MICA

MICA

Mica is a term for group of more than 35 phyllosilicate (from Greek phyllon, leaf, or sheet silicates, form parallel sheets of silicate tetrahydrate - Si2O5 or a 2:5 ratio) with layered texture and perfect basal cleavage (Cleavage, in mineralogy, is the tendency of crystalline materials to split along definite crystallographic structural planes. These planes of relative weakness are a result of the regular locations of atoms and ions in the crystal, which create smooth repeating surfaces that are visible both in the microscope and to the naked eye).

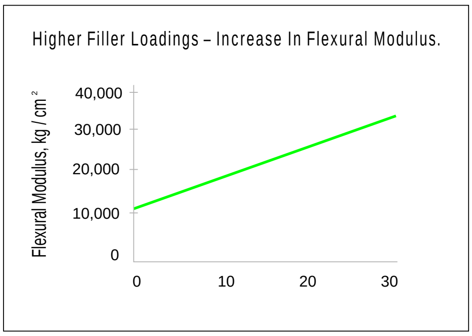
This perfect cleavage is due to weak bonding between the layers resulting in splitting or delamination (separation into constituent layers) of the mica layers into thin mica sheets.
Mica in mineral form is basically potassium aluminiosilicates with some Aluminium atoms replaced by Magnesium and iron and may contain traces of other elements..
Muscovite and Phlogopite are 2 most important commercial types of Mica with unique characteristics of Mica,

- Chemical inertness.
- Superior electrical and thermal insulating properties.
- High temperature stability.
- Excellent mechanical properties.

Mica is used commercially in Sheet and Ground forms. High quality mica sheets ae used in electronics and electrical applications. Built up mica produced by mechanised or hand setting of overlapping splitting and alternate layers of binders and splitting, and reconstituted mica (mica paper) are used in electrical insulation material.
In ground form, commercial micas are divided into Wet Ground and Dry Ground grades depending on method of production.

Aspect Ratio
In many applications for reinforced plastics, especially reinforced polyolefin such as polypropylene and thermoplastic olefins, the product must not only be strong, but also stiff or rigid to perform as designed. This stiffness is known as the flexural modulus of the plastic and is expressed in Pascals (Pa) or as pounds per square inch (psi).
Plastic stiffness begins with plain resin without performance-enhancing additives. The stiffness is a function of the polymer type and molecular weight, as well as the thickness and shape of the plastic part. Most polypropylenes and thermoplastic olefins (TPOs) used for components in automobiles and appliances are not stiff enough, in their natural state, to be satisfactory in high-performance parts.

Filler Loading and Flexural Modulus or Stiffness
Adding a fine mineral will increase the stiffness or flexural modulus of a polymer system. Generally, the more mineral used–that is, the higher the filler loading–the greater the increase in flexural modulus.



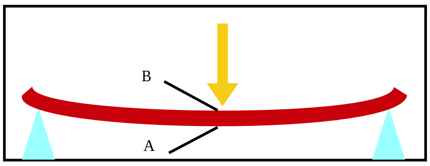
Aspect Ratio and Flexural Modulus or Stiffness

In choosing a mineral to increase flexural modulus, there are two important factors to consider: a mineral's aspect ratio and its particle size. The aspect ratio of a pigment particle is defined as the greatest length of the particle divided by its thickness. Particles that are essentially spherical, such as those of ground calcium carbonate (GCC), have equal lengths and thicknesses and have aspect ratios of 1:1. Talc, Mica are long, thin, platy minerals, as can be seen in the scanning electron micrograph below. For Talcs, the aspect ratio is much higher, typically about 20:1.

Since Mica has high aspect ratio it is widely used in plastic, polymer and phenolic compounds with electrical applications as filler of choice.

Mica improves material properties significantly, such as, **higher heat deflection temperature** (The heat deflection temperature or heat distortion temperature (HDT, HDTUL, or DTUL) is the temperature at which a polymer or plastic sample deforms under a specified load. This property of a given plastic material is applied in many aspects of product design, engineering, and manufacture of products using thermoplastic components.) ,Mica is widely used to **increase tensile strength** (Ultimate tensile strength (UTS), often shortened to tensile strength (TS) or ultimate strength is the maximum stress that a material can withstand while being stretched or pulled before failing or breaking)

Mica increases **flexural strengths** (flexural strength, also known as modulus of rupture, bend strength, or fracture strength a mechanical parameter for brittle material, is defined as a material's ability to resist deformation under load. The transverse bending test is most frequently employed, in which a rod specimen having either a circular or rectangular cross-section is bent until fracture using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture.



Mica reduces **isotropic shrinkage** (uniform shrinkage in the size of the moulded parts because the density of polymer varies from the processing temperature to the ambient temperature. The shrinkage of plastic parts can be as much as 20 percent by volume, when measured at the processing temperature and the ambient temperature.)

Mica layers reduce **permeability**, & enhance the **dielectric, heat resisting** and **insulating properties**.

Mica reinforced polypropylene is widely used in **RRIM (Reinforced Reaction injection Moulded)** automotive parts, such as, fan blades, dashboard panels floor and grill panels, plastic seats, ignition system parts, air-conditioning heater housing including fascia and fenders fixed next to steel parts while maintaining a similar appearances and similar coefficient of thermal expansion.

Mica provides superior **dimensional stability**, virtually **eliminate warpage** and produce a **superior painted surface.**

Uses of Dry Ground Mica

Functional fillers for plastics.

Fillers are generally relatively cheap, solid substances which are added in high percentages to plastics, paints and paper to adjust the volume, weight, cost or technical performance. Fillers for plastics are divided into inactive extended fillers, and active functional fillers. Inactive fillers are used to basically reduce the cost whereas; functional fillers are used to change a specific property of the plastics according the requirement of application.)

Tape-Joint cement compounds for gypsum dry wall.

Joint compound also known as drywall compound is a white substance similar to plaster used to seal joints between sheets of drywall, primarily in building construction. It is often referred to simply as mud.

- **Pigment extender in paint industry.**

A Extender pigments are primarily used to reduce the cost of a paint formulation. However, they can also modify pigment properties such as flow (viscosity), sedimentation stability, film strength.

- **Rolled roofing and asphalt shingles.**

Asphalt roll roofing or membrane is an inexpensive roofing material commonly used for buildings that feature a low sloped roof pitch in North America. The material is made up of an organic felt or fibreglass mat, saturated with asphalt, and faced with granular stone aggregate. Roll roofing is usually restricted to a lightweight mat compared to shingles, as it must be rolled for shipment. Roll roofing is regarded as an inexpensive, temporary material.

- **Additive / Filler to drilling muds in well drilling industry.**
- **Mould release agent in rubber industry.**

Uses of Wet ground Mica

Since wet ground mica retains its brilliance of its cleaved surfaces, most of the application is in pearlescent paints (pearl like shine and smooth finish) and in cosmetics.

Mica provides an excellent **sound reduction** and **sound barrier properties**. Mica replaces asbestos in acoustic compounds that eliminate road and engine noise.

TYPICAL PHYSICAL PROPERTIES OF MICA (MUSCOVITE)	
Colour	White, off-White, Ruby, Green, Monoclinic
Shape	Thin Flakes / Powder
Aspect Ratio	20 – 40
Bulk Density (gm / cm^3)	2.7 – 3.2
Hardness (Moh's Scale)	3 – 4
pH (BS 3483)	6.5 – 8.5
Water Solubility (BS 1775)	Virtually Insoluble
Refractive Index	1.55 – 1.61
Tensile Modulus GPa	172
Tensile Strength MPa	255 – 296 (sheets with stressed edges)
Dielectric Constant @ 104 Hz	2.0 – 2.6
Max temperature with little of no of decomposition °C	500 – 530
Thermal conductivity Wm-1K-1	2.5 x 10-5

TYPICAL CHEMICAL PROPERTIES OF MICA (MUSCOVITE)		
Silica	(SiO_2)	Approx 45 – 50 %
Alumina	(Al_2O_3)	Approx. 30 – 40 %
Potassium	(K_2O)	Approx. 10 %
Iron	($FeeO_3$)	2 – 3 %
Sodium	(Na_2O)	Less than 1 %
Titanium	(TiO_2)	Less than 0.5 %
Moisture @ 100 ° C (free)		Less than 0.5 %
Magnesium	(MgO)	Less than 1 %
Phosphorous	(P)	Traces
Sulphur	(S)	Traces
Graphic Carbon	(C)	0.44 %
Loss on ignition (water of crystallisation)	(H_2O)	3.50 %
Calcium (Lime)	(CaO)	Traces

Trigon Chemicals Pvt. Ltd.

722/AB/15, Nirmal, Laxmi Park Colony, Navi Peth, Pune-411 030. India.
Telephone: +91 (20) 24530071, Fax: +91 (20) 24530110
Email: aditya@trigon-chemie.com, Web: www.trigon-chemie.com