FILM TRANSFER TECHNOLOGY ADVANCEMENTS FOR COMPOSITES

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Abstract

The composite industry has been driven to reduce the cost of composite parts. The Film Transfer Technology allows the manufacturer to increase the value of manufactured parts. The Film Transfer Technology expands the manufacture's capability to coat, protect, and produce products with printed images during the production process. For example, a manufacturer can immediately produce a wood grain panel at no capital cost.

The Film Transfer Technology is applicable for SMC, BMC, Infusion and open mold manufacturing processes. The coating provides protection to the end product and image in chemical, abrasive, and outdoor environments. Thus, the Film Transfer Technology increases the composite manufacturer's capability to sell decorative products within the Marine, Transportation, and Architectural markets at a higher value.

Background

Coating composite parts after they are manufactured presents a challenge. Do to the release agents and the surface density, the part requires surface preparation before coating. This is a labor intensive process.

There are means of coating in mold during the manufacturing process. The process of in mold coating requires retooling of the mold to allow injection ports for the coating. The SMC or BMC is entered into the mold and pressed out. At some point in time before the part is fully cured, the mold is partially opened to inject the coating into the mold. The mold is then once again pressed back onto the part to complete the cure of the part, and to allow the coating to crosslink to the part.

This process does present some challenges. The number and placement of the coating injection ports within the mold, the determination of when to inject the coating, and the total coating cost are some challenges in mold coating.

Coating a product provides protection and aesthetics' to the end part. The amount of value added to a coated part varies. The main purpose of coating a part is protection of the part, but it is the aesthetics of the coating which helps add value to the part. The Film Transfer Coating can address both protection and aesthetics for the end manufacturer.

Film Transfer Hard Coating (FTHC)

The Film Transferable Hard Coating (FTHC) is a unique film that has specialized hard coating on one side. The hard coating that is applied to the film has unsaturated sites that are available to crosslink to a polymer. As an unsaturated polymer going through the curing process comes in contact with the hard coating on the film, the hard coating upon the film will crosslink to the polymer. The film acts as a transfer agent allowing the coating to transfer from the film to the cured part.

The FTHC can eliminate the downstream operations of hard coating thermoset parts. During the curing process of an unsaturated polyester resin, the FTHC will transfer the hard coating onto the cured part. The FTHC can be utilized in compression molding processes with BMC and SMC resin system. The FTHC can be utilized in infusion operation. And the FTHC can be utilized in open mold operation. Thus, the Film Transfer Technology increases the manufacturer's capability to coat and protect parts during the manufacturing process.

The FTHC must be orientated in a manner in which the hard coating will be in contact with the resin. During the curing process of the polyester resin, the Film Transferable Hard Coating will transfer on to the surface of the polyester part. The film can remain on the cured part as a protective measure for transportation or upstream manufacturing processes. When it is necessary to remove the film, the Hard Coating will remain on the cured part.

Primary Features of the Film Transferable Hard Coating (FTHC)

~ Coat parts during the manufacturing process
~ Immediate in plant coating capability at minimal capital cost
~ Zero VOC in plant coating capability
~ Increased Durability of Parts (Scratch resistance, Chemical resistance)
~ Increase Weatherability of Parts (Increased life span of parts)

The Hard Coating Properties

Adhesion:	4-5 (ASTM D3359)
Transmission:	Greater than 92%
Haze:	Less than 1.00%
Pencil Hardness:	Greater than 3H
	#OOOO Steel wool resistance
Taber Abrasion:	CS-10F wheels, 500g loads each for 100 cycles
	Change in haze is less that 5%
Chemical Resistance:	Ketones (Acetone, Cyclohexanone)
	Alcohols (N-Propyl Alcohol, Iso-Propyl Alcohol)
	Alkaline Cleaners
	Acidic Cleaners

Weatherability

The main function of a coating is to provide protection of the part. The Film Transfers Hard Coating's ability to withstand abrasion and chemical environment is a perceived value. The Film Transfers Hard Coating capability to withstand harsh outdoor environments is an added value by increasing the life span of the part. *Table I* lists the Xenon arc weatherablity data for the different types of Film Transfer Hard Coating upon various unsaturated polyester resins. This data was compiled after the samples were subjected over 7000 hours in a Xenon Arc Weatherometer.

The FTHC-TX is the standard UV inhibited coating. The FTHC-CUV is a higher level of UV inhibited coating. The FTHC-TX was tested upon a polyester resin with UV absorbers and a standard general purpose (GP) resin to determine the increased benefit of the FTHC-TX. The FTHC-CUV was tested upon a general purpose resin to determine the increased weatherablity between the FTHC-CUV and the FTHC-TX.

Table I: Xenon Arc Weatherometer Data

WR Xenon Weatherometer Data
Total Hours: **7034**
Cycle Type: **Arizona (Dry)**
Measurement Type: **Reflectance**

Sample	Illum	L*	a*	b*	DL*	Da*	Db*	DE*
FTHC-TX / UV resin	D65	24.807	-0.070	-0.598	-0.187	0.008	-0.073	0.200
	A	24.756	-0.227	-0.647	-0.191	-0.014	-0.075	0.206
	CWF 2	24.775	-0.059	-0.687	-0.190	0.012	-0.086	0.209
FTHC-CUV / GP resin	D65	25.413	-0.066	-0.532	0.419	0.012	-0.007	0.419
	A	25.367	-0.200	-0.578	0.420	0.014	-0.006	0.420
	CWF 2	25.382	-0.005	-0.610	0.417	0.016	-0.010	0.417
FTHC-TX / GP resin	D65	25.538	-0.068	-0.590	0.544	0.010	-0.064	0.548
	A	25.488	-0.216	-0.640	0.540	-0.002	-0.068	0.545
	CWF 2	25.505	-0.061	-0.674	0.540	0.010	-0.073	0.545

Transfer of Printed Images

The ability to transfer a coating from a film to a cured part has been expanded upon by the ability to print upon the film. The FTHC technology was developed to also have material printed upon it. The ability to print, transfer and protect a printed image on to the cured substrate can expand the manufacturer's capability.

The manufacturer can easily increase the value of a product by having an image placed on the product. For example, a wood grain panel would sell for a higher price than a plan white panel.

Figures 1-6 gives an illustrated example of utilizing the Film Transfer Hard Coating with a wood grain image in a compression molding process.

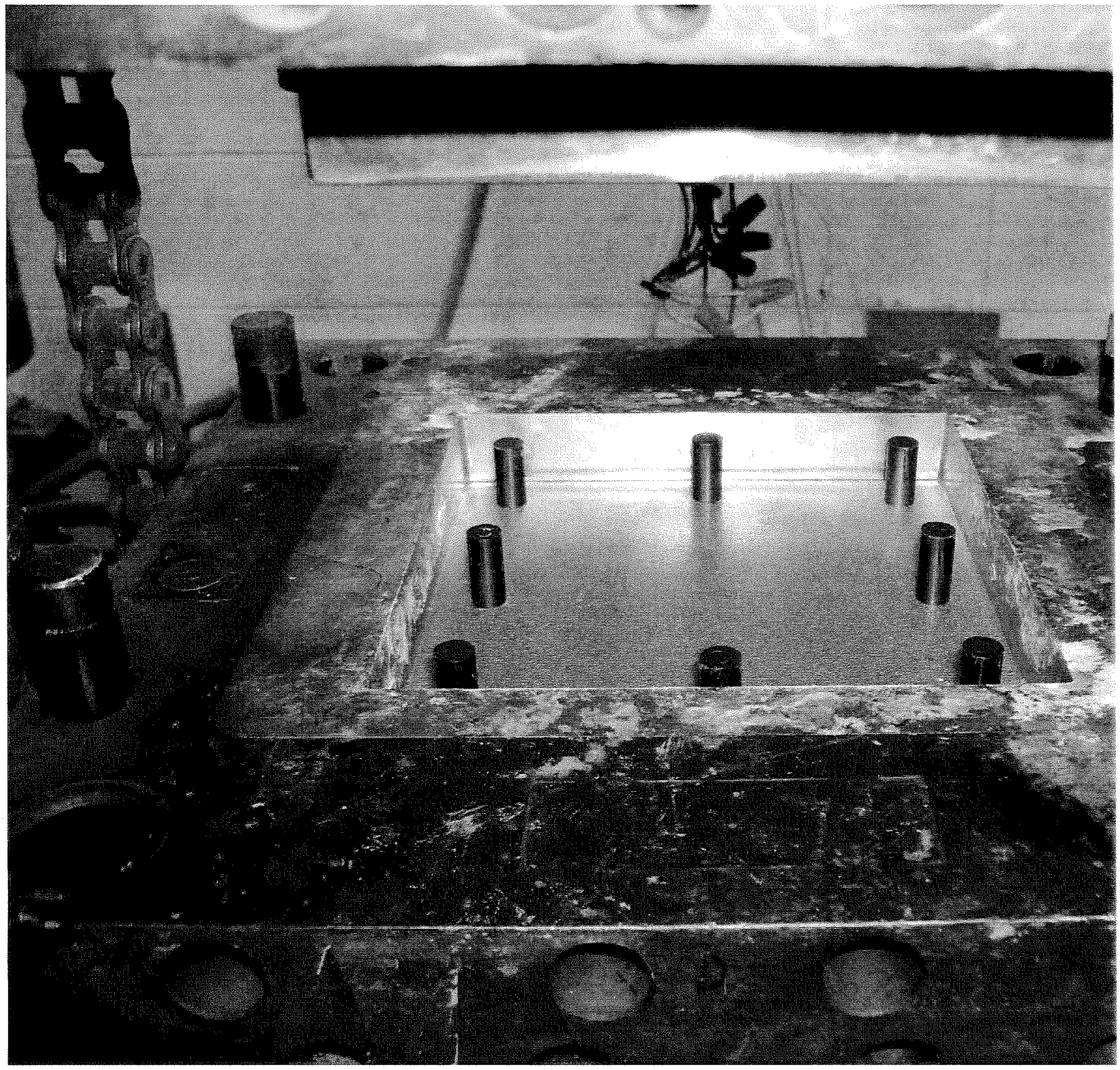

Figure 1: Compression mold for a plaque. Tool temperature at 300 deg F

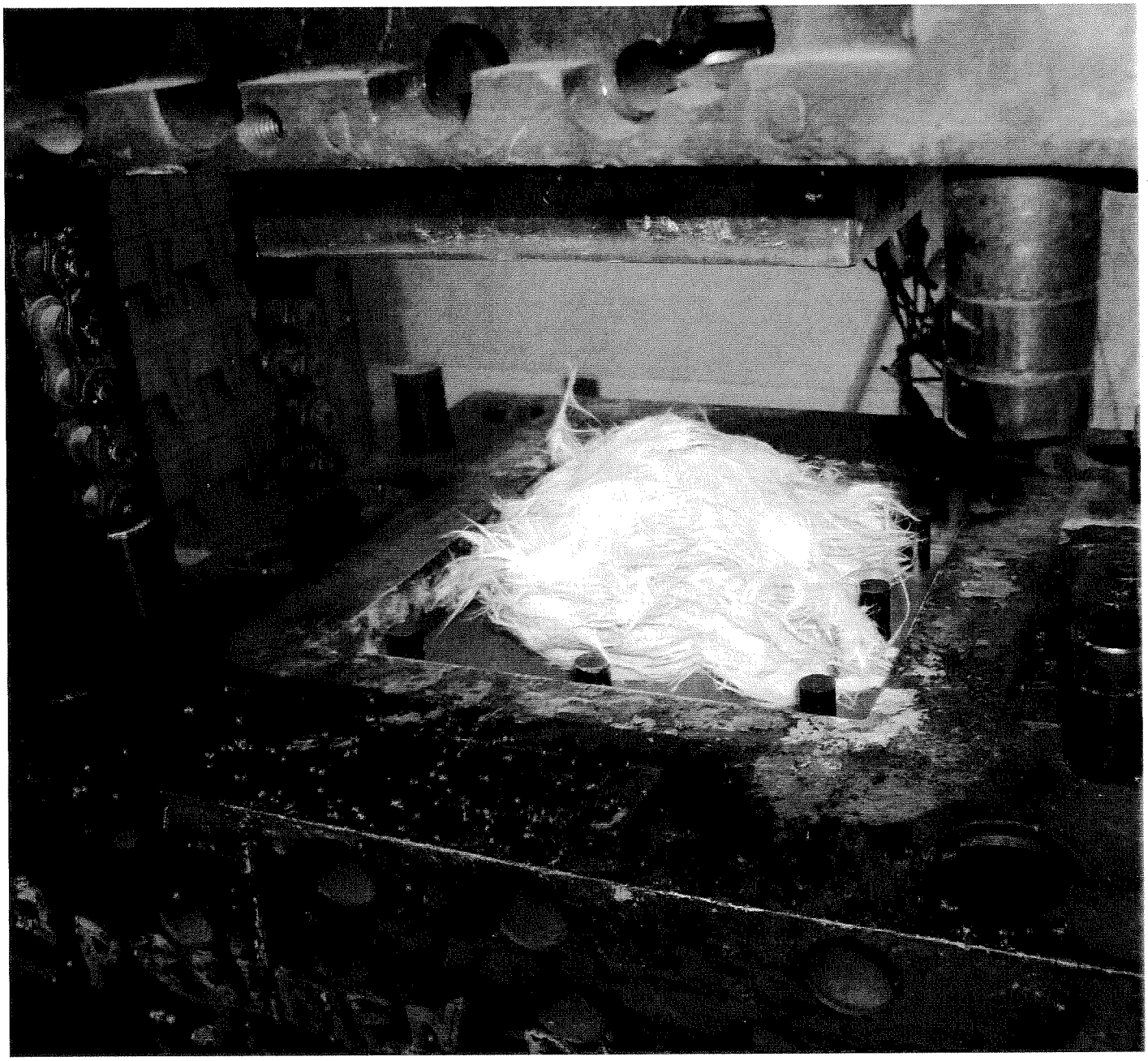

Figure 2: Compression mold with BMC compound.

Figure 3: Compression mold with BMC compound and the FTHC with a wood grain image. The Film is oriented in a manner in which the coated/printed side of the film is in contact with the BMC compound.

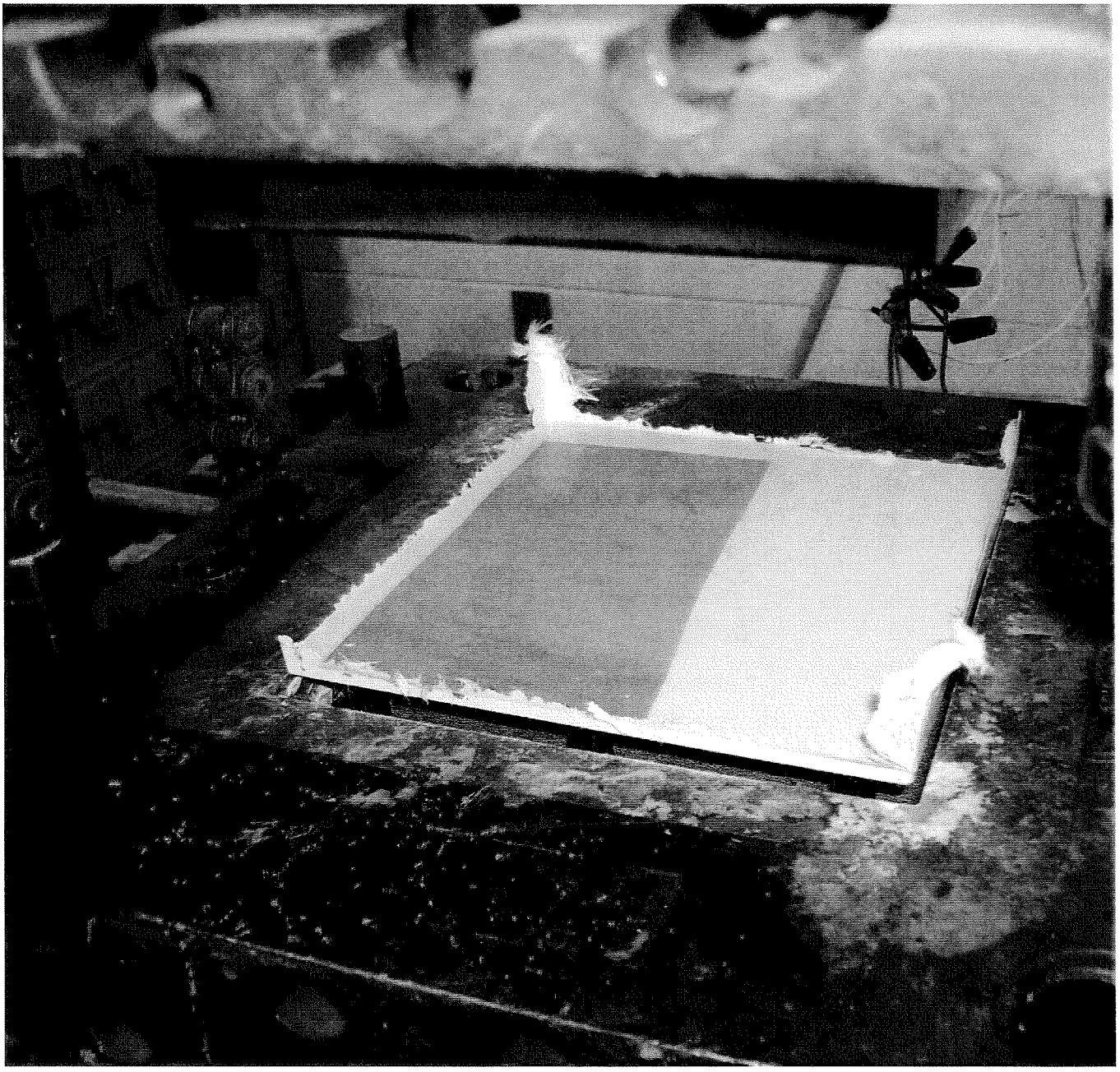

Figure 4: The BMC compound and Film Transfer Hard Coating with the printed wood grain image are press out within the tool to form the plaque with the printed image.

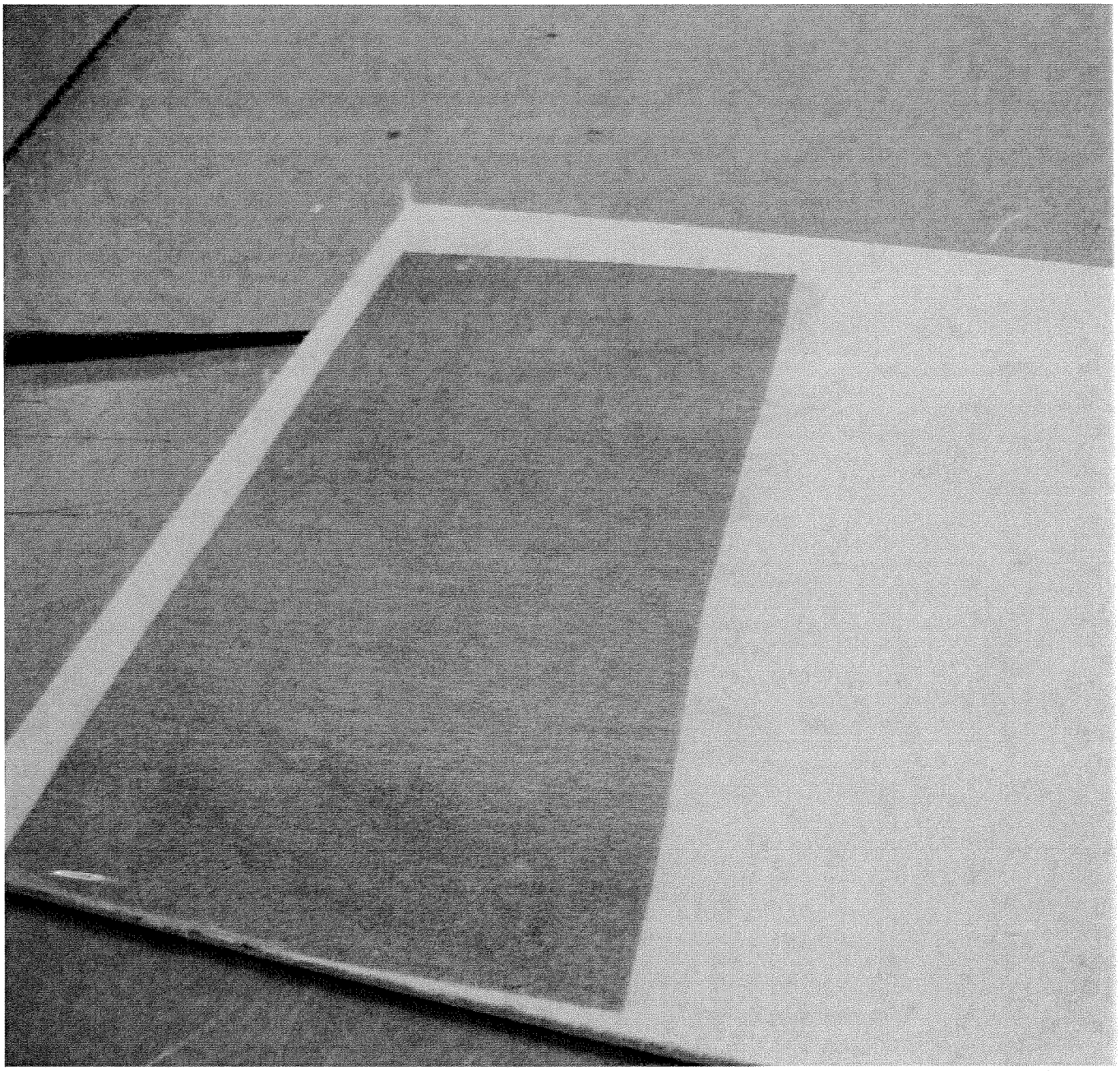

Figure 5: The plaque is allowed to cool. The film remains on the plaque as a protective measure for transportation or further upstream manufacturing processes.

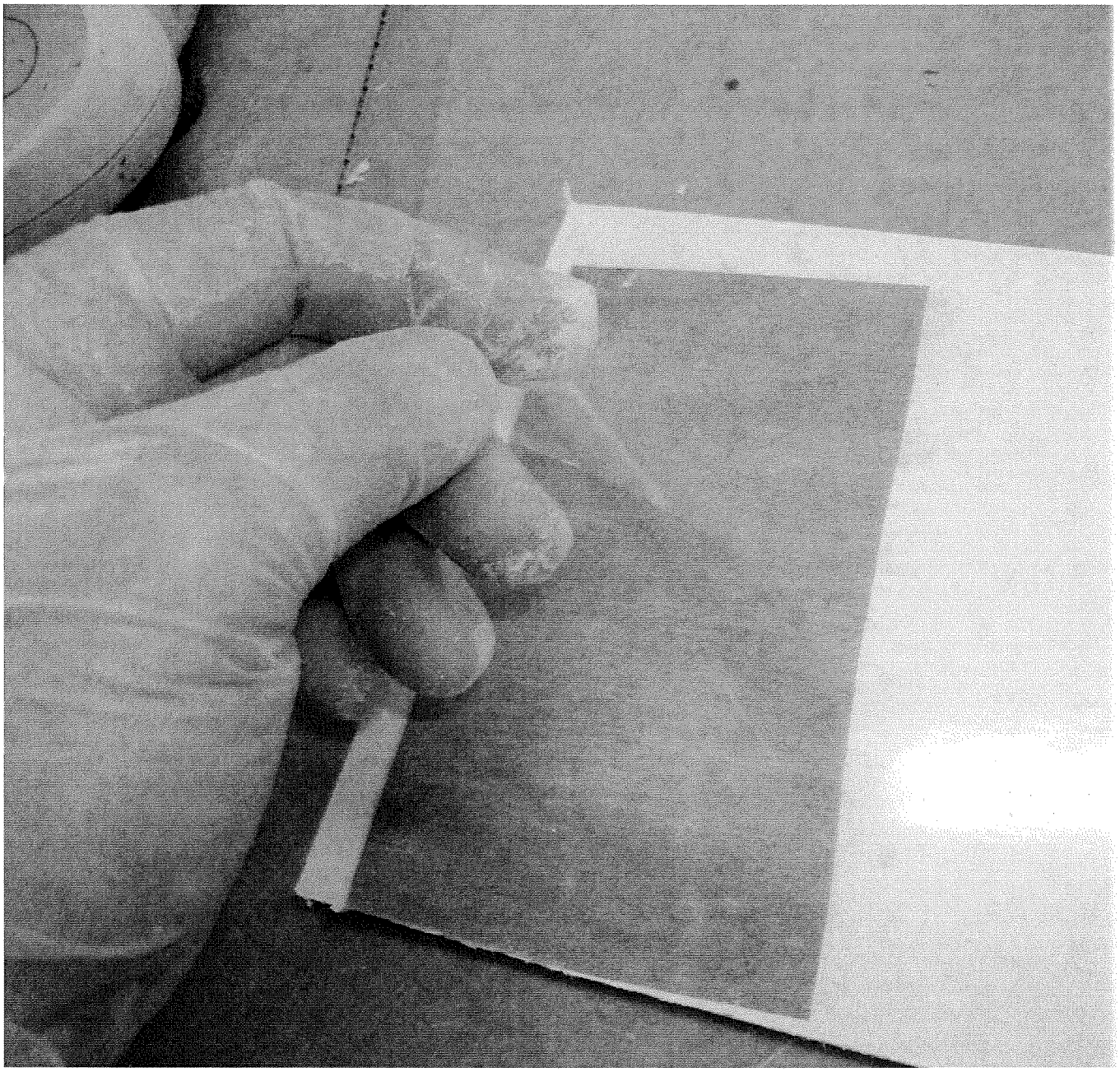

Figure 6: The film is removed from the plaque leaving behind the printed image and the hard coating to protect the wood grain image.

Conclusion

The Film Transfer Technology immediately expands the manufactures capability, markets, and ability to create higher value products with no increase in capital costs. The Film Transfer Technology requires creative ideas, products, and applications to further develop within the FRP industry.