Additive Systems for Plastisols & Flexible PVC applications

Global Solution Providers

Patcham (FZC)
Contents

• Plastisol - Introduction

• Plastisol Manufacturing process

• Additives in PVC Plastisols
  
  Wetting & Dispersing Agents

  Deaerators
Patcham Laboratory (Headquarters)
PVC Plastisol

- PVC Plastisol
  PVC Plastisol are liquid dispersion systems of polyvinyl chloride and PVC copolymer resin in compatible plasticizers.

- Main Ingredients
  - PVC Resin
  - Fillers
  - Plasticizers
  - Heat Stabilizers
  - Additives
  - Solvents
Plastisol Manufacturing Process

- Add 3 quarters of liquids to the mixer and then start agitator.
- Add solids in order from fillers, blending resins, Dispersion resins and other dry ingredients.
- Mix until creamy smooth paste has been reached & temperature not above 35°C.
- Add all balance paste materials and liquids with some additional mixing.
- Deareation usually required, except foam applications.
- Total time depends on formula, volume and equipment.
Problems and Issues Related to Plastisol

<table>
<thead>
<tr>
<th>Raw Materials</th>
<th>Rheology Factors</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Long Dispersion Time</td>
<td>• High viscosity</td>
<td>• Pinholes</td>
</tr>
<tr>
<td>• Pigment Streaks/Incomplete Wetting</td>
<td>• Poor air release due to pseudoplastic rheology</td>
<td>• Air entrapment</td>
</tr>
<tr>
<td>• Flooding and floating of colorants</td>
<td></td>
<td>• Shade Variations</td>
</tr>
<tr>
<td>• Storage stability</td>
<td></td>
<td>• Low production yield</td>
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</table>

Pseudoplastic rheology
Additives in Plastisol

• Pigment Wetting and Dispersing Agents
  Pat-Add DA 815
  Pat-Add DA 948
  Pat-Add DA 2025

• Deaerators
  Pat-Add AF 5103
Pigment wetting and dispersion process

The dispersing of solid pigments into the liquid phase of a plasticiser is an important step in plastisol processing.

Proper dispersion influences several parameters like
- color / -strength
- flooding / floating
- viscosity
Pigment Wetting And Dispersion

Agglomerated/flocculated particles

Dispersion

Primary Particles

1 particle

Pigment powder

De-flocculated

>100,000 particles

Primary particles
Pigment dispersion process - Wetting

**Pigment powder:**
agglomerated particles

Added to the liquid medium:
apparent pigment volume fraction consisting of

1. Adsorbed and entrapped air
2. (Adsorbed water)
3. Pigment

**Poor wetting means:**
- high apparent solids volume fraction
- low pigment solids
- high viscosity
- low milling efficiency
Pigment dispersion process - Wetting

During the wetting step, air and moisture occurring on the pigment surface are driven off and replaced by the liquid.

Good wetting (adjusting Surface Tension liquid phase, through wetting agent):
- enabling high pigment solids
- low viscosity
- high milling efficiency
Pigment dispersion process

De-agglomeration:

- During this step, the pigment agglomerates are broken up by energy input and accordingly reduced in size.
- This mechanical separation can be achieved by dissolvers or different types of mills ‘Grinding’. The amount and the duration of the energy input are the main factors for a complete separation of primary pigment particles.
**Pigment dispersion process**

*Stabilization:*

- Whatever the actual size of the pigment particles in a grinding medium, the smaller they are the greater is their tendency to interact.
- Once the pigment particles have been optimally dispersed, they must be stabilized. By adding the dispersant on the pigment surfaces, attractive forces between the pigment surfaces can be neutralized.

Sterical stabilisation
Higher volume contributes to thicker adsorbed layer, preventing attractive forces to dominate stabilizing forces: stable dispersion!

Thickness adsorption layer preventing agglomeration ...
Pat-Add DA 815

- A multi-purpose solvent-free wetting and dispersing additive
- Its electro neutral composition enables to stabilize organic and inorganic pigments, particularly carbon blacks.
- Particularly suitable for the production of PVC Colorants/Color Master paste for PVC.
- Produce a Newtonian behavior of the material by reducing viscosity.
Pat-Add DA 815

Guide Formulation of Pat-Add DA 815 for Color Master Paste

<table>
<thead>
<tr>
<th>Raw Materials</th>
<th>Yellow Iron Oxide</th>
<th>Phthalo Blue</th>
<th>Carmine Red</th>
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<tr>
<td>Cl Number</td>
<td>PY 42</td>
<td>PB 15:3</td>
<td>PR 122</td>
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<tr>
<td>DOP</td>
<td>33.0</td>
<td>64.0</td>
<td>64.0</td>
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<tr>
<td>Pat-Add DA 815</td>
<td>2.0</td>
<td>14.0</td>
<td>14.0</td>
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<tr>
<td>Pigment</td>
<td>65.0</td>
<td>22.0</td>
<td>22.0</td>
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<tr>
<td>Total</td>
<td>100.0</td>
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<tr>
<td>SOP</td>
<td>3.0%</td>
<td>63.64%</td>
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</table>
Pat-Add DA 815

Phthalo Blue  Yellow Iron Oxide  Carmine Red
Pat-Add DA 948
HMVP Dispersing agent

• High Molar Volume polymer, 100% active dispersing agent
• Specially designed for use in EP- and PUR floorings, systems based on polyols, UPR (unsaturated polyester) or thermoplastics, such as used in, PUR foams, plastisols and gel coats
• Pigment concentrates results in low viscosity, enabling higher pigment loadings, at optimal pigment dispersion.
• FDA 21 CFR 175.300 approved (US FDA)
Pat-Add DA 948
HMVP Dispersing agent

Color Master Paste Guide Formulation

<table>
<thead>
<tr>
<th>Raw Materials</th>
<th>White TR-902</th>
<th>SP.Black 4</th>
<th>PB 15:4</th>
<th>PR 112</th>
<th>PY 83</th>
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<tbody>
<tr>
<td>DOP</td>
<td>23.20</td>
<td>55.00</td>
<td>55.00</td>
<td>60.00</td>
<td>65.00</td>
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<tr>
<td>Additive</td>
<td>1.80</td>
<td>10.00</td>
<td>7.50</td>
<td>6.00</td>
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<tr>
<td>Pigment</td>
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<td>30.00</td>
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<td>30.00</td>
<td>20.00</td>
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<tr>
<td>DOP</td>
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<td>5.00</td>
<td>7.50</td>
<td>4.00</td>
<td>11.00</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100.00</strong></td>
<td><strong>100.00</strong></td>
<td><strong>100.00</strong></td>
<td><strong>100.00</strong></td>
<td><strong>100.00</strong></td>
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<tr>
<td>% SOP</td>
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<td>33.30</td>
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</table>
Pat-Add DA 948
HMVP Dispersing agent

Color Master Paste
Pat-Add DA 948
HMVP Dispersing agent

Color Master Paste

Viscosity after one week stability at Room Temperature

<table>
<thead>
<tr>
<th>Material</th>
<th>Pat-Add DA 948</th>
<th>Reference</th>
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<tr>
<td>TiO2</td>
<td>1428</td>
<td>1493</td>
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<tr>
<td>Special Black 4</td>
<td>2104</td>
<td>1950</td>
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<td>PB 15 : 4</td>
<td>1840</td>
<td>1980</td>
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<td>PY 83</td>
<td>1692</td>
<td>1751</td>
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<tr>
<td>PR 112</td>
<td>1440</td>
<td>1841</td>
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</table>
Pat-Add DA 2025

- High performance wetting and dispersing agent
- Outstanding dispersion and stabilization of blowing agents such as ADC and Zinc Oxide, TiO₂ and fillers
- Better cell structure and uniform distribution of blowing agent in Plastisol matrix
- Low viscosity of ADC paste and thus easy handling and reduction in loss.
Pat-Add DA 2025

Dispersion of ADC Powder

<table>
<thead>
<tr>
<th>Raw Materials</th>
<th>Parts by weight</th>
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<tbody>
<tr>
<td>DOP</td>
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<tr>
<td>ADC POWDER</td>
<td>50.00</td>
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<tr>
<td>Pat-Add DA 2025</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100.25</strong></td>
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</table>
Pat-Add DA 2025

Performance as Viscosity Depressant

<table>
<thead>
<tr>
<th>Raw Materials</th>
<th>Blank</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
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<tbody>
<tr>
<td>E-PVC</td>
<td>100.00</td>
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<td>100.00</td>
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<tr>
<td>Stabilizer</td>
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<td>2.00</td>
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<tr>
<td>DOP</td>
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<td>75.00</td>
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<td>75.00</td>
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<tr>
<td>Pat-Add DA 2025</td>
<td>0</td>
<td>1.00</td>
<td>1.75</td>
<td>2.25</td>
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<tr>
<td>Filler</td>
<td>75.00</td>
<td>75.00</td>
<td>100.00</td>
<td>125.00</td>
</tr>
</tbody>
</table>

Formulation Detail:
- 1%phr Additive
- 1.75%phr Additive, 100%filler
- 2.25%phr Additive, 125% filler

![Viscosity Depressant Profile](image)
Pat-Add AF 5103

• Green Chemistry air releasing and de-airing agent for use in PVC plastisol.
• faster and consistent foam destruction including microform.
Pat-Add AF 5103

Key benefits

• Remove entrapped air during plastisol preparations
• Avoid surface defects like pin holes
• Attain smooth finish
• Work with higher volumes more easily
• No adverse effect in foamed applications
Pat-Add AF 5103

Performance as Deaerator

On mixing

After 48 hours
Disclaimer

While every effort is made to provide accurate and complete information on The PATCHAM ADDITIVES, various data may vary depending upon different raw materials, formulations, test procedures and test conditions.

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Thank you!