ACOUSTICRYL™ SD-380 Copolymer Emulsion
For Liquid Applied Sound Damping Coatings

Regional Product Availability
- Global

Description
ACOUSTICRYL™ SD-380 is an acrylic copolymer emulsion which can be used in sprayable waterborne sound and vibrational damping coatings.

Key Attributes
- This latex leads to peak vibrational damping centered around 38°C in a wide range of unplasticized formulations when measured in accordance with SAE J1637 or ASTM E-756. Damping at 38°C also occurs with center excitation measurement techniques.
- This latex is designed to be able to be formulated at high filler levels to facilitate stable coating formulations.
- This latex is non-ammonia neutralized which results in low odor formulations and is an excellent choice for paint shop applications.

(These properties are typical but do not constitute a specification)

Typical Properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>Typical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Milky white</td>
</tr>
<tr>
<td>Class</td>
<td>Acrylic Copolymer</td>
</tr>
<tr>
<td>Solids (%)</td>
<td>50 – 51</td>
</tr>
<tr>
<td>Wet Density (lb/gallon)</td>
<td>8.7 – 8.9</td>
</tr>
<tr>
<td>pH</td>
<td>8.5 – 9.5</td>
</tr>
<tr>
<td>Brookfield Viscosity (cP)</td>
<td>10 – 300</td>
</tr>
<tr>
<td>DSC Midpoint Tg (°C)</td>
<td>+16</td>
</tr>
<tr>
<td>Peak Damping Location (°C)</td>
<td>+38</td>
</tr>
<tr>
<td>Particle Size (nm)</td>
<td>155 – 185</td>
</tr>
</tbody>
</table>

Formulating
The following are suggestions and best practices to consider when developing formulations based on the ACOUSTICRYL™ SD-380 Copolymer Emulsion.

Mixing
Due to the very high viscosity of the typical sound damping coating formulation, the desired mixing equipment for these formulations are mixers that would typically be used for caulks or other paste-like, high viscosity products. We prefer a dual-blade planetary mixer to ensure the full and even incorporation of all of the ingredients in the formulation. In addition, we recommend vacuum capabilities with the mixer in order to allow for the entrained air to be pulled out of the high viscosity formulations during the mixing process to provide a smooth and consistent final product.

Order of Addition
The typical order of addition is to first mix together the wet ingredients (latex, free water, dispersant, surfactant, defoamer) followed by the addition of the solid pigments and extenders to the wet mixture. These solid ingredients should be added slowly to the wet ingredients while sufficiently mixing everything together. If solid ingredient addition during mixing is not possible, the addition of the solid ingredients (fillers, extenders, pigments,
starches, expandable microspheres) should be done in several steps with sufficient mixing between each step. The final step in the coating preparation is the fine tuning of the rheology to the required viscosity through the addition of the rheology modifier. Significant levels of rheology modifiers are typically required to create the desired rheology based on several factors of the formulation which will be elaborated on in future sections.

**Pigment Volume Concentration**
The balance between cost and performance is going to dictate the amount of filler that should be added to the formulation. Typically, higher levels of pigments and extenders will have a negative impact on the damping properties of these coatings while lower levels of pigments and extenders will generally help the damping properties within the typical recommended filler loading ranges. Coating formulations between 40% pigment volume concentration (PVC) and 65% PVC are possible with the ACOUSTICRYL™ SD-380 Copolymer Emulsion depending on the level of performance that is desired as well as the types of pigments and extenders that are used. Fillers with small particle sizes, larger aspect ratios or higher oil absorption values may limit the levels of the extenders that can be added. A good starting point is typically a 50 PVC formulation with the ACOUSTICRYL SD-380.

**Formulation Solids**
Total formulation solids will be dictated by the pigment volume concentration that is chosen. Higher PVCs will lead to higher coating solids while lower PVCs will lead to lower coating solids. A 40 PVC formulation with the ACOUSTICRYL SD-380 Copolymer Emulsion would have its maximum mass solids at 73% and its maximum volume solids at 63% while a 65 PVC formulation with the ACOUSTICRYL SD-380 would have its maximum mass solids at 85% and its maximum volume solids at 75%. In general, maximizing the total solids on both a volume basis and a mass basis will speed up the drying process during the bake and minimize possible coating imperfections that arise during the bake. As a general rule of thumb however, when formulating at elevated PVCs we typically recommend staying below mass solids of around 80% and staying below volume solids of around 65% through the addition of free water in order to ensure the maximum level of stability with the formulation. The types and shapes of the fillers will also play a role in the maximum formulation solids that can be obtained for given PVC. Using low oil absorption fillers with more regular shapes will allow for easier formulating at higher mass and volume solids compared to when high oil absorption fillers or fillers with irregular shapes are used.

**Pigments and Extenders**
The most common type of extender for these coatings is calcium carbonate due to its cost and its ability to be incorporated in high volume solids coatings easier than other types of fillers and extenders. In addition, other fillers such as mica, talc or wollastonite or clays can be used to impart unique characteristics related to damping, pumping or drying. Important properties to consider when developing the filler package are the relative sizes of the fillers, the oil absorption of the fillers and the shapes of the fillers. Larger fillers will be easier to incorporate into the coating; however, the maximum size of the filler’s particle size distribution will be dictated by the pumping and spray equipment and is typically around 300um. In general, a broad filler particle size distribution centered around 40 um has been shown to lead to the best formulation stability and still be able to be handled by typical application equipment. Titan 200 calcium carbonate meets those requirements. In addition to the importance of the larger size, low oil absorption fillers like calcium carbonate will be easier to incorporate than higher oil absorption fillers like mica or talc. Uniquely shaped fillers like mica or wollastonite are also more difficult to incorporate but can add to the damping capability of the coating due to their plate or needle-like shapes. For simplicity, our starting point formulations typically use some fraction of calcium carbonate and mica related to the PVC of the coating. Higher PVCs will require more calcium carbonate and less mica (7.5 parts CaCO₃ to 1 part mica by mass) due to the constraints of adding mica into the high
PVC formulations. Lower PVC formulations typically can tolerate significantly higher levels of mica (2 parts CaCO₃ to 1 part mica).

**Dispersants**

Dispersants are an essential ingredient for waterborne formulations in order to help with the formulation stability. We typically recommend polyacid dispersants for these systems. TAMOL™ 1254 Dispersant has been shown to have sufficient dispersing capabilities with a minimum of 0.3% active dispersant on the total fillers. Higher levels of dispersant between 0.6% and 1.0% active dispersant on total filler can also be used to impart superior mechanical stability to the formulation. Dispersants are not interchangeable with surfactants; both serve different purposes in stabilizing the formulation.

**Surfactants**

Small levels of surfactant are typically recommended in these formulations to improve the long term, heat age and mechanical stability of these formulations. TERGITOL™ 15-S-40 Surfactant has been shown to be an effective surfactant for these formulations at levels of around 0.5% active surfactant on polymer solids. The addition of significantly higher levels of TERGITOL 15-S-40 or the addition of lower EO length surfactants at the recommended use level can cause a plasticization effect for the coating which can shift the location of peak damping by a few degrees. Surfactants are not interchangeable with dispersants in the formulation; both serve different purposes in stabilizing the formulation.

**Rheology Modifiers**

In order to obtain the necessary sag resistance for these coatings which can be applied at thicknesses on vertical surfaces between 2 mm and 6 mm, the rheology modifier is one of the more important parts of any formulation. This is especially true when needing to balance the sag resistance of the coating with the ability to pump the coating with the least amount of force. Volume exclusion thickeners, like ACRYSOL™ ASE-60, offer thickening of the water phase. ACRYSOL ASE-60 Rheology Modifier also offers very quick viscosity equilibration, good shear thinning characteristics, a low yield point and a very high level of sag resistance. We recommend to not using associative as the rheology modification technique. The levels of the rheology modifiers that will be required will be dependent on the rheology targets, the rheology modifier choice, the PVC levels of the formulation and the fillers used in the formulation. The dispersants and surfactants used in the formulation will also contribute to the level of the rheology modifier that is required.

**Defoamers**

Foam generation in these high viscosity coatings should be minimized due to its impact on a range of properties from wet density to sprayability to the high temperature bake appearance. In addition to the use of mixing equipment with de-aeration capabilities, low levels of defoamer can be used to control the foam in the high viscosity coatings which will naturally want to trap any air that is brought into the coating through mixing or pigment and filler addition. Air entrapment is especially problematic with the use of certain fillers and pigments which have irregular shapes or low oil absorption values. Drew L-493 or Byk-093 defoamers are two products that have been demonstrated to reduce the foam in these coatings with levels between 0.1% and 0.2% of the total formulation.

**Colorants**

A carbon black pigment or carbon black dispersion is typically added at low levels to the formulation to give the gray appearance of the typical damping treatment. We typically use a carbon black dispersion, UCD 1530E, at 0.5% of the total formulation; however, a suitable carbon black pigment could be added to impart the same gray tone.

**Starches**

Starches are used in damping formulations which are to be baked at elevated temperatures at typical levels between 1% and 4% of the total formulation in order to impart a high
temperature viscosity boost for these coatings during the high temperature bake. Without
the starch, the rheology of these coatings will typically drop during the high temperature
bake which introduces sag and the potential for contractive forces which lead to peel away
from the substrate. The role of starch in these formulations revolves around the starch’s
insoluble to soluble transition when the coating reaches 70°C during the bake. During this
thermal transition, the starch undergoes a viscosity increase which counters any drop in
coating viscosity during the high temperature bake with these 2 mm to 6 mm thick coatings.
Starches such as Penford Gum 200 have been shown to impart the desired performance
properties compared to other starches which do not provide as much stiffening. In looking
for alternative starches, the identification of an unmodified, high molecular weight starch is
essential to obtain the greatest stiffening effect at elevated temperatures and therefore
provide the desired properties from the starch in the formulation.

Expandable Microspheres
Expandable microspheres are typically used at low levels to help with the drying of these
coatings when applied at 2 mm to 6 mm wet coating thicknesses. They function by
expanding during film formulation which creates small pores for the evaporating water to
escape through the film which allows for more uniform drying at these elevated
temperatures. Expandable microspheres such as Expancel 031WU40 (which begins to
expand around temperatures of 85°C) have been shown to impart the desired performance
properties when used with ACOUSTICRYL™ SD-380 Copolymer Emulsion at levels
between 0.15% active on the total formulation and 0.30% active on the formulation
depending on several factors of the formulation including the PVC and the types of fillers
that are used. A general rule of thumb is that higher levels of the expandable microspheres
will be required for lower PVCs or lower levels of expandable microspheres will be required
for higher PVCs. In addition to having just one expandable microsphere, having two
different expandable microspheres with Expancel 031WU40 and another microsphere like
Expancel 091DU80 (which begins expansion around 120°C) could also have benefits in
improving drying while reducing the expansion and contraction forces that develop in the
coating during the elevated temperature bake. Alternative expandable microspheres can be
found with consideration of the temperature of expansion, the temperature of collapse as
well as the expansion ratio compared to our recommendations.

Preservatives
Typical formulations with the ACOUSTICRYL SD-380 Copolymer Emulsion should have
acceptable bio-spoilage resistance without adding a preservative; however, an additional
biocide, such as KATHON™ LX 1.5% could be used at its recommended dosage to provide
additional protection.

Table 1: 50 PVC starting point formulation for the ACOUSTICRYL™ SD-380 Copolymer
emulsion. Rheology modifier levels can be modified to obtain the desired rheology
properties.
Typical Damping Profile

Figure 1: Typical damping vs. temperature profile with the above starting point formulation when tested in accordance with the ASTM E-756 test method. A base beam of 1.6 mm thick by 12.7 mm wide with a 200 mm coated length was used. A mass of 2.44kg/m² was applied to the bar and the coating was baked at 150°C for 30 minutes. The final baked coating thickness was 3.5 mm with this applied coverage. The damping data was interpolated to a constant frequency of 200Hz. Peak damping for an ACOUSTICRYL™ SD-380 Copolymer Emulsion formulation should occur around 38°C.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penford Gum 200</td>
<td>1.45</td>
</tr>
<tr>
<td>Starch</td>
<td></td>
</tr>
<tr>
<td>Expancel 031WU40</td>
<td>0.26</td>
</tr>
<tr>
<td>Expanding Agent</td>
<td></td>
</tr>
<tr>
<td>ACRYSOL™ ASE-60 (1:1 dilution)</td>
<td>1.93</td>
</tr>
<tr>
<td>Rheology Modifier</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.00</td>
</tr>
<tr>
<td>Formulation Solids (%)</td>
<td>77.4</td>
</tr>
<tr>
<td>Coating PVC (%)</td>
<td>50.0</td>
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</tbody>
</table>

Handling Precautions

Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

CAUTION! Keep combustible and/or flammable products and their vapors away from heat, sparks, flames and other sources of ignition including static discharge. Processing or operating at temperatures near or above product flashpoint may pose a fire hazard. Use appropriate grounding and bonding techniques to manage static discharge hazards.

CAUTION! Failure to maintain proper volume level when using immersion heaters can expose tank and solution to excessive heat resulting in a possible combustion hazard, particularly when plastic tanks are used.
**Storage**

Store products in tightly closed original containers at temperatures recommended on the product label. Keep from freezing – product stability may be affected. Storage temperature: 1-49°C (34-120°F). STIR WELL BEFORE USE.

**Disposal Considerations**

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Dow Technical Representative for more information.

**Product Stewardship**

Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products - from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

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