ThreeBond
TECHNICAL NEWS

Three Bond Technical News
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Microcapsule and Its Application to a Locking Agent for Screws

Introduction

Microcapsules has been applied and used for pressure-sensitive copying paper for almost 30 years. During the time, microcapsule technology has been remarked as a seed of new technology and exotic material, and expected and actually tried for various applications. However, only small number of products have been marketed and obtained revenue steadily as compared with other technologies.

This issue explains about microcapsules: the functions, the manufacturing methods, and the application usages. In addition, this also introduces precoat bolt with MEC process (process of locking agent on screws) as one of the application usages that have been marketed.

Contents

1. Microcapsules

1-1 About Microcapsules

Microcapsules are tiny vessels in which a liquid or solid material called "core material" is encapsulated with a membranous sheath made of, for example, polymer or membranous material. Although their size is not clearly specified, microcapsules ranging from 5 to 300μm are generally used.

Microcapsules are fabricated beforehand so that core material can be extracted by breaking membrane with desired means such as pressure, heat, light, acid, or chemical. In addition, microcapsules can release core material gradually through small holes on the membrane even though the membrane is not broken.

1-2 Functions of Microcapsules

Microcapsules have a simple structure in which a liquid or solid material is encapsulated with a membranous material. However, they offer superior functions, as discussed below, compared to non-capsulation applications.

a) Isolation of reactant

If there are two materials that will react with each other and either material is encapsulated, such materials can be stored in one package since they will not react each other while mixed.

The precoat bolt with MEC process utilizes this function. Also, pressure-sensitive copying paper utilizes this function for developing color.

b) Protection of volatile material

Typical usages of this function are microencapsulated aroma and organic solvent. These are advertisement leaflets and tissue papers that produce aroma of lemon and/or apple when scratched their part of pictures by nail, and cigarettes that are processed with encapsulated menthol.

TB2450 used in the precoat bolt with MEC process utilizes this function and microencapsulates organic solvent.

c) Protection from humidity and oxygen

Liquid crystals (cholesteric type) can be applied for toys, advertisements and thermometers because this function enables to protect the materials from humidity and oxygen.

d) Safe handling of toxic materials

Once toxic materials such as insecticides, weed killers, and disinfectants that are used in the agricultural field, are microencapsulated, they can be handled safely.

In addition, when curing agents for epoxy resins are microencapsulated, the materials can be handled with no risk of rash.

e) Confinement of taste and odor

When a medicine that has a disagreeable taste or smell is encapsulated, it can be taken easily.

1-3 Manufacturing Method of Microcapsules

Various manufacturing methods have been shown in patents and reference materials, including the following:

a) Interfacial polymerization
b) In situ polymerization
c) Submerged curing coating (orifice method)
d) Phase separation from aqueous solution (coacervation method)
e) Phase separation from organic solution
f) Submerged drying
g) Melting dispersion cooling
h) Others

Discussed below is the complex coacervation method, which is an aqueous-solution-based phase separation method that is relatively popular.

<<Complex coacervation method>>

Thin aqueous solution containing gelatin and gum arabic (approximately 1 % dilution) is heated to 40°C. An oily material that will serve as a core material is added to this solution, and the resultant mixture is agitated to create an oil-in-solution emulsion. When acetic acid is added to this emulsion in order to reduce the pH to 4.0, a dense colloid phase is generated in which oil particles are covered with gelatin and gum arabic. After this colloidal phase has cooled, only the coacervated portion is gelated. When a protein-setting agent such as aldehyde is added in order to set the coacervate, a microcapsule is formed.

1-4 Application Examples of Microcapsules

Although the applications of microcapsules are limited, as previously discussed, they are used in fields that absolutely require microcapsules. Discussed below are some application examples.

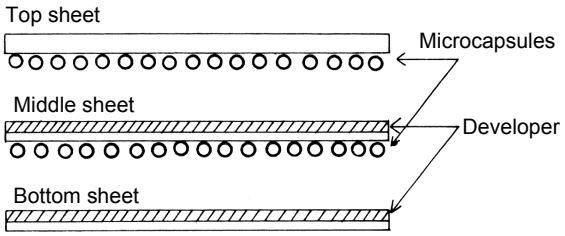
a) Pressure-sensitive copying paper

Many people know that pressure-sensitive copying paper is a typical application example of microcapsules, but few are aware of the mechanism involved. Most people believe that ink is microencapsulated, and the microcapsules are then broken when characters are written by a ballpoint pen, releasing the ink to generate color. This is not an accurate description of the actual mechanism.

Pressure-sensitive copying paper consists of two or three different types of sheets. In two-sheet copying paper, a top sheet whose back surface is coated with microcapsules is combined with a bottom sheet whose front surface is coated with developer. In three-sheet copying paper, a middle sheet whose front surface is coated with developer and back surface is coated with microcapsules is sandwiched by top and bottom sheets (see the figure on the next page).

When characters are written using a ballpoint pen, microcapsules are broken, and couplers (colorless

material) leach from them and react with developer to generate colors. Fuji Film's Prescale applies this mechanism in order to indicate pressure with color densities.



b) Medicines

The three major reasons that microencapsulate medicines are as follow:

1) To eliminate disagreeable taste or odor when a medicine is taken
2) To prolong the effect of a medicine (The capsule is not broken immediately, so the content will leach out little by little.)
3) To protect medicine from degradation by the surrounding environment.

c) Aromas

As microcapsules can be broken to give off an aroma by rubbing them with the fingernails or crumbling them by hand, they are used in tissue paper, menthol cigarettes, advertisement leaflets, and the like.

d) Liquid crystals

Thermosensitive cholesteric-type liquid crystals are primarily used for thermometers and advertisements purposes.

The thermometer attached on the back of the binder for this Technical News utilizes these thermosensitive cholesteric-type liquid crystals.

e) Adhesives

Microcapsule-type adhesives make ordinal two-part adhesives to one-part adhesives by encapsulating either one of two-part adhesive agents. However, from the viewpoint of practical use, there are some problems. Specifically, it is uncertain whether microcapsules are completely broken, and also whether the broken content can be sufficiently mixed with another agent.

In addition, there are risks of problems that microcapsules may be broken by the shutter mechanism in the automatic adhesive coating system, and also that the agent may leach from capsules through the membranous sheath to gel in the bottle. Cemedine Co., Ltd. is selling products that have resolved these problems, but sales have been less than expected due to the problem of the microcapsules being unable to be broken satisfactorily.

f) Screw-locking agents

The basic concept is the same as that of adhesives. Screw-locking agent is an optimal application of microcapsules as adhesives usage, since the microcapsules are completely broken by the resistance generated when screws are tightened, and agents are automatically mixed by the screwing effect. The precoat bolt with MEC process have been developed fully utilizing this mechanism. This process will be discussed later in detail.

g) Artificial salmon roe

Very large microcapsules (although they are too large to truly accurately be referred to as "microcapsules") are used to form artificial salmon roe. The microcapsules are made from sodium alginate and calcium chloride by the orifice method and, therefore, in a broad sense, it can be said that this food is an application example of microcapsules. Most people say that artificial salmon roe has virtually the same appearance and taste as the natural product.

2. Application of Microcapsules to Screw-Locking Agent

Precoat bolt with MEC process utilizes the "isolation of reactant" function of microcapsules. Discussed below are about MEC process and its advantages, types, and characteristics.

2-1 About Precoat Bolt with MEC Process

Precoat bolts mean bolts and screws that are processed pre-coating, and MEC is derived from an abbreviation for MICROENCAPSULATION.

The MEC process is a processing technique in which coats microencapsulated reactive curing agent on the threads of screws, bolts, plugs, and pipe threads, gives locking and sealing functions on the screws themselves incorporates locking and sealing agents on the screw. MEC processed screw will not react in the condition as it is.

When the screw is tightened, microcapsules are broken and the curing agent leaches and immediately starts curing reaction, then prevents looseness and leakage at the thread.

Since the threads of MEC-processed screws and bolts are incorporated with locking and sealing agents, it is not required to make taping and coating locking agent as needed on conventional methods.

As MEC-processed bolt is simply tightened, the thread is locked and sealed.

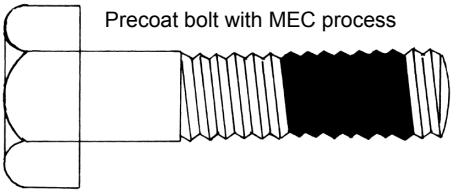
2-2 Advantages of Precoat Bolt with MEC Process

a) Since the mixture of base agent and microencapsulated curing agent is precoated onto a bolt or screw, it can be locked and sealed only by tightening.
b) Since curing is quick, it is possible to move to next process soon after assembled.
c) It has excellent heat resistance.
d) It is not necessary to use accelerators because the precoating material can polymerized-cured on chemically stable materials such as zinc-plated, unichromated, chromated, and black-oxide-finished bolts, in a similar way to

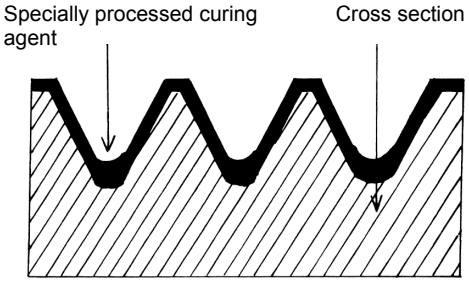
plain steel bolts.

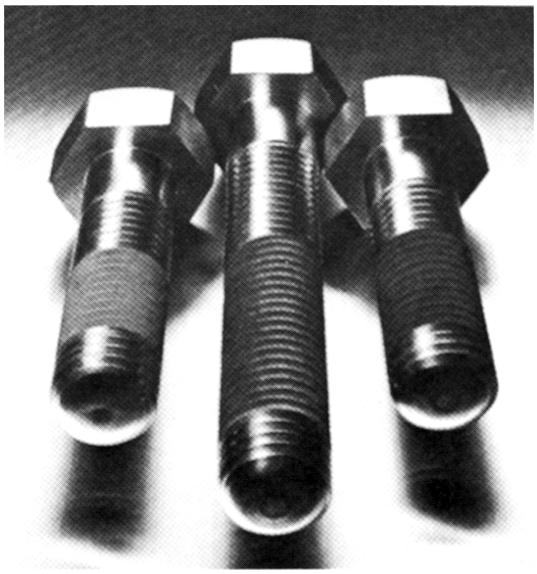
e) It has a low coefficient of friction, and thereby provides sufficient axial force.

f) It is dry, and free from odor and the risk of fire.



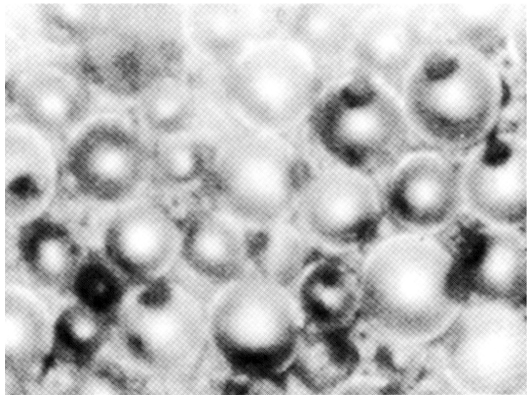
Cross section of precoat bolt with MEC process





▲ Precoat screw with MEC process

▼ Microscopic picture of microcapsules used in the MEC process



2-3 Types and Characteristics of Precoat Bolts with MEC Process

a) Types of curing agents used in precoat bolt with MEC process

Strength level	Heat resistance	Application category of screw	Curing agent	Former product name (prototype)	Color tone	Capsule size, μm	Adhesive strength, kgf-cm (*1)	Characteristics	Curing time	Major component
High strength	Moderate temperature	General-purpose Screws	TB2430	(MSL #6)	Blue	20 to 70	380 to 550	High-strength, standard type (*2)	40 h	Epoxy
Mid - strength	Moderate temperature	General-purpose	TB2401	M300	Red	125 to 300	450 to 500	Mid-strength, standard type for general screws	6 h	Acrylic (anaerobic)
			TB2402	M300T	Red	125 to 300	450 to 500	Modified TB2401 (axial force improved)		
			TB2403	M300C	Red	125 to 300	400 to 470	Low torque loss, improved axial force, standard type		
	Heat resistance	General-purpose	TB2415	M305	Yellow	125 to 300	400 to 450	Mid-strength, heat-resistant type for general screws		
	Moderate temperature	Screws	TB2405	M100	Green	125, max.	400 to 450	Mid-strength type for M3 or smaller screws		
			TB2406	M200	Green	125 to 210	400 to 450	Mid-strength type for M3, M4, and M5 screws		
Low strength	Moderate temperature	General-purpose	TB2410	L300	Blue	300, max.	350 to 400	Low-strength, easy-detachment type		
			TB2450	MC30	Gray	300, max	300 to 350	Least-torque-loss type		Synthetic rubber

*1 A JIS Class-2 M10×1.5 plain steel bolt and nut are used. These figures are loosening torque values measured under the following conditions: the initial tightening force is 300 kgf-cm and the part is cured at 25°C for 24 h.

*2 When the mixture is heat-aged at 25°C for 48 h, the curing process is accelerated and the strength increased. The material, when heated, offers higher vibration and impact resistance, and adhesive strength.

b) Bolt material and adhesive strength (kgf-cm)

Curing agents used in precoat bolt with MEC process are broadly classified into three categories with respect to strength. Discussed below are the high-strength agent TB2430, mid-strength agent TB2403, and low-strength agent TB2410. Although mid-strength agents are further divided into six grades, the adhesive strength shows no significant difference in these grades and, therefore, TB2403 is selected as a representative of this grade.

Test bolt: JIS Class-2 M10×1.5 plain steel bolt

	TB2430 (48hr)		TB2403 (24hr)		TB2410 (24hr)	
	Tightening torque: 0 kgf-cm	Tightening torque: 300 kgf-cm	Tightening torque: 0 kgf-cm	Tightening torque: 300 kgf-cm	Tightening torque: 0 kgf-cm	Tightening torque: 300 kgf-cm
Plain steel	140 to 210	380 to 480	180 to 250	400 to 470	70 to 120	340 to 390
Brass	130 to 220	410 to 500	180 to 240	360 to 420	70 to 110	340 to 390
Aluminum	110 to 160	360 to 440	200 to 250	380 to 430	80 to 130	320 to 370
Stainless steel	150 to 230	500 to 600	180 to 240	430 to 480	70 to 120	330 to 390
Zinc-plated	130 to 200	370 to 450	180 to 250	380 to 440	70 to 120	320 to 390
Chromated	160 to 240	360 to 560	180 to 250	400 to 470	70 to 120	340 to 390
Chrome-plated	130 to 220	360 to 520	140 to 180	370 to 430	60 to 100	320 to 370
Unichromate	160 to 240	450 to 520	180 to 240	380 to 450	70 to 120	330 to 380
Nickel-plated	140 to 190	430 to 500	140 to 180	360 to 400	50 to 90	320 to 370
Black-oxide-finished	110 to 180	400 to 510	150 to 200	370 to 430	60 to 100	330 to 380

c) Bolt (screw) diameter and adhesive strength (kgf-cm)

Test bolt: JIS Class-2 M3 to M14 steel bolt

Bolt diameter	Pitch, mm	Nut thickness, mm	Tightening torque, kgf-cm	TB2430 (48hr)		TB2403 (24hr)		TB2410 (24hr)	
				Not tightened	Tightened	Not tightened	Tightened	Not tightened	Tightened
M3	0.5	2.4	10	2.4 to 3.6	11.0 to 13.0				
M4	0.7	3.2	20	5 to 10	18 to 28				
M5	0.8	4	40	16 to 20	44 to 54	16 to 26	44 to 56	8 to 14	38 to 50
M6	1.0	5	80	26 to 36	90 to 105	32 to 44	90 to 115	16 to 30	85 to 100
M8	1.25	6.5	150	80 to 100	180 to 220	85 to 130	190 to 240	30 to 55	160 to 190
M10	1.5	8	300	140 to 210	380 to 480	180 to 250	400 to 470	70 to 120	340 to 390
M12	1.75	10	500	240 to 300	740 to 940	280 to 420	660 to 800	160 to 240	540 to 680
M14	2.0	11	900	340 to 400	1200 to 1600	460 to 600	1250 to 1500	210 to 320	950 to 1100

d) Chemical resistance (kgf-cm)

Test bolt: JIS Class-2 M10×1.5 plain steel bolt

Tightening torque: 300 kgf-cm

Chemical	Immersion conditions	TB2430	TB2403	TB2410
Blank	RT × 7 Days	380 to 480	400 to 470	340 to 390
Water	95 to 100 °C × 7 Days	540 to 660	400 to 470	310 to 380
Gasoline (regular)	45 to 50 °C × 7 Days	350 to 450	370 to 440	330 to 380
Engine oil #30	95 to 100 °C × 7 Days	500 to 640	400 to 470	330 to 380
Gear oil #90	95 to 100 °C × 7 Days	560 to 660	380 to 450	320 to 370
Antifreeze	95 to 100 °C × 7 Days	600 to 660	390 to 460	340 to 410

e) Sealing performance

Test equipment as illustrated in Figs. 1 and 2 was used. The chamber was pressurized to 20 kgf/cm^2 and maintained for 5 h, as shown in Figure 3. Then, the test bolts were examined for leakage.

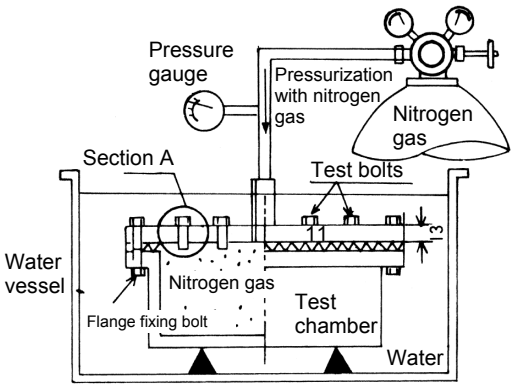


Fig. 1 Test Equipment - General View

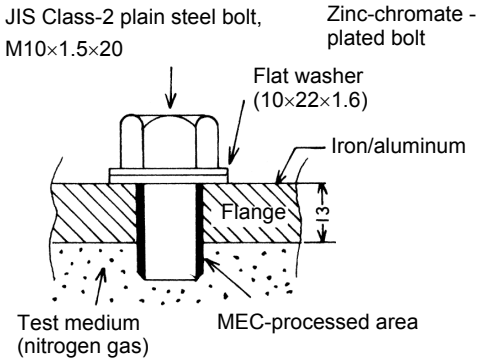


Fig 2. Details of "A"

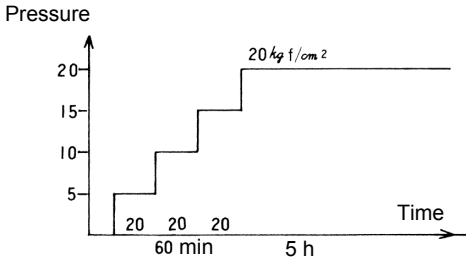


Fig. 3

Test results (number of bolts caused leakage per 20 test bolts)

	TB2430		TB2403		TB2410	
	Plain steel bolt	Zinc-chromate-plated bolt	Plain steel bolt	Zinc-chromate-plated bolt	Plain steel bolt	Zinc-chromate-plated bolt
Steel flange	0/20	0/20	0/20	0/20	0/20	0/20
Aluminum flange	0/20	0/20	0/20	0/20	0/20	0/20

f) Heat resistance (thermal applied adhesive strength) (kgf-cm)

The table below shows adhesive strength at each test temperature in the range of -40°C to +150°C.

Test bolt: JIS Class-2 M10×1.5 plain steel bolt

Tightening torque: 300 kgf-cm

	TB2430	TB2403	TB2410
-40 °C	500 to 600	400 to 450	350 to 400
-20 °C	480 to 560	390 to 480	350 to 400
25 °C	420 to 480	380 to 480	340 to 390
40 °C	410 to 480	390 to 460	320 to 380
50 °C	410 to 460	380 to 440	290 to 350
60 °C	370 to 440	360 to 440	280 to 340
70 °C	330 to 400	360 to 400	250 to 330
80 °C	300 to 370	330 to 340	250 to 310
100 °C	250 to 320	270 to 290	230 to 310
120 °C	220 to 260	220 to 250	220 to 300
150 °C	180 to 210	200 to 220	180 to 260

Conclusion

The MEC process eliminates the need for seal tape and coating of locking agent and, for this reason, it is very well suited for fulfilling the needs for automation and labor saving, and its applications are steadily broadening. As the MEC process is applied to all industrial fields that utilize threads, some application examples are discussed herein.

Field	Applications
Automotive industry	Cylinder stud bolts Flywheel set bolts Transmission extension housing mounting bolts Engine-block stud bolts Plug-head tapered screws Transmission level plugs Differential gears stud bolts Differential gear serration bolts Intake-manifold mounting bolts Seatbelt mounting bolts Steering-box fixing bolts Seat fixing bolts
Agricultural - machinery industry	Tractor gear-casing stud bolts Tractor rear-axle housing Fixing bolts for a rice transplanter's transplant cans and lids Rice-transplanter transmission bolts
Others	Golf shoes and spikes Tap indication screws Snowmobile clutch-pin fixing bolts Veranda mounting bolts for public housing Power-tool fixing screws Small screws for glasses Small screws for the reel assembly of fishing tackle Small screws for cassette tapes Hydraulic-equipment controller PT plugs Small fixing screws for switches Water-supply tap packing fixing screws Gas-meter outer-cover fixing screws Unit bath doorknobs Gas-cock mounting screws Baby-carriage pole fixing screws Sewing-machine shaft-holding screws Protective-fence mounting bolts Electric-sewing-machine fixing screws Audio-equipment fixing screws Motorcycle muffler mounting bolts

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1)

2)

3)

- The test results shown above are not product standards. Before using, it is recommended to make sure the performance with the parts on the intended applications.
- TB is an abbreviation for Three Bond.

Next News

Ultraviolet Irradiation System

1. About Ultraviolet Rays
2. Types and Characteristics of Ultraviolet Source
3. Cooling System
4. About Safety of the Ultraviolet Irradiation System

New Products

Electroconductive Resin

ThreeBond 3300 Series

The ThreeBond 3300 series are one kind of electroconductive materials that are targeted for electronic and electric equipment and classified into three categories, pastes, adhesives, and paints, according to the applications.

ThreeBond 3340: Copper paste

A special design is used for oxidation prevention to realize highly conductive copper paste. Its conductivity is the same as that of silver paste.

«Properties and Characteristics»

Properties		
1-1	Binder:	Phenol resin
1-2	Electroconductive filler:	Electrolytic copper powder
1-3	Thinner:	Alcohol and polyhydric alcohol derivative
1-4	Viscosity:	170,000 ± 30,000 cps (25°C)
1-5	Specific gravity:	2.6 ±0.1 (25°C)
Basic characteristics		
2-1	Volume resistivity:	1 to 2 × 10^{-4} Ω•cm
2-2	Sheet resistivity:	30 to 50 mΩ/□
2-3	Printing conditions:	150-mesh screen printing (film thickness: 20 μm, min.; film width: 0.5 mm, min.)
2-4	Curing conditions:	150°C × 30 to 60 min (standard conditions)
2-5	Film hardness:	Pencil hardness 9H (150°C × 60 min)
2-6	Adhesion:	100/100 for phenol, glass epoxy, ceramics (alumina), and polyimide

ThreeBond 3325: Paste containing special silver filler

Through the use of special electroconductive fillers, the amount of precious metal in the silver paste can be reduced, thereby cutting costs by 30% to 40%. This new paste will substitute for the silver paste used in electrodes, printed boards, and jumper wires.

«Properties and Characteristics»

Properties		
1-1	Binder:	Single-part, heat-curing polyurethane
1-2	Electroconductive filler:	Special silver filler
1-3	Thinner:	Ester or Ketone solution
1-4	Viscosity:	80,000 ± 5,000 cps (25°C)
1-5	Specific gravity:	1.88 ±0.1 (25°C)
Basic characteristics		
2-1	Volume resistivity:	3 to 4 × 10^{-3} Ω•cm
2-2	Sheet resistivity:	0.5 to 0.7 Ω/□
2-3	Printing conditions:	Mesh screen printing (mesh size: 100 to 150)
2-4	Curing conditions:	150°C × 30 min (standard conditions)
2-5	Film hardness:	Pencil hardness 9H
2-6	Adhesion:	100/100 for phenol, glass epoxy, ceramics (alumina), polyimide, and PET

ThreeBond 3301: Silver adhesive

This single-part, heat-curing silver filler adhesive enables fast curing at temperatures as low as 120°C (the curing temperature of conventional adhesives is 150°C). It is used to for the adhesion of electrodes, leads, and the like.

«Properties and Characteristics»

Properties		
1-1	Binder:	Epoxy resin
1-2	Electroconductive filler:	Silver powder
1-3	Viscosity:	170,000 ± 30,000 cps (25°C)
1-4	Specific gravity:	3.3 ±0.1 (25°C)
Basic characteristics		
2-1	Volume resistivity:	1 to 3 × 10^{-3} Ω•cm
2-2	Sheet resistivity:	0.4 to 0.6 Ω/□
2-3	Printing conditions:	150-mesh screen printing
	Dispenser:	The nozzle bore shall be at least 0.5 mm.
2-4	Curing conditions:	150°C × 30 min (standard conditions)
2-5	Film hardness:	Pencil hardness 9H
2-6	Adhesion:	Metals, ceramics, and heat-curing resins

ThreeBond 3350: Silver paint

This solvent-type silver paint is dried at room temperature. It features strong adhesion and, for this reason, can be applied to plastics for which conventional paints cannot be used. The paint is optimal for capacitor electrodes, wave shields, and screw electroconductive locking.

«Properties and Characteristics»

Properties		
1-1	Binder:	Acrylic resin
1-2	Electroconductive filler:	Silver powder
1-3	Thinner:	Toluene or n-butanol
1-4	Viscosity:	3,000 ± 500 cps (25°C)
1-5	Specific gravity:	1.9 ±0.1 (25°C)

Basic characteristics		
2-1	Volume resistivity:	5×10^{-4} Ω•cm
2-2	Sheet resistivity:	0.2 Ω/□
2-3	Application tool:	Brush, spatula, spray, and dispenser
2-4	Curing time	25°C × 24 h 1 h (at 70°C)
2-5	Film hardness:	Pencil hardness HB to F (film thickness: 40 μm)
2-6	Adhesion:	Metals, ceramics, plastics, etc.

Single-Part, Epoxy-Compounded Resin

ThreeBond 2062, 2063 Series

«Overview»

The ThreeBond 2062, 2063 series consist of low-temperature-curing, single-part, epoxy-compounded resins that polymerized-cure at approximately 100°C to form a cured object featuring excellent electrical and physical properties. These resins can widely be used for adhesives, seals, and injection moldings.

«Advantages»

(1) Low-temperature heating and short time curing are possible.
100°C × 40 to 60 min
120°C × 20 to 30 min
150°C × 10 min

(2) Excellent preservation stability
The ThreeBond 2062, 2063 series can be preserved for 5 to 6 months at 25° C without degradation.

(3) As the ThreeBond 2062, 2063 series can be cured at relatively low temperatures compared to current heat-curing resins, it is possible to form a cured object having less thermal distortion.

(4) No foaming
The ThreeBond 2063 series features very low heat generation during the curing process and, therefore, a high-quality cured object can be formed.

(5) Since the ThreeBond 2062, 2063 series are single-part resins, the mixing and stirring processes can be omitted, allowing the user to work on an automated production line.

«Characteristic Table»

	ThreeBond 2062	ThreeBond 2062B	ThreeBond 2063	ThreeBond 2063B	ThreeBond 2063C
Appearance	Reddish brown	Reddish brown	Gray	White	Aluminum color
Viscosity (25°C), cps	70,000	40,000	200,000	100,000	300,000
Specific gravity (25°C)	1.40	1.40	1.41	1.54	1.43
Nonvolatile component, %	99, min.	99, min.	99, min.	99, min.	99, min.
Standard curing conditions	100°C × 40 min or 120°C × 30 min	100°C × 40 min or 120°C × 30 min	100°C × 60 min or 120°C × 30 min	110°C × 60 min or 120°C × 30 min	100°C × 60 min or 120°C × 30 min
Advantage	Fast curing, heat-resistant adhesion	Fast curing, heat-resistant adhesion	High-strength adhesion, impact peeling resistance	Thermal shock resistance, elasticity	Impact peeling resistance
Application	Prevention of flux adhesion, fixing and adhesion of terminal	Adhesion of electric and electronic components	Adhesion of structure	Potting	Adhesive sealing
Shearing adhesive strength, kg/cm^2	180	180	300	270	280
Peeling adhesive strength (T), kg / 25-mm width	1	1	14	4.8	5
Hardness (25°C), Shore D	93	93	88	87	89
Glass transition point, °C	125	125	90	75	95
Thermal expansion coefficient, /°C	3.75×10^{-5}	3.75×10^{-5}	6.1×10^{-5}	6.3×10^{-5}	5.5×10^{-3}

Water-Based Adhesive

ThreeBond 1541, 1541B

«Overview and Advantages»

ThreeBond 1541 is single-part, water-based adhesive with acrylic emulsion as its major component. This adhesive features substantially improved initial bonding performance that cannot be achieved by current adhesives, and offers initial bonding performance similar to that of organic-solvent-based adhesives.

Since water is used as the solvent, ThreeBond 1541 is harmless to the human body. It features excellent water and heat resistance, and can bond not only water-absorbing materials such as styrene foam, urethane foam, and wood to which organic-solvent-based adhesives cannot be applied, but also glasses, plastics, and ceramics. As a result of these properties, ThreeBond 1541 is widely used as a general-purpose adhesive.

«Composition and Properties»

	ThreeBond 1541	ThreeBond 1541B
Appearance	Light yellow	Light yellow
Major component	Acrylic emulsion	Acrylic emulsion
Nonvolatile component	60%	63%
Viscosity (25°C)	2,500cps	20,000cps
Specific gravity (25°C)	1.00	1.00

«Evaporation Amount and Time»

Test method

Apply the adhesive to a glass plate (50 × 50 mm) such that a wet coating of 100 g/m^2 is formed on the plate, then place it in a thermo-hygrostat (25°C and 65 %), and measure the evaporation amount using a chemical balance.

(Unit: %)

	3 min	5 min	8 min	10 min	15 min	20 min	25 min	30 min
ThreeBond 1541	-	53	-	74	86	93	97	98
Solvent-based chloroprene adhesive	78	89	93	95	96	97	98	-

«Peeling Adhesive Strength for Various Test Pieces»

Test conditions

Application method:	Both surfaces of the test piece are coated with Percorder #50.	Pressure-bonding method:	A 5-kg roller is moved back and forth 5 times.
Open time:	60 min	Peeling tester:	Instron (peeling speed: 200 mm/min)
Set time:	48 h		

(Unit: kg / 25-mm width)

	Aluminum foil	Cotton canvas		Aluminum foil	Cotton canvas
Epoxy	3.3	1.1	Polycarbonate	4.8	1.2
ABS	4.3	1.4	Soft vinyl chloride	1.2	0.9
Polyester	4.1	1.2	Nylon	3.8	2.0
Polyethylene	3.7	1.1	Slate	3.5	2.4
Polypropylene	0.4	0.3	Aluminum	4.1	1.8

Contact-Point Rejuvenator

ThreeBond 2500 Series

«Overview»

The ThreeBond 2500 Series are contact-point rejuvenators, the major component of which is a specially synthesized oligomer featuring extremely stable chemical properties. These products stabilize the contact resistance and improve the reliability of contact points with protecting contact points, which are vital parts of electric and electronic equipment, from vulcanization and oxidation, and preventing contact resistance increase resulting from periodic reciprocatory motion. By using this rejuvenator, it is possible to replace contact points with those made of cheaper materials and reduce the thickness of plated films, thereby contributing to cost reduction.

«Characteristics and Effects»

1. Rust prevention and protection of contact points

The contact-point rejuvenator coats the contact-point surface with a thin film, intercepts corrosive gases and moisture, prevents the generation of oxide and/or sulfide film and consequently protects the contact points.

2. Mechanical lubrication effect

The contact-point rejuvenator improves the lubrication of the movable contact point and reduces wear, deformation, and mechanical fatigue.

3. Cleaning of the contact-point surface

The contact-point rejuvenator softens various sucked and worn foreign objects that are deposited on contact points, facilitates removing effect and restores conductivity.

«Advantages»

1. The contact-point rejuvenator withstands corrosive gases such as gaseous hydrogen sulfide and sulfur dioxide.
2. The contact-point rejuvenator features excellent moisture resistance.
3. The contact-point rejuvenator provides superior adhesion against all metals.
4. It has excellent lubrication properties.
5. The contact-point rejuvenator features excellent cleaning performance.
6. The contact-point rejuvenator has a double sided reversible electroconductive property: when the coated film is thin, the rejuvenator acts as a conductor; however, when the film is thick, the material acts as an insulator.
7. The contact-point rejuvenator features excellent feeling properties.

«Applications»

IC, IC sockets, slide switches, DIP switches, torque switches, tuners, volumes, power switches, connectors, sockets, terminals, electrodes, lubrication mechanical parts, push switches, rotary switches, etc.

«Types»

Product name	Color	Viscosity	Specific gravity	Appearance	Coefficient of friction
ThreeBond 2572E	Beige	500CPS (25 °C)	0.88 (25 °C)	Oil	0.12 (100 °C)
ThreeBond 2572C	Beige	1000CPS (25 °C)	0.93 (25 °C)	Oil	0.95 (100 °C)
ThreeBond 2572D	Beige	Consistency: 320 (25 °C)	0.92 (25 °C)	Grease	0.95 (100 °C)

News from Abroad

▣ Last autumn, the new head office and manufacturing plant building of Three Bond of America were completed in Torrance near Los Angeles (see picture), and operation was begun. With the completion of the new manufacturing plant, the products and services supply network was established in the U.S., allowing customers to use our products with ease.

Within several years, most Three Bond products will be manufactured in the U.S. It will stabilize production schedules, deliveries, and services.

▣ Our anaerobic adhesives (TB1300 series) and instant adhesives (TB1700 series) have been used for mechanical parts assembled on the production lines of aircraft manufacturers. Our anaerobic adhesives meet the requirements of the Military Specifications and are regarded as high-quality products. With respect to anaerobic adhesives being delivered to the General Services Administration of the Federal Supply Service, both the product performance and quality-control system of Three Bond of America are certified and, for this reason, presence of the General Services Administration staffs is not necessary during the inspection, and products are now shipped directly to the Administration after our internal inspections.

Moreover, our products are not only certified by Boeing, Lockheed, and Northrop, but are also widely used in aviation-related industries. In Three Bond of America, same as Three Bond Japan, sales engineers visit users directly to provide good services, and users are welcomed it. In addition, American companies of Japanese enterprises receive same products with same quality as in Japan and they use our trusted products. On the other hand, various types of adhesives are sold and used allover the country through major local wholesalers and supermarkets.

* Location (address, telephone, and telex) and chief executive officer

Three Bond of America
20815 Higgins Court, Torrance, CA 90501, U.S.A.
TEL: (213) 320-3342 Telex: 23-664634 THREEBOND TRNC.
Ichiro Ukumori

* Brazil (South America)

Three Bond of Brazil has enjoyed a gradual increase in orders of anaerobic adhesives for liquid gaskets from domestic transport machinery manufacturers, in addition to the current business operation of delivery to South American countries. We would like to express our sincere appreciation for our customers' longtime use of our products. We plan to increase the product lineup in order to contribute to our customers' further development in the future.

* Europe

Three Bond of Europe received new orders for precoat bolts for use on the production lines of car manufacturers. These products have also been used in vital assemblies of the production equipment.

ThreeBond TECHNICAL NEWS
THREE BOND CO., LTD.
1456 Hazama-cho, Hachioji-shi, Tokyo 193-8533, Japan
Tel: 81-426-61-1333