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A Review on Synthesis and Characterization of Insulating Materials

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ABSTRACT: The materials which have very high resistivity i.e. offers a very high resistance to the flow of electric current. Insulating materials plays an important part in various electrical and electronic circuits.[6] Insulating material also prevents leakage of current [6].Mica is most widely used insulating material in electrical industries.

KEYWORDS: dielectric constant (έ), dielectric loss (έ) and (tanδ)

I.INTRODUCTION

The energy lost for an insulating material depends on the the thermal properties and thicknesses of the insulation.[3] Glass-ceramics are polycrystalline materials of fine microst0ructure that are produced by the controlled crystallization (devitrification) of a glass.[5] The mechanical properties of glass-ceramics are superior to those of the parent glass. In addition, glass-ceramics may exhibit other distinct properties which are beneficial for particular applications, as exemplified by the extremely small coefficient of thermal expansion of certain compositions in the Li_2O_2-AlO_3-SiO_2 system which consequently are suitable for thermal shock resistant applications [5] Professional Plastics offers a full-range of insulating materials found in electronic and electrical equipment.

Insulating materials are typically considered to be materials with a surface resistivity greater than $10^{12}\Omega$/sq (ohms per square) [7].the insulation industry continues to develop a new product to increasing demand. commanly used fiberglass and cellulose products are the most economical.[7] Dielectric strength is the minimum voltage which when applied to an insulating material will result in the destruction of its insulating properties. If the operating voltage is increased gradually at some value of voltage, the breakdown of the insulating materials will occur. The property which attributes to such type of break down is called the dielectric strength. dielectric strength of an insulating material is the maximum potential gradient that the material can withstand without rupture.dielectric strength of mica is 80kV/mm. A thumb rule suggested by many experts is that life of insulator is halved for 8-10 degree centigrade rise above the recommended operating temperature for a given apparatus.The insulating material should have low density to reduce the weight of equipment in which insulating material is being used.[6]

II.MICA INSULATORS

Natural mica sheet were exposed to semiquantative spectrographic analysis. The difference in resistivity between the two samples decreases as the frequency increase. Silicate materials as mica have alternating structure of the oxygen and silicon atoms in covalent bonding forming tetrahedral units. Lower oxygen atoms have all the shared electron pairs available to hold adjacent sheets of the structure together natural mica is related to mixture of the two types the molecular structure in layer system, each layer consists of a pseudo - octahedral gibbsite plane chemically bonded by bridging oxygen and hydroxyl groups to two tetrahedral silica planes. The mica materials has electrical resistivity is 800-900 ^{0}C. [1]

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Table 1. Properties of Mica:

Physical Properties	Mechanical Properties	Electrical Properties	Chemical Properties
Translucent	Tough	Low Temperature Coefficient	Not easily Soluble
Optically Flat	High Tensile Strength	High Electrical Resistance	High Chemical Resistivity
Colourless	Flexible	High Q factor	High ageing
Elastic	Die Punched	High Dielectric Strength	_
Incompressible	Elastic	Enormous Dielectric Power	_

III. PROPOSED INSULATING MATERIALS

The marble materials has the same insulating properties like mica, the absorption coefficient of creta marble is 0.8% Wt, also mica has absorption coefficient 0.1%Wt.compressive strength 69 Mpa and mica have 3 kgf/cm^2[1,6]
The other materials which are very hard and tough are used for insulator purpose , Professional Plastics offers a full-range of insulating materials found in electronic and electrical equipment [7].The marbles material have the same properties like mica insulators. Mica has elastic and tough and having high tensile strength. Marbles has also tough and have high tensile strength [1-6]

Other insulating materials to be compared with mica are:
1) Silica sand
2) Marbles
3) Unprocessed stones from mines
4) Fiber glass
5) Granite
6) Ceramic
7) Acrylic
8) Glass

Table 2. Properties of proposed insulating Materials

Sr.no.	Particular	Physical Properties	Mechanical Properties
1.	Silica sand	Colourless, Greater permeability	Crystalline structure
2.	Marbles	Variety of colours	Tough
3.	Unprocessed stones from mines	Milky white	Tough, Rocky structure
4.	Fiber Glass	Transparent and thick	Brittle
5.	Telephone Black Granite	Black in colour, amorphous	Very tough
6.	Ceramic	Powder form	Flexible , high tensile strength
7.	Acrylic	Flat sheet	Flexible, high tensile strength, Elastic
8.	Glass	Transparent and thin	Low tensile strength, less tough

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By conducting only Physical and Mechanical test on the above materials, as compared to mica a Telephone black Granite gives similar results.

IV. FUTURE SCOPE

We further have to conduct chemical and electrical tests on the proposed insulating materials and try to replace mica. If not possible, we will change some properties of mica so as to overcame its dis-advantages by synthesis method.

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