National Casein Adhesive Evaluation
Heat Performance

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OBJECTIVE

The objective of this project was to evaluate the heat resistance of membrane pressed thermoformed vinyl panels manufactured by the Natural Resources Research Institute (NRRI) using a polyurethane dispersion (PUD) adhesive mix supplied by National Casein Company.

METHODS AND MATERIALS

National Casein supplied one adhesive for use in manufacturing rigid thermoformed (RTF) panels in the NRRI Membrane Press Technology Center. The adhesive was identified as number 48-50-1. It was a non-catalyzed adhesive.

The adhesive was applied to routed medium density fiberboard (MDF) manufactured by UniBoard Canada. A high volume low pressure (HVLP) Binks Mach 1 spray gun was used to spray the adhesive onto the MDF. Two spray passes of adhesive were added to each panel edge resulting in a wet mil thickness of 5-7 mils. Approximately 2-4 wet mils of adhesive was added to the face of the panel using recommended spray techniques. The panels were then lifted from the stack and allowed to air dry for a minimum of one hour and a maximum of two hours. The board sizes used during this project were 3/4- x 10- x 13-in and 3/4- x 16- x 24-in.

The routed doors were covered with a sheet of Reneer Ontario 12 mil polyvinyl chloride (PVC) thermoforming vinyl. Thermoforming was completed using commercial pressing parameters. The prewarm cycle length was 20 seconds and the pressure cycle was 50 pounds per square inch (psi) of air pressure for 50 seconds. The cooling cycle length was 20 seconds. The internal membrane temperature was set at 275°F (135°C) to achieve edge temperatures of approximately 170°F (77°C), respectively. This temperature was verified with paper thermometers placed on the vertical edge of the board. Following the completion of the laminating cycle, the doors were removed from the tray, stacked individually upside-down and allowed to completely cool before trimming.

Samples (5- x 5-in) for heat testing pieces were cut from each panel corner. Testing was completed according to the NRRI heat performance standard procedure NRRI 96-1. All four corners were retained for heat testing at NRRI. The samples were labeled according to the adhesive type and membrane temperature on the back side. The uncut edges were labeled A and B for reporting purposes during the test.

A forced air oven was preheated to 170°F (77°C). The specimens were then placed in the oven for 30 minutes at 170°F (77°C). One tray of specimens was removed at a time and evaluated for edge creep of the vinyl. A magnifying eyepiece with a scaled reticle was used to measure deformation of the foil at the bottom edge. Then the temperature was increased in 5°F increments until a failure on both edges was recorded. An average of the two sides was taken to give a failed temperature for each piece. Failure was defined as foil deformation of $\geq$0.2 mm (length of visible wood) or other significant foil movement.

RESULTS AND DISCUSSION

This adhesive was easily sprayed and cleaned-up. The green colorant in the adhesive formulation allows for a better view of the adhesive on the board. The viscosity of the sprayed adhesive on the MDF sample was too high to achieve adequate leveling. This would cause telegraphing when pressing thinner films. A smooth glue film could only be achieved by applying a wet glue thickness of 5-6 mils on the face of the board.

Table 1 shows the mean heat resistance and mean vinyl creep of each panel manufactured during the trial. All panels were placed in the 170°F (77°C) oven. After 30 minutes, the specimen temperature had reached at least 160°F but not 170°F (77°C), as indicated by paper tape thermometers placed on a few specimens to monitor specimen temperature throughout the test. All specimens showed complete failure after the first 30 minutes in the 170°F (77°C) oven.

Table 1.--Heat resistance testing results for National Casein adhesive.

Panel #	Sample	Adhesive	Board Size (in.)	Failure Temperature (°F)			Temp Failure by board size (°F)
				Side A	Side B	AVG	
1	1	48-50-1	10x13	170	170	170 (76.7°C)	170
	3			170	170		
2	1			170	170		
	3			170	170		
3	1		16x24	170	170		170
	3			170	170		
4	1			170	170		
	3			170	170		

Note: Samples were placed in an oven at 170°F (77°C). After 30 minutes all samples showed failure. Heat tapes indicated a sample temperature of 160°F (71°C) had been achieved.
Vinyl used was 12 mil Reneer Ontario.
Boards 1, 4, 5, and 6 were sent to National Casein.