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Effect of Fillers on Di-electric Strength of PTFE Based Composites

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Abstract- In the present work, a systematic study on the effect of different fillers namely; glass (f), granite, graphite, garnet, antimony trisulphide, alumina, carbon, marble, mica, sand, porcelain, bronze, tixolex-25, china clay and wollastonite on di-electric strength property of virgin PTFE and different filled PTFE composites (filler content 5-50%) were made with an idea to arrive at optimum filler content for achieving maximum properties. 5% marble filled PTFE shows the highest di-electric strength value than other filled grades and the lowest di-electric strength shown is 20% in case of graphite filled PTFE as graphite itself is a conductive material.

Index Terms- PTFE, fillers, di-electric strength

I. INTRODUCTION

Poly tetra fluoro ethylene (PTFE) is a highly crystalline, chemically inert plastic and has excellent electrical, insulation and thermal properties. PTFE is resistant to practically every known chemical or solvent and its surface is so slippery that almost no substance would stick to it. Moisture did not make it swell and it did not degrade after long exposure to sunlight and its melting point is 327^{o}C.

PTFE has a wide spectrum of applications – right from the kitchen upto hi – tech purposes: This high profile and versatile engineering plastic is indispensable in areas of defence, space research, nuclear energy, chemical, mechanical, electronic, solar energy and electrical systems. Important electrical properties of PTFE are: PTFE is one of the best insulators known. In thin sections, it will insulate to 5.00 kV / mm. These are specific grades of PTFE which have greater dielectric strength. It is frequently used in wire and cable wrap, and to separate conductive surfaces in capacitors. Thick walled close tolerance extruded tubing is the PTFE shape of choice where machining or drilling long lengths to close tolerances is impossible. Multi hole tubing can be extruded. From PTFE can also be machined into standoff insulators, and it can also be used in different types of high voltage encapsulation devices for electrical components.

Different fillers are incorporated into PTFE to improve its properties like low wear resistance, low thermal conductivity, high elongation, low load bearing capacity, etc., The fillers selected for present work are ceramic, metallic and non-metallic based, namely; glass (f), granite, graphite, garnet, antimony trisulphide, alumina, carbon, marble, mica, sand, porcelain, bronze, tixolex-25, china clay and wollastonite with filler contents varying from 5 – 50%. The choice and quantity of fillers to be incorporated into PTFE depends upon specific end applications.

In the present work, an attempt is made to study the effect of filler and filler content on di-electric strength / breakdown voltage.

II. EXPERIMENTAL METHODS AND PROCEDURE

2.1. Selection of raw materials (fillers) and their characterization:

The study is on polytera flouro ethylene (PTFE) used in the filled grades HIFLON 71 grade. The properties of HIFLON 71 and fillers used are;

PTFE (H - 71): HIFLON H-71 is a white fine powder of virgin PTFE grade with an average particle size of approximately 50 microns. It is a non – flowing and lumpy due to very fine particle size. This grade is generally recommended for making various filled grades.

1. Glass (f) filler: Glass fiber is the most widely used filler. It improves the creep resistance of PTFE, both at low and high temperatures. It is chemically stable (except to strong alkalis and HF). It has little affect on electrical properties of PTFE and its wear and friction behavior. A known uncommon problem with glass filled PTFE is discoloration of the unfinished parts, in particular, on the inside of the large billets. The glass used in PTFE compound was treated by a proprietary process by certain resin manufactures to reduce this discoloration.

Type: E- glass, Miled fibers, nominal diameter, 13 micron
Appearance: White powder
Nominal length: 0.8mm
Aspect ratio: Min.10
Density: 2.5gm/cc
Particle size: 800 microns
Name of the supplier or source: M/s. Owens Corning fiber glass corporation TELEDO, OHIO
Screen size: 794 micron
Moisture, % w/w: 0.08 maximum

2.Granite filler: Granite is coarse- grained igneous rock consisting essentially of quartz (20-40 %) alkali feldspar and mica. They have a high proportion of silica (77%) and relatively high soda and potash. It has a low specific gravity (2.7 gm/ cm^2) and this fact is of great importance in understanding the nature of continental and oceanic surface. Granite and related rocks make up the great bulk of the continental crust. Granite ranges in colour from light grey to medium grey and pink. The colour of feldspar has the greatest influence on the overall colour of the rock.

Source: Khammam Granite (stone rock) Quarries. Black granite were broken into pieces, crushed and ground in a ball-mill at laboratory of college of technology, OU, Hyderabad, Telangana.

3.Graphite filler: Graphite is a crystalline modification of high purity carbon. Graphite filled PTFE has one of the lowest coefficients of friction. It has excellent wear properties, in particular against soft metals, displace high load carrying capability in high speed contact applications and is chemically inert. It is often used in combination with other fillers.
Appearance: Black fine powder, irregular particles
Refuse on sieve: 44 microns
% w/w: 1.0 max
Source: synthetic
Purity: greater than 99 % C, 1.00% ash content
Particle size: < 7.5 m
Density: 2.26 gm/cc
Name of the supplier: M/s. Industrial graphite, Uppal, Hyderabad, Telangana

4.Garnet filler: Garnet stones are very hard and whitish in colour with unknown composition.

Source: Garnet stones which are available at University College of technology are used.

.Antimony trisulphide filler: Black crystals, orange-red crystals. They are insoluble in water, soluble in conc. HCl and sulphide solutions.
Specific gravity: 4.562
Melting point: 546°C

Derivation: (a) occurs in nature as black crystalline stibnite (b) as precipitated from solutions of salts of antimony trisulphide is an orange-red precipitate, which is filtered, dried and ground.

6.Alumina filler: Alumina in a highly pure form is obtained by dehydration of a high grade bauxite after it is purified from iron oxide. It is an excellent electrical insulator and is used to improve mechanical properties of compounds used in high voltage applications. As it is very hard, machining of the sintered part should be avoided whenever possible. Complicated shapes should be made by isostatic moulding
Purity of Alumina: 99.5%
Particle size: < 25 microns
Name of the supplier: Carborandum Universal Limited, Cochin

7.Carbon filler: Amorphous carbon is one of the most inert fillers except in oxidizing environments, where glass performs better. Carbon adds to the creep resistance, increases the hardness and raises the thermal conductivity of PTFE. Carbon filled compounds have excellent wear properties, in particular when combined with graphite. The combination of the above properties makes carbon / graphite compounds and the performed material for non- lubricated piston rings. The use of softer carbon has the additional advantage that it lowers tool wear during machining. Thus allowing machining to very close tolerances. Carbon containing compounds have some electrical conductivity and are therefore antistatic.
Base: Amorphous petroleum coke
Purity: 99%
Particle size: < 75 microns
Density: 1.8 gm/cc

8.Marble filler: It is a metamorphic form of calcium carbonate usually containing admixtures of iron and other minerals which impact various colour patterns. Marble chips are often used as source of carbon dioxide in laboratory experiments.

Source: University College of technology, OU, Hyderabad, Telangana. Cured porcelain blocks are crushed and ground in a ball mill at laboratory of College of technology, OU, Hyderabad, Telangana.

8.Mica filler: Many of several silicates of varying chemical composition but with similar physical properties and crystal structure. All characteristically cleave into thin sheets, which are flexible and elastic. Synthetic Mica is available which has electrical and mechanical properties superior to those of natural mica, it is also water-free. Mica is soft, translucent solid, non combustible. Heat resistant to 600°C. Colourless to slight red, brown to greenish yellow.
Specific gravity: 2.6 – 3.2
Refractive index: 1.56- 1.60
Di-electric constant: 6.5- 8.7
Hazards (dust): irritant by inhalation, may damage lungs

9.Sand (Silica/ Silicon dioxide) filler: Occurs widely in nature as sand, quartz, flint and diatomite. It is colourless crystal or white powder which is odorless and tasteless. Insoluble in water and acids except HF. Soluble in molten alkali when finely divides and amorphous. Combines chemically with most metallic oxides melts to a glass with lowest know coefficient of expansion. It is used in the manufacture of glass, water glass, ceramics, abrasives, water filtration, pharmaceuticals, cosmetics, hydrated and precipitated grades as rubber reinforcing agents including silicone rubber, anticaking agent in food and as thermal insulator. Fused ablative material in rocket engines, space craft etc.
Specific gravity: 2.2- 2.6
Melting point: 1710° C
Boiling point: 2230 ° C
Hazard: toxic by inhalation, chronic exposure to dust may cause silicosis

Source: Chinnagudem lake (water flow), Nalgonda, Telangana. Washed and dried sand was crushed and ground in a ball mill at laboratory of College of technology, OU, Hyderabad

11.Porcelian filler: Potassium aluminum silicate, a mixture of clays, quartz and feldspar usually contain atleast 25% of alumina. Ball and china clays are ordinarily used. A slip or slurry is formed with water to form a plastic, moldable mass which is then glazed and fired to a hard smooth solid. It has high impact strength, impermeable to liquids and gases, resistant to chemicals except HF and hot string caustic solutions, usable upto 1093 ° C but subject to heat shock. It is used in reaction vessels, spark plugs, electrical resistors, electron tubes, corrosion resistant

equipments, ball mills and grinders, food processing equipments, piping, valves, pumps, tower packing, and lab ware.
Specific gravity: 2.41
Compression strength: 100.00kg/cm^2
Grades: chemical and electrical

Source: University College of technology, OU, Hyderabad, Telangana. Cured porcelian blocks are crushed and ground in a ball mill at laboratory of University College of technology, OU, Hyderabad, Telangana

12.Bronze filler: It is an alloy of copper and tin, usually containing 1-10 % tin. Special types contains 5-10 & of Al, fractional % of P as deoxidizer or low % of Silicon. Addition of high % of bronze powder to PTFE results in a compound having high thermal conductivity and better creep resistance than most of the other compounds. Bronze filled PTFE is often used for components in hydraulic systems, but it is not suited for electrical applications and it is attacked by certain chemicals. Bronze has a tendency to oxidize, bronze filled compounds should therefore be used fresh and containers should always be kept closed. Some discoloration of the finished part during the sintering cycle is normal and has no impact on its quality. It is used in spark resistant tools, springs, cosmetics (as powder), electrical hardware, architecture and fine arts.
Appearance: Brown powder
Flow ability: 20/30 sec/ 50gm
Apparent density: 3200- 4800 gm/ml
Refuse on sieve at 63 microns: 0.1 max
Refuse on sieve at 40 microns: 5.0 max
Particle size: < 60 microns
Density: 8.95 gm/cc
Copper % w/w: 88.2- 89.8
Tin % w/w: 8.5-9.5
Zinc % w/w: 1.7-2.3
Phosphorous % w/w: 0.1 max
Others % w/w: 0.5 max
Hazard: powder is flammable
Source: Metal powder Limited, Coimbatore

13.Tixolex- 25 filler: Tixolex- 25 is a white fine free flowing synthetic hydrated sodium silico aluminate obtained by precipitation.
Drying loss (2hours at 105 ^oC): 8 max
Ignition loss at 900 ^oC: 14 max
DOP absorption: 200-270 gm/cc
Specific gravity: 2.0-2.1
Ultimate particle size: approximately 20 microns
Tap density: 0.28 – 0.33 gm/cc

14.China clay (Kaoline) filler: A white burning aluminium silicate which due to its great purity has high fusion point and is the most refractory to all clays. Its composition is mainly Kaolinite (40% alumina, 55 % silica + impurities and water). It is white to yellowish or grayish fine powder. It is insoluble in water, dilute acids and alkali hydroxides. It has high lubricity (slipperiness), non-toxic, non combustible. It is used in filler and coatings for paper and rubber, refractories, ceramics, cements, fertilizers, chemicals (especially aluminium sulphate) catalyst carrier, anti caking preparations, cosmetics, insecticides, paint, adsorbent for clarification of liquids and electrical insulators
Occurrence: South eastern US, England, France
Grades: Technical, NF, also graded on basis of colour and particle size
Containers: cartons, paper bags, drums bulk
Specific gravity: 1.8- 2.6

15. Wollastonite: It is a natural calcium silicate, available in metamorphic rocks. It is used in fine medium paint grades, ceramics, paint extender, welding rod coat, rubber filler, silica gels, paper coating, filler in plastics, cements, mineral wool, wall board and soil conditioner.
Colour: white to brown, red, grey, yellow.
Mohs hardness: 4.5- 5.0
Specific gravity: 2.8-.2.9
Occurrence: New York, California
Source: Wolkan Limited, Udaypur, Rajasthan

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Photograph 1: Virgin PTFE and different fillers used.

The fillers are mixed intimately with PTFE in various proportions; percentage of fillers used are 5, 10, 15, 20, 25, 30, 40 and 50 on the basis of weight. Weighed quantity of filled PTFE powder is moulded into a standard bush shape(billet) at room temperature by compression moulding technique. The billets are than sintered at maximum temperature of 375^{0}C following a specific sintering cycle depending on the dimensions (94mm×25mm) of the billet. Di electric strength was measured on the skived tapes veneered out from said sintered billet.

NOTE: Tixolex – 25 filled PTFE having more than 25% is not suitable to make billets, and it failed filler stability test (400^{0}C for 45 minutes).

2.1.Studies on effect of sintering temperature and moulding pressure on di-electric strength for virgin PTFE and its filled composites:

Constant pressure and temperatures are for virgin PTFE and its filled PTFE composites (5-50%) i.e, 250 kg/cm^2 and 350^o C respectively.

2.2. Machine used:

Di-electric machine: BIPLEX, ATOCHEM, FRANCE
Type of machine: Electrical balance
Model: AE-160
Accuracy: 0.0001gm (0.01 gm/mg)

2.3Testing and characterization of the composites:

a) Moulding of the billets: PTFE compression moulds are simple in design. In most of the cases, moulds are cylindrical in shape whose internal surface is smooth and free from scratches and other defects. Moulds are normally made of carbon steel. In case of large scale production, hard chrome plated moulds are recommended. Billet size is 94mm×26mm. a weighed quantity of filled PTFE was taken into the clean and dry stainless steel mould and pressed in between two pusher plates. The lumpy material was sieved with 2mm aperture sieve. The lower plate inside the mould rests on the lower platen of the 150tonnes capacity hydraulic press, while the upper plate ,must freely slide within the mould cavity. For pressing the hydraulically operated press is used. It is a vertical hydraulic type having sufficient day light since PTFE powder has a compression ratio of upto 4:1. The closer speed of the press is also critical to avoid air tapping in the mould. Initially, the mould is rested over a support. The material was poured into the mould. Then the support is removed and placed on the mould. After placing the top pusher, the powder was pressed (as per recommended pressure) in the hydraulic press at a speed of 2mm/sec. Spacer bar was removed after applying the 100kg/cm^2 pressure to the mould for 2 minutes. This material was compressed at 500 kg/cm^2 pressure, pressure rise time is 5 minutes and holding for 5 minutes. The pressure was released within 2 minutes. The pressed PTFE block called preform (green block) is removed slowly from the mould. The preform is brittle. Hence, handling of the preform should be done carefully. Final stage in the moulding process is the ejection of the preformed part from the mould. Preform ejection from the mould was carried out in one smooth continuous stroke at a speed of 3.5mm/sec

Calculations:

$P_1S_1 = P_2S_2$

$P_1 = P_2S_2/ S_1$

P_1 = Recommended pressure as per grade

P_2 = Pressure to be given

S_1 = Moulding area

S_2 = Ram area

$S_1 = D^2$

Billet weight = C/A x Density x Height

b) Sintering of the billets: The billet which was taken from mould is now placed in free air circulation oven for sintering. The oven started for sintering. During this process, the PTFE in filled PTFE melts (softness) and coalescesion and adhesion bonds will be produced in between PTFE particles and filled particles, which makes the billet rigid. After cooling to room temperature the billet was taken out for doing various tests.

c) Skiving of the billets: Skiving of the billet was done on the skiving machine. For this purpose special arrangement was done. This arrangement consists a low rpm motor with spring loaded drum on to which tapes will be wound during skiving operation. For the experiment purpose of dielectric strength, 0.1mm thickness tape has been made.

Photograph2: Virgin PTFE and its filled composite billets- before and after sintering including skiving tapes.

2.5. Test procedure of machines and calculations:
Determination of di-electric strength:

For determining the di-electric strength, 0.5mm thickness tapes are skived form the billet and these are conditioned at 23^o C for 24 hours before testing its breakdown voltage. For this required. The measurement consists of applying an increasing A.C electric field across two standardized electrodes In which the sample tape is tightly gripped and the voltage at which breakdown results was then noted only HIFLON 71 grade and only 0.1mm tapes were specified for testing breakdown voltage / di-electric strength according to ASTM standard *D 149 volume- 8.01 (these specification recommends very fine particle size of PTFE. Particle size of HIFLON 71satisfy this requirement of ASTM standard). As per the requirement of ASTM standard, 0.1mm thickness virgin PTFE and 15 % glass, granite, garnet, graphite, antimony trisulphide, alumina,carbon, marble, mica, porcelain, sand, bronze and wollastonite filled PTFE tapes were made and subjected to breakdown voltage test. Three consecutive tests were carried out for each sample and average breakdown voltage is taken to calculate the dielectric strength.

III. Results and Discussions

3.1. Physical observation on billets of filled PTFE (5 – 50%) composites (before and after sintering & skiving) at constant temperature (375^{0}C) and pressure (250 kg / cm^2):

1. Glass(f) filled PTFE: Before sintering, all performed billets are smoth and shining with off white colour. There are no cracks and bulging on their surface. Roughness and off white colour were observed for all the percentages (5 – 50%) in increasing order. Cracks in 505 glass filled PTFE may be due to improper mixing of filler in PTFE. From 5 to 40% filled PTFE, the tape is smooth. The smoothness decreases with increasing filler content.

2. Granite filled PTFE: The colour of granite powder is black. Before sintering, the billet colour is cement gray for 5 to 50% filer content. After sintering, the roughness increased with increasing filler content. There were no cracks observed before and after sintering for 5 – 50% granite filled PTFE .But while skiving the tape, the billets of 40 and 50% filled PTFE got damaged and this may be due to poor bonding between filler and PTFE.

3. Graphite filled PTFE: Billets from 5 – 50% showed no cracks and no bulging is noticed before sintering and shining surface is seen on their part. But after sintering, all billets become rough on surfaces with black colour as filler percentage increased. 50% graphite filled PTFE billet got damaged while skiving and inserting the rod for making tape.

4. Garnet filled PTFE: Before sintering, 5 – 50% garnet filled PTFE billet shows colour changes from light gray as percentage of filler increases. After sintering, the colour is light chocolate to dark chocolate as filler content increases. For 50% filled PTFE, the billet got damaged while skiving the tape. The roughness also increases as increases as percentage of filler increases.

5. Antimony tri sulphide filled PTFE: 5 to 50% antimony tri sulphide filled PTFE billets were made with shining surface before sintering but after sintering 25 to 40% billets developed cracks on diameter side and 50% billet got damaged while skiving the tape. Shining surface was observed after sintering also.

6. Alumina filled PTFE: Before and after sintering, there are no cracks and no bulging for alumina filled PTFE billet. The colour of alumina filled PTFE billet has gradually increased from white to off white as percentage of filler content increased. Roughness is found in increasing order from 5 to 50% on surfaces of alumina filled PTFE (after sintering) billets.

7. Marble filled PTFE: Before sintering the billet colour is very bright, whitish like PTFE upto 15%. From 20 to 50 % off white colour is observed with increases in filler content. No cracks and no bulging took place before sintering. After sintering 5 to 10% the colour of the billet is off white. 15 to 50% billet colour is stonish (cement). For 30 and 40% marble filled PTFE, visible bulging and multiple cracks were developed on the surface.

8. Mica filled PTFE: With 5 to 20% mica filled PTFE, billets could be made. However, for percentage above 20%, we could not make billet due to very fine particle size of mica powder. Before and after sintering for 5 to 20% mica filled PTFE, cracks and bulging are not observed. As percentage of filler increases, the colour of the billet has changed from light colour to off white colour.

9. Sand filled PTFE: Before sintering, the billet colour is light ash to dark ash as 5 of filler increases. After sintering at 375^0C for 14 hours sintering cycle, the colour of the billets vary from light brownish to dark brownish as filler content increases.

10. Bronze filled PTFE: The colour of the pre sintered billet varies from brown to chocolate brown with increase in percentage of filler content. After sintering also there is no change in colour but roughness has developed like other filled PTFE billets. No cracks and no bulging were observed before and after sintering at 375^0C for 14 hours sintering cycle.

11. China clay filled PTFE: For 5% china clay filled PTFE, the billet has no cracks and bulging before sintering and after sintering. The colour of the billet is white before and after sintering. For 10% china clay filled PTFE, the single crack was observed on the surface. But for 15% filled PTFE, multiple cracks were observed before sintering. Billet got into two pieces before sintering for 20% china clay filled PTFE and from 25 to 50% filled PTFE, there was no billet formation. This may be due to particle size of china clay being below 25 microns and hence not compatable to PTFE (~ 60 microns).

3.2. Report on Di – electric strength of 5 – 50 % filled grades PTFE:

Fig. 1 (a, b, c) and Table 1 shows the di – electric strength of filled PTFE. It is a measure of the ability of the material to hold energy at high voltage; di – electric strength is voltage per unit length at which failure occurs if the di – electric strength exceeded, the di – electric material begins to break down and the passage of current (electronic) occurs.Break down voltage of skived tape (0.1mm thick) was measured following ASTM standard D 149 Vol. – 8.01; Di – electric strength values were calculated from the break down voltage (BDV) value. In this study, filler content of 5 – 50% was used in PTFE for all the fillers (glass, graphite etc.,) . Di – electric strength study was done against pressure variation, keeping temperature constant (375^oC), and against temperature variation, keeping pressure constant (250 kg / cm^2).The effect of filler and its content on di – electric are shown in Fig. 1 (a, b, c). In case of glass(f), granite, marble, antimony tri sulphide and alumina filled PTFE, di – electric strength decreased with increase in filler content upto 40 % for glass, granite, alumina and antimony tri sulphide; and 25% for marble filled PTFE. Thereafter di electric strength started increasing with further increase in filler content. Maximim di electric strength value (21.844 kV /mm) was found with 5% marble filled PTFE and minimum di electric strength value of 7.11200 kV / mm was observed in case of 20% graphite filled PTFE respectively; whereas, in case of bronze, porcelain filled PTFE, di – electric strength decreased with increase in filler content upto certain percentage (25%, 20%). Thereafter di electric strength started increasing in cases of mica, wollastonite, sand etc., and then decreased with increase in filler content.

Sl. No.	% of Filler Con-tent	Dielectric Strength (V/Mil) of						
		Glass filled PTFE	Granite filled PTFE	Graphite filled PTFE	Garnet filled PTFE	Alumina filled PTFE	AntimonyTrisul-phide filled PTFE	Carbon filled PTFE
01.	5	1117.600	1625.600	795.000	1930.400	1854.200	2014.900	947.420
02	10	931.164	1201.400	790.000	1524.000	1016.000	1303.800	863.600
03	15	990.000	1117.600	736.600	1143.000	990.600	1247.400	769.600
04	20	887.500	990.600	711.200	878.840	977.900	1099.800	740.000
05	25	871.900	965.200	711.200	914.400	939.800	985.500	720.000
06	30	850.900	863.600	711.200	926.600	889.000	947.400	720.000
07	40	845.800	726.440	-	939.800	850.900	762.000	720.000
08	50	863.000	853.440	-	980.440	956.600	812.800	-

Sl No.	% of filler con-tent	Marble filled PTFE	Mica filled PTFE	Sand filled PTFE	Bronze filled PTFE	Wollastonite filled PTFE	Porcelain filled PTFE	China Clay filled PTFE
01	5	2184.400	1108.960	863.600	1964.200	931.200	1270.000	914.400
02	10	1625.600	897.400	914.800	1278.400	956.600	1150.600	-
03	15	1134.500	939.800	1005.800	1028.700	905.800	1041.400	-
04	20	999.060	905.800	1016.000	947.600	922.800	878.800	-
05	25	846.600	1066.800	1049.000	896.600	998.200	1066.800	-
06	30	914.400	939.800	751.800	965.200	876.300	1031.200	-
07	40	948.200	-	863.600	845.820	-	795.200	-
08	50	982.200	-	1023.600	812.800	-	795.200	-

Dielectric Strength of Virgin PTFE – 2200 V/Mil.

Table: 1:- Di electric strength (kV /mm) values of glass(f), graphite, garnet, alumina, antimony tri sulphide, carbon, marble, china clay, porcelain, sand, bronze and wollastonite filled PTFE at different filler content.

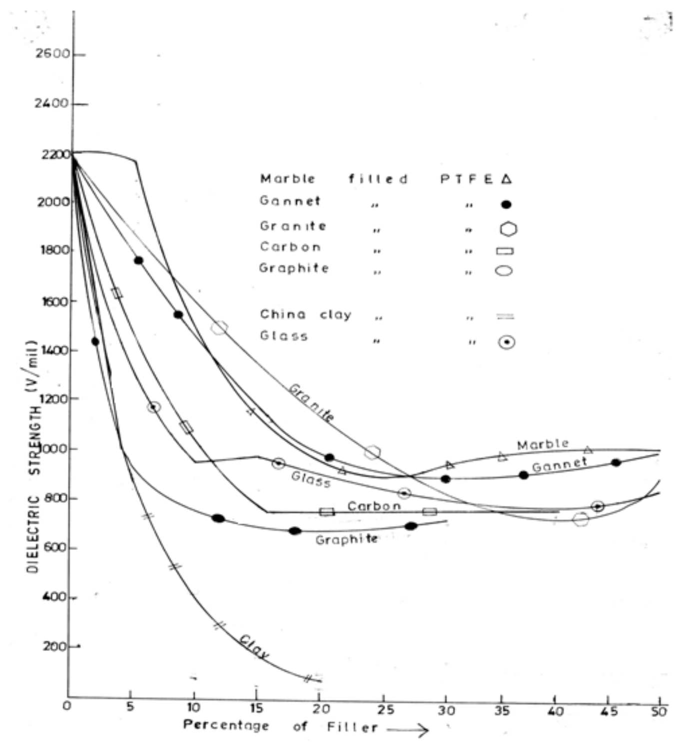

Fig.1 (a): Di-electric strength vs % of filled PTFE composites

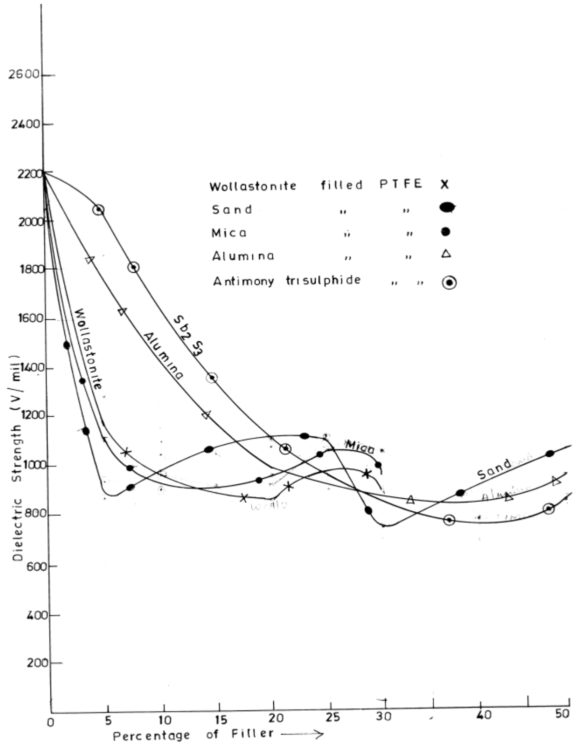

Fig.1 (b): Di-electric strength vs % of filled PTFE composites

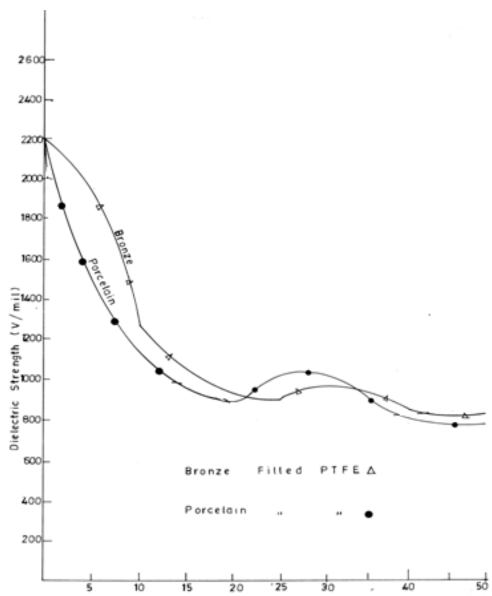

Fig.1 (c): Di-electric strength vs % of filled PTFE composites

IV. Conclusion

In the present study, an attempt is made to check billet formation and electrical property like di electric strength of glass(f), granite, graphite, garnet, antimony tri sulphide, alumina, carbon, marble, mica, sand, porcelain, bronze, tixolex – 25, china clay and wollastonite filled PTFE as a detailed study.

In all the cases, there is no significant weight change / loss within the testing temperature range of 25 to 400^0 C ; both PTFE and fillers are quite stable . Thermal stability of the fillers upto 375^0C is very much essential for making a good quality moulded filled composites.

However, Tixolex – 25 cannot be used as filler in filled PTFE as it failed in filler stability test (400^0C).

5% marble filled PTFE shows the highest di-electric strength value than other filled grades and the lowest di-electric strength shown is 20% in case of graphite filled PTFE as graphite itself is a conductive material.

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