What are the applications of nano clay as a filler in coatings?

Clay particles at the nano size possess some unique characteristics unlike the other fillers. The nanoclay particles are in the platelet form with thickness of just 1 nm and width of 70~150 nm. This high aspect ratio of 100~150 imparts some anisotropic characteristics to the film. The specific surface area is of the order of 700~800 sq m/ gm. Therefore loading of only a few percent (2~7 %) of nanoclay into a polymer matrix drastically alters the properties due to high interfacial interaction. The optical transparency of the coating film remains unaltered as the nanosize particles are too fine to scatter the incident visible light due to its higher wave length.

The nano clay particles may be looked upon as inorganic polymer molecules. Their size is comparable to the polymeric macromolecules. Organic surface treatment or encapsulation makes these clay particles compatible with the organic polymers. This enables formation of hybrids with novel physico-chemical properties. Such materials can be used to design newer film forming materials. The mechanism of functioning of nano clays in coating films is based on the following structural aspects of the nano-clay/ polymer hybrids:

1. High interfacial area leading to strong adsorption of polymer molecules which immobilizes the segmental motion of the polymer molecules
2. High aspect ratio providing a rigid barrier distributed across the film at nanoscale
3. Relatively inert chemical composition unlike calcite or dolomite
4. Existence of a gallery or interlayer gap of 1 nm which can be used for inserting other molecules like a dye or a polymer
5. Expandability of the gallery by several folds with macromolecules so as to decrease the thickness of the platelet which further increases the aspect ratio.

Following novel properties are obtainable in the coating films by nanoclay incorporation:

- High mechanical strength: Nanoclay increase the Tg of the polymer matrix by 10~15 deg C. The tensile strength goes up by 50~60 %. This results in films which are tougher and display high scratch resistance. In emulsion paints, it opens up a

possibility of altering conventional relationships between Tg and MFFT. Harder films will yield better impact resistance and dirt repellency. In a way, nano clays act like “cross linkers”

- Imperviousness: Superior barrier properties retard ingress of water, gases and vapors across the film improving corrosion resistance of epoxy paints. In masonry coatings the efflorescence as well as the carbonation can be effectively prevented.
- Enhanced heat resistance: Nanoclay increases the dimensional stability and the heat distortion temperature of the films. There is a marked reduction in weight loss upon heating due to the arrest of the gaseous decomposition products. Formation of char layer and platelet structure impart good fire retardancy to the matrix.
- Higher electrical conductivity: Nanoclays enhance electrical conductivity of the polymer matrix owing to the existence of ionic moieties in the layered structure. This enables formation of conductive films. When incorporated in conductive polymers like polyaniline, polypyrrole and polythiophene their electrical conductivity can be further enhanced.
- Nano clay pigments: Nano clay particles intercalated with dyes act as bright colored pigments with good fastness properties (Planocolors). These are devoid of heavy metals like lead, chromium, cadmium and mercury.
