MINIFIBERS, INC.

Evaluation of Low Viscosity Epoxy formulations using SHORT STUFF® ESS5F

2022

Purpose

To evaluate Short Stuff® HDPE fibers as a Fumed Silica replacement in a "low" viscosity Industrial Epoxy coating.

TEST DESCRIPTION

To evaluate viscosity performance of an unpigmented industrial epoxy formulation by replacing Fumed Silica with SHORT STUFF® ESS5F as rheology control. Standard commercial "Low Viscosity" Bis A epoxy and a cycloaliphatic amine hardener were selected. Initial Viscosity, visual color evaluation and gel time were evaluated.

Low Viscosity Epoxy Formulations

Product	Description	Parts by weight F S Control	Parts by weight Experimental ESS5F	Supplier
Epoxy Resin	Araldite® GY 507	100.0	100.0	Huntsman
Coloring	White Dispersion	14.0	14.0	Heubach®
Coloring	Black Dispersion	4.0	4.0	Heubach®
Curing Agent	Amine Cycloaliphatic Hardener	50.0	50.0	Huntsman
Fibers	SHORT STUFF® ESS5F	---	**0.6 %** On total formulation	MiniFIBERS, Inc.
Silica	Aerosil®200	**1.2%** On total formulation	---	Evonyk
Deaerator	Airex 931	0.5% On total formulation	0.5% On total formulation	TEGO®

SHORT STUFF® Physical Properties

Grade	ESS5F
Average Fiber Length (mm)	~0.1
Fiber Diameter (µm)	5
Surface Area (m^2/g)	12

Experimental:

Step 1.

To prepare two low viscosity mixtures with Fumed Silica as control and ESS5F as the experimental sample.

First step is to add half of the deaerator and both color dispersions to each mixture Part B (Hardener) while mixing under low shear. Add Fumed Silica to CONTROL mixture. Continue mixing both solutions for 20 minutes at a shear speed of 150 and add the remainder deaerator.

Step 2.

In a separate receptacle, weigh the low viscosity epoxy resin (Part A). Gradually blend in ESS5F at a shear speed of 150 rpm. and mix for 20 minutes.

Measure Viscosity of Part B Control containing Fumed Silica and Part A experimental containing ESS5F.

Step 3.

Mix Parts A and B. 2:1 Parts by Weight.

Results:

Appearance with Fumed Silica and ESS5F Before Cure

Epoxy with Fumed Silica (1.2% by Wt.) **Hardener with ESS5F (0.6% by Wt.)**

Epoxy resin Part A **Epoxy resin with ESS5F (0.6%)**

Initial Viscosity:

	Fumed Silica (Control)	ESS5 (Experimental)
Brookfield Viscosity @25°C Spindle #3, Speed 20	**1,600 cps**	**1,200 cps**

GEL TIME Measurements:

Control Formulation: Fumed Silica

Materials	% by Wt.
Araldite® GY 507+ Aerosil® 200 (1.2%)	100
Parte B Cycloaliphatic Amine	50
Gel Time 100 g, 24 °C, min	**29**

Experimental Formulation: ESS5F

Materials	% by Wt.
Part A – Araldite® GY 507 (0.6%)	100
Part B- Cycloaliphatic Amine + ESS5F	50
Gel Time 100 g, 24 °C, min	**29**

Cured Appearance (10 gram trays)

Control + Aerosil® 200 (1.2%)

Experimental + ESS5F (0.6%)

Drawdown over glass substrate

Control + Aerosil® 200 (1.2%)

Experimental + ESS5F (0.6%)

Summary of Observations:

- Aerosil® 200 Control and ESS5F Experimental require a similar average time of 20 min to disperse into solution.
- ESS5F displayed a slightly lower initial viscosity (@ 50% less by weight).
- The Gel Time for both samples was equal at 29 minutes.
- The color development of the ESS5F experimental sample was improved vs the Aerosil® 200 control.
- The drawdown over glass for the experimental prepared with ESS5F provided a smooth appearance. The drawdown containing Aerosil® 200 displayed some large defects in the film. Additional deaerator, or longer mixing time may be may be required.
- Similar overall flexibility for both the Aerosil® 200 control and the ESS5F experimental sample was observed.

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