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## Formulating Guidelines for Hauthane Polyurethane Dispersions

The following guidelines are based on Hauthaway's experience in formulating coatings using our Hauthane polyurethane dispersions. The guidelines are by no means exhaustive or meant to exclude other raw material or processing alternatives. A list of raw materials suppliers for the products mentioned is appended below.

**Coalescing Solvents** – Except for the co-solvent free grades (e.g. HD-2024, HD-4664, HD-4669, HD-4675), all Hauthane polyurethane dispersions contain n-methyl pyrrolidone (NMP), n-ethyl pyrrolidone (NEP) or dipropylene glycol dimethyl ether (DMM). NMP and NEP are very effective coalescing solvents for polyurethane dispersions; consequently most of the NMP/NEP containing grades require little or no additional co-solvent to form films. DMM, however, is a much less effective coalescing agent, so grades containing this solvent require the addition of extra co-solvent. Hauthaway recommends the use of DPM or blend of DPM/DPnB as the most effective solvents to further coalesce and enhance the performance properties of these films. The list below shows other suitable coalescing solvents.

DPM – dipropylene glycol methyl ether (Dow Chemical, Eastman Chemical, Lyondell Chemical)

DPnB – dipropylene n-butyl ether (Dow Chemical, Eastman Chemical, Lyondell Chemical)

PM – propylene glycol methyl ether (Dow Chemical, Eastman Chemical, Lyondell Chemical)

Propylene glycol (various)

Butyl cellosolve (various)

Texanol (Eastman Chemical)

In the case of the DMM containing grades, coalescing solvents should be added at 2 - 3% based on resins solids. For the harder co-solvent free grades, coalescing solvent should be added at 3 – 5% based on resins solids to attain optimal film formation properties.

**Crosslinking Agents** – The carboxylic functionality on Hauthane polyurethane dispersions makes them ideally suited for reaction with a number of crosslinking agents such as carbodiimides (Dow's Zoldine XL-29SE or Nisshinbo/GSI-EXIM's Carbodilite V-02-L2), polyaziridines (Polyaziridine LLC's PZ28, DSM NeoResin's CX-100), melamines (Allnex's Cymel 385) and epoxies (Momentive's Epi-Rez 3510-W-60). Water dispersible isocyanates such as Bayer's Bayhydur XP-7165, or Vencorex's Easaqua X D 401 / M 501 are also suitable for both hydroxyl functional grades, like HD-6000 (L-2883) or HD-6002 (L-2996), as well as for conventional grades. See supplier contact details on page 4.

**Defoaming Agents** – Dow Corning's DC65 added at 0.1 - 0.2%, or Allnex's Knockdown DF-155 at 0.1 – 0.2% on total formulation weight.

**Gloss Flattening Agents** – To produce coatings with semi-gloss, satin or flat gloss finishes, Hawthaway has found silicas like Evonik’s TS-100 and non-silica powders such as Pergopak M3 (Albemarle Corp.) or Bermasilk MK (Bergen Materials) to be effective materials.

**Flash Rust Inhibitors** – The addition of ammonium benzoate at 1 – 2% of total formulation will eliminate flash rusting on metal substrates.

**Leveling/Wetting Agents** – The most effective wetting agents for the Hawthane line are BYK 348 from BYK Chemie or Tego’s Tegowet 270. These materials should be added at about 0.8% on total formulation weight.

**Mar-reducing Additives** – Synthetic wax additives such as BASF’s Jonwax 26 or silicone additives such as Dow Corning’s HV-490 may be used to reduce marring from incidental contact. Polyethylene waxes such as those available from MicroPowders may also be used, but may separate with time. Re-dispersion will be required.

**Pigment Dispersants** – Surfynol SE-F from Air Products is suggested for the dispersion of pigments in polyurethane dispersions at 4 – 6% on total formulation.

**Rheology Modifiers** – For thickening the viscosity of polyurethane dispersions, associative thickeners are available from several sources including:

Dow Chemical (Formerly Rohm & Haas)	Acrysol RM 825
Cognis	DSX-1514
Elementis Specialties	Rheolate 210 or 310
Royal Adhesives (formerly Parachem)	Paragum PG-500

These materials should be added at the manufacturers recommended levels.

**UV Stabilizers** – A 50/50 blend of Tinuvin 292/Tinuvin 1130 from BASF (formerly Ciba Specialty Chemicals) provides excellent exterior exposure protection. This blend should be diluted 1 to 1 with a water miscible solvent such as Dowanol DPnB before adding to the polyurethane dispersion. The recommended level of addition is 1 – 3% solids on solids.

**Acrylic Emulsions** – Generally, Hawthane polyurethane dispersions are compatible with a wide variety of acrylic emulsions. Hawthaway has evaluated a number of grades from the major manufacturers and has reported on the compatibility and stability in a study entitled, “Compatibility and Stability of Hawthane Polyurethane Dispersions with Various Acrylic Emulsions.” This study is available upon request or may be accessed on the Hawthaway web site: [www.hawthaway.com](http://www.hawthaway.com).

## **Order of Addition**

The order of addition of the components in a coating formulation is an important consideration in creating a stable liquid paint, as well as, an aesthetically pleasing and

durable finish. Hawthaway suggests the following procedure to produce the optimal coating properties.

Most formulations using polyurethane dispersions (PUD's) also include acrylic emulsions. If this is the case, start by placing the acrylic emulsion in a mixing vessel.

Next, add the coalescing solvent in a premixed blend with water under agitation. This helps to prevent shocking the acrylic emulsion during the addition of coalescing solvent. Shocking can result in grit formation or even gellation in extreme cases. The ideal mixture would be a 50/50 blend of water and coalescing solvent, but any reduction of the cosolvent is beneficial. Stir this mixture for at least 20 minutes. A similar procedure may be followed for pure PUD-based formulations.

At this point, if the formulation is pigmented, add a pre-dispersed or solid pigment under agitation. Allow sufficient time to adequately mix the pigment dispersion or to grind the solid pigment and to attain the ultimate color values. Solid pigments may be ground into PUD's directly, but will likely require the use of a wetting agent to attain the desired Hegman grind. See the section on Pigment Dispersants above for suggested products and amounts.

If the acrylic emulsion has a different pH than the PUD, be sure to adjust the pH of the acrylic to the same range as that of the PUD using a diluted ammonia solution. This will also prevent shocking of both the acrylic and polyurethane. Under agitation, slowly mix in the PUD and stir for several minutes to allow sufficient blending.

The formulation may be thickened with rheology modifiers to the appropriate viscosity at this stage. See the section above on Rheology Modifiers.

Finally, add leveling agents, UV-stabilizing packages and other additives at this point to complete the formulation. Stir sufficiently to optimize the mix.

## Supplier Contact Index

### **Air Products & Chemicals, Inc.**

Allentown, PA  
(800) 345-3148  
[www.airproducts.com](http://www.airproducts.com)

### **Albemarle Corporation**

Baton Rouge, LA  
(800) 535-3030  
[www.albemarle.com](http://www.albemarle.com)

### **Allnex USA**

Smyrna, GA  
(800) 433-2873  
[www.allnex.com](http://www.allnex.com)

### **BASF Performance Polymers**

Charlotte, NC  
(800) 231-7868  
[www.basf.com](http://www.basf.com)

### **Bayer Corporation**

Pittsburgh, PA  
(800) 662-2927  
[www.bayermaterialsciencenafta.com](http://www.bayermaterialsciencenafta.com)

### **Bergen Materials, Corp**

Odessa, FL  
(727) 847-0605

### **BYK Chemie**

Wallingford, CT  
(203) 265-2086  
[www.byk.com](http://www.byk.com)

### **Cognis Corporation**

Cincinnati, OH  
(800) 359-8626  
[www.cognis-us.com](http://www.cognis-us.com)

### **Dow Chemical Company**

Midland, MI  
(800) 447-4369  
[www.dow.com](http://www.dow.com)

### **Dow Corning Corporation**

Midland, MI  
(800) 634-9660 for distributor referral  
[www.dowcorning.com](http://www.dowcorning.com)

### **Dupont**

Wilmington, DE  
*United States:* (800) 255-4596  
*Canada:* (800) 263-5924  
[www.dupont.com](http://www.dupont.com)

### **Eastman Chemical Company**

Kingsport, TN  
(800) EASTMAN  
[www.eastman.com](http://www.eastman.com)

### **Elementis Specialties**

(800) 866-6800  
[www.elementis-specialties.com](http://www.elementis-specialties.com)

### **Lyondell Chemical Corporation**

Houston, TX  
(888) 777-0232  
[www.lyondellbasell.com](http://www.lyondellbasell.com)

### **Micro Powders Corporation**

Tarrytown, NY  
(914) 793-4058  
[www.micropowders.com](http://www.micropowders.com)

### **Nisshinbo/GSI-EXIM America, Inc.**

New York, NY  
(212) 684-5760  
[www.gsiexim.com](http://www.gsiexim.com)

### **Royal Adhesives & Sealants**

South Bend, IN  
(800) 763-7272  
[www.royaladhesives.com](http://www.royaladhesives.com)

### **Tego (Evonik Goldschmidt Corp)**

Hopewell, VA  
(800) 446-1809  
[www.Tego.us](http://www.Tego.us)

### **Vencorex**

(800) 537-0280  
[www.northam@vencorex.com](mailto:www.northam@vencorex.com)