Textile Coatings and Binders

UNION CARBIDE

PLAINTIFF'S EXHIBIT
UC-996

July 28, 1975

TO: Distribution List Attached

SUBJECT: Latex Storage and Handling

Gentlemen:

During the warm summer months, it is important that we again remind our latex customers about the importance of good housekeeping procedures and sanitary storage techniques. If problems due to bacteria attack are going to occur, now is the time they are likely to do so.

While our textile latexes are protected by the addition of a bacteriostat prior to shipment, it is impossible to utilize a level that would provide unlimited, trouble-free storage life. Consequently, exposure to severely, contaminated material in a customers' tank or line can overcome this protection and deterioration will begin. Your Regional Technical Manager can provide more detailed information and assist in the resolution of difficulties.

The attached article is an up-dated version of our storage and handling booklet. While it is oriented toward the coatings industry because of the publication where it appeared, the principles are equally applicable to our textile customers. Additional copies are available both from Long Island City and the regional latex plants.

Regards,

Pete

E. L. Peterson

ELP:lrp
Att.

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MAY 1975

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Modern Paint and Coatings

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Efficient Latex Handling For Water-Borne Coatings

UNION CARBIDE COATINGS MATERIALS

SPECIAL PRODUCTION ISSUE

Efficient Latex Handling For Water-Borne Coatings

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This report covers the latest techniques for trouble-free receiving, storage and handling of latex emulsions for the manufacture of aqueous coating products.

MANUFACTURERS converting their systems from organic solvent-based to water-borne coatings must recognize two key characteristics of their new materials — the relatively corrosive nature of water, which determines materials of construction for handling equipment, and the suspended nature of latex. The recognition that latexes are suspensions of very small particles in water defines required equipment and operating procedures.

Special factors that must be considered in the design and operation of a latex handling and storage facility are:

- Skins and scrap
- Filtration
- Foam

Even the most sophisticated handling and storage system cannot prevent the formation of skins or scrap. Practical designs, however, can reduce skin and scrap formation to a manageable level.

Latexes are emulsions consisting of particles in the range of 0.1 to five microns suspended in water by means of a stabilizing system, usually a surfactant or stabilizing colloid. Evaporation of water from the surface of the latex concentrates the polymer particles and produces a "skin" of polymer that cannot be redispersed in the latex.

Additions of certain solvents, salts and other materials, or freezing of the water in the latex, can sometimes destroy the effectiveness of the stabilizing system and generate cottage cheese-like coagulation of the polymer.

Water Evaporation

When a closed tank has established uniform temperature and the latex is in equilibrium with the vapor phase, the rate of escape of water molecules to the vapor phase equals the rate of return of water molecules to the surface of the latex.

If a portion of the tank wall in the vapor space is cooled below the temperature of the rest of the system, water vapor condenses on the cooled surface and reduces the vapor concentration below equilibrium levels. Additional water evaporates from the surface of the latex to replace that which was condensed. The net effect is for water to evaporate from the surface of the latex, condense on the wall and run down the side of the tank. The surface of the latex then concentrates to form thickened masses and skins.

These skins, formed when the vapor space is cooled, generally float on the surface of the latex and move up and down with the liquid level in the tank.

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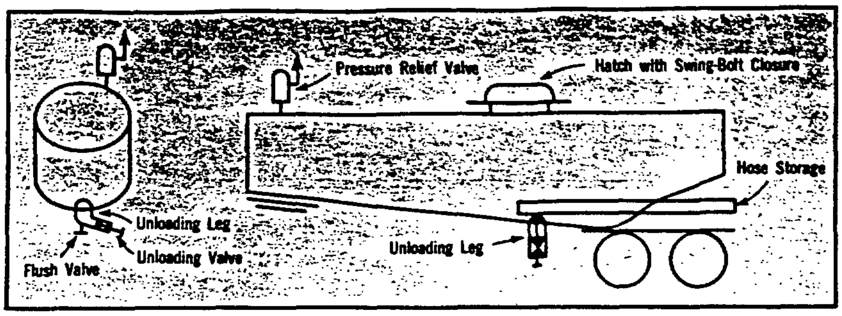

Figure 1 — Sketch of latex tank truck arrangement.

When the tank is filled, air bubbles entrained in the fresh latex float to the surface under the skin and prevent the skin from sinking into the latex. In many systems, the latex skin forms a floating roof, which limits further skin formation.

If a portion of the tank wall in the vapor space is heated above the temperature of the rest of the system, any water on the inside surface of the wall evaporates and condenses on the surface of the cooler latex. Any latex splashed on the wall dries out, leaving a film of polymer on the wall. These deposits will usually become firmly attached to the wall and remain in the tank when the latex is removed. Deposition of solids on the inside walls of the tank is undesirable because a tank cleaning operation will eventually be necessary.

The evaporator-condenser effect can also occur in storage tanks when warm latex is added to a cold tank, or when the tank wall in the vapor space goes through temperature cycles. The amount and rate of surface coagulation is aggravated in latexes having high total solids, high latex viscosity and elevated temperatures.

A latex with high total solids can generally tolerate little water loss before skins and masses result. High viscosities tend to stabilize the position of the surface layer, resulting in more severe concentration. Elevated latex temperatures speed up the water transfer process.

Coagulation

In addition to coagulum from water evaporation, upset of the latex stabilizer system can cause coagulation. A latex is stabilized by a system that imparts an electrostatic or electrosteric charge to each particle. This system develops repelling forces when two particles approach each other.

Addition of materials that unbalance or neutralize the stabilizer system can cause the latex to coagulate into great masses of unusable jelly or flocculates.

Materials that may cause this type of coagulation include multivalent salts, such as those of calcium, aluminum or zinc, and such solvents as acetone or isopropanol. Mixing one latex with another may also cause coagulation. Tanks, lines, pumps and other equipment in which latex will be handled must be clean and free of contaminants other than latex residues known to be compatible.

The stabilizer system can also be upset by freezing of the latex and, therefore, should not be subjected to freezing conditions. Wintertime shipments of drums of latexes to coatings manufacturers are made in heated vans when required by location conditions and destination. Bulk shipments are made in insulated tank cars that have long cooling times. Bulk storage of latexes should be in insulated tanks equipped with hot water or electrical heat tracing when required by weather conditions.

Minimizing Skins and Scrap

Evaporator-condenser effects can be minimized through the use of proper storage procedures and equipment. The most effective techniques limit temperature differences in the latex storage system.

Indoor installation of storage tanks and transfer lines helps control temperature cycling. The insulation of tanks and lines is also effective. For outdoor tanks and transfer lines, insulation is a necessity if skin formation is to be minimized. Agitators in latex storage tanks also reduce skin formation, but they limit the operating volume of the tank because the blades must be immersed to be effective. In many systems, agitators are not necessary.

The evaporator-condenser effect can also occur in drums filled with warm latexes. The drum lid rapidly cools to room temperature and then becomes an excellent condenser surface. The effect can also occur in drums stored out-of-doors, where the ambient temperature significantly cycles from day to night. When the drum lid cools down at night, below the temperature of the latex, the water transfer process begins.

Because of this effect, drums must be filled with cool latex and the latex covered with a polyethylene film placed directly on the surface of the latex before the lid is closed. The drums should be stored inside where temperature variations are limited.

Similarly, the evaporator-condenser effect can take place in tank trucks and tank cars. To limit this effect, only insulated rail cars and tank wagons are used by suppliers, and efforts are made to size the container to fit the shipment so that the container can be filled shellfull. Short distance shipments to coatings manufacturers from strategically located latex production sites, operated by such suppliers as Union Carbide, can also minimize the vital time factor.

Latex Filtration

When a sample of latex is filtered through a screen, some oversize material, called "filterable solids," invariably remains on the screen. These filterable solids may be composed of "seeds" generated in latex manufacture during the polymerization reaction, and a small amount of coagulum that always forms during storage and handling of latexes.

Most of the "seeds" that form during the polymerization reaction are removed by the latex manufacturer. Scavenger filters are used by the latex manufacturer to additionally filter the latex at various stages. Latexes are filtered when packaged or loaded out for bulk shipments.

A good practice for the coatings manufacturer is to filter bulk shipments again, through screens of 40 to 60-mesh size, when the latex is transferred from storage tanks for production.

Foam

Latexes generally contain significant amounts of surfactants and, therefore, readily foam. The foam interferes with efficient utilization of drums and storage tanks, and makes the volume of latexes difficult to measure.

Foaming is usually caused by air entrainment, or by the evolution of gas dissolved in the latex. Entrainment of air bubbles can be the result of free fall of a latex from a hose into a drum or tank, or vigorous agitation in a tank.

Another common cause of foaming is splashing of the latex as it flows into a drum or tank or is forced under pressure against the side of a tank. Latexes should be fed in near the bottom of a tank below the liquid surface to minimize foam formation.

Storage of a latex under pressure for an extended period of time without agitation, or for a short time with agitation, can cause appreciable amounts of air or nitrogen to dissolve in the latex. When the pressure is released, the dissolved gas comes out of solution, causing foam generation in the latex. Generally, it is preferable to store latexes under atmospheric pressure.

Temporary application of pressure to assist in a latex transfer does not usually cause difficulties, but the best practice is to transfer latex by means of a pump.

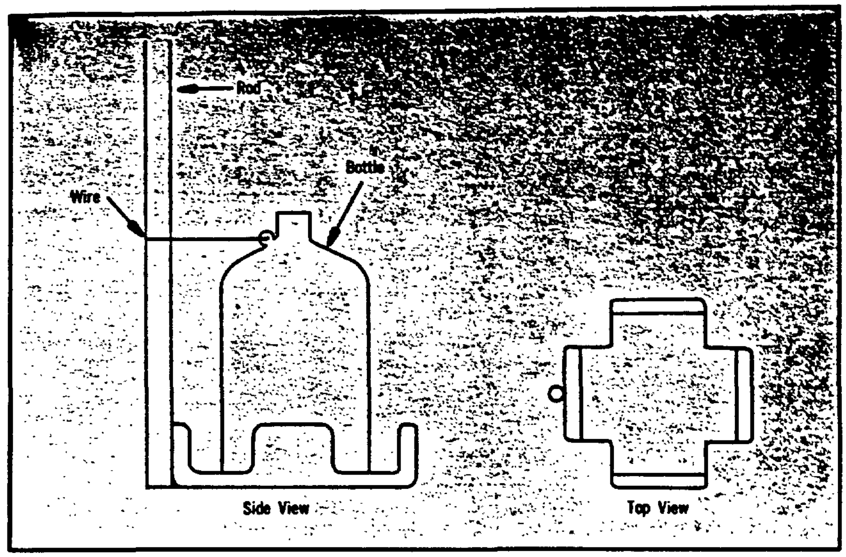

Figure 2 — Sampling rod and bottle for quality control examination of latex from tank truck or rail car.

Tank Trucks and Rail Cars

Tank truck shipments of latex to coatings manufacturers are made in insulated stainless steel tanks. Rail shipments are made in insulated baked phenolic-lined steel tanks. Pressure equipment is sometimes used to permit unloading by air pressure or for providing pressure assistance to the truck transfer pump. A sketch of a tank truck arrangement is shown in Figure 1.

Most coatings manufacturers require their quality control laboratory to examine a sample of latex shipments before accepting delivery. Samples should be taken from the middle of the tank by plunging a sample bottle to about one-half of the depth of the tank and allowing it to fill. A sample rod and bottle device is shown in Figure 2.

If more than one compartment of a tank is filled, a sample from each compartment should be taken. The samples should be combined and analyzed for total solids, viscosity and filterable solids according to the standard test procedures.

Samples should not be taken from the surface of the latex because if any skins or thickened materials have formed in the shipment, the coagulum would be concentrated near the surface and the sample would show a disproportionately large amount of coagulum. Also, samples should not be taken from the unloading leg. Flush valves occasionally leak a small amount of latex into the leg, which can generate skins. In cold weather the leg contains antifreeze solution, which can be drained or mixed into the latex when the tank is off-loaded.

The coatings manufacturer's receiving equipment should be sized so that the transfer of the shipment from the tank truck to the storage tank can be accomplished in about an hour. This will allow sufficient time for inspecting the latex, setting up, unloading, rinsing and stowing of the truck's transfer equipment.

Pumps used to unload the latex are mounted on the tractor. Transfer of low viscosity latexes (less than 1,000 cps) can be made with a two or three-inch Roper positive displacement gear pump. Shipments of high viscosity latexes (greater than 1,000 cps) usually require the three-inch Roper gear pump, although small shipments of 1,000 gallons or less can be handled with two-inch equipment and lines. An air compressor is also desirable truck equipment.

Connections from the tank to the pump and from the pump to the receiving line are made with two or three-inch butyl rubber chemical transfer hose coupled with Kamlok quick coupling fittings.

The driver opens the flush valve and the unloading valve and starts his pump. If the customer receives a significant amount of foam in his storage tank, it may be from a leaky hose connection between the truck tank and the pump suction. If this occurs, application of a few pounds of air pressure to the truck tank should relieve the problem. Pump cavitation may occur when unloading the high viscosity latexes. This can also be corrected by applying air pressure to the truck tank.

The latex should enter the storage tank through a bottom or side connection near the bottom to avoid the formation of significant amounts of foam.

Rail Car Unloading

There are basically three different unloading procedures that can be used for rail cars. If the tank car is at a higher elevation than the storage tank, the latex can be transferred by gravity. A pump can be located near the siding and used to transfer the latex. Or, the car can be pressurized to about 20 to 25 psig with air to force the transfer.

Care must be taken not to excessively blow air from the car to the storage tank. If the storage tank is located more than about 20 feet higher than the tank car, the transfer will require a pump. The route of the latex transfer should be from the car to the pump, if used, and into the storage tank at a level below the surface of the latex. A typical arrangement of a latex tank car is shown in Figure 3.

Materials of Construction

Latexes contain water, free monomer and salts and, therefore, present problems in the selection of materials of equipment construction. Moreover, pH of the latexes ranges from about 3 to 10. Materials of construction known to be satisfactory for equipment used with latexes are listed in Table I. Specific installations, under certain conditions, may permit use of other materials.

Figure 4 is an installation flow diagram for a latex bulk storage system designed to operate with a minimum of problems. This arrange-

Table I — Satisfactory Materials for Latex Handling Equipment

Materials of Construction	Application: Tank Linings	Piping	Gaskets
Reinforced polyester	X	X	
Baked phenolic lined steel			
Plasite 3066 (1)	X	X	
Lithcote LC-19 (2)	X	X	
300 series stainless steel	X	X	X
Polyethylene	X	X	
Polypropylene	X	X	
Butyl rubber		X	X
Ethylene-propylene rubber		X	X
Teflon			X
Asbestos			X

(1) Wisconsin Protective Coating Corp. (2) Lithcote Corp.

ment provides for filtration of latex as it is fed out to production, and circulation of the tank contents through the filter if desired.

The receiving line and return line from the pump loop are fed in near the bottom of the tank below the surface of the latex. The liquid level indicator provides a measure of the tank contents. Humidifiers are not necessary. If the vent line is long enough to prevent the wind from blowing into the tank, the amount of water vapor that can be absorbed by air breathed into the tank is very small.

If temperature cycles are expected, the tank should be insulated to guard against the evaporator-condenser effect. It is generally good practice to insulate the tank, even if it is located indoors. If the tank is located outside, insulation is essential.

Freeze protection should also be provided at appropriate locations by tracing the tank and lines with a warm water or electric tracing system. Steam should never be used to trace latex systems. In some instances, the latex may be circulated through a warm water heat exchanger and back to the tank. Underground tanks should also be considered because they provide a uniform and cool storage temperature with protection from freezing.

Bulk storage tanks are generally operated for many months before having to be cleaned. Lined steel tanks and reinforced plastic tanks must be cleaned manually. The surface skins and any loose wall fouling should be removed. In order to avoid damaging the lining, personnel working in the tank should wear rubber boots and not use sharp tools. Fresh air masks will generally be required unless the tanks are thoroughly aired out before entry.

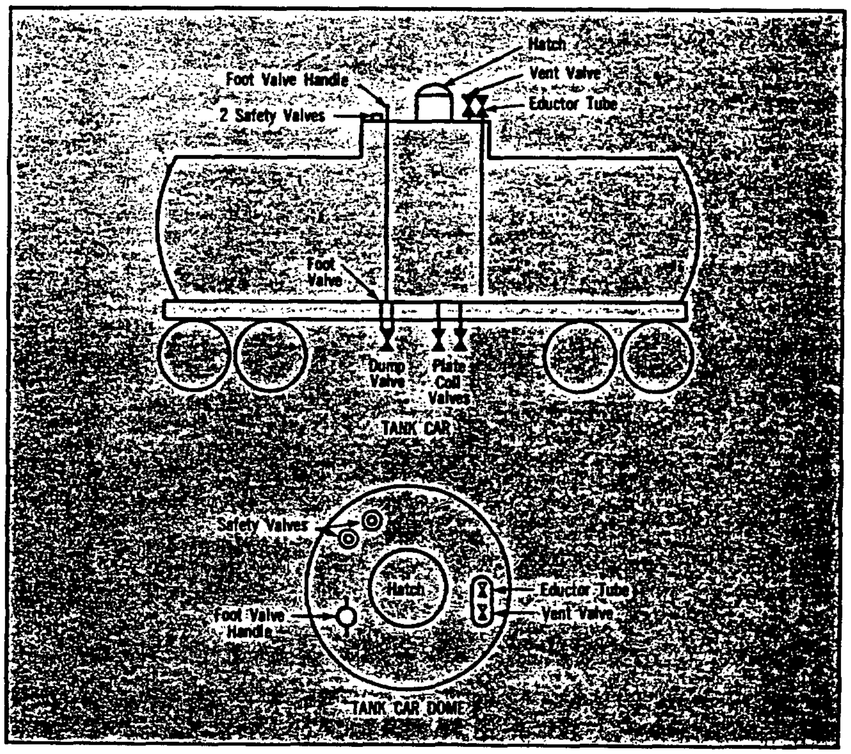

Figure 3 — Sketch of tank car and fittings for latex handling.

Pumps

Many different kinds of pumps are used to transfer latexes. Positive displacement pumps have the widest utility in latex systems, but centrifugal pumps with double mechanical seals can be used as well.

Air-operated diaphragm pumps, such as the Wilden or the Warren-Rupp Sandpiper, are the most inexpensive and easiest to install and maintain. They generally provide trouble-free operation. Pumping rates can be varied by adjusting the air pressure to the pump or throttling down on the discharge valve. If the discharge valve is closed, the pump stops and the pressure in the discharge line builds up to the same level as the operating air pressure. No safety valve is required. A disadvantage is that the pumps use a large amount of air — a latex flow rate of 60 gallons per minute would require about 60 cubic feet per minute of air.

Rotary, sliding vane, positive displacement pumps, such as the Blackmer or Foster pumps, have been used successfully. These pumps are electrically driven, constant speed pumps. They can be purchased with internal relief valves or with clutches designed to release at a pre-set torque level. If the internal relief valve is used, it should be cleaned periodically to be sure it stays in operable condition. Lantern rings should be provided in the packing glands so that the packing can be lubricated frequently with a grease gun to keep out the latex.

Piping

Lines should, of course, be sized for the specific installation; however, the following is a general guide for pipe sizing.

In two-inch lines, low-viscosity latexes can be transferred about 100 feet at rates of up to 4,000 gallons per hour without generating more than about a

60-psig pressure drop. If faster flow rates or longer distances are necessary, the lines should be of three-inch diameter.

High-viscosity latexes, above about 1,000 cps, cannot be transferred long distances at more than about 1,000 gallons per hour through two-inch lines. Higher flow rates require the use of three-inch piping.

Butterfly valves with cast iron bodies, stainless steel discs and stems, and ethylene propylene rubber (EPR) linings work well in latex service.

Filters

A basic filter design consists of a basket mounted inside a vessel. Flow is into the top, inside the basket, through the wall of the basket and out through a bottom outlet.

The screen can be cleaned by soaking in hot (above 70°C.) five per cent aqueous sodium hydroxide solution, or by soaking in acetone. The sodium hydroxide solution hydrolyzes the resin so that it becomes water soluble. Acetone swells and softens the resin so that it can be brushed off the screen.

Suitable basket filters for latexes are manufactured by Hayward Manufacturing Co. of Elizabeth, N.J., and the Winston Manufacturing Co. of Houston, Tex.

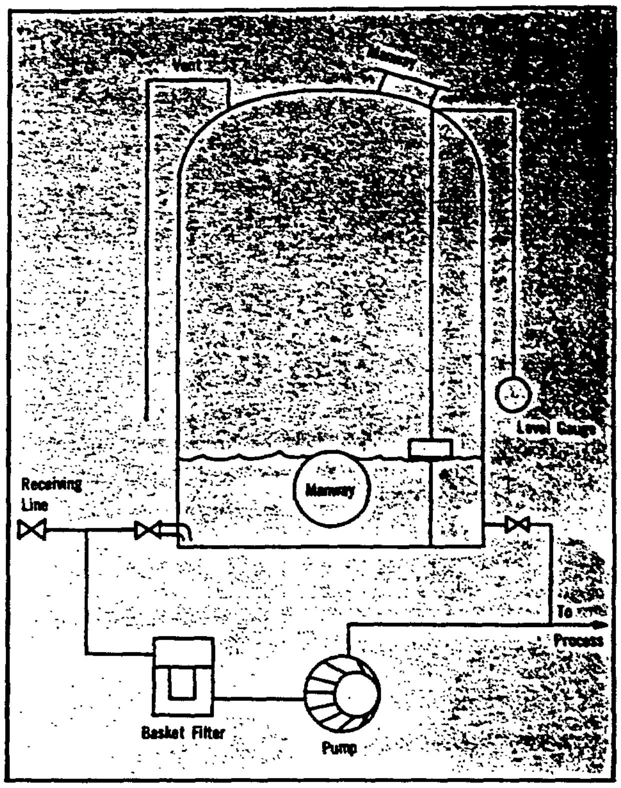

Figure 4 — Latex bulk storage tank system.

Drum Handling

Drum shipments of latexes are made in open-head, 55-gallon Liquipak containers. The Liquipak is a fiber drum with an inside coating of polyethylene, a polyethylene-lined lid, and a sheet of polyethylene installed on the latex surface under the lid.

When a shipment of drums is received, at least two of the drums should be opened and visually inspected. The appearance of a small amount of foam and/or some skins on the surface of the latex is normal. If the shipment is received during cold weather and there is any evidence of freezing, the temperature of the latex should be measured and reported. The key latex properties — total solids, pH, viscosity and filterable solids — can be checked according to standard test methods.

The low-viscosity latexes particularly tend to stratify on standing. Other latexes develop a water layer on the surface. Skins and coagulum may accumulate with storage time, particularly when the drums are stored under cycling temperatre conditions. To maintain homogeneous material, the drums should be agitated before use and any skins that may have formed on the surface removed.

Drums should be stored inside, out of the sun. Where there is danger of exposure to subfreezing temperatures, storage should be in a heated area.

Latexes in drums are storage stable for extended periods. Drums should be stored not more than two high, and in a dry place to minimize deterioration of the fiber walls. Stock should be controlled so that the oldest drums are used first.

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