

PLASTEC SPECIAL REPORT SIXTEEN

PRODUCTION OF SOLAR PANELS

- POLYESTER FIBERGLASS WITH A RIGID POLYURETHANE CORE
- FLEXIBLE MATTRESS DESIGN

Process Description and Cost Analysis

by

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INTRODUCTION

PLASTEC was requested by MERADCOM Electrochemical Division to prepare a cost analysis for fabricating plastic solar panels. Basically the construction of the solar panel is a fiberglass/polyester case with a rigid foamed polyurethane core. The cover plates are glass. The size of the panels is 2 ft. x 5 ft. The panels are designed for roof installation, exposed to a wide variety of environments.

DISCUSSION

Four fiberglass/polyester fabrication methods were evaluated for fabricating the skins. These were:

1. Spray-up
2. Hand lay-up
3. Resin transfer molding
4. Compression molding

The foam core would be made by spraying the polyurethane onto the molded case. According to Isocynates Products Div., Witco Chemical, each spray pass produced a foam layer from 3/4 inch to 1 inch thick which becomes tack free in 3 to 18 seconds for a two pound density foam.

Another foam process which can be used for production is automatic metering of the foam into the case. Place a release paper between the case and a particle board cover. The case is then placed in a hydraulic press (to hold the mold and plate together) and held until ready. The cycle time is approximately 8 minutes.¹ Or if desired for permanent bonding of the base plate to the foam and case, the release paper would not be used. An adhesive coating may be required on the base plate for good bonding to the foam.

The cost analysis does not include the bottom plate for the solar cell, glass plates or adhesive for bonding the glass plates to the case. The reason that the cost of the bottom plate is not included in the cost estimate is that building codes vary, affecting the choice of material. The requirements can vary (non-burning, fire resistant, etc.) so that the bottom plate can range from a plastic sheet to metal, plastic board, plywood, etc.

Table I, reproduced from PLASTEC Report R37, contains the typical properties of commercial foams. Table II includes a brief description of the fiberglass reinforcements and other terminology.

1. "Mechanized Foam Line Cuts Cost," *Plastics Technology*, p. 49-52, June 1976.



CASE FABRICATION1. SPRAY-UP

A combination chopper and spray gun are used simultaneously to spray catalyzed resin and chopped roving onto the mold. The deposited resin-fiberglass deposit is then manually worked to remove the air and densify the laminate - additional layers may be added to obtain the required thickness. Part is then cured at room temperature or it may be accelerated by applying moderate heat. Parts should be made with a gel coat.

Advantages

- Low cost molds
- Inexpensive equipment
- Roving is the lowest cost reinforcement

Disadvantages

- Labor cost per unit is high
- Only one finished surface
- Quality is dependent on worker's skill
- Thickness control is dependent on operator's skill
- *Exhaust system required
- *Good housekeeping practices required for health and safety

*Ref. - Good Practices for Employees - Fiberglass Layup and Sprayup -
HEW Publication No. (NIOSH) 76-158, April 1976.

Stepwise Process Description

- Spray up of chopped roving and a UV stabilized white pigmented polyester resin.
- Gel coat - A nominal .030 inch thick gel coat will be applied to the mold and allowed to cure for 45 minutes.
- Chopped roving/polyester backing - A nominal 1/8 inch thick layer of chopped glass roving and polyester resin would then be applied over the gel coat, rolled to remove the air and allowed to cure. The case would be trimmed in the mold after the resin had hardened to a Barcol hardness of 20.

- Raw material costs $.0375 \text{ ft}^3 = 3.5 \text{ lb}$
- Gel coat 3.5 lb @ \$1.00/lb = \$ 3.50
- 70-75% resin 30-25% glass roving is \$.55/lb
- 15 ft² x .125 inch thick = 14.65 lbs @ \$.55/lb = 8.05
- 2 lb density foam = 1.66 ft³ = 3.32 lbs @ \$.75/lb = 2.49
- Total \$14.04

Fiberglass/epoxy molds

Molds @ \$200/mold

Estimated life of mold = 200 units

Mold cost per unit = \$1.00

Labor costs @ \$15.00/hr

Mold preparation - 10 minutes	=	\$ 2.49
Spray gel coat - 5 minutes	=	1.25
Spray fiberglass/resin - 5 minutes	=	1.25
Roll out - 5 minutes	=	1.25
Remove part & trim - 5 minutes	=	1.25
Spray foam - 5 minutes	=	1.25
Labor costs	=	8.74
Raw materials costs	=	14.04
Mold costs	=	1.00
Total		\$23.78

2. HAND LAY-UP

Fiberglass reinforcement and liquid resin are placed on the mold surface and the entrapped air is removed with squeegees or rollers. Additional layers of fiberglass and resin are then added until the desired thickness is obtained.

Advantages

Simplest process
Low cost molds
Minimum equipment

Disadvantages

Labor cost per unit is high
Quality is dependent on worker's skill
Only one finished (smooth) surface
Surfaces are frequently poor so that patching and trimming is often required (repair)
*Good housekeeping practices required for health and safety
*Exhaust system required

*Ref. - Good Practices for Employees - Fiberglass Layup and Sprayup -
HEW Publication No. (NIOSH) 76-158, April 1976.