Additives for Solvent-Free Epoxy Floor Coatings

1. Introduction

Many floors of offices, factories and warehouses are coated with floor coatings. Features of a floor coating are good physical properties and a low price. 2K Polyurethane coatings and Epoxy coatings are used for these floors. Especially, Epoxy floor coatings are widely used because of their excellent durability, abrasion resistance, load bearing, impact resistance, chemical resistance, oil resistance and so on.

Recently, due to environmental issues and odor problems, solvent-free epoxy floor coatings are getting more and more popular. Solvent-free types are better for our health and have less unpleasant odors. Furthermore, using a solvent-free type, we can get a thicker coating.

On the other hand, there are a lot of issues such as foaming, poor workability and poor self-leveling since containing no solvents results in an increased viscosity and shorter pot life. Therefore, various additives are used to solve these problems.

In this document, we would like to introduce our additives which are used for solvent-free epoxy floor coatings.

2. Pigment-Wetting and Dispersing Agent

2-1. Typical properties of DISPARLON DA-325

Table-1

Appearance	Light yellow to amber, viscous liquid
Active component	Amine salt of polyether phosphate
Non-volatile matter	95% by wt.
Acid value	14
Amine value	20

The pigment-wetting and dispersing agent DISPARLON DA-325 is a solvent-free polymer type dispersant. DA-325 is composed of a phosphate group for absorbing onto pigments and a polyether part for compatibility. The polyether part extends in resins and creates a steric hinderance repulsion effect. Therefore DA-325 is effective for the wetting and dispersing of pigments.

2-2. Wetting and dispersing effects of DA-325

This is the dispersing test result of DA-325 in a solvent-free epoxy floor coating which contains talc as the body pigment. Without dispersant, pigment particles flocculate and cause an increased viscosity. The dispersant wets the pigments, prevents pigment flocculation and provides decreased viscosity. Figure-1 shows the flow curves of the floor coatings containing DA-325. DA-325 decreased the viscosity, and provided "Newtonian flow" at a dosage level of 2% or more. As shown in Photo-1, DA-325 improved the fluidity of the paint. Thus DA-325 can make pigment dispersion easy at the production stage, and improve the self-leveling properties during the paint application.

Table-2 Formulation

Component	Parts
jER 815 (Mitsubishi Chem.)	75
Talc #1 (Takehara Kagaku)	75
DA-325	X

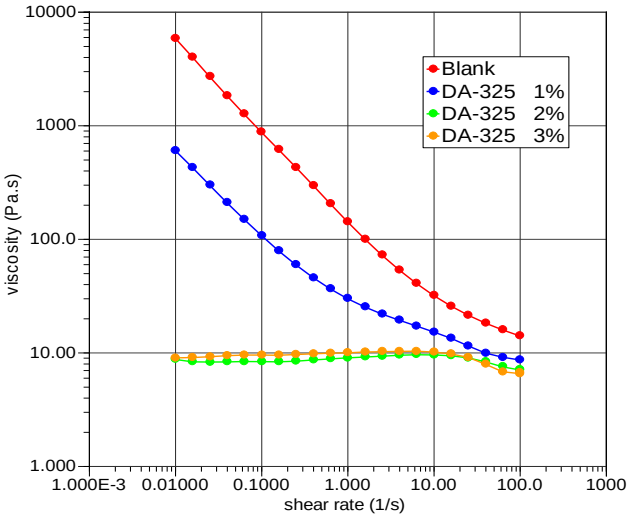


Figure-1 Flow curve change by DA-325

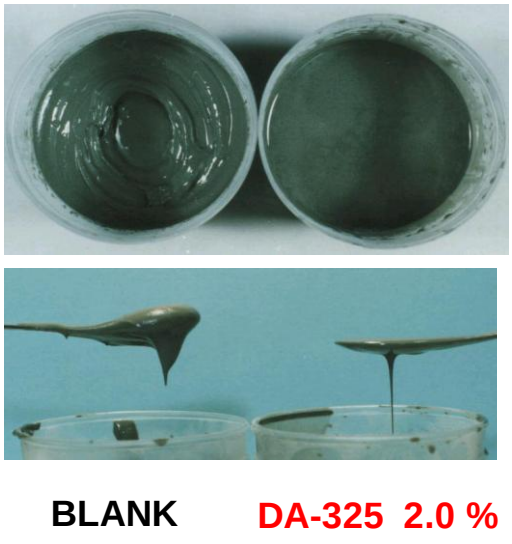


Photo-1 Fluidity of the paint improved by DA-325

3. Defoamer

3-1. Typical properties of DISPARLON defoamers

Table-3

	SPX-20	SPX-21	SPX-44
Appearance	Colorless to light yellow liquid		
Active component	Vinyl polymer	Acrylic polymer	Silicone
Active %	20%	20%	1%
Solvent	Solvent naphtha Butyl acetate	Solvent naphtha Xylene	Ethyl acetate

DISPARLON SPX-20 and SPX-21 are Vinyl / Acrylic polymer type defoamers. SPX-20 and SPX-21 are suitable for high polar resin systems like Epoxy resins and they have leveling properties as well as defoaming properties.

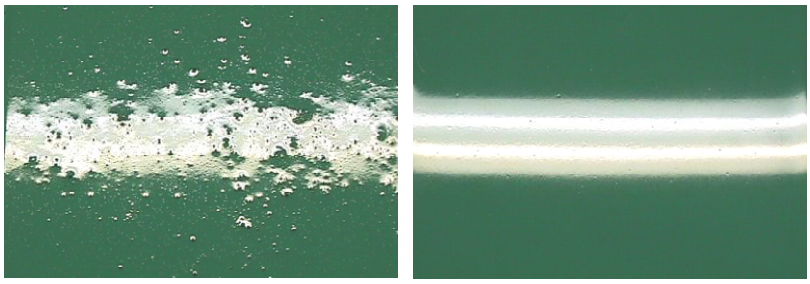
DISPARLON SPX-44 is a silicone type defoamer. SPX-44 has a strong defoaming effect, can be used in a wide range of paints and has no influence on the film clarity.

3-2. Defoaming effect of DISPARLON defoamers

This is the defoaming test result of DISPARLON defoamers in a solvent-free epoxy floor coating. Compared to the Blank, SPX-20 showed an excellent defoaming effect. (Photo-2)

Table-4 Formulation

Component	Parts
EP-4510 (Adeka Corp.)	50.0
$CaCO_3$	35.0
Talc	5.0
TiO_2	7.0
Phthalocyanine green	1.5
Iron oxide yellow	1.5
SPX-20	1.0
EH-428W (Adeka Corp.)	20.0



BLANK **SPX-20 1%**

Photo-2 Defoaming effect of SPX-20

Next is the defoaming and transparency test result in an Epoxy clear topcoat. SPX-44 was superior to Additive A (competitor) regarding defoaming property and clarity. (Photo-3)

SPX-44 can be used in an Epoxy clear topcoat formulation.

Table-5 Formulation

Component	Parts
jER 828 (Mitsubishi Chemical)	90
SY-40M (Sakamoto Yakuhin)	10
Defoaming agent	0.5
DOCURE KH-816 (Kukdo)	58.0

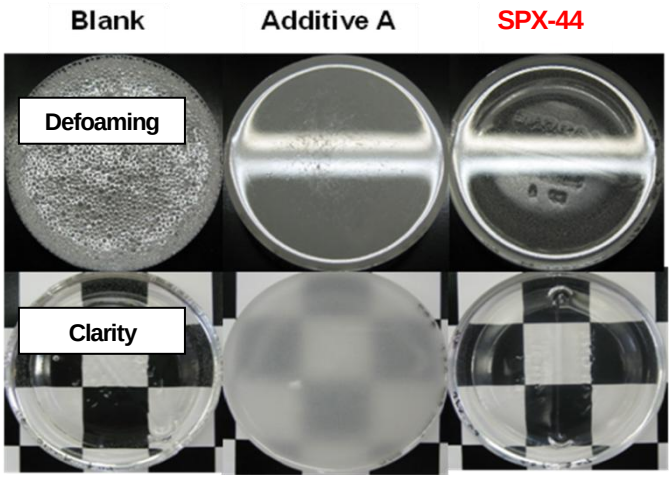


Photo-3 Defoaming and Clarity of SPX-44

4. Combination of Dispersant and Defoamer

Combining a dispersant and a defoamer has a synergistic effect.

Formulation-1

Table-6

Component		Parts	Function	Supplier
Part A	YD114E	100	Epoxy resin	Kukdo
	CR-93	5	TiO_2	Ishihara industrial
	Talc	40	Filler	Takehara chemical
	DA-325	3.5	Dispersant	Kusumoto Chemicals
	SPX-20	1.5	Defoamer	Kusumoto Chemicals
Part B	KH816	55	Hardener	Kukdo
Part C	FUSELEX 100~200M	80	Silica	Tatsumori
	FUSELEX 60~100M	100	Silica	Tatsumori

Figure-2 shows flow curves of Part A. DA-325 decreased the viscosity and gave flow curves close to a Newtonian flow. SPX-20 didn't affect the paint flow property.

As shown in Photo-4, DA-325 reduced viscosity and made air-releasing easier, but didn't have defoaming property so the film appearance of DA-325 was similar to Blank. SPX-20 defoamed the film well, but was not perfect. However, the combination of DA-325 and SPX-20 provided an excellent film. This is because DA-325 which reduces viscosity and makes air-releasing easier helps the defoaming effect of SPX-20. Furthermore, lower viscosity and the leveling effect of SPX-20 enhanced the self-leveling properties of the paint and improved the film appearance.

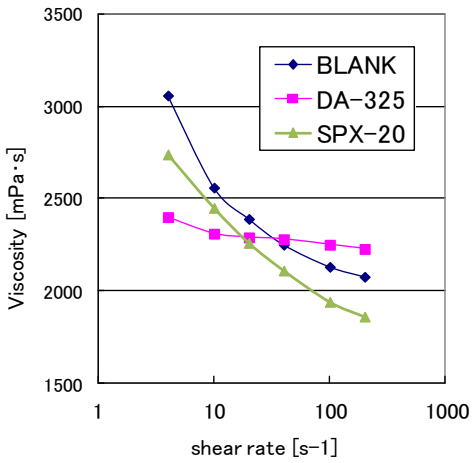


Figure-2 Flow curve
(Part A)

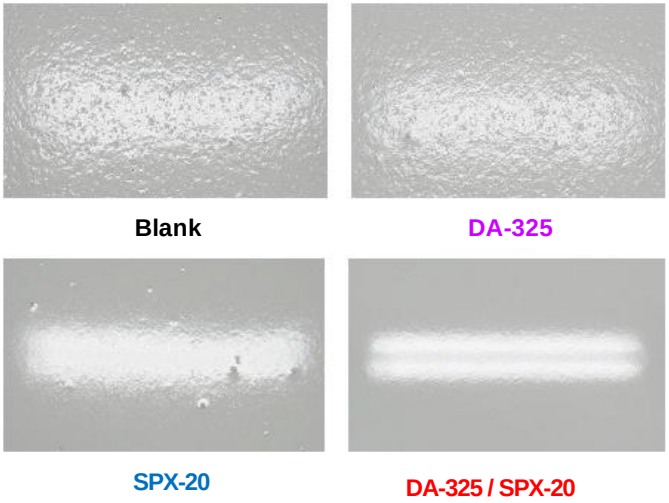


Photo-4 Film appearance

Formulation-2

Table-7

Component		Parts	Function	Supplier
Part A	EPOTEC YD128	85	Epoxy resin	ADTIYA BIRLA
	SY-40M	15	Glycidyl ether	Sakamoto Yakuhin Kogyo
	CR-93	5	TiO_2	Ishihara industrial
	Talc	40	Filler	Takehara chemical
	Dispersant	X		
	Defoamer	Y		
Part B	Versamine C60N	60	Cycloaliphatic amine	Cognis

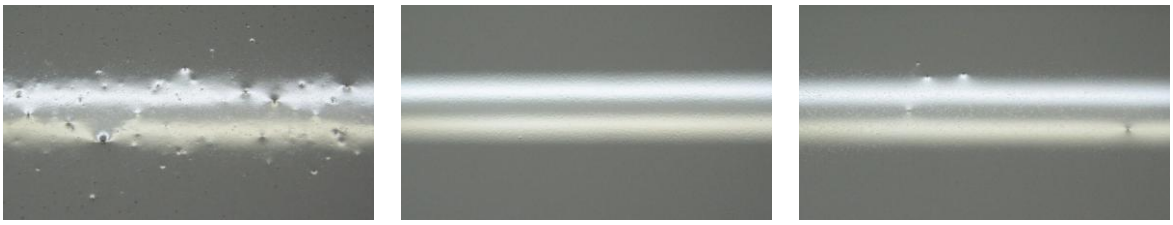


Photo-5 Film appearance (sop% : solid % on total pigment)

In this formulation, the combination of DA-325 and SPX-21 provided an excellent film, and was superior to the combination of competitive Dispersant A and competitive Defoamer A.

Figure-3 shows the mechanism of the synergetic effect of a dispersant and a defoamer.

Foam in a fluid floats to the surface and then breaks up caused by the defoamer particles. However, if the viscosity of a coating solution is high, the foam floating rate is slow, therefore, the film is crosslinked before foam reaches the surface. Thus the defoaming of a high viscosity fluid is very difficult.

A dispersant reduces the viscosity of a coating and provides a Newtonian flow, therefore, helps the air-release and the defoamer can break foam bubbles on the surface efficiently with the help of the dispersant. So the combined use of a dispersant and a defoamer has the synergetic effect.

Furthermore, lower viscosity provided by a dispersant is good for the self-leveling of a floor coating. A leveling agent or a defoamer which has leveling effect (e.g. SPX-20 / SPX-21) also helps the self-leveling.
The combination of a dispersant and a defoamer provides excellent film surfaces.

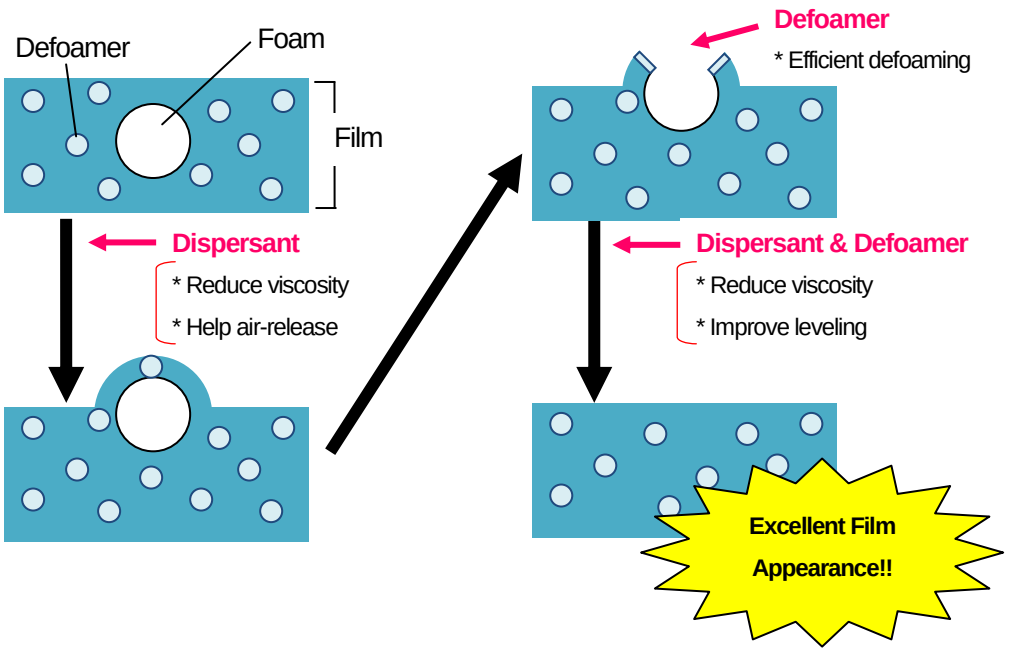


Figure-3　Mechanism of the synergetic effect of a dispersant and a defoamer

As mentioned in this document, the combination of different kind of additives is very effective to get an excellent appearance of Epoxy floor coatings.