*

This pepper studied the effect of composition of PA66 and PTFE in 80% to 20%. Three micro composite are prepared by reinforcing fine particle such as molybdenum disulfide PA66/PTFE/MOS2; PA66/PTFE/MOS2/SIC of different geometrical shapes to form the mixture. These composition poured into corotating twin screw extruder and then injection molding was used for formation of bar of the composite. The mechanical properties according to ASTM are a tensile strength, flexural strength and impact strength including the hardness of the blend of the micro composites. MOS2 in the blend increases the flexural strength. The composition PA66/PTFE/MOS2 increases the mechanical property.

III. PROBLEM STATEMENT

The main problem is corrosion, wear, coefficient of friction and heat dissipation in journal bearing of sugarcane conveyor.

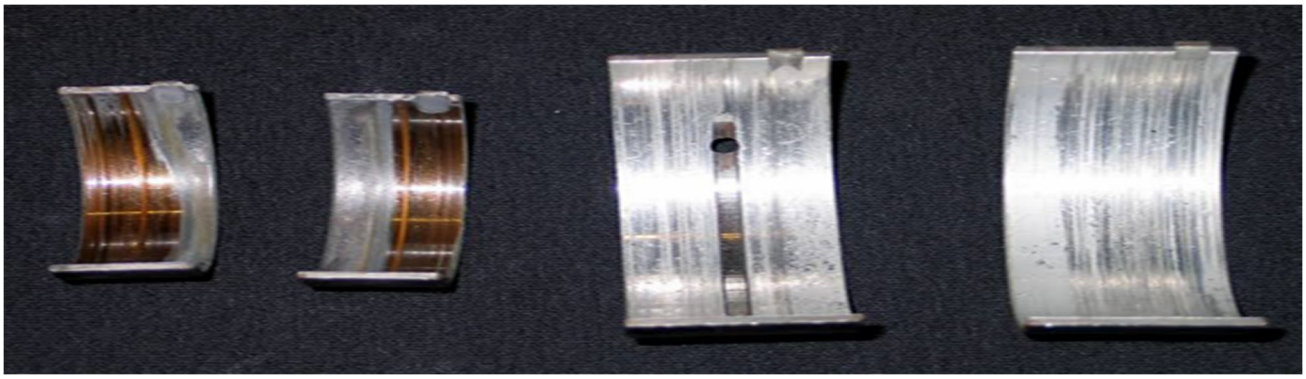

FIG 1- Journal bearing

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

IV. OBJECTIVE

The main objective is to determine

A. Wear rate
B. Coefficient of friction
C. Corrosion.

V. PROPOSED METHODOLOGY

The following material are used in manufacturing of the composites.

1) Polyamide 66 (PA66)
2) Glass fiber (GF)
3) Polytetrafluoroethylene (PTFE)
4) Carbon nanotube (CNT)

a) *Polyamide 66:* Polyamide 66 is a semi crystalline, thermoplastic commodity polymer that find widespread use in applications that require considerable strength but low toughness. It is widely used engineering thermoplastic. It possess an outstanding combination of properties such as low density, easy processing, good strength and solvent resistance.

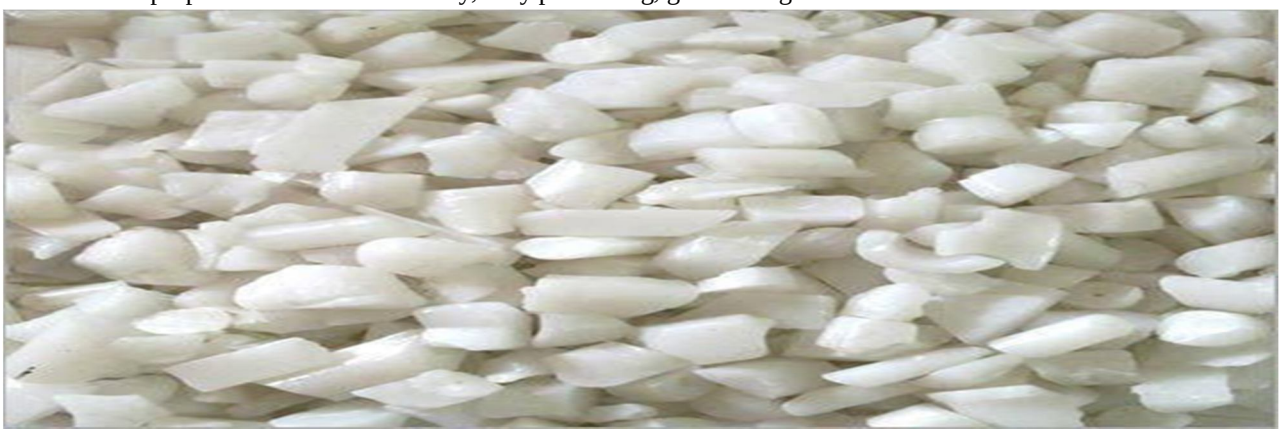

FIG 2-PA66

b) *Glass fiber:* Glass fiber which are short fiber reinforcement have been successively used to improve the strength to high pressure. Glass fiber improve the load carrying capacity and the thermal conductivity. These are a positive effect to decreasing wear losses of pure polymer. Therefore the thermal conductivity which is provided by glass fiber to polymer, gives good wear performance to polymeric material.

FIG 3-Glass fiber

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c) *Polytetrafluoroethylene:* An engineering plastic, have been widely used in industrial fields because of its excellent thermal stability, good solvent resistance and good solvent resistance and low friction coefficient. However, its application is greatly limited by its poor mechanical property and difficult to process. A lot of research has been made to improve the mechanical property by means of incorporation of PTFE with various neat polymers/fillers. Such as fiber, fine partial, whiskers.

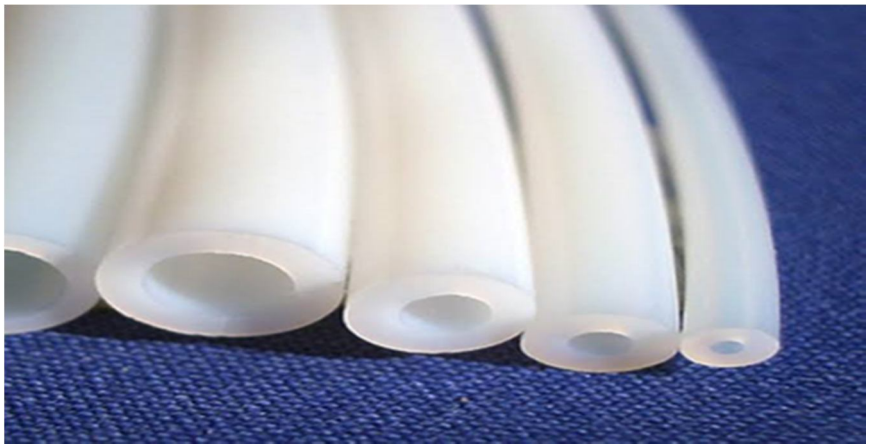

Fig 4- PTFE

d) *Carbon nanotube:* Superior stiffness and strength to all other materials. Twice the thermal conductivity of diamonds. Resistance to high temperature possess. CNT has good resilience.

FIG 5- CNT powder

A. *Fabrication Process*

1) *Ball Mil:* Granules are converted in to powder by planetary Ball mill machine.

FIG 6 - planetary ball mill machine.

2) *Injection molding:* It produce tubes, rods and other shaped continues from length. Heated polymer is fed in to shaped die by using screw.

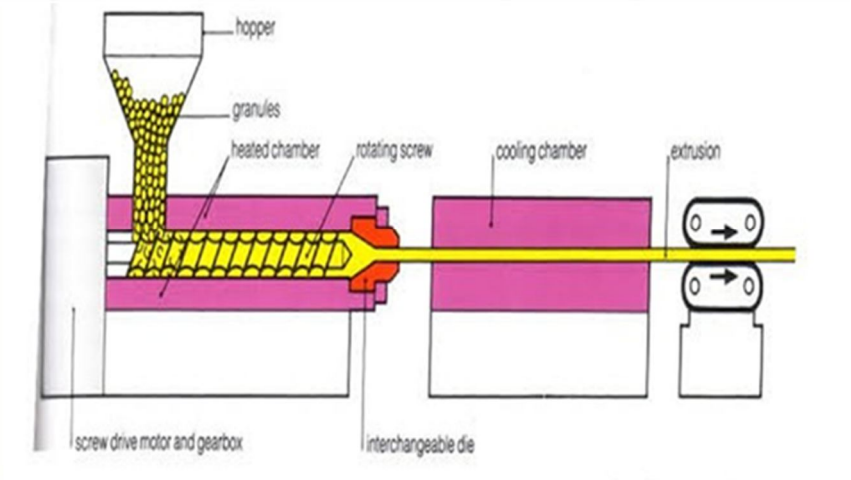

FIG 7- Extrusion injection molding.

VI. DESIGN OF EXPERIMENT

A. *Taguchi Method*

The experimental layout is obtained from different material composition, load and sliding velocity by L8 mixed design in Minitab. In this experiment we consider mixed level and 3 factor. First factor is material which has four level, second factor is load which has two level. Third factor is sliding velocity which has two level.

TABLE 1– Mixed L8 Array of design

MATERIAL	LOAD	SLIDING VELOCITY
1	1	1
1	2	2
2	1	1
2	2	2
3	1	2
3	2	1
4	1	2
4	2	1

ABLE 2– Mixed L8 Array of design

MATERIAL	LOAD	SLIDING VELOCITY
90-10	100	0.10
90-10	120	0.15
85-15	100	0.10
85-10	120	0.15
75-25	100	0.15
75-25	120	0.10
70-30	100	0.15
70-30	120	O.10

VI. EXPECTED OUTCOMES

A. Effect on Wear

When the weight % of glass fiber in polyamide composite increases with addition of PTFE, It is found that glass fiber increases the wear rate but PTFE reduces wear rate. The base material is PA66 hence it reduces wear.

B. Effect on Coefficient of Friction

The COF is reduced because increase in weight % of glass fiber in PA composite.it is because the glass fiber avoid the negative transfer phenomenon of PTFE. Hence the weight % of glass fiber and carbon nanotube reduces COF and CNT has high load carrying capacity.

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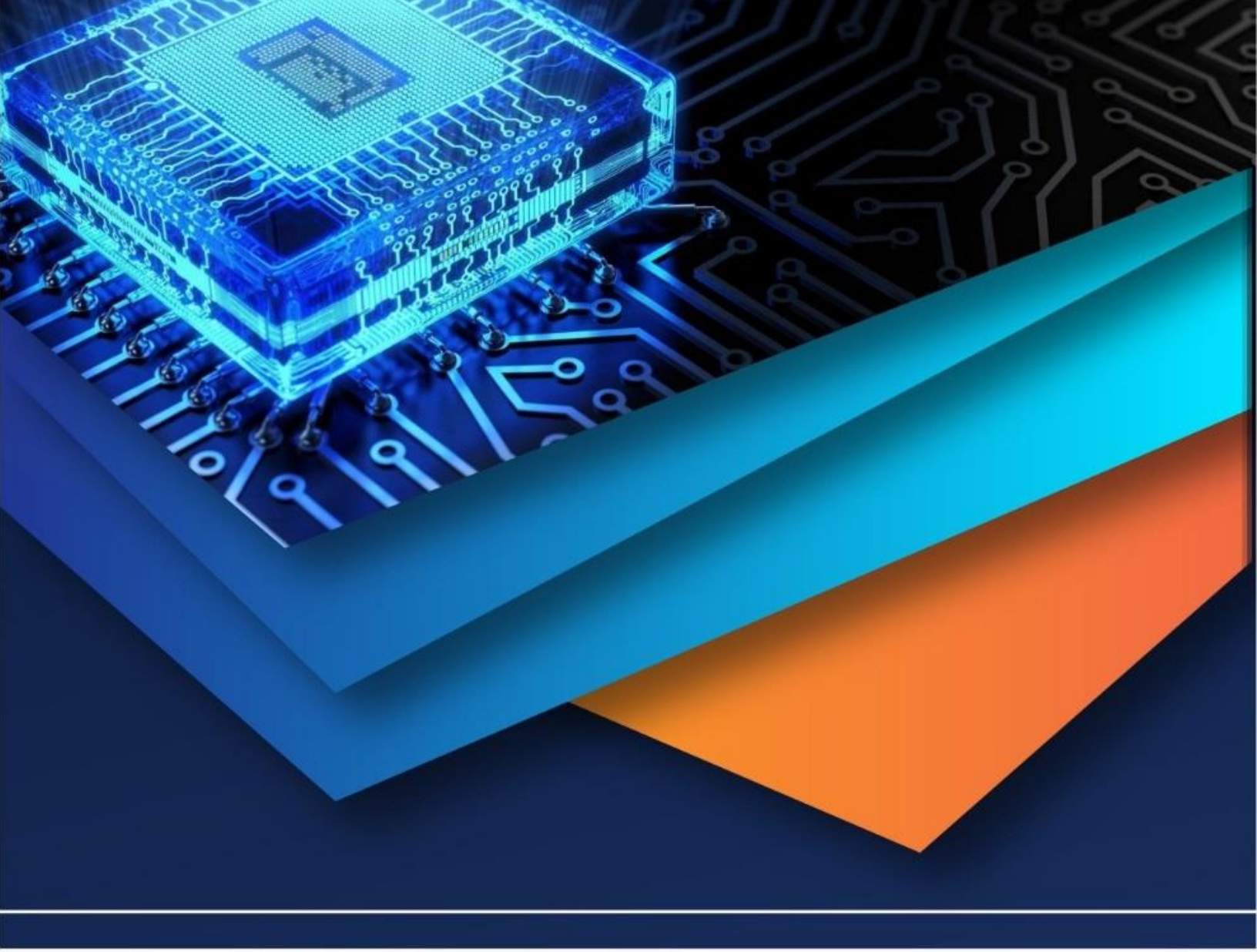

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