

# Fives Methods of Powder Surface Modification

Surface modification is the act of modifying the surface of a material by bringing physical, chemical or biological characteristics different from the ones originally found on the surface of a material.

According to the application requirements, changing the physical and chemical properties of the powder material surface, such as surface composition, structure and functional groups, surface wettability, resistance to aggressive environment, electrical properties, optical properties, adsorption and reaction characteristics, etc., to meet the needs of modern new materials, new processes and new technology development.

In this passage, I am going to introduce to you five common methods of powder surface modification.

## 1. Physical coating method

The physical coating method is using high polymer or resin to treat the powder surface, generally including the cold method and hot method.

The main factors affecting the physical coating modification effect are the shape of the particle, specific surface area, porosity, type and amount of coating agent, coating treatment process, etc.

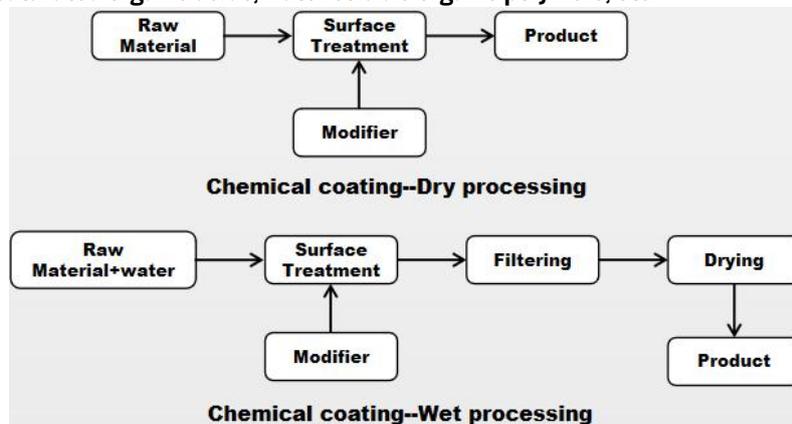
The modification agent including high polymer, phenolic resin, furan resin, etc. The physical coating method could be applied to powders such as foundry sand and silica sand.

## 2. Chemical coating method

The principle of chemical coating is using the adsorption or chemical reaction happened between the functional groups in the organic molecules and the surface of the inorganic powder to coat the surface of the particles, generally including dry and wet methods. The modifier in the wet modification process must be water-soluble. In addition to surface functional group modification, the method also includes surface coating modification using free radical reaction, chelation reaction, sol adsorption, etc.

The main factors affecting the chemical coating modification effect are surface properties of the powder, the type, loading amount, and application method of the powder modifier, modification process, modification equipment, etc.

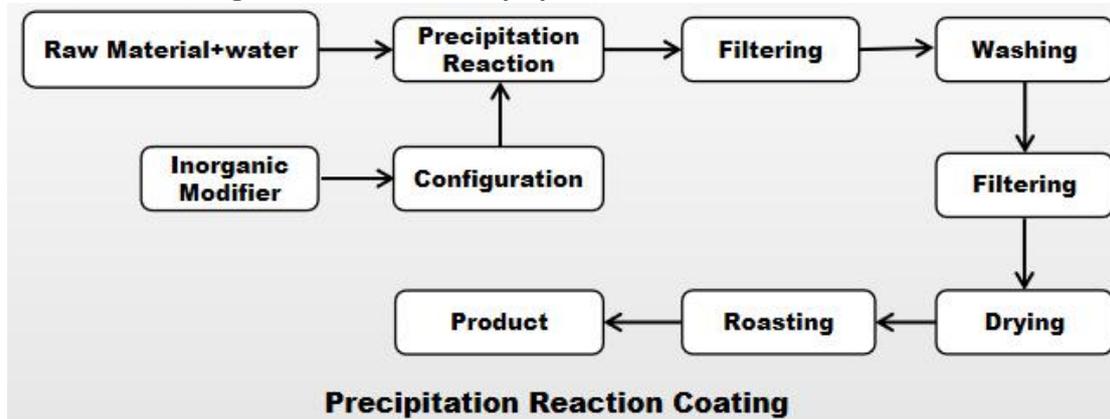
The powder modifier of the chemical coating including various coupling agents such as silane, titanate, aluminate, zirconium aluminate, organic chromium, higher fatty acid, and its salt, organic ammonium salt and various other types of surfactants, phosphoric acid Esters, unsaturated organic acids, water-soluble organic polymers, etc.



And this method is applied in the modification of Quartz sand, silica powder, calcium carbonate, kaolin, talc, bentonite, barite, wollastonite, mica, diatomaceous earth, brucite (such as XK-1250SA/90 is coated with stearic acid, widely used in PVC compound), barium sulfate, dolomite, titanium dioxide, aluminum hydroxide, [magnesium hydroxide](#), Alumina etc.

### 3. Precipitation reaction method

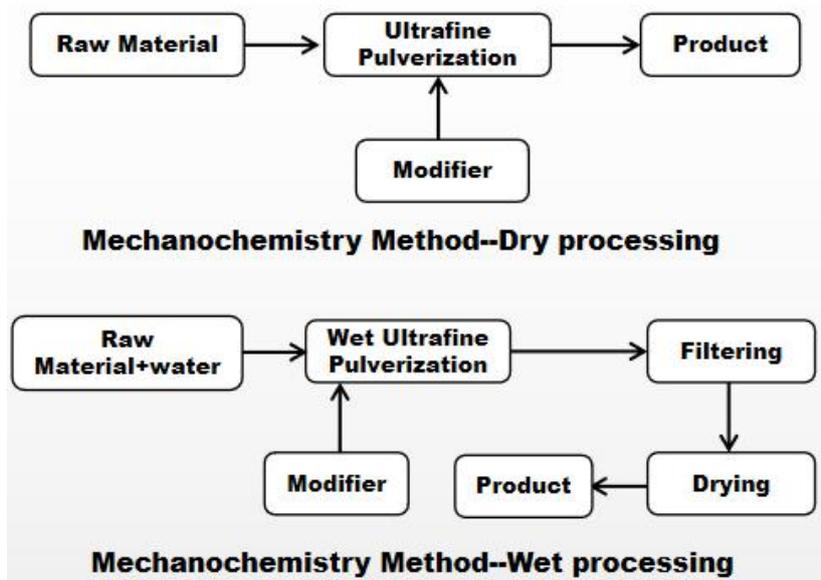
By the precipitation reaction of inorganic compounds on the surface of the particles. This method is to form one or more layers of "coating" to improve the surface properties of the powder, such as luster, tinting power, covering power, color retention, weather resistance, electrical, magnetic, thermal and bulk properties, etc.



The main factors affecting the precipitation reaction modification effect are the nature of the raw material (particle size and shape, surface functional groups), the variety of inorganic surface modifiers, the pH value, concentration of the slurry, reaction temperature and reaction time, washing, dehydration, drying or roasting, and other subsequent treatment processes. This surface modification method could apply to powder such as titanium dioxide, pearl mica, alumina. And the modifier could be various inorganic compounds such as metal oxides, hydroxides, and their salts.

### 4. Mechanochemistry method

This method uses ultrafine pulverization and other strong mechanical effects to activate the surface of the powder. Then to change the crystal structure, solubility (amorphization of the surface), chemical adsorption, and reaction activity (increase surface-active points or active group of the particle surface), etc.



The modification equipment and agents of mechanochemistry method including Ball mills, jet mills, high-speed mechanical impact mills, etc., grinding aids, dispersants, modifiers, etc.

The main factors affecting the mechanochemistry modification effect are the type of mills, working method of the machine, crushing environment (dry, wet, atmosphere, etc.), type and amount of grinding aid or dispersant, time of action of mechanical force, and crystal structure, chemical composition, and particle size and particle size distribution of powder.

This method applies to powders such as Kaolin, talc, mica, wollastonite, titanium dioxide, etc.



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## 5. Intercalation modification method

This method utilizes the weak binding force between the crystal layers of the mineral powder particles with a layered structure (such as molecular bonds or van der Waals forces) or the existence of exchangeable cations and changes the interface properties and other properties of the powder through ion exchange reactions or chemical reactions.

The modifiers of the intercalation modification method including quaternary ammonium salts, polymers, organic monomers, amino acids, and other organic intercalating agents.

The main factors affecting the intercalation modification effect are the nature of raw materials, reaction environment, types and dosage of the intercalating agent, etc. And this method applies to powders such as Kaolin, graphite, mica, hydrotalcite, vermiculite, rectorite, metal oxide and layered silicate, etc.

That's all for today's feed, hope this passage can help you when you do surface modification to your powder. Thank you for your time and if you have any questions please feel free to contact Author Elena: [kmt\\_elena@163.com](mailto:kmt_elena@163.com).