2. MICA

2.1 Introduction

Mica is a hydrous aluminium-silicate with a highly laminated sheet-like structure. The most common types are muscovite, biotite and phlogopite. [1,2] The three types differ with respect to the proportion of iron, magnesium and aluminium contained within their crystal structures.[1] The most important industrial varieties are aluminium rich muscovite (white mica) and magnesium rich phlogopite (amber mica). Important physical properties of muscovite and phlogopite are listed in Table A6.

Commercially mica is available in the form of sheets and powder. Sheet mica is the most valuable and is derived from large crystals that can be cut, stamped or punched for electrical applications.[1,2] Mica products in sheet form can also be made by a papermaking like process or by binding overlapping small flakes with a suitable cement or a borosilicate glass. [1] Powder forms produced by dry and wet grinding techniques differ in their properties and find a wider application. The main properties that make mica a valuable mineral in industrial applications are listed in Table 1.

2.2 Applications of mica

The primary uses of mica in the 19th century were stove-windows, shades for open flame lights and furnace peep-hole covers. Mica has become a material of paramount importance for its various industrial uses in the modern era. Commercially, mica is processed in a number of forms, namely, natural sheet mica, micanite or built-up mica and mica paper or reconstituted mica. These forms are used primarily in the domestic

electronics and electrical industries. Ground mica, another important form of mica is used in construction, plastic, rubber, paints, printing and other industries. [2,4]

Table 1: Attractive properties of Mica [1,2,3]

Property	Advantages
Chemical	Chemically inert to acids, alkalis and organic solvents and oils even at high temperatures.
Mechanical	Good shape stability. High elasticity. High shear and compressive strength. Perfect cleavability, incompressible.
Electrical	High dielectric strength, high surface and volume resistivity, ability to resist sparking and corona effects
Thermal	High thermal stability, low thermal conductivity, non-flammable and infusible
Optical	Translucent in thin films, absorbs and is stable to UV.
Other	Moisture resistant

Splitting mica is chiefly used as raw material in the manufacture of built-up mica or micanite products.[4] Coarse ground mica flakes find use in oil well drilling, ornamental displays, as automotive components, refractory bricks and surface coating. It provides fire resistance, sound absorption and mechanical strength. [4]

In 1995 the polymer industry, in North America, consumed 134000 tons of mica (muscovite and phlogopite). Of the total mica consumption, 25% was used in the plastic industry and 20% in the paint industry. Phlogopite, in the plastic and paint industry, accounted for 22% of the total mica market. [5]

2.2.1 Construction

Mica is added at 4 - 20 % to cement and plaster mixtures for application in wall sheets, asphalt felts, roof shingles and insulating materials. Advantages imparted by mica include increased resistance to sulphide and chloride corrosion; decrease in the apparent viscosity allowing lower water to cement ratios; increased toughness and shape stability and improved tensile and bending strengths. [1]

The main construction application in the USA is as wallboard joint cement where it is used to fill the gaps between individual boards. Incorporation of dry ground mica improves flow properties, builds body, reduces shrinkage and cracking and provides a smooth, non-absorbent surface. The thin platelets also provide surfaces for the cement to bond onto. These same properties make mica valuable as a filler for all types of sealants for porous surfaces such as wall board masonry, concrete slabs and as a crack filler. [1]

Mica is also used in acoustic and thermal insulation applications including fire resistant gypsum boards. [1]

2.2.2 Coatings

Up to 20 - 40% micronised mica can be added to specialist paint and coating formulations. The reason for use varies from simply being a pigment extender, to mechanically reinforcing the paint, reducing sagging and running, improving anti-corrosive properties, improving resistance to UV degradation and imparting decorative effects such as texturing and sheen. Mica can also be used to substitute up to 25% of the aluminium in silver paints to reduce cost. [1]

2.2.3 Fillers in Plastics

Mica is a relatively low cost filler that improves thermal and dimensional stability, compression and bending modulus, resistance to UV [5] and dielectric properties. It can also improve the notched impact strength of some polymers. It is used in polypropylene to increase the heat deflection temperature (HDT).[5] In high-density polyethylene films the addition of mica increases tearability. It is also used in rotomoulded tanks to reduce permeability to chemicals and vapours. [1]

2.2.4 Electrical and electronic

These markets use mica mostly in sheet form although built-up mica is now being used as a substitute. Applications include electrical heating appliances as well as electric and lighting controls. [1] Mica is known to have excellent dielectric properties. However, in single sheet form it is extremely rigid and is only suitable as support for conductive or resistive wiring [6]. It is also used in the manufacture of fire resistant cables where the mica is applied as a tape to form a fire barrier.

2.2.5 Welding electrodes

Mica is essential in the manufacture of quality welding electrodes. It creates an insulating surface on metal wires, helps to produce meltable slags and prevents welds from cracking. There is currently no substitute for mica in this application. [1]