



## Introduction of fabric organic coating agent

What is fabric organic coating agent?

Fabric coating agent, also named as coating glue, which is a uniform coating on the surface of the fabric that can form a polymer fabric by the coating agent. It can get a unique hand feeling, appearance and a variety of special features, which can greatly enhance the value-added products. At present, the coated textiles account for 30% of the total textiles, while the coating agent consumption has reached about 50% of the total amount of textile auxiliaries. Therefore, the research of coating agent has been paid much attention by people.

What are the types of fabric organic coating agents?

Coating agent can be divided into solvent-based and water-based according to the usage. Solvent-based coating agent has a good film-forming, high water pressure, drying fast, low solid mass fraction, but requires a large number of organic solvents, the cost is high, and it's toxic and easy to fire, pollute the environment. Due to the increasing price of the international crude oil, the price of the solvent is also rising, which increase the cost. For Water-based coating agent, the water pressure is low, drying is slow, but it's non-toxic, non-combustible, and safe with low cost. It is also made to thick coating products, it is beneficial to the production of colored coated products. Therefore, many manufacturers are willing to use coating agents according to different chemical structure classification, such as Polyacrylates, polyurethanes, polyvinylchloride, silicone (also named as polysiloxanes).

Silicone coating agent had developed successfully by the German WACKER company in the 1970s, followed by the United States Dow Corning, Shin-Etsu Chemical have also launched their own silicone coating agent and put on the market. This paper introduces the preparation and application of silicone coatings for newly developed fabrics in recent years.

What are the properties of silicone coatings?

Good water repellency and air permeability. The main chain of the silicone is composed of Si and O atoms alternately connected, Si atoms using  $sp^3$  hybrid and with organic groups (such as methyl, etc.), is a semi-inorganic semi-organic polymer compounds. When the silicone is coated on the surface of the fabric, the oxygen of the silicon dipolar will point to the surface of the fabric and the methyl outward to the air and form a directional arrangement on the surface of the fabric. The organic groups such as methyl groups convert the high energy, and the surface of the fabric is shielded, so that the critical surface tension of the fabric surface is greatly reduced, resulting in good water repellency; and still maintains good hygroscopicity for the uncoated layer.

In addition, the bond length of Si-O (0.164 nm) is longer than the C-C bond (0.154 nm) and the C-O bond (0.142 nm), the bond angle of Si-O-Si is large ( $143^\circ$ ), So that the stroma of the lateral





rotation on the Si atoms is small, the polysiloxane chain can be free to rotate, and the free space increases, the relative density of the space decreased, so the air permeability improved. If the silicone elastomer is made into a thin film, the air permeability of N<sub>2</sub>, O<sub>2</sub>, CO<sub>2</sub> and other gases in the air that is 30-50 times higher than that of the natural rubber at room temperature.

#### Excellent heat resistance

The bond energy of Si-O (452 kJ / mol) in the organosilicon compound is higher than that of the C-C bond (356 kJ / mol) and the bond energy C-O (358 kJ / mol), so that it has excellent heat resistance. But if the silicone elastomer contains 5% KOH, it begins to decompose at 125 °C . Therefore, when producing the silicone coating agent, it is necessary to remove impurities such as residual catalyst to ensure that the coating agent can be used in the 250-300 °C environment for long-term.

#### Good weather resistance

Silicone coating agent has excellent stability, UV resistance and anti-radiation, tear strength, permanent elasticity and good adhesion to the fabric fastness in the environment of -50 ~ 250 °C . The brittle point of general-type silicone elastomer is -50 ~ -60 °C , the using life is up to 10 years in the out-door environment.

#### Good mechanical performance

The tensile strength of the silicone elastomer is about 10MPa, and the elongation at break is about 10 times. After coating with the coating agent for the he pongee fabric, the tear strength and the breaking strength are significantly increased.

#### Physiological inert (non-toxic)

As the silicone is semi-inorganic semi-organic polymer materials, pure dimethyl silicone oil is not toxic, no stimulation of the skin. It can be used in food, cosmetics, drugs, because of these features, it has the performance of physiological inertia.

#### Preparation and application of silicone coating agent

Silicone coating agent imparts the fabric a strong tear strength, outstanding water vapor permeability, excellent flexibility and resistance to ultraviolet light, it is widely used in raincoats, umbrellas, tarpaulins, nautical clothing, baby pants, hot air balloons, skiing Shirts, protective clothing and other fabric. According to the main components, silicone coating agent is divided into two types, mixed type and modified type.

#### Mixed type organic silicone coating agent

Such coating agent is generally the active group of polysiloxane and other components in accordance with the proportion of mixing in the system. The method is simple, has been studied





in early time and has been deeply concerned by the researchers, but the components and their proportions should be appropriate.

The mass fraction of 10%~85% Polysiloxane, 0.5%~20% acid, and 5%~40% solids (the particle size is 1~5  $\mu$  m, density 0.12~1.8g/mL) were mixed evenly to obtain silicone composition. The composition has non-irritating, non-corrosive, non-combustible properties, and can impart good water and antifouling properties to textiles, leather, glass, ceramics, and metals. The polysiloxane may be methyl silicone oil or hydrogen-containing silicone oil, functional silicone oil, cyclosiloxane (e.g., octamethylcyclotetrasiloxane, hexamethylcyclotrisiloxane). The acid is sulfurous acid or hydrohalic acid, sulfamic acid, etc. The solid particles is mica, graphite, polyethylene, polypropylene and so on.

Using  $\alpha$  ,  $\omega$  -vinyl dimethylsiloxy polydimethylsiloxane or terminal hydroxyl polydimethylpolyvinylsiloxane [polymerization degree is not higher than 150, viscosity 4100 mPa  $\cdot$  s (25  $^{\circ}$ C)] silicone cross-linking agent (Viscosity 2 ~ 55mPa  $\cdot$  s, such as methyl trimethoxysilane, methyltrichlorosilane and so on) containing at least three reactive groups (Si-H, Si-OH, Si-OR groups), and a catalyst (such as tetraisopropyl titanate, NaOH, chloroplatinic acid) capable of reacting between the two are formulated as a silicone coating composition for use as textile coating. The cured coating is flexible (foldable), flexible, especially suitable for use in airbags. Some people use vinyl silicone oil, hydrogen-containing silicone oil, chloroplatinic acid, tackifiers (such as epoxy silicone oils, alkoxy silanes), silicone resins and crosslinking inhibitors such as tetramethylvinyltetrasiloxane or Unsaturated amine, pyrimidine, acetylene alcohol) is formulated as a silicone composition which is applied to the inner surface of the airbag to form a protective coating which improves its high temperature mechanical properties and adhesion to the substrate.

The olefin-containing polysiloxane, the hydrogen-containing silicone oil, the silicon powder and the hydrosilylation reaction catalyst are formulated into a silicone rubber composition. The elongation of the coated fabric is more than 800%, and it is used as an air bag, inflatable lifeboat and so on. It has a long lasting pressure maintaining characteristic. Olefin-based silicone oil having a viscosity of 100 to 500 Pa  $\cdot$  s, a hydrogen-containing silicone oil, an alkoxy silane (e.g., 3-methacryloxypropyltrimethoxysilane, etc.), SiO<sub>2</sub> powder, zirconium complex (such as zirconium tetraacetylacetonate) and catalyst (chloroplatinic acid solution or chloroplatinic acid alkenyl compound) made to silicone rubber composition, coated on the, exposure in high temperature and high humidity environment for a long time, finally still contain strong adhesive properties.

The mass fraction of hydroxyl silicone oil 10 to 80% (viscosity: 50 to 1000 Pa  $\cdot$  s) and 20% to 50% of methyl silicone oil (viscosity 50 ~ 500 Pa  $\cdot$  s) mixed heating to 60 ~ 80  $^{\circ}$ C, stirring 0.5 ~ 1h. Cooling to room temperature, adding 1% ~ 10% hydrogen-containing silicone oil (active hydrogen





mass fraction of 0.4% ~ 1.6%), stirring 0.5h, the viscosity of 80 ~ 300Pa • s. And 0.5% to 1% of an organotin catalyst (such as dibutyltin dilaurate, dibutyltin diacetate), 0.5% to 1% of a functional group containing an epoxy group, a mercapto group, an amino group and a ureido group Silane coupling agent (e.g., 3-aminopropyltrimethoxysilane, 3-glycidoxypropyltrimethoxysilane, 3-mercaptopropyltrimethoxysilane, etc.) to prepare a silicone coating agent.

#### Modified type organic silicone coating agent

The modified silicone coating agent is obtained by polymerizing silane coupling agent and / or reactive silicone oil with an isocyanate or an acrylic monomer. The preparation process of this coating agent is complicated, but can obtain unique property.

#### Development trend of fabric organic coating agent

Coating processing is a important method of textile treatment, coated fabric production has a broad prospect, its manufacturing and application areas are inseparable from the development of new coating agent research. To develop new varieties to obtain competitive advantage, the development trend of silicone coating agent is as follows: First, the development of special functional products. With the development of high-tech computers and telecommunications, electromagnetic radiation has become the fourth largest pollution threat to human health after noise pollution, air pollution and water pollution. The coated fabric with electromagnetic shielding is extremely important in modern people's life and work. In addition, with insulation, warming, anti-bacterial, anti-sound, flash, reflective and other special features of the coated fabric should also be concerned. Second, multi-functional product development. Multifunctional coating agent can give the fabric a different style and function, such as waterproof, moisture, flame retardant (or anti-ultraviolet, or resistant to hydrolysis of mildew) triple effect, but also the future development trend of the coating. Third, cost. Silicone coating agents are unique, but more expensive, the cost of materials should be reduced to expand the field.

