# ACRYSIRUP

## MethylMethacrylate Resin

Rapid Curing Coating System


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DIANAL AMERICA, INC.

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**DIANAL AMERICA, INC.**

9675 Bayport Blvd., Pasadena, TX 77507, U.S.A.
Phone: +1 (713) 758-8100 • FAX: +1 (281) 474-2757
Toll Free: +1 (800) 776-3659
www.dianal.com • Acrysirup@dianal.com

RYOKO

Manufactured by:

**RYOKO CO., LTD.**

14-1 Koami-Cho Nihonbashi
Chuo-Ku Tokyo 103-0016, Japan
Phone: +81 (3) 5651-0656
FAX: +81 (3) 5651-0055

# 1. Introduction

ACRYSIRUP is a reactive methacrylate based coating system produced by Ryoko Co., Ltd. (subsidiary of Mitsubishi Rayon Co., Ltd.) and marketed in the USA by Dianal America Inc.

ACRYSIRUP consists primarily of methylmethacrylate (MMA) monomer, acrylic polymers, mineral fillers and pigments. Under the correct application and curing conditions, ACRYSIRUP will give a durable and high quality finish to a variety of substrate surfaces.

Color Tile with Patterned Coating System

# 2. Features and Benefits of ACRYSIRUP

**1) Rapid Cure**

ACRYSIRUP curing time is one of the shortest of any coating system; ACRYSIRUP can be cured in 30 - 60 min. The floor can be used soon after the application (see Table-1).

**2) Low temperature Cure**

ACRYSIRUP can be cured at temperatures as low as -30°C (-22°F).

**3) Excellent chemical resistance**

ACRYSIRUP products have excellent chemical resistance especially to organic acids, inorganic acids and alkalines that are commonly found in the industrial kitchens.

**4) Excellent physical properties such as,**

High compression resistance
High impact fracture resistance
Excellent wear resistance
High flexibility
Resistance to cracking

**5) Excellent light exposure property and weatherability**

**6) Can be applied over concrete and asphalt substrates**

**Table-1 Waiting Time & Curing Temperature range for various flooring systems**

| Flooring System | Activity | Waiting Time before use | | Temperatures at which system can be applied | |
|---|---|---|---|---|---|
| | | 5°C (41°F) | 20°C (68°F) | Lowest | Highest |
| ACRYSIRUP | Walking | 1 Hour | 1 Hour | -30°C (-22°F) | 40°C (104°F) |
| | Heavy Work | 2 Hour | 2 Hour | | |
| Epoxy Resin | Walking | 2-3 days | 12-24 hours | 5°C (41°F) | 40°C (104°F) |
| | Heavy Work | 7-14 days | 3-7 days | | |
| Urethane Resin | Walking | 2-3 days | 12-24 hours | -5°C (-23°F) | 40°C (104°F) |
| | Heavy Work | 7-14 days | 3-7 days | | |
| Cement System | Walking | 3-4 days | 2-3 days | 5°C (41°F) | 45°C (113°F) |
| | Heavy Work | 14-20 days | 7-10 days | | |

# 3. Applications

ACRYSIRUP is used for various floor or pavement coating:

**Architecture**
Food manufacture
Supermarkets
Commercial Kitchens
Refrigerated warehouses
Public facilities with high traffic
Chemical plants and machine shops
Warehouses
Parking lots

**Civil Engineering**
Pavement coloring
Non-skid coating
Surface reinforcement of water permeable roads
Overlaid patterned coating system
Road marking
Wear resistant overlay
Repairing of cracks and ruts in flooring substrates
Waterproofing of concrete bridge decks
Salt damage protection of concrete

# 4. Curing Process

ACRYSIRUP resin consists mainly of Methylmethacrylate (MMA) monomer and acrylic polymers. Hardener such as 50% Dibenzoyl Peroxide (BPO-50) and fillers are mixed into the ACRYSIRUP to make a compound before applying. In the compound, hardener reacts with an amine catalyst that is added in advance, which decomposes to form free radicals.

As soon as the compound is spread on a substrate to make a coating layer, paraffin wax migrates and forms a thin film on the surface. The paraffin wax film shuts off oxygen going into the coating layer. Free radicals react first with the inhibitor and oxygen, then with MMA monomers. The monomers start to polymerize and the compound cures in 30 to 60 min. As ACRYSIRUP contains poly-functional-monomers, cured films are very tough and have excellent physical performance.

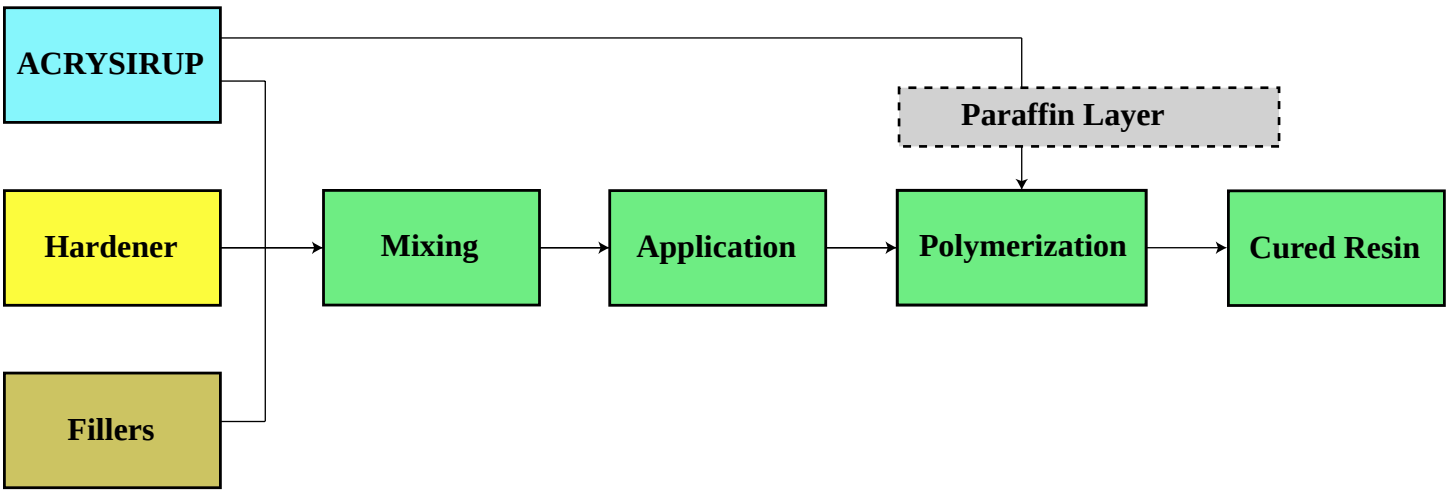



Figure-1 Curing Process

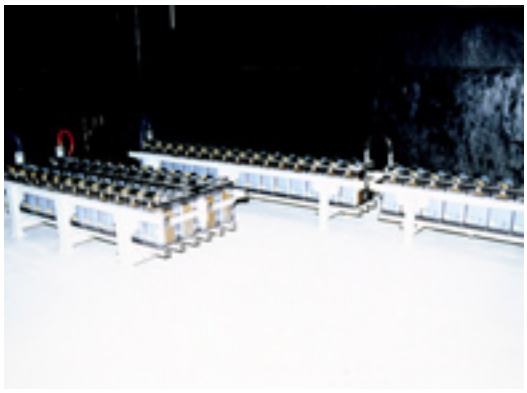
Each picture is an actual example of an ACRYSIRUP application. Some of these examples are installed with different grades of ACRYSIRUP that are included in this brochure.

## Actual Examples (Architectural applications)

Industrial Kitchen

Concourse of Railway Station

Battery Storage Room



Parking

## Actual Examples (Road usage)

Non-skid coating

Non-skid coating

Patterned coating system

Topcoat for water permeable road

Railway Station Platform

Walkway

Repairing of cracks and ruts in flooring substrates

## Actual Examples (Civil Engineering applications)

Repairing of collapsed concrete

Before installation → After installation

Pedestal of Girder → Magnified picture

Protection and Landscape Coating

Concrete Bank

Concrete Wall

# 5. Materials & Products line

There are several products in the ACRYSIRUP product line (see Section 7-1, p. 12), typical properties are:
The viscosity ranges from 30 to 500 mPa·S.
ACRYSIRUP offers hard, soft, or elastic type coating systems.

ACRYSIRUP coating systems consist of a priming process, base coating process and top coating process. The basecoat compounds are usually a mixture of basecoat resin, specially formulated sand, filler and toner (or pigment). Resins for the topcoat are designed to give good exposure properties and high chemical resistance.

ACRYSIRUP resins used for each process depend on the requirements or performance that each process needs.

Standard-grade ACRYSIRUP does not cure over 35°C (95°F). Ryoko has special Summer-grade resins curable at high temperature and available during the summer season.

Coating systems using ACRYSIRUP resins need the materials showed in Table-2.

**Table-2 Materials used for ACRYSIRUP coating systems**

| Materials | | Grade | Note |
|---|---|---|---|
| Resin | Primer | FP-90 | For Concrete Substrate |
| | | FP-460 | For Asphalt Substrate |
| | Basecoat | FC-411 | For 2-3mm thickness Self-leveling Coating System |
| | | FM-510 | For 4-7mm thickness Resin Mortar |
| | Topcoat | FT-130 | Excellent weatherability, abrasion and chemical resistance. Usually topcoat resins are colored with special pigment dispersion called MRT toner. |
| Sand or Filler | Sieved Sand | Alumina Sand spread for nonskid finish | |
| | Mixed Sand | For Self-leveling Finish or Resin Mortar. Compounds specially blended with some kind of aggregate, sand or fine filler | |
| Others | MRT toner | 12 Standard Colors. Pigments used for ACRYSIRUP are specially formulated in order to avoid poor reaction. | |
| | Hardener | 50% Dibenzoyl Peroxide. Must be weighed by accurately. | |
| | Promoter | Applied for Low Temp. | |
| | Clean up | MMA Monomer. Clean up for trowel, brush, bucket, etc. | |

# 6. Physical Properties

## 6-1) Liquid Properties of ACRYSIRUP

Liquid properties of ACRYSIRUP are shown in Table-3. Viscosity depends on temperature and changes to viscous liquid at low temperature. Because workability of the compound depends on viscosity, the mixing ratio of resin and sand should be slightly adjusted depending on jobsite temperature.

**Table-3 Liquid Properties of ACRYSIRUP Resins**

| Grade | Appearance | Specific Gravity 20°C (68°F) | Viscosity mPa·S 20°C (68°F) | Curing Time (min.) | Typical Uses |
|---|---|---|---|---|---|
| FP-90 | SYL | 0.99 ± 0.02 | 100-200 | 15-30 | Primer for Concrete |
| FC-411 | SYL | 1.00 ± 0.02 | 200-370 | 30-45 | Self-leveling basecoat, 2-3mm thickness |
| FM-510 | SYL | 0.97 ± 0.02 | 40-130 | 30-45 | Slightly Hard Resin Mortar basecoat, 4-7mm thickness |
| FT-130 | CL | 0.97 ± 0.02 | 310-410 | 34-44 | Topcoat, Excellent Resistance to Hot water |

SYL: Slightly Yellowish Liquid CL: Clear Liquid
Test condition of curing time: Resin/BPO-50 = 100/2, tested at 20°C (68°F)

## 6-2) Physical Properties of Cured Resins

**Table-4 Physical Properties of Typical Primer and Basecoat Resins 20°C (68°F)**

| Item / Grade | Specific Gravity ($g/cm^3$) | Flexural Strength PSI ($N/mm^2$) | Tensile | | Hardness (Shore A) |
|---|---|---|---|---|---|
| | | | Strength PSI ($N/mm^2$) | Elongation (%) | |
| | JIS K 5400 | JIS K 6911 | JIS K 7113 | JIS K 7113 | - |
| FP-90 | - | - | 4,500 (31.0) | 2.0 | - |
| FP-460 | 1.12 | - | 1,200 (8.3) | 180 | 96 |
| FC-411 | 1.14 | 2,450 (16.9) | 2,000 (13.8) | 130 | 95 |
| FM-510 | 1.10 | - | 1,150 (7.9) | 160 | 88 |

Test Method (Japan Industrial Standard)
JIS K 5400: Testing method for paints
JIS K 6911: Testing methods for thermosetting plastics
JIS K 7113: Testing method for tensile properties of plastics

**Table-5 Physical Properties of Typical Topcoat Resin FT-130**

| Topcoat FT-130 | Test Results | Testing Method |
|---|---|---|
| Hot Water Resistant | ○ | Soak in water at 50°C (122°F) for 24 hours |
| Water Resistant | ○ | Soak in water at 20°C (68°F) for 30 days |
| Pollution Resistant | ○ | Mitsubishi Rayon Method |
| Gloss | 13 | 60º gloss |
| Pencil Hardness | HB - F | JIS-K5400 |
| Abrasion Loss | 83mg | JIS-K7204 |

1. Pollution Resistant: Coated with mixture of black carbon/specialty soil/Glycerin (=2/35/63) and left for 24 hours, then washed with mild detergent (10%) and wiped with gauze cloth.
2. Abrasion Loss Testing Method: Taber Abrasion Testing Method
   Wheel: CS-17, Weight: 1,000g, Rotation Speed: 1,000rpm

## 6-3) Physical Cured Properties with Typical aggregate formulations

Table-6 shows physical properties of ACRYSIRUP FC-411 and FM-510 formulated with mixed filler (compound of calcium carbonate, quartz, sand and/or gravel).

**Table-6 Typical Formulation and Physical Properties**

| Test Item \ Resin Grade | | | Self-leveling basecoat | Resin Mortar Basecoat |
|---|---|---|---|---|
| | | | FC-411 | FM-510 |
| Mixing Ratio | | Resin | 100 | 100 |
| | | Filler | 150-200 | 350-400 |
| Application Thickness(mm) | | | 2-3 | 4-7 |
| Performance | Specific Gravity (g/cm$^3$) | | 1.70-1.85 | 1.85-2.30 |
| | Compressive Strength (PSI (N/mm$^2$)) | | 3,600-4,350 (25-30) | 3,600-4,350 (25-30) |
| | Flexural Strength (PSI (N/mm$^2$)) | | 2,400 (16.5) | 2,600-3,200 (18-22) |
| | Compressive Elasticity (PSI (N/mm$^2$)) | | 305,000 (2,100) | 290,000 (2,000) |
| | Tensile Strength (PSI (N/mm$^2$)) | | 1,850-2,150 (13-15) | 725 (5) |
| | Tensile Elongation (%) | | 3-4 | 2 |
| | Abrasion Loss(mg) | | 85 | 70 |
| | Impact Resistance(times) | | 40 | 100 |

1. Each performance differs by the mixing ratio of resin and filler (or sand).
2. Abrasion Loss Testing Method: Taber Abrasion Testing Method
   Wheel: CS-17, Weight: 1,000g, Rotation Speed: 1,000rpm
3. Impact Resistance Test Method: (By Japan Floor Coating Industries Association)
   Steel ball: 1000g Height: 1m
   The number in the table represents impacts before a crack occurs on the coating layer.

## 6-4) Chemical Resistance

| | Chemicals | FT-130 | | Chemicals | FT-130 |
|---|---|---|---|---|---|
| Inorganic Acids | Boric Acid 3% | ○ | Others | Beer | △ |
| | Chromic Acid 20% | ○ | | Blood | ○ |
| | Chromic Acid 40% | △ | | Grape Juice | ○ |
| | Hydrochloric Acid | ○ | | Milk | ○ |
| | Nitric Acid 10% | ○ | | Honey | ○ |
| | Nitric Acid 30% | △ | | Sea Water | ○ |
| | Phosphoric Acid conc. | △ | | Soap and Water | ○ |
| | Phosphoric Acid 10% | ○ | | Vegetable Juice | ○ |
| | Sulfuric Acid 30% | ○ | | Whisky | △ |
| | Sulfuric Acid 50% | ○ | | Wine | △ |
| Organic Acids | Acetic Acid 20% | ○ | Solvents | White Spirit | ○ |
| | Acetic Acid 30% | △ | | Acetone | × |
| | Acetic Acid 80% | × | | Ethylene glycol | ○ |
| | Citric Acid 30% | ○ | | Formaldehyde 35% | ○ |
| | Lactic Acid 10% | ○ | | Butyl alcohol | × |
| | Oxalic Acid 10% | ○ | | Chloroform | × |
| Alkalis | Ammonia 10% | ○ | | Cyclohexane | ○ |
| | Ammonia 30% | △ | | Dichloromethane | × |
| | Potassium Hydroxide 50% | ○ | | Dibutyl Phthalate | △ |
| | Sodium Hydroxide 30% | ○ | | DOP | △ |
| | Ammonium Chloride | ○ | | Ethanol 10% | △ |
| | Ammonium Sulfate | ○ | | Ethyl Acetate | × |
| | Calcium Chloride | ○ | | Glycerol | ○ |
| | Potassium Chloride | ○ | | n-Heptane | ○ |
| | Sodium Carbonate | ○ | | n-Hexane | ○ |
| | Sodium Chloride | ○ | | Isopropyl Alcohol | × |
| | Sodium Sulfate | ○ | | Methanol | × |
| Natural Oils and Fats | Animal Fats | ○ | | Monochlorobenzene | △ |
| | Castor Oil | ○ | | Perchlorethylene | × |
| | Linseed Oil | ○ | | Phenols | △ |
| | Olive Oil | ○ | | n-Propyl Acetate | × |
| | Vegetable Fat | ○ | | n-Propyl Alcohol | × |
| Petroleum products | Crude Oil | ○ | | Silicone Grease | ○ |
| | Diesel Oil | ○ | | Styrene | △ |
| | Gasoline (normal octane) | △ | | Toluene | × |
| | Gasoline (high octane) | × | | Carbon Tetrachloride | × |
| | Kerosene Oil | ○ | | Trichlorethylene | × |
| | Mineral Oil | ○ | | Xylene | × |
| | Petroleum | ○ | | | |

The test procedure: Place sealed ring cups on specimens, fill each cup with test chemical, maintain 23°C (73°F) and evaluate appearance after specimens are washed and dried.

○=Suitable △=Slightly suitable ×=Not suitable

# 7. Formulation and Grade Selection

## 7-1) ACRYSIRUP Floor Coating Systems

ACRYSIRUP has 4 standard floor coating systems named FC-System (2-3mm thickness, Self leveling coating System), FM1-System (4-7mm thickness, Thin resin mortar System), FM2-System (7-15mm thickness, Thick resin mortar System) and FS-System (Granite-like finish System). Each system should be used in suitable applications considering the performance and physical properties required.

**Table-7 Suitability of ACRYSIRUP coating systems**

| Application | Resistance to | FC-System | FM1-System | FM2-System | FS-System |
|---|---|---|---|---|---|
| **Kitchen in** Hotel, Hospital Meal Service Center, Restaurant, Others | Boiling Water | × | ○ | ○ | × |
| | Hot Water | ○ | ○ | ○ | ○ |
| | Organic Acid | ○ | ○ | ○ | ○ |
| | Grease | ○ | ○ | ○ | ○ |
| **Food Factory such as** Bakery, Meat processing, Dairy processing, Pickles, Sauce, Brewery, Winery, Soft Drink, Others | Boiling Water | × | ○ | ○ | × |
| | Hot water | ○ | ○ | ○ | ○ |
| | Organic Acid | ○ | ○ | ○ | ○ |
| | Chemicals | ○ | ○ | ○ | ○ |
| | Grease | ○ | ○ | ○ | ○ |
| | High load bearing | ○ | ○ | ○ | ○ |
| | Wear | × | ○ | ○ | ○ |
| **Other Factory such as** Print, Metalizing, Paper Manufacture, Machine shop, Body shop | Wear | × | ○ | ○ | ○ |
| | High load bearing | ○ | ○ | ○ | ○ |
| | Solvent | × | × | × | × |
| | Impact | △ | ○ | ○ | △ |
| **Other use such as** Car Parking, Deck, Corridor, Veranda, Warehouse Others | Weather | ○ | ○ | ○ | ○ |
| | Waterproofing | × | × | × | × |
| | Chemicals | ○ | ○ | ○ | ○ |
| | High load bearing | ○ | ○ | ○ | ○ |
| | Wear | × | ○ | ○ | ○ |

○=Suitable △=Slightly suitable ×=Not suitable

## 7-2) Preparation and Application Guide

**Preparation Guide**

ACRYSIRUP is anaerobic (cures in the absence of Oxygen). Therefore, if the formulations of ACRYSIRUP, filler and pigment are not appropriate, the compounds will not cure. It is important to note the following suggestions.

1. Filler must be dry.
2. Porous and bulky filler such as perlite should not be used.
3. Filler must be used for high density packing. If the filler consists of coarse filler only, the compound sometimes will not cure.
4. The maximum particle size of filler depends on the thickness of the coating film. Usually maximum size is 1/3 to the thickness.

5. ACRYSIRUP and filler must be mixed such that ACRYSIRUP rises to the surface after troweling.
6. No additional resins or chemicals should be mixed into ACRYSIRUP without testing first.
7. Carbon-black should not be used in ACRYSIRUP, because it reacts with free radicals and causes poor curing.
8. Organic dye or organic pigments discolor ACRYSIRUP. So, inorganic pigments or non-reactive dyes should be used.
9. Plasticizer in toners sometimes obstructs the curing of ACRYSIRUP.

**Application Guide**

Condition of substrate, kind of substrate, temperature during application and condition of application are very important to ensure ACRYSIRUP cures properly. The conditions below must be checked before application, and if these conditions are not correct, appropriate treatments or countermeasures must be taken.

***Suitable substrate***

1. In the case of fresh concrete:
   Ensure that the surface of substrate is dry.
   Summer season : leave it over 3 weeks
   Winter season : leave it over 4 weeks
   Remove any brittle concrete with a polisher or scraper.
   Polymer-cement mortar is not suitable for the substrate overlaid by ACRYSIRUP, because it causes poor curing, peeling or swelling.
2. In the case of old substrates:
   Remove old coating materials, brittle layer and oil by polisher or scraper
   Remove emulsion paints by scraper.
   Dry wet substrate with a flame.
3. In the case of asphalt:
   Compact the asphalt to get strong adhesion between coatings and asphalt
   Newly applied asphalt must be left to dry for about 1 month, to allow oil to dry completely.
   Because asphalt concrete is soft and weak, plastic or elastic primer and the same type basecoat must be used.

***Temperature***

1. Standard-grade ACRYSIRUP resins:
   ACRYSIRUP can be installed at -30°C to 30°C (-22°F to 86°F).
   Use accelerator AC-102 if temperature is under 5°C (41°F)
2. Summer-grade ACRYSIRUP resins are applied at 30°C to 50°C (86°F to 122°F).
3. The amount of hardener and accelerator mixed into ACRYSIRUP depends on the surface temperature of the substrate and the resin grade.

***Other***

1. If the ACRYSIRUP resin is too thick (over 2mm), bubbling will occur due to the heat of reaction.
2. When ACRYSIRUP compound is applied on a vertical wall or slanting floor, thixotropic agent must be added to the mixture.
3. In the case of application in a closed room, ACRYSIRUP compound often does not cure completely because the paraffin wax in the ACRYSIRUP resin doesn't migrate to the surface to form an Oxygen barrier film on its surface. In this case, circulate air in the room with a fan.

## 7-3) Mixing ratio of the hardener to ACRYSIRUP

Mixing Ratio of the hardener (BPO) to ACRYSIRUP resins depends on the temperatures shown in Table-8. If too much or too little hardener is added to adjust curing time, the result is poor curing. When too much hardener is added in order to shorten the curing time, it will cause weak adhesion between the basecoat and topcoat.

**Table-8 Mixing ratio of BPO-50 and AC-102 per 100 of ACRYSIRUP**

| Temp. °C (°F) | FP-90 | | FC-411, FM-510, FP-460 | | FT-130 | |
|---|---|---|---|---|---|---|
| | BPO-50 | AC-102 | BPO-50 | AC-102 | BPO-50 | AC-102 |
| 30 (86) | 1 | - | 1.2 | - | 2 | - |
| 20 (68) | 2 | - | 2 | - | 3 | - |
| 10 (50) | 4 | - | 4 | - | 5 | - |
| 5 (41) | 5 | 1 | 5 | 1 | 6 | 1 |
| 0 (32) | 6 | 1 | 6 | 1 | 6 | 2 |
| -10 (14) | 6 | 4 | 6 | 2 | 6 | 3 |
| -20 (-4) | 8 | 8 | 6 | 6 | 6 | 6 |

BPO-50: Compound of Dibenzoyl Peroxide and plasticizer. The content of BPO is 50%.

AC-102: Compound of MMA monomer and Amine. Used as a catalyst on installing ACRYSIRUP at low temperature below 5°C (41°F).

1. When AC-102 is used in combination with BPO-50, mix AC-102 into ACRYSIRUP resins first, then after mixing adequately, add BPO-50.
2. **To avoid explosive reaction, do not mix AC-102 directly with BPO-50. Use clean measuring cups.**

# 8. Handling and Storage

**HANDLING:**

- Handle in well ventilated area.
- Close container tightly during and after use.
- Keep away from open flame, spark or heat-source.
- Ground equipment for prevention of static electricity.
- Use explosion proof, electrical appliance or other apparatus.
- Use spark proof hand tools.
- Keep dirty rags, paint sludge and paint dust soaking in water before disposal.
- Wear proper personal protective equipment to avoid contact with skin, eyes, mucous membranes and clothing. In case of eye contact, flush immediately with water for at least 15 minutes and get medical attention; for skin, wash thoroughly with soap and water.
- Clean hands and face thoroughly after handling. Dispose of contaminated protective gloves, goggles and caps, properly.
- Install proper local ventilation and wear a respirator in closed or confined working spaces.

**STORAGE:**

- Store in cool, dark, well ventilated conditions. Avoid direct sunlight.
- Keep away from ignition source or heat source. Keep containers upright and tightly closed when not in use.

**ENGINEERING CONTROLS:**

- Use explosion-proof equipment.
- Install proper exhaust to prevent high concentration of vapors.
- Ground equipment for fluid transfer, pumping and stirring.
- Arrange the workplace to cut off the influence of heat or ignition source.
- In indoor applications, use automatic application equipment, a local exhaust system and other respiratory protective equipment so installers can avoid exposure to fumes.

**PERSONAL PROTECTIVE EQUIPMENT:**

- Eye/Face Protection: Wear safety goggles.
- Skin Protection: Wear gloves impervious to organic solvent and chemical.
- Respiratory Protection: Wear gas mask for organic gas. Wear air mask in closed space.

~~ For further information, please review the MSDS for each product. ~~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9675 Bayport Blvd., Pasadena, TX 77507, U.S.A.
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**RYOKO CO., LTD.**

14-1 Koami-Cho Nihonbashi
Chuo-Ku Tokyo 103-0016, Japan
Phone: +81 (3) 5651-0656
FAX: +81 (3) 5651-0055


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