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Research paper

Identification and Analysis of Mechanical Properties of Composite Materials for Pipe Hanger Application

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Abstract

In this paper an innovative material was developed to overcome the high wear rate originated in slide bearing material (SBM). It is reviewed from various literatures that many nearby industries like Power Plants and Oil & Gas Factories uses this type of SBM. The material used in the preparation of SBM is pure Polyterafluoroethylene (PTFE) which has a property of self lubrication and lower friction coefficient instead of hardness and high coefficient of friction. The high wear rate obtained from the PTFE can be condensed by integration of appropriate glass and bronze filler materials. The property of varying load (VL), sliding distance (SD), sliding velocity (SV) and filler content in Polyterafluoroethylene are experimentally tested for the development of new object. A relative analysis based on the properties of four different composites for the improvement of PTFE by the addition of filler content.

1) PTFE, (PTFE + 15 % Glass Filler + 20 % Glass Filler + 30% Glass Filler and 40% Glass Filler etc.)
2) PTFE, (PTFE + 15 % Bronze Filler + 20 % Bronzes Filler + 30% Bronze Filler and 40% Bronze Filler etc...)

Taguchi technique is used for the preparation of experimental chart and the data collected after the experimental results were setup in Annova Table. Co-efficient of friction and Hardness is robustly subjective due to composition of filler material content. The results were tabulated to find the material having the superior wear performance.

Keywords: *PTFE, Composite material, hardness, tensile strength*

1. Introduction

PTFE Slide bearings using all industry are used in wide range of applications. They support chemical plant, heavy Engineering industry, power plants, buildings and bridge & electrical equipments also. PTFE slide movement for axial movement direction any structure that moves as a result of thermal, seismic or differential forces [1].In industry PTFE is applied to high load, the Slide movement is good. The movement is in axial directions only [2].

Advantages:
1) High Wear rate.
2) Coefficient of friction is low.
3) Less hardness & good strength.
4) Wear performance is good.
5) Vibrations are damped mainly used for Polytetrafluoroethylene [4]

Polytetrafluoroethylene is a Fluorocarbon –based polymer is commonly abbreviated PTFE [5]-[6] This Fluor plastic family offers high chemical resistance, low and high temperature capability, resistance of weathering, low friction, electrical and thermal insulation, and "slipperiness" [7]-[8].

1.1 Problem Study

Main disadvantages of Polyterafluoroethylene are, it has poor wear resistance, Friction & Low hardness of materials. So, PTFE is suitable only for light loads and for low vibration systems.

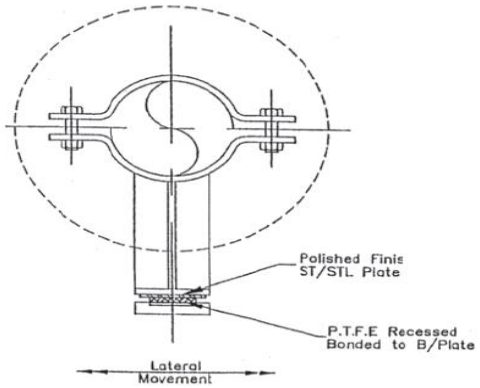

Fig1:.PTFE Alignment

2. Nature of Work

PTFE is used in the Slide bearing applications in Power plants, Sugar Plant, Oil & chemical industry, Over Bridge & electrical industry [3]. The fig 2 depicts the use of Polyterafluoroethylene in Power plant industry. Fig 3 shows the view of the alignment of PTFE for Top plate & Bottom plate refers Position. Upper component welded on SS304/SS304L & bottom portion pasted using Araldite for bonding the Polytetrafluoroethylene.

Fig 2: .PTFE power plant arrangement

PTFE has Low friction, wear, Hardness, so improve the mechanical Properties suitable filler materials are added to PTFE material.. In the proposed work Bronze & glass are used as filler materials to improve the mechanical properties of PTFE.

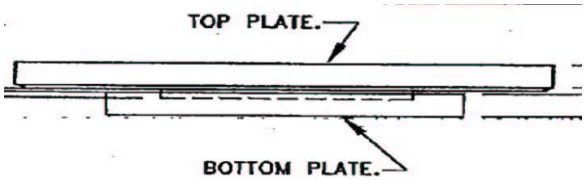

Fig 3:.PTFE Vs SS316 ALIGNMENT

3. Material Composite Structure

(A).Virgin PTFE
(B).15% Glass Filled PTFE (PTFE + 15% Glass)
(C).15%bronze Filled PTFE (PTFE+15% Bronze)

3.1 Manufacturing Procedure

Step1: A PTFE + filler material of the specified percentage is prepared for finding the mechanical properties.

Step2: performing moldings operation using Hydraulic Press Machine Fig4 depicts process discussed below.

Polyterafluoroethylene specific Gravity= 2.25
PTFE size = Length Width X Thickness (mm)
PTFE Weight =Length X width X Thickness X Specific Gravity
Area = Length X Width
PTFE Pressure = min 250 (kg/cm^2) to max 350 (kg/cm^2) (standard)
Preforming Force = pressure x Applied Area
Holding Time = 8 to 10 minutes

Step3: heating of the prepared material using Sintering oven is shown in Table I
Gradual Temperature = 1.5 Degree / minutes
Heating Temperature = Maximum 375 Degree Celcius (standard)

Step4: Cooling at atmosphere Temperature.

Step5: Machining

Step6: Shearing

Table I Sintering Process Steps

Sintering process-oven			
Step	Temperature degree (Celsius)	Rate of raise (degree/min)	Duration (minutes)
1	30-300	1.5	180
2	300-3450	0.4	115
3	345-345	0	60
4	345-375	0.33	90
5	375-375	0	260
6	375-345	0.25	120
7	345-300	0.5	90
8	300-30	1.5	180
Total time(minute)			1095

4. Experimental Results

Testing of the specimen prepared by the above mentioned procedure is carried out in Central Institute of Plastic technology (CIPET), test results are discussed below.

Fig.4: performing- Hydraulic press

i. Test specimen

The specimen of thickness 2.5mm,length 85mm,width of 85mm is taken for testing various properties like wear, hardness, friction ,density are made and the test specimen is shown in fig 5

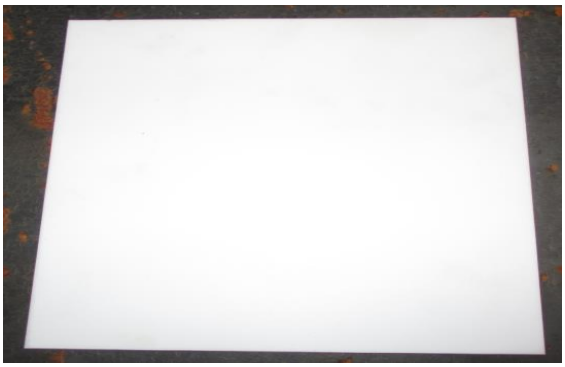

Fig.5 Test specimen

ii. Wear rate:

Comparison chart of the different composites are shown in TABLE II, Fig 6 depicts the comparison chart of the wear rate of the PTFE material and it's composite.

Table 2: Wear Rate Data

PTFE composites	PTFE
PTFE	95
PTFE+15%glass filler	61
PTFE+15%Bronze filler	72

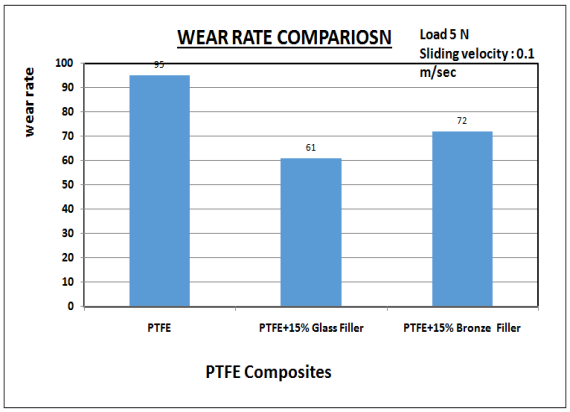

Fig 6:. Wear rate of PTFEand PTFE composites

iii. co-efficient of friction

The following table depicts the co efficient of friction of the specified PTFE materials, the friction of the material is tested and the results are tabulated in the following table and the comparison chart is made for the same in Fig.7.

Table Iii: Coefficient Of Friction

PTFE composites	PTFE
PTFE	0.17
PTFE+15%glass filler	0.15
PTFE+15%Bronze filler	0.17

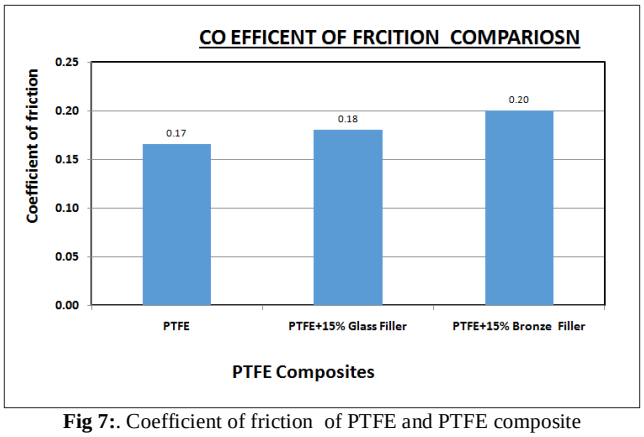

Fig 7:. Coefficient of friction of PTFE and PTFE composite

A. Density

Density of the specimen is tested and its results are tabulated in table IV and the comparison chart of the same is been depicted in fig 8.

Table Iv: Density Datas

PTFE composites	PTFE
PTFE	516
PTFE+15%glass filler	530
PTFE+15%Bronze filler	741

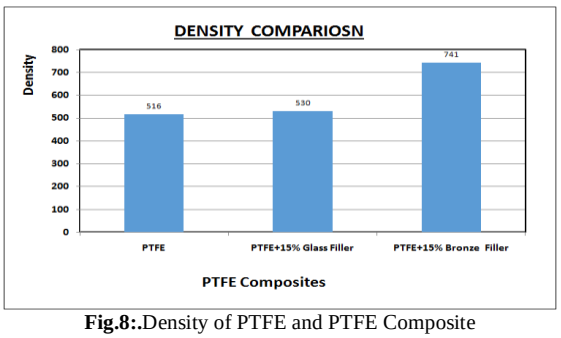

Fig.8:. Density of PTFE and PTFE Composite

B. Hardness measurement

cimens as per ASTM D224 standards on a shore D scale standard. Several locations for each specimen and the average hardness value were calculated. Applied Load = 44.5N, Hold time was 15 s. In this composite seen that addition of filler materials to PTFE causes a significant improvement in the hardness (up to 15% increase). In particular, the composite. (PTFE + 15 % Bronze Filler) displayed the maximum hardness, Fig 9 which more than likely is due to the presence of the Glass fiber particles.

Table V: Hardness Datas

PTFE composites	PTFE
PTFE	52
PTFE+15%glass filler	57
PTFE+15%Bronze filler	61

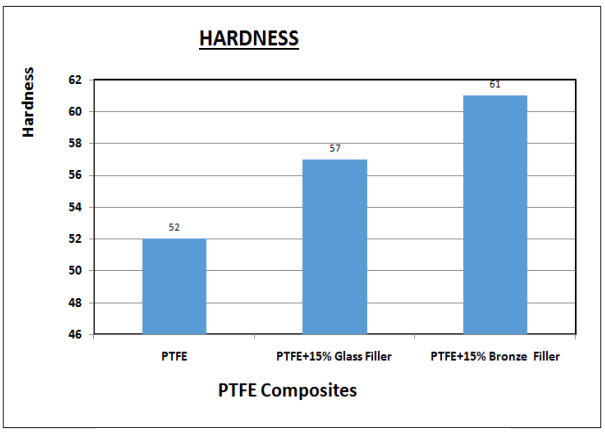

Fig 9: Hardness of PTFE and PTFE Composites

C. Tensile strength measurement

Tensile strength of the specimen is measured and tabulated in table VI and the comparison chart is depicted in Fig 10.

Table Vi: Tensile Strength

PTFE composites	PTFE
PTFE	29.4
PTFE+15%glass filler	23.8
PTFE+15%Bronze filler	22.17

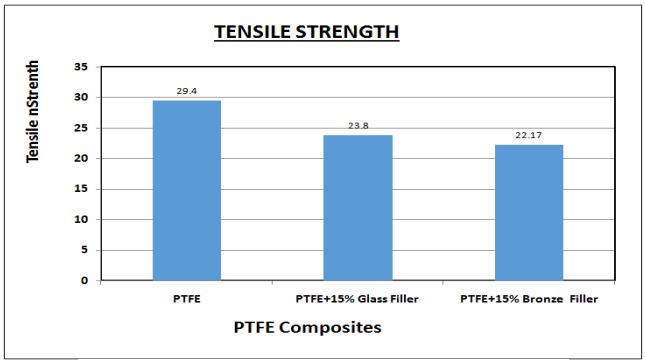

Fig .10:. Tensilse strength of PTFE and PTFE composites

4. Conclusion

Here the proposed work is tested experimentally and the various results of the tested specimen is projected and the results prove that by adding the filler materials like bronze and copper the various mechanical properties of the composite material PTFE is improved. Thereby the life cycle of the material is increased.

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