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# EFFECT OF SURFACE-TREATED MICA FLAKES ON HDPE COMPOSITES

## Introduction

High Density Polyethylene (HDPE) is commonly reinforced with mineral fillers to improve stiffness and dimensional stability. Among these fillers, mica flakes are of particular interest due to their plate-like morphology and reinforcing efficiency. However, effective reinforcement depends strongly on the quality of interfacial adhesion between mica and the polymer matrix.

This article summarizes morphological studies on HDPE composites reinforced with surface-treated mica flakes, focusing on the role of coupling agents and filler concentration.

## Surface Treatment of Mica Flakes

In the investigated system, mica flakes were surface treated using:

- Silane coupling agents
- Titanate coupling agents

These surface treatments were applied to modify the mica–polymer interface, with the aim of improving adhesion between the inorganic filler and the HDPE matrix.

## Morphological and Interfacial Analysis

Morphological studies examined the effect of surface treatment on the HDPE–mica interface. The results showed that surface-treated mica exhibited improved interaction with the polymer matrix compared to untreated mica.

Among the two treatments, silane-treated mica composites demonstrated superior interfacial adhesion relative to titanate-treated systems. This indicates that silane coupling agents are more effective in enhancing compatibility between mica flakes and HDPE under the conditions studied.

## Effect of Filler Loading

A critical observation from the study is that the improvement in interfacial adhesion was only detectable at mica concentrations above 20 wt%.

**At lower filler loadings:**

- The effect of surface treatment on adhesion was not clearly observable.
- Interfacial differences were insufficient to be detected through morphological analysis.

**At higher filler loadings:**

- The influence of surface treatment became pronounced.
- Improved polymer–filler interaction was evident, particularly for silane-treated mica.

This suggests that a minimum filler concentration is required before interfacial effects become measurable in HDPE–mica composites.

### Directional Dependence of Interfacial Adhesion

Another key finding is that enhanced interfacial adhesion was direction dependent. The improved interaction between mica and HDPE:

- Could not be observed uniformly across the surface of the sample
- Was detectable only when measurements were made parallel to the surface

This behavior is consistent with the anisotropic nature of mica flakes, where orientation and alignment relative to the measurement direction influence the apparent interfacial response.

### Conclusion

Morphological studies of HDPE reinforced with surface-treated mica flakes demonstrate that coupling agents play an important role in modifying the polymer–filler interface. Silane-treated mica shows better adhesion to the HDPE matrix than titanate-treated mica, but this improvement becomes evident only at filler loadings above 20 wt%. Additionally, the enhancement in interfacial adhesion is directionally dependent and is observed primarily in measurements parallel to the composite surface. These findings highlight the importance of both surface chemistry and filler concentration when designing mica-reinforced HDPE composites.