Fibergrate
Composite Structures

TECHNICAL REPORT

Evaluating the Durability of Fibergrate® FRP Grating in Extreme Temperatures

July 16, 1998

Abstract

An impact resistance study of molded fiberglass reinforced plastic gratings at ambient, elevated and cryogenic temperatures. Gratings are evaluated with respect to retention of load/deflection after impact and comparative, localized damage in the impact zone. A fixed 360 pound electric motor, dropped from a height of 6' to simulate an industrial accident was used to impact the grating. The performance of the grating is further explained in the results.

Introduction

Fiberglass reinforced gratings may be subjected to an extreme range of service temperatures. Presented herein is the outcome of a series of tests on Fibergrate's resin systems in square mesh molded grating. The performance of the gratings are explained in the results and tables of the report.

Procedure

1. Size: 41" x 41" – closed bar
2. Mesh: 1-1/2" deep, 1-1/2" square mesh molded grating
3. Resins: Premium grade Fibergrate® Polyester IFR, premium grade vinyl ester Vi-Corr® and general purpose Corvex®; general purpose Chemgrate® Polyester CP-84, and premium grade vinyl ester VE-25.
4. Three samples of each resin system were tested in ambient (between 75°F and 80°F), elevated (200°F) and low (-30°F) temperatures. Retention of load/deflection and impact damage are presented as averages of the three tests.
5. All samples of each grating type were cut from one large grating panel.
6. The samples are center loaded, concentrated load prior to and after impact to 1000 lbs.
7. Impact areas are measured from visual inspection and retention of modulus recorded.
8. Each grating was drilled and fitted for a temperature probe at an intersection.
9. Elevated temperature gratings were placed in an oven for two hours at 250°F and impacted at 200°F.
10. Cryogenic temperatures were achieved by packing the sample in an insulated box with dry ice.
11. The samples were impacted at center span (36" clear). Each sample was mounted in test frame 10" above the floor to allow maximum deflection at impact. The load support beams provided 1/2" of bearing support on 2 sides.

Results

The results clearly demonstrate superior performance at all temperatures in the vinyl ester system due to the high elongation and toughness of the vinyl ester polymer. Polyesters demonstrated excellent resistance to impact and capability of servicing typical industrial applications at extreme temperatures. Damage to the grating changes with temperature (Table 1). Ambient temperature damage is a combination of small compressive fractures, matrix fractures, chip outs, and fibrous delamination in the strike zone. Gratings impacted at elevated temperatures actually had less damage than ambient and cryogenic impact. This is due to the increased flexibility at higher temperatures. Gratings tested at -30°F showed greater physical damage; however, they retained excellent load/deflection properties (Table 2). All gratings were serviceable after impact and would provide adequate support and chemical resistance until the impacted area could be replaced. Replacement urgency will be dictated by the chemical exposure and traffic demand. The gratings would not require replacement in mildly corrosive environments. The test successfully demonstrates that fiberglass reinforced molded grating is capable of servicing a broad range of temperatures without significant loss of physical properties. Given that there is no sophisticated link between laboratory impact test results and the behavior of real applications, this data will provide considerable benefit to design and material selection.

TABLE 1

RESIN	TEMPERATURE	MENISCUS CRUSHED/ SMALL CHIP OUTS	GLASS DELAMINATION
IFR	Ambient	6” x 8”	0
	200°F	6” x 8”	0
	-30°F	10” x 10”	1” x 1-1/2” (1 area)
Vi-Corr®	Ambient	6” x 8”	0
	200°F	5” x 7”	0
	-30°F	6” x 6”	0
Corvex®	Ambient	6” x 8”	0
	200°F	10” x 12”	1-1/2” x 2” (1 area)
	-30°F	10” x 8”	2” x 2” (2 areas)
CP-84	Ambient	6” x 8”	No Data Available
	200°F	6” x 8”	No Data Available
	-30°F	14” x 10”	No Data Available
VE-25	Ambient	6” x 6”	No Data Available
	200°F	6” x 6”	No Data Available
	-30°F	8” x 8”	No Data Available

TABLE 2

Retention of Modulus

Resin	Load 100 lbs	Load 200 lbs	Load 300 lbs	Load 500 lbs	Load 1000 lbs
IFR	94.14%	96.11%	98.30%	95.37%	95.50%
Vi-Corr®	102.00%	102.50%	101.40%	100.00%	97.88%
Corvex®	94.00%	94.30%	93.20%	92.10%	92.11%
CP-84	88.86%	90.00%	88.43%	87.37%	81.50%
VE-25	94.00%	94.30%	93.20%	92.10%	92.11%

Retention After Impact at 200°F

Resin	Load 100 lbs	Load 200 lbs	Load 300 lbs	Load 500 lbs	Load 1000 lbs
IFR	86.02%	82.00%	85.85%	84.03%	84.29%
Vi-Corr®	86.40%	88.77%	89.06%	87.81%	88.38%
Corvex®	77.00%	78.00%	78.70%	78.90%	74.29%
CP-84	66.02%	62.00%	65.85%	69.03%	74.29%
VE-25	77.00%	78.00%	78.70%	78.90%	79.00%

Retention After Impact at -30°F

Resin	Load 100 lbs	Load 200 lbs	Load 300 lbs	Load 500 lbs	Load 1000 lbs
IFR	95.57%	95.11%	96.15%	96.34%	95.00%
Vi-Corr®	107.00%	101.65%	102.22%	102.33%	102.28%
Corvex®	95.00%	94.00%	93.50%	93.20%	92.10%
CP-84	93.57%	92.11%	86.15%	86.34%	85.00%
VE-25	95.00%	94.00%	93.50%	93.20%	92.10%