TECHNICAL REPORT

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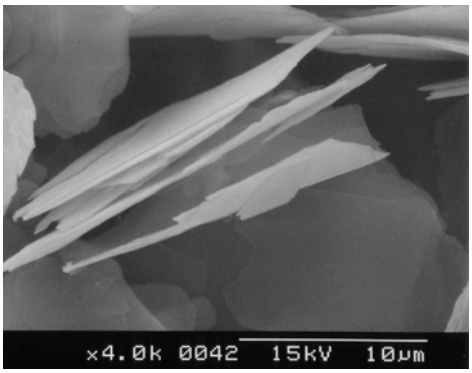
Mica Reinforced Polypropylene

1. Characteristics of Mica

Mica is a silicate naturally-layered inorganic mineral the main characteristic of which is the fact that it can produce a powder with a higher aspect ratio (major axis/thickness) than is possible with other inorganic fillers. Mica is also highly elastic, and has excellent chemical and thermal stability and electrical insulation.

These particular features and physical properties are fully utilized, with ground mica powder being used as a highly functional filler for a variety of industrial uses. As can be seen by the fact that mica is used as a raw material for make-up such as foundation and eye-shadow, mica is an extremely safe material and has no problems whatsoever with harmful substance regulations anywhere in the world.

Although talc is another type of inorganic filler which, like mica, comes in flake form, mica has easily the higher aspect ratio and elasticity, and possesses extremely good thermal stability. Furthermore, there is a need for care with talc concerning the possibility of trace amounts of asbestos depending on the region of production; in the case of mica, however, there is no danger of asbestos whatsoever.



Mica Powder SEM Image

2. Effects of Mica Filler on Plastics

Mica is used to fill plastics with the aim of improving its physical properties and has the following beneficial effects:

- Improves rigidity (bending elasticity)
- Low warpage
- Reduces isotropic mold shrinkage
- Improves thermal deformation temperature
- Improves electrical insulation
- Improves vibration absorbency
- Provides gas barrier

Generally speaking, plastics that have been filled with glass fiber have a high tendency to deform through warpage, and have problems with highly anisotropic mold shrinkage and chapping of the plastic surface; however, by combining mica with glass fiber, it is possible to solve these problems. There are many cases in which the desired physical properties of plastics have been achieved by combining fillers to bring about mutual effects.

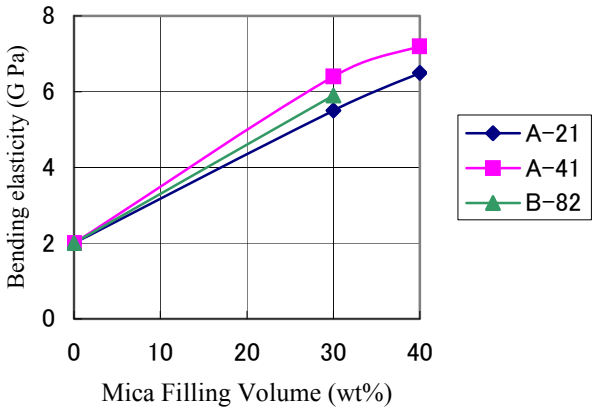
Talc is also used as a filler in plastics, and can bring about the effects described above but cannot achieve the excellent physical properties of mica. On the other hand, talc is normally selected for use as a filler due to its lower cost, with mica often being used when a higher standard of physical properties is required from the plastic.

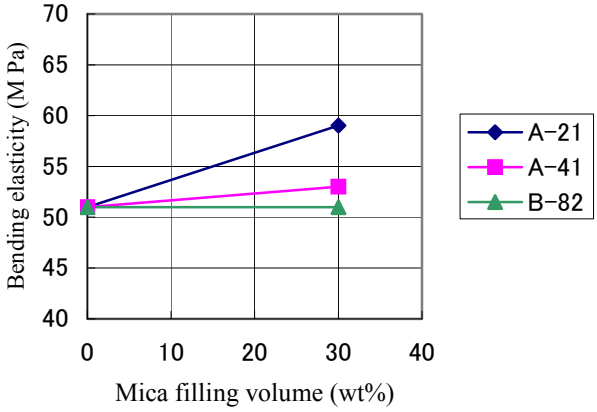
In terms of the problems associated with using mica as a plastic filler, there are cases where the impact strength of certain plastics will decrease and where the welding strength will decrease depending on the mold dimensions. Furthermore, mica ore is of a brownish red color and affects the color tone of plastics into which it has been filled, meaning that it is not appropriate for uses which require high levels of whiteness or transparency.

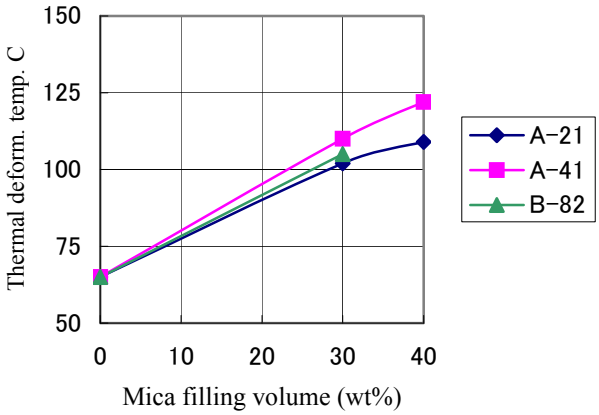
3. Physical properties of mica reinforced polypropylene

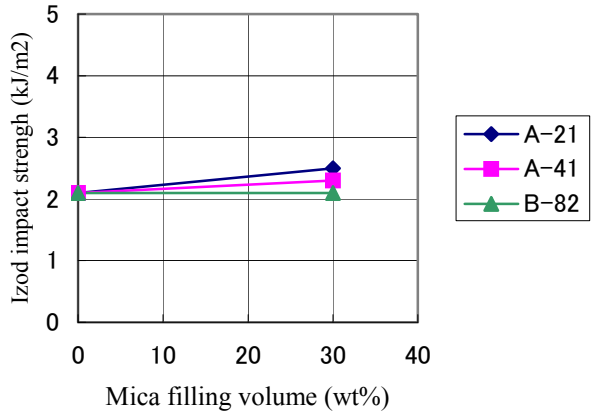
The mica reinforced polypropylene obtained at Yamaguchi Mica has the following physical properties:

Mica Product Grade (average particle size in μm)	Mica filling volume wt%	Bending elasticity G Pa	Bending strength M Pa	Thermal deformation temperature in Celsius	Izod impact strength kJ / m^2
—	0	2	51	65	2.1
A-21 (22μm)	30	5.5	59	102	2.5
A-21 (22μm)	40	6.5	—	109	—
A-41 (47μm)	30	6.4	53	110	2.3
A-41 (47μm)	40	7.2	—	122	—
B-82 (180μm)	30	5.9	51	105	2.1









Generally speaking, with mica reinforced polypropylene the mica filling volume is approximately 30 – 40 wt%.

With complex reinforced polypropylene which combine mica and glass fiber, the mica filling volume is approximately 20 – 40 wt% and the glass fiber filling volume is approximately 10 – 30 wt%.

4. Uses of mica reinforced polypropylene

The uses of mica reinforced polypropylene are outlined in the below table. Most uses are automobile-related, and it can be used as a complex reinforced polypropylene with materials such as glass fiber depending on the required level of physical properties.

Field	Examples of applications	Required properties of plastic
Automobiles	Engine room: different types of housing Engine room: fans Different types of cover Instrument panels Front end modules Door modules Lamp housing etc.	High rigidity Low warpage High thermal deformation temperature Low mold shrinkage
Electrical Products	Air conditioner fans Various types of housing	High rigidity Low warpage High thermal deformation temperature
	Speaker cone	High rigidity

5. Points of consideration concerning mica reinforced polypropylene production methods

Normally, compound pellets are created using a kneading extrusion machine for a given composition of mica and virgin polypropylene, with the molded material then being produced by inserting the compound pellets into an injection molding machine. Alternatively, the molded material can be produced by creating masterbatch pellets with a high concentration of 70 to 80 wt% using a kneading extrusion machine, with these then being mixed with virgin pellets and inserted into the injection molding machine.

Manufacturing molded materials by directly inserting premixed mica and polypropylene into the injection molding machine is difficult due to the resulting poor dispersion.

Insertion into the kneading extrusion machine is carried out by creating premixed mica and polypropylene and then using a hopper. In the case of high filling, additional filling is carried out using a side-feed. There is a need for mica to be well kneaded in order to improve dispersion and, as with glass fiber, carrying out insertion from the final part of the kneaded material is not recommended.

Furthermore, due to the fact that screw abrasion occurs easily when kneading mica, it is advisable to use screws that have been treated for abrasion-resistance.

6. Recommended grades

Yamaguchi Mica's recommended product grades for mica reinforced polypropylene are as follows:

Grade name	Average particle size μm	Bulk density g / ml	Adhesive moisture %	Characteristics
SYA-21R	27	0.21	0.5	Wet ground MICA powder, high aspect ratio, very small particle size, used in applications requiring excellent physical properties and good external appearance, Muscovite produced in India
SYA-41R	45	0.18	0.3	Wet ground MICA powder, high aspect ratio, used in applications requiring excellent physical properties, Muscovite produced in India
SB-061R	130	0.27	0.3	Dry ground MICA powder, large size, lower price, Muscovite produced in India

It is also possible to outsource production within Japan of other compounds and high density masterbatches.