Additives and Heat Stabilizers for PVC Plastisol

PATCHAM

A Sustainable Approach to Modern Coating Technology.

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Patcham FZC is a well-established manufacturer of specialty additives headquartered in the United Arab Emirates. Since its inception, Patcham has steadily grown into a leading supplier of specialty additives for Paint & Coatings, Ink, PVC and Composite industries.

The company's Pat-Add range of coating additives includes wetting & dispersing agents, defoamers, slip & leveling agents, rheology modifiers. Whilst keeping focus on environmental sustainability, the company produces products using green raw materials that are APEO free and have low or no VOC.

These products are multi functional and multi compatible, which simplifies the production process, reduces the chance of errors and minimizes inventory thus improving cost effectiveness.

Patcham has built a strong manufacturing and R&D infrastructure that enables the rapid transition from concept to products. The company has strategically located technical service laboratories, offices and representatives around the world to provide the most efficient customer service. In addition, a well-developed robust supply chain network enables it to deliver its products and services to customers around the globe with minimal lead-time.

TABLE OF CONTENTS

Introduction

What is a Plastisol?

PVC Plastisol are liquid dispersion systems of polyvinyl chloride and PVC copolymer resin in compatible plasticizers. The liquids may vary in viscosity from thin milk-like fluids to heavy pastes that have the consistency of molasses.

Main Ingredients	
PVC Resin	Fillers
Plasticizers	Solvents
Additive	**Heat Stabilizers & Kickers**

Figure 1. Color Master Paste of Plastisol

Figure 2. Various Applications of Plastisols

Application

The range of plastisol applications is extremely wide, and so are the variety of production methods.

Plastisol products include the following:

- Artificial leather (e.g. gloves, boots)
- Automotive artificial leather
- Dipped goods and dip coatings (e.g. tool handholds, bar ends)
- Toys (e.g. dolls, balls, toy, animals, anatomic models for education)
- Floorings
- Wall coverings
- Roofing membranes
- Carpet backing and heavy weight coatings
- Conveyor belts

Introduction

Issues

Raw Materials - Issues

- Long dispersion time
- Pigment streaks/Incomplete wetting
- Flooding and floating of colorants
- Storage stability

Rheology Factors - Issues

- High viscosity
- Poor air release due to pseudoplastic rheology

Application - Issues

- Pinholes
- Air entrapment
- Shade variations
- Low production yield

Figure 3. Longer dispersion time

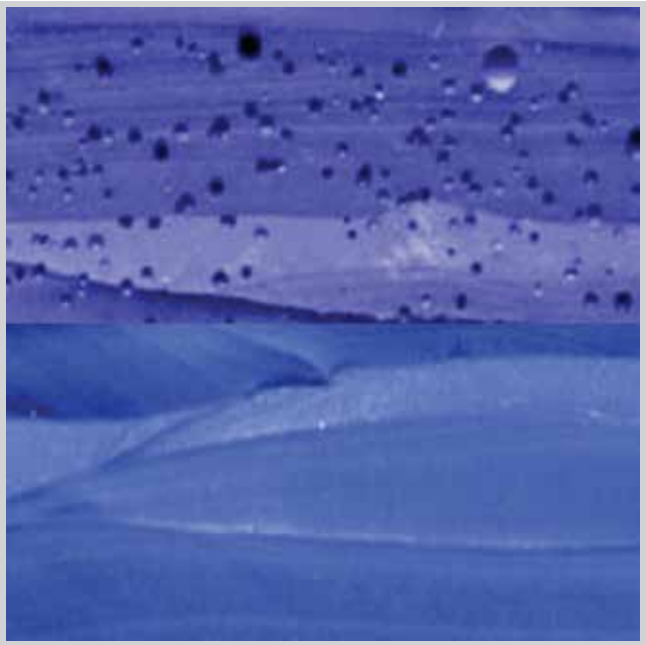


Figure 4. Air entrapment

Figure 5. Incomplete wetting/High viscosity

Patcham Additives

Wetting and dispersing additives

Dispersion of particles in plasticizer, there are deficiencies that need to be corrected through the use of additives. High viscosity, long dispersion time, flooding and unstable pigment concentrates are some of the issues related to wetting and dispersion (Figure 3 and 4).

Introduction of energy by the use of machines through high shear will break down agglomerated particles into its individual particles. If these individual particles are not fully stabilized, the finely distributed particles reagglomerate and form flocculates (Figure 6).

Pat-Add wetting and dispersing additives stabilize the dispersed particles by adsorbing onto the surface of pigments or filler particles. Electrostatic repulsion or steric hindrance (Figure 7) will govern on the stabilization of individual particles of pigments/fillers.

For the specific application, it is recommended that compatibility with the plasticizer should be considered for selecting the best additive that will be utilized.

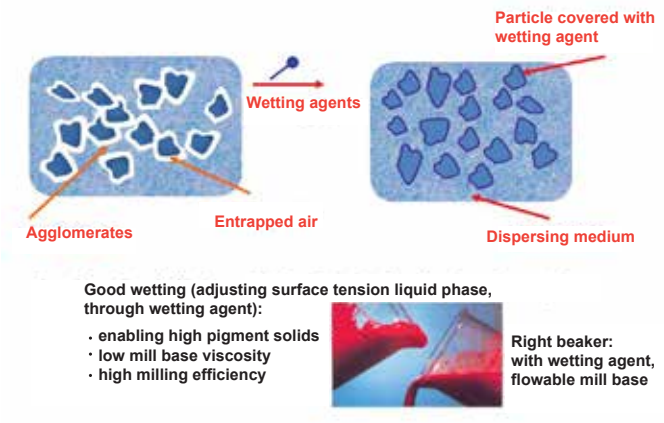


Figure 6. Wetting and dispersing process

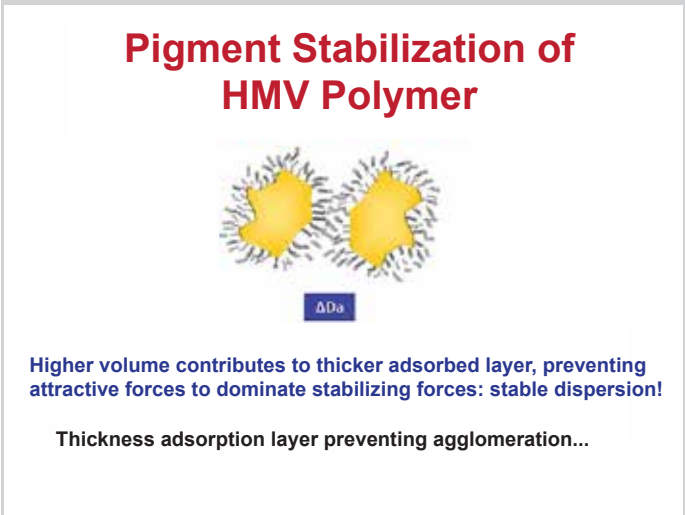


Figure 7. Stabilization of dispersed particles

Advantages of Pat-Add Wetting and Dispersing Additives:

- Higher pigment loading with constant viscosity
- Shorter dispersion time
- Excellent wetting of pigments and fillers
- Improved flow behavior
- Increase product yield
- Improved color homogeneity
- Longer storage stability of dispersions

Patcham Additives

Pat-Add DA 3225

Pat-Add DA 3225 is a HMV ultra-charge polymer technology based wetting and dispersing additive for solvent borne and solvent free applications. Designed with ultra-dense adhesion charges, providing the strongest attachment onto pigment surface.

Benefits:

- Higher pigment loading with lower and flowable viscosity
- High color strength development
- No adverse effect in end use application
- Efficient in pigment dispersion of organic, inorganic and basic black pigment
- Improves storage stability

Figure 9.
Colorants in Plastisol Application

Resin Minimal Pigment Concentrate					
Raw materials	**PY 83**	**PR 112**	**PB 15:4**	**PG 7**	**Raven 450**
DIDP	76.00	64.00	62.00	54.00	67.00
Pat-Add DA 3225	**4.00**	**6.00**	**7.50**	**10.50**	**3.00**
Synergist	-	-	-	0.50	-
Pigment	20.00	30.00	30.00	35.00	30.00
Grinding: Transfer materials to a Horizontal Bead mill, Maintain temperature 77-86°C					
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 2.
Plastisol Colorants Formulation with Pat-Add DA 3225

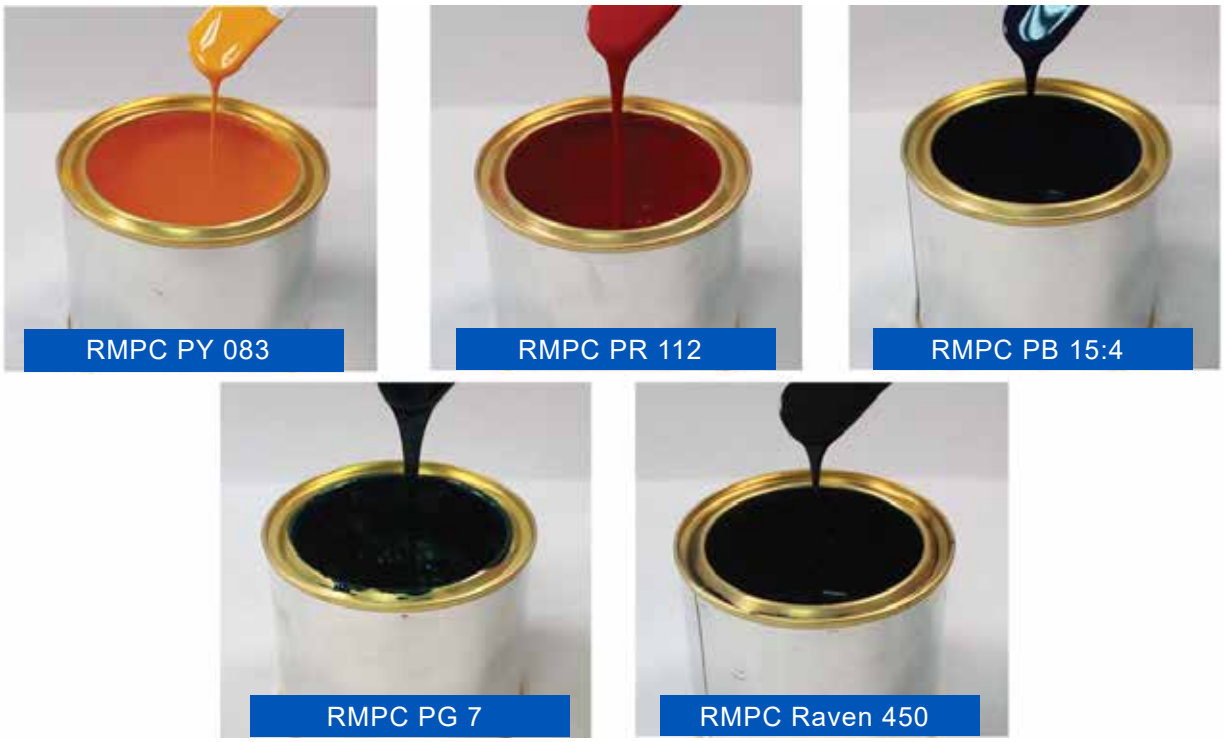


Figure 10. Colorants in Plasticizer with Pat-Add DA 3225

Patcham Additives

Pat-Add DA 895

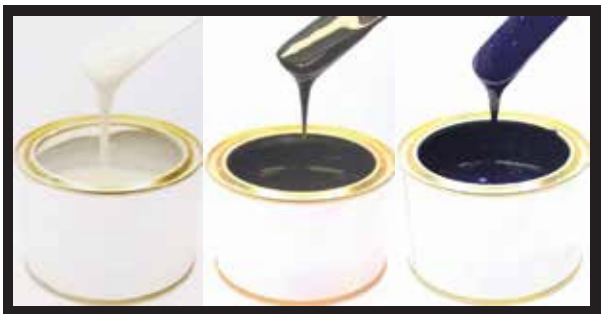
A multi-purpose solvent-free wetting and dispersing additive for PVC plastisol and thermoplastics. Its electroneutral composition enables it to stabilize organic and inorganic pigments, particularly carbon blacks.

Particularly suitable for the production of PVC Colorants/ Color Master paste for PVC. Pat-Add DA 895 creates a Newtonian behavior of the material by reducing viscosity.

Raw Materials	TiO_2 - rutile PW 6	Phthalocyanine blue PB 15:3	Yellow iron oxide PY - 42	Special black 4 - PBlk - 7	Bayferrox Red Iron Oxide 130² PR 101
	% by weight				
% SOP	**2.5**	**18.2**	**15.00**	**38.00**	**12.00**
Liquid epoxy resin	30.50	59.00	30.00	63.20	25.30
Reactive diluents (C12-C14 type)	7.50	14.90	12.30	16.00	18.50
Pat-Add DA 895	**1.50**	**4.00**	**7.50**	**5.70**	**6.00**
Aerosil 972	0.30	-	-	-	-
Pat-Add AF 35	**0.20**	**0.10**	**0.20**	**0.10**	**0.20**
Pigment	60.00	22.00	50.00	15.00	50.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 1. Guide formulation with Pat-Add DA 895

Flow behavior RMPC in Styrene free UPR



PW 6	PBlk 7	PB 15:3
9.13 Poise	47.73 Poise	33.08 Poise

Viscosity at 25°C/77°F

Tinting of UPR Colorants to White Gel Coats

2% RMPC Phthalo Blue 15:3

Initial After 24 hrs

2% RMPC PBlk 7

Initial After 24 hrs

Patcham Additives

Pat-Add DA 2025

Pat-Add DA 2025 is a wetting and dispersing agent for use in PVC plastisol.

Pat-Add DA 2025 is most effective for wetting of inorganic pigments, including titanium dioxide, extenders and blowing agents such as ADC and zinc oxide.

Figure 11. Pigment wetting of Pat-Add DA 2025

Figure 12. Pat-Add DA 2025 in three-roll mill

Raw Materials	Parts by weight
DOP	50.00
ADC Powder	50.00
Pat-Add DA 2025	0.25
Total	**100.25**

Table 3. Guide formulation with Pat-Add DA 2025

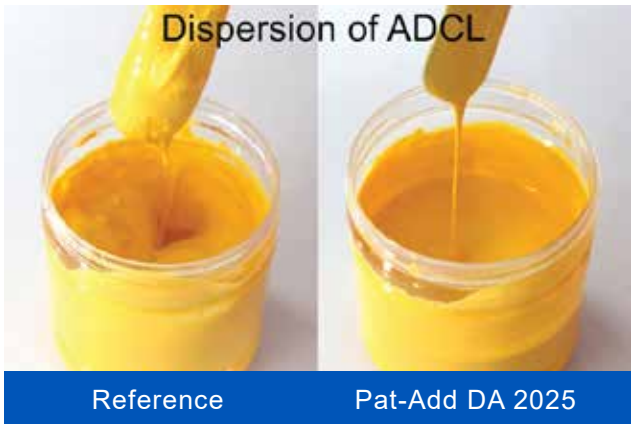


Figure 13 shows Pat-Add DA 2025 will allow higher filler loading without high viscosity build up. This will enable the formulator to make highly filled plastisol without compromising workability of the paste.

Patcham Additives

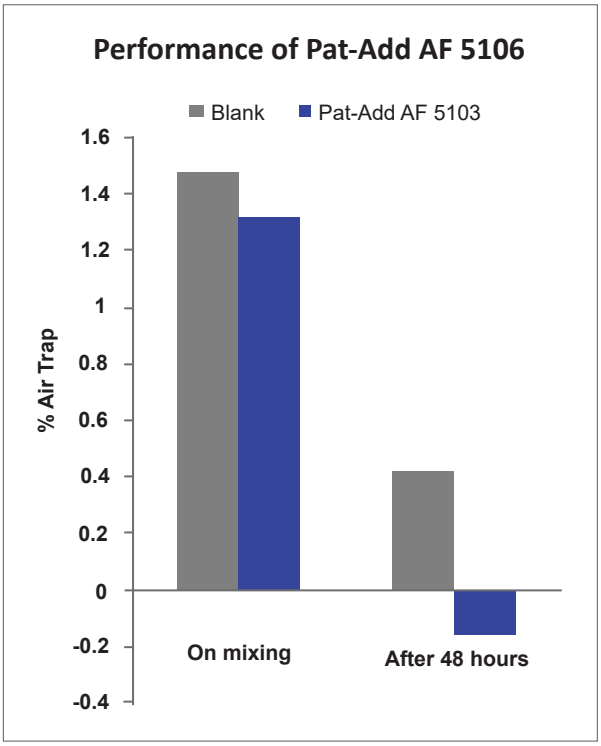
Deaerators

Pat-Add AF 5106

Pat-Add AF 5106 is a green bio based additive used as air release and de-airing agent. Pat-Add AF 5106 removes entrapped air in plastisol preparations and eliminates surface defects of cured plastisol articles.

Key benefits of Pat-Add AF 5106:

- 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 foam applications

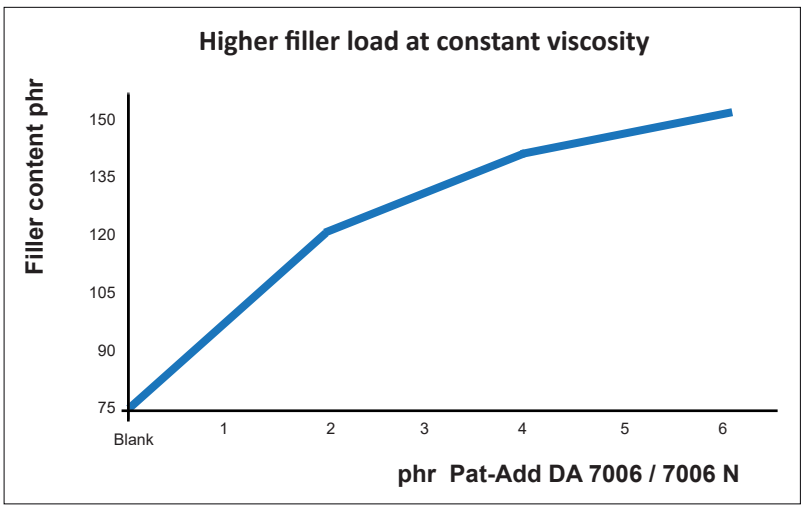


Pat-Add DA 7006 / 7006 N

Pat-Add DA 7006/7006 N is a medium volatile viscosity depressant for PVC plastisols. It keeps the plastisol mass workable over long period of storage and prevents viscosity build up. It also allows incorporating more filler by keeping same viscosity of the PVC plastisols.

Main benefits are:

- High filler loading with constant viscosity
- Extremely effective for filler wetting
- Provides excellent stability of PVC plastisols without any sedimentation



PVC Heat Stabilizer

Issues

- PVC resin needs relatively high processing temperatures
- Resin suffers heat degradation at the lower temperatures than processing temperatures
- Results in loss of properties
  - Mechanical
  - Colour

Heat Stabilizers

Type	Grade	
Barium / Zinc	Patstab 301	Low phenol, Nonylphenyl free
	Patstab 303	
	Patstab 307	
	Patstab 306	---
	Patstab 308	
	Patstab 324	
	Patstab 336	
	Patstab 355 SF	PTBBA, 2-EHA free
Calcium / Zinc	Patstab 405	PTBBA, 2-EHA free
	Patstab 411	
	Patstab 410	PTBBA, 2-EHA free Phenol free Nonylphenyl free
	Patstab 401	---
	Patstab 409	
	Patstab 415	
	Patstab CZL65	

Kickers (PVC Foam Stabilizers)

Kicker Potassium / Zinc	Patstab 701 (Fast)	Phenol free
	Patstab702 (Medium)	
Kicker Barium / Zinc	Patstab 305 (Medium/ Fast)	---
	Patstab 321K (Medium/ Fast)	Phenol free
Kicker Calcium/ Zinc	Patstab 419K (Medium)	Phenol free

PATCHAM

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