**Investment Casting**

Ethyl silicate 28 and ethyl silicate 40 are used as binder agents in investment casting. The investment casting methods that use ethyl silicate are the lost-wax process and the Shaw process. The characteristics of the two are that both are capable of casting products with quite complex shapes, but the lost-wax process in particular is outstanding at recreating shapes. With regard to the size of products, the Shaw process is capable of casting products with large dimensions (3t max., with 0.5 to 300kg being the optimum range). Ethyl silicate 40 can be used as it is as a binder agent for investment casting, but we also supplies hydrolyzed ethyl silicate solution which has been optimized for investment casting. See the HAS Series page for information about our products.

**Zinc Rich Paint**

Galvanization is carried out as a measure to prevent rust, but in answer to the needs of clients who wished to carry out rust prevention by painting, we developed Zinc Rich Paint which contains a large quantity of zinc powder. Zinc Rich Paint is used as antirust primer for the steel structures and steel plate of ships, bridges and other steel. Ethyl silicate 40 is used to powerfully bind the zinc powder in this Zinc Rich Paint.

**Crosslinking Agent for Silicone Rubber**

Ethyl silicate is used as a cross-linking agent for silicon rubber (RTV). Ethyl silicate forms a multidimensional cross-linking structure by reacting as shown below.

Ethyl silicate acts as a cross-linking agent in the same way for C-OH group in resins such as epoxy resin. Instead of ethyl silicate, N-propyl silicate from the same family can also be used.
Surface Coating Agent

There are two main applications for surface coating agents that use ethyl silicate. These are outlined below.

Surface Hardener

Acrylic resin, polycarbonate resin and other plastics are outstanding in terms of shock-resistance and their light weight, but they are vastly inferior to glass in terms of abrasion-resistance. This means that these plastics have the disadvantage that small scratches appear easily on the surface, detracting significantly from the appearance of products.

By applying products that use ethyl silicate onto plastic surfaces, a sub-micron SiO2 membrane is formed on the plastic surface, which improves abrasion-resistance and minimizes scratching.

Surface Modifying Agent

By applying ethyl silicate onto a variety of different substrates, heat resistance and weather resistance are dramatically improved, and the fields of application of the substrate are vastly improved. In addition, by applying it to plastic or glass, it is possible to improve light transmittance and prevent light reflection more effectively. Furthermore, it is possible to form an SiO2 film on the particle surfaces, thereby improving the dispersibility of the particles as well as other characteristics.

Other Applications

Other conceivable applications for ethyl silicate are outlined below.

Applications to Films to Shut-out Gases

There is an extremely great need in the market for packaging materials that shut-out oxygen, nitrogen, carbon dioxide, ethylene, and moisture vapor, or selectively shut-out some of these substances. By shutting-out these gases it becomes possible to prevent biotic, chemical, and physical changes in the packaged substances. PCC is developing coating liquids capable of providing these benefits. The following performance improvements can be achieved by using products that use ethyl silicate in shutting-out gases:
Oxygen blocking ability

Water vapor blocking ability

Heat resistance

By improving these functions, it may be possible to create substances that are particularly well suited to packaging materials for foodstuffs, etc.

Resist Materials

Integrated circuits (ICs) continue today to become more and more dense. In the process of manufacturing ICs, the circuit wire width achieved in manufacturing is less than 1μm, with the majority now in the range of 0.18μm to 0.13μm, and there is talk that processes below the 0.1μm level have been established. For conventional visible light rays and sources of ultraviolet light, single-layer resist has been used, but when KrF or ArF excimer lasers come to be used as light sources, the style of resist used is one achieved by mixing an acid-forming agent into photosensitive resin, and using the acid that results from the photochemical reaction. Silicides which can be dry-etched are thought to fulfill the same function, and the application of ethyl silicate and other alkyl silicates to resist materials is being reviewed.

Ceramic Materials

Active development is taking place in the field of ceramic materials which are outstanding in terms of heat-resistance, specific gravity, and thermal conductivity as leading-edge materials for spacecraft and aircraft, and as materials for the automotive industry and industry in general. There are two types of these ceramic materials: alumina, zirconia, mullite, and other oxide-type materials; and silicon carbide-type and sialon and other silicon nitride type materials, which are nonoxide-type materials. In the methods of manufacturing a wide variety of ceramic materials, there is evidence of methods of pyrolyzing organic polymers to form silicon carbide materials and silicon nitride materials.

Ethyl silicate is used in organo-metallic compounds, and its use in inorganic continuous fibers made from silicone, titanium, carbon, and oxygen and composite materials using these fibers is currently under review.

Silica Hybrid Materials with Organic Polymers

Ethyl silicate is mixed into a polymer that has a function group within the molecules of polyvinyl alcohol (PVA) or some similar substance, and by creating a hybrid using the
sol-gel method, the tensile strength and dynamic visco-elasticity of the polymer is improved.

**NOTES**

All information in the leaflet is based on our present knowledge and experience. We reserve the right to make any changes according to technological progress or further developments. Performance of the product described herein should be verified by testing.

We specifically disclaim any other express or implied warranty of fitness for a particular purpose or merchantability. We disclaim liability for any incidental or consequential damages.

Please send all technical questions concerning quality and product safety to: silanes@SiSiB.com.