VINYL HYDROSOLS

SUMMARY:
Various hydrosol formulations and mixing techniques have been studied in PolyOne R&D laboratories. This study has resulted in the development of new hydrosol formulations and formulating techniques. Vinyl hydrosols have excellent colloidal stability. Films and coatings produced from these hydrosols exhibit properties which are equal to films cast from organosols, i.e.; good tensile strength, clarity, gloss, heat stability, etc. In this report, the formulation is based on Geon® 137 resin, but can be extended to other resins with some modifications. The Geon® 137 based hydrosol is stable after five months of shelf storage with minimum viscosity aging.

DISCUSSION:
The term "Hydrosol" is frequently used to describe any fluid, colloidal system in which the continuous phase is water. In this report, a "Vinyl Hydrosol" refers to a dispersion of PVC resin and plasticizer in water, formulated for use in vinyl coatings, water-based ink, or other similar applications.

A major driving force for developing the hydrosol technology is that it offers an alternative to organosol technology. Organosols have been widely used in the coating industry, but are under pressure from the ever tightening EPA solvent emission regulations. Higher solvent prices and processing hazards, in terms of fire and toxicity, are also of concern.

A schematic diagram for making a hydrosol is given in Figure 1. The first step in producing a hydrosol is to prepare a plasticizer emulsion. All liquid ingredients, such as heat stabilizers or co-plasticizers, are also incorporated into the emulsion at this stage. The next step is to disperse the resin in water. All solid ingredients, such as fillers and pigments, should also be dispersed into the water at this stage. Maintaining a pH above 8.5 is essential for good dispersability and colloidal stability. Once the resin is completely dispersed in water, the plasticizer emulsion is slowly added to the resin dispersion to produce a resin/plasticizer/water dispersion – or "Hydrosol". The detailed step-by-step procedure follows:

The Geon® 137 hydrosol prepared by the following procedure resulted in a very stable hydrosol in that it withstood 10 minutes in the 1200 rpm Eppenbach shear test, and is stable after five months of shelf storage. Table I shows viscosity and stability data of a Geon® 137 based hydrosol.

DETAILED HYDROSOL MAKEUP PROCEDURE

The following procedure is a starting hydrosol formulation containing 100 grams of a dispersion resin, Geon® 137.

- **Preparation of Plasticizer Emulsion:**
  1. Dissolve 2 grams of SAS-30[(1)] active basis surfactant in 20 grams of water, and mix well with a spatula. Measure the pH, and add enough Morpholine to raise the pH over 8.5. Call this Solution (A).

  2. Mix 38 grams of DOP and 2 grams of heat stabilizer, such as Thermolite 831[(2)], then add 1.4 grams of Triton X34[(3)] surfactant. Emulsify the mix using an Eppenbach homogenizer for 4 minutes with the speed set at 3000 rpm. Call this Solution (B).

  3. Slowly add Solution (A) to Solution (B) while agitating them with the Eppenbach homogenizer with the speed set at 3000 rpm. After all of Solution (A) is added to Solution (B), increase the homogenizer speed to 4000 rpm and mix for 10 minutes. This is the plasticizer emulsion. Call this Solution (C).

- **Preparation of the Resin/Water Dispersion:**
  4. Mix 100 grams of de-mineralized water and 0.28 grams of Morpholine in a Dispersator mixer using a Cowles type blade. Slowly add 100 grams of Geon® 137 resin while the dispersator is running at 2000 rpm. Keep the pH above. 8.5 with additional Morpholine. If foaming becomes a problem, add a defoamer, such as Drew L-139[(4)] . Call it Dispersion (D).

- **Preparation of Hydrosol:**
  5. When the resin is completely dispersed, and after mixing for at least 4 minutes at 2000 rpm, reduce the speed to 800 rpm.

  6. Slowly add entire amount of plasticizer emulsion, Emulsion (C), into the resin Dispersion (D) and mix for 4 minutes at 800 rpm.

  7. Deaerate to a boil (12 mm Hg vacuum).

TABLE I

BROOKFIELD VISCOSITY DATA (CENTIPOISE)

	Unstirred	After Mixing for 10 Minutes at 1200 rpm
Initial	V_2 6760 V_{20} 1700	----------
1 Day	V_2 7680 V_{20} 1600	----------
4 Days	V_2 8750 V_{20} 2075	6650 1550
130 Days	V_2 6400* V_{20} 2105	6750 2105

TABLE II

RAW MATERIAL MANUFACTURER'S

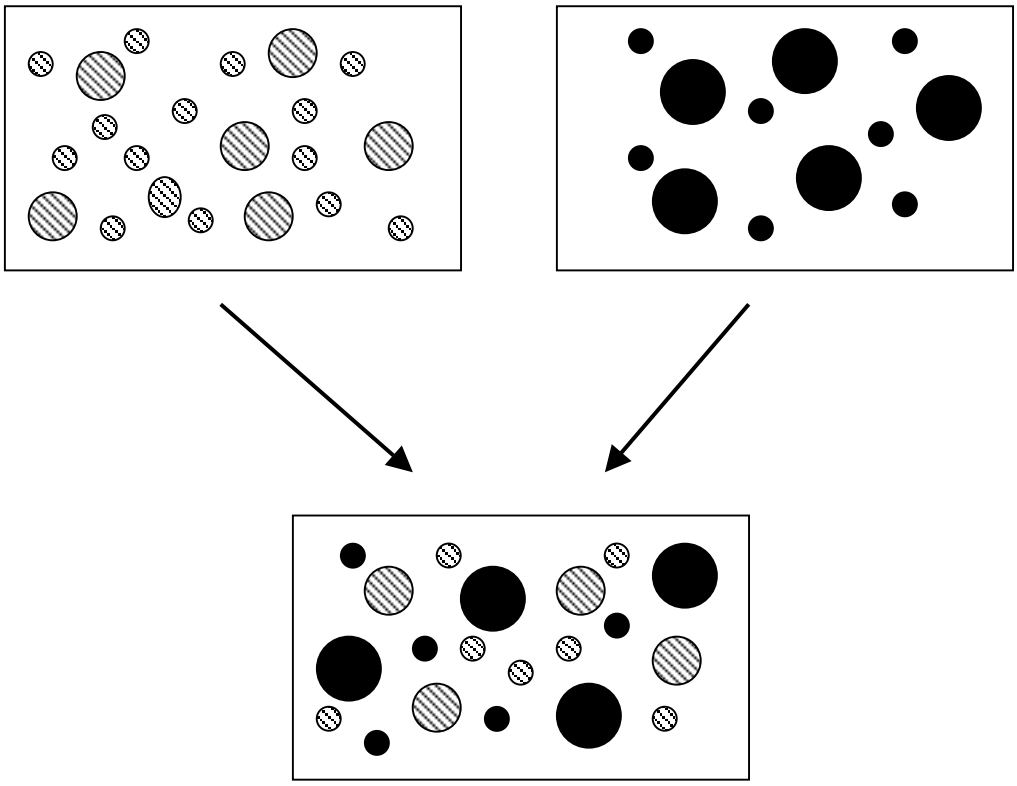
[(1)]SAS-30	Secondary Alkane Sulfonate, Sodium Salt Anionic surfactant by American Hoechst Corporation
[(2)]Thermolite 831	Dioctyltin Diisoctyl Thioglycalate heat stabilizer by M & T Chemicals Inc.
[(3)]Triton X-45	Octylphenoxy Polyethoxy Ethanol Nonionic surfactant by Rohm & Haas Company
[(4)]Drew L-139	100% active proprietary liquid defoamer by Drew Chemical Company

FIGURE 1

HOW TO MAKE "HYDROSOL": SEE THE PROCEDURE FOR DETAILS

Water / Oil Emulsion
(Plasticizer Emulsion)
(2 Phase)

Solid / Water Dispersion
(Resin Dispersion)
(2 Phase)



Solid / Oil / Water Dispersion
(Hydrosol)
(3 Phase)

PolyOne Corporation / 33587 Walker Road, Avon Lake, Ohio 44012

TAB016 MARCH 2004