

1. Definition and Characteristics

Silicone pastes SILOKSAN P are homogeneous two phase mixtures of polydimethylsiloxane oils and fine silica filler.

Owing to specific organic-inorganic structure of contained silicone oil and the choice of the appropriate filler, silicone pastes of SILOKSAN P series have a number of exceptional properties and the most important are:

- stability over a wide range of temperatures,
- the minimal variability of the rheological, chemical and electrical characteristics as function of temperature and frequency,
- water repellency, anti-adhesiveness and incompatibility with organic substances,
- good resistance to fire and
- non-toxicity and physiological inertness

2. Areas of Application

Silicone pastes SILOKSAN P are widely used in electrical engineering, electronics, plastics processing and chemical industries for:

- prevention of occurrence of creeping discharge in electrical insulators,
- prevention of corona discharge and protection of high-voltage installations from high corona effect,
- filling of electrical circuits in order to prevent the ingress of moisture, dust and gases,
- filling and sealing of electronic components and assemblies,
- protection of automotive ignition systems and battery terminals from arcing, corrosion and dust,
- lubrication of electric cables before pulling through protective tubes and shells,
- protection of screw threads from sticking and corrosion,
- separation of moulds in processing of plastics,
- lubrication and sealing of valves of pipelines transporting hot and corrosive liquids,
- lubrication and sealing of laboratory glassware,
- impregnation of asbestos gaskets against flange sticking.

3. Range of Products

The range includes silicone pastes SILOKSAN P 1 and P-2, which differ mainly in the penetration number. Silicone paste SILOKSAN P-1 (hard) is used in all applications specified above as dielectric in electrical engineering and electronics. Silicone paste SILOKSAN R-2 (softer) is more suitable for applications in which its anti-adhesiveness, lubricity and release properties are of dominant importance.

4. Physical and Chemical Properties

Table 1 summarizes the most important properties of silicone pastes SILOKSAN P 1 and P-2.

Characteristics	Unit	Type of Silicone paste	
		P-1	P-2
Color		gray, white to transparent	
Density at 20°C	kg/m ³	1100 - 50	1050 - 50
Penetration number			
bond	mm, ' 10	370 - 420	400 - 420
after 24 hours	mm, ' 10	320 - 370	350 - 400
Dielectric strength	kV.'mm	mm 140	mm 140
Dielectric constant		29-3 1	2.9 - 3.1
Dielectric loss factor		7. 10 ⁻³	7. 10 ⁻¹
Surface resistivity	Ohm/cm'cm	10 ⁻¹	10 ⁻¹
Electrical arc resistance	second	30	
Dropping point	°C	-	-
Volatility (24h at 150oC]			
Temperature range of application		-50 do +200	- 50 do + 200

Because of thixotropy, the penetration number decreases after several months of storage. The original consistency is easily obtained by mixing the paste.

Silicone pastes SILOKSAN P-1 and P 2 are dispersed in aliphatic, aromatic and chlorinated hydrocarbons (for example, benzene, toluene, carbon tetrachloride, trichlorethylene, etc.), and are insoluble in water (max. 2), lower alcohols, acetone, etc.

Silicone pastes SILOKSAN P-1 and P-2 have little effect on other materials and do not affect metals and the majority of plastics. However, after prolonged contact of silicone paste with some plastics, these plastics can lose the strength of the material due to migration of plasticizers.

5. Technical Problems

5.1. In the field of electrical engineering and electronics:

a) High voltage insulators:

Moisture, industrial and environmental contaminants form layers on high voltage insulators, causing energy loss due to leakage of electric current (the so-called "creeping discharge"), and arcing.

The problem is particularly acute in long transmission lines and other electrical equipment located in industrial areas or near the sea, where the porcelain / glass insulators are subjected to intensive influence of wet, sour and salty atmosphere, or an atmosphere saturated with different ionized solid particles. In rainy and foggy weather, layering on the surface of insulators becomes electroconductive, which inevitably leads to an overcurrent and flashover. To avoid this, the insulators must be cleaned and washed, which is hard work requiring lengthy power outages. If insulators are protected by silicone paste, there is no flashover for more than 2 years, and without cleaning of insulators. The protective effect of silicone paste depends on the type of contaminants and can be explained in two ways:

1. When pollution is of electrolytic nature, on the surface of insulators with silicone paste protection, there are no conditions for the creation of the electrolytic layer - because of its hydrophobicity, the electrolyte is collected in the form of droplets and thus the surface becomes non-conductive.
2. In the pollution by layering of ash, sand, dust and grime on the surface of insulators with silicone paste protection, flashovers do not occur, since the individual particles are coated with a dielectric layer of silicone paste.

b) Corona discharge:

Corona is a luminous discharge occurring due to the ionization of air around the insulated and non-insulated conductors in creating the critical voltage gradient, resulting in power loss. Experience has shown that a layer of silicone paste can significantly reduce the voltage gradient, thus eliminating the corona effect.

c) Electrical installations, ignition systems and electronic components

Electrical installations (distribution boxes, cable connectors, connectors, etc.) are often exposed to moisture, dust and other harmful agents. By filling all the components placed in a box, tightness of the system can be achieved. Suitable insulator for this purpose is a silicon paste, due to the absence of solidification that enables disassembly of installation.

Electronic components such as diodes and transistors, are sensitive to temperature changes. In order to maintain their performance, it is necessary to draw away the heat generated during operation. For this reason, the components of high power (for example, rectifier diodes) are equipped with heat sink. Silicone paste is used as a means of transferring heat from electronic components to the radiator, and for the encapsulation of entire electronic installation.

5.2. In the field of lubrication and sealing:

- a) Silicone pastes are excellent lubricants and sliding agents for plastic-plastic, plastic-metal and other combinations (except for a steel-steel combination), especially suitable for slow / intermittent movement and high temperatures. These properties of silicone pastes come to the fore in applications such as lubrication of electrical cables before pulling through protective tubes and shells and removal of the insulating layer, lubrication for screw threads, etc.

- b) Because of their anti-adhesiveness and thermal resistance, silicone pastes are used as releasing agent in the treatment of polyester, epoxy, polyamide and other thermoreactive resins. Applying a thin layer of silicone paste on the model makes it easy to release the casting, which is characterized by high gloss and precision.
- c) Lubrication of laboratory glassware (shut-off valves and threads) and industrial pipelines' valves, in conditions such as vacuum, oxygen, chemicals and solvents, implies high requirements in terms of sealing. Because of their low vapour pressure, thermo oxidative stability and incompatibility, silicone pastes provide good sealing under these conditions.

6. The advantages of silicone paste

(for protection of high voltage insulators)

Silicone paste SILOKSAN P-1 takes has been formulated to meet special requirements for protection of porcelain and glass high voltage insulators and has the following advantages:

- coating is easily applied by brushing, spraying or dipping,
- it is effective in very thin layers: in a case of extreme industrial pollution, layer thickness of 0.75 mm is effective for at least 2 years
- suitable consistency and lack of syneresis: it is soft enough to absorb dust particles and resistant to wind, rain and hail
- it has good stability: its consistency remains approximately constant over a wide temperature range and resists oxidation under the influence of corona discharge for a very long period of time
- it is easy to replace: the old layer is simply removed with a cloth (there is no need for soaking, washing or use of solvents).

7. Method of Use

Silicone paste SILOKSAN P-1 is applied to the insulators by brushing with a soft brush or lint-free cloth. It is recommended to apply the paste by spraying or dipping in the 30% dispersion of the paste in a suitable organic solvent. Suitable dispersion can be prepared by mixing 30 parts of SILOKSAN P-1 with 70 parts of trichloroethylene. This solvent is suitable because of its incombustibility, high evaporation rate and low toxicity. The simplest method of applying is spraying with a spray-gun, but it has disadvantage of spilling the material.

Dipping is ideal for use on folding or new insulators. If necessary, prior to coating with silicone paste, insulators are washed in detergent solution, rinsed with water and dried. Insulators, which were covered with a non-silicone paste, should be thoroughly cleaned with an organic solvent, then polished with a clean cloth impregnated with silicone paste SILOKSAN P-1, so a thin layer of paste is brought into close contact with the porcelain or glass surface. This improves the adhesion of subsequent layers of paste (which are applied by brush or spray) to the surface of the insulator.

The ideal thickness of the paste SILOKSAN P-1 depends on the degree of industrial or natural contamination, so the more detailed recommendations cannot be given without the knowledge of local environmental pollution. However, the approximate thicknesses of coatings, which provide effective protection for 2 years, are listed in Table 2. The values are based on years of experience.

The degree of contamination	layer thickness	consumption
LOW: High humidity, heavy fog with little smoke	0,2	20
AVERAGE: High humidity, sea mist, chemical evaporation	0,4	40
HIGH: High humidity, heavy evaporation and smoke, fly ash or cement dust	0,75	75

The thickness of a layer can be approximately determined on the basis of the application method. By brushing with long hair brush, coating thickness of 0.2 - 1.0 mm can be obtained, depending on the level of brushing out. By using 30% dispersion of SILOKSAN P-1 in trichloroethylene or other suitable solvent, obtained thickness of coating is about 0.25 mm. Application with a brush on a flat surface gives layer thickness of about 0.05 mm. Spraying this dispersion on a vertical surface gives layer thickness of 0.2 mm with one spray. Desired coating thickness is obtained by applying another layer or more layers after short time required for solvent to evaporate.

Insulators coated with silicone paste SILOKSAN P-1 are very easy to clean. The old layer of paste is removed simply by wiping with a cloth, without the use of solvents or detergent solutions. Fresh paste is then applied directly to the surface. Slight residues of the old paste do not interfere with application, but help to get good contact between the new layer and the surface of the insulator.

8. Health hazard

Silicone pastes SILOKSAN P-1 and P-2 are non-toxic. It is believed that the acute oral dose is greater than 9000mg/kg. Silicone pastes may cause eye irritation, but do not cause skin irritation. In case of contact with eyes, rinse with clean water.

9. Packaging and storage

Silicone pastes SILOKSAN P-1 and P-2 are supplied in PE-canisters with a net weight of 5 kg.

Silicone pastes SILOKSAN P-1 and P-2 have a shelf-life of one year in sealed original packaging and under normal storage conditions.