UNITED STATES DISTRICT COURT

MIDDLE DISTRICT OF LOUISIANA

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COBALE CO., L.L.C., Plaintiff	*	CIVIL ACTION NO. 02-276 D-M3
versus	*	
AUSIMONT USA, INC. and POLYMER GROUP, INC. Defendants	*	JURY TRIAL DEMANDED

COMPLAINT FOR PATENT INFRINGEMENT, UNFAIR TRADE PRACTICES, AND BREACH OF CONTRACT

Plaintiff, Cobale Co., L.L.C.., through its undersigned attorneys, for its Complaint against the defendants, states:

JURISDICTION AND VENUE

1.

This is an action for patent infringement arising under the patent laws of the United States, Title 35, United States Code §§ 101, *et seq*, and for related claims of breach of contract; all as hereinafter more fully appears.

2.

This Court has subject matter jurisdiction over all causes of action set forth herein pursuant to the patent laws of the United States, 35 U.S.C. §§ 281, *et seq.*, 28 U.S.C. §§ 1331 and 1338(a), and under the supplemental jurisdiction provisions of 28 U.S.C. § 1367(a).

3.

Venue is proper in this judicial district and division pursuant to 28 U.S.C. §§ 1391(b) and (c) and § 1400(b).

INITIALS	DOCKET#
KK	1

JS, Summons

PARTIES

4.

Plaintiff, Cobale Co., L.L.C. (Cobale), is a Louisiana limited liability company having its principal place of business at 12558 S. Choctaw Drive, Baton Rouge, Louisiana 70895, and is the owner of certain patents at issue herein, as set forth in detail *infra*.

5.

Defendant Ausimont USA, Inc. (Ausimont), on information and belief, is a Delaware corporation having a place of business at 10 Leonard Lane, Thorofare, New Jersey 08086-2150, and is in the business of manufacturing granular resins fit for use in various industrial settings. On further information and belief, Ausimont is not registered to do business in Louisiana, but is doing business in Louisiana and in this district.

6.

Defendant Polymer Group, Inc. (PGI), on information and belief, is a Delaware corporation having a place of business at 201 North Church Street, Mooresville, North Carolina 28115, and is in the business of manufacturing non-woven veils and cores from polyester, acrylic, and fluoropolymer used in surfacing, interlaminar bulking, and corrosion application. On further information and belief, PGI is not registered to do business in Louisiana, but is doing business in Louisiana and in this district.

COUNT 1 - PATENT INFRINGEMENT

7.

On or about July 9, 1996, United States Patent No. 5,534,337 (the '337 patent) was duly and legally issued, relating to corrosion resistant reinforced thermosetting plastic laminates and a surfacing veil for incorporating into the laminate. A copy of this patent is attached as **Exhibit A**. Cobale is the assignee of all rights under the '337 patent, including the right to bring suit for present and past infringement of the '337 patent.

8.

On or about November 18, 1997, United States Patent No. 5,688,600 (the '600 patent) was duly and legally issued, relating to corrosion resistant reinforced thermosetting plastic laminates and a surfacing veil for incorporating into the laminate. A copy of this patent is attached as **Exhibit B**. Cobale is the assignee of all rights under the '600 patent, including the right to bring suit for present and past infringement of the '600 patent.

9.

Upon information and belief, defendants Ausimont and PGI have unlawfully infringed the claims of the '337 and/or '600 patents by making, using and/or selling devices that infringe one or more of the claims of the '337 and/or '600 patents, including by making, using and/or selling products which incorporate corrosive resistant Halar veils and are covered by at least one or more claims set forth in patents '337 and/or '600. Alternatively, defendants Ausimont and PGI have contributed to the infringement by other, non-related third-parties and have induced those same third-parties to infringe the '337 and/or '600 patents.

10.

Upon information and belief, prior to a recent sale of assets to PGI, Ausimont produced a melt-blown fiber known under the trademark "Halar." Ausimont later sold the division of its corporation responsible for producing the Halar (melt-blown fiber division) to PGI, which, upon information and belief, is now the sole producer of the Halar veils in the world.

11.

Upon information and belief, Ausimont continues to sell the resin to PGI, which, in turn, continues to manufacture a Halar veil which may be incorporated into a product covered by the '337 and/or '600 patents.

12.

Upon information and belief, PGI has contracted with FRP Supply and Distribution, Inc. for the distribution of the Halar veils to certain end users across the country and throughout the world.

13.

Upon information and belief, Ausimont and PGI has outwardly and openly encouraged third-parties to use the Halar veil technology in such a manner that infringes at least one or more claims of the '337 and/or '600 patents. In fact, PGI, possibly at the insistence or instruction of Ausimont, has been involved in at least one trade show at which PGI representatives directly encouraged those in the industry to use Halar veil in products covered by the '337 and/or '600 patents.

14.

Upon information and belief, defendant Ausimont has, in turn, induced PGI to infringe the '337 and/or '600 patents. In conjunction with the sale of the division of Ausimont responsible for making the Halar veil to PGI, Ausimont, on information and belief, transferred certain documentation relating to the '337 and/or '600 patents to PGI. It is with this information that PGI has had the opportunity and ability to induce third-parties to directly infringe the '337 and/or '600 patents.

15.

Defendants, Ausimont and PGI, therefore, have engaged in activities which constitute direct infringement of the claims of the '337 and/or '600 patents, in violation of 35 U.S.C. § 271.

Alternatively, defendants, Ausimont and PGI, have engaged in activities which constitute contributory infringement or have induced third-parties to infringe the claims of the '337 and/or '600 patents, in violation of 35 U.S.C. § 271.

16.

As will be set forth *infra*, defendant Ausimont has had full and complete knowledge of the '337 and/or '600 patents, the products that they cover, and the business entities which have the exclusive rights to manufacture, use, and sell products covered by the patents. Thus, defendant Ausimont's infringement, whether direct, contributory, or an inducement to infringe, has been knowing and willful.

17.

Defendants, Ausimont and PGI, are jointly and severally liable for their direct infringement, contributory infringement, and/or inducement of others to directly infringe the '337 and/or '600 patents.

18.

Cobale has suffered irreparable injury by reason of the defendants direct infringement, contributory infringement, and/or inducement of others to directly infringe the ′337 and/or '600 patents, and will continue to suffer additional and irreparable injury unless the defendants are preliminarily and permanently enjoined by this Court from continuing such infringement.

COUNT 2 - BREACH OF CONTRACT AGAINST AUSIMONT

19.

As a complete and independent ground of relief, Cobale alleges breach of contract against Ausimont, and incorporates by reference paragraphs 1 through 18 herein.

20.

In March 18, 1994, 4B Plastics, Inc. (4B Plastics) agreed (the agreement) to work exclusively with Ausimont to develop and sell fiber reinforced plastic (FRP) composites and coatings that utilize Halar Veil, Halar Filament, or Halar Powder through distributors worldwide. The FRP which is the subject of the agreement includes, but is not limited to, 4-B's technology. A copy of the agreement is attached as **Exhibit C**.

21.

The agreement was later assigned by 4B Plastics to Cobale. Thus, Cobale possesses the fully panoply of rights associated with the agreement, including the right to enforce its terms and bring a cause of action for breach of the terms of the agreement.

22.

Pursuant to the agreement, Ausimont agreed to pay to 4B Plastics a commission on all "pounds" of Halar veil sold to distributors for fiber reinforced plastic composite applications. The commission was based on a pricing schedule contained within the agreement.

23.

Despite actual sales, Ausimont has failed to pay 4B Plastics and/or Cobale sums rightfully due it under the terms of the agreement. Cobale has informed Ausimont of its default. However, despite amicable demand, Ausimont has continued to refuse to pay the sums owed.

24.

Upon information and belief, Ausimont has also sold Halar Filament and/or Halar Powder to third-parties since the inception of the agreement. Again, despite its agreement to work exclusively with 4-B or its assignee, Cobale, Ausimont has not compensated Cobale for the sales of Halar Filament and/or Halar Powder.

25.

Cobale is equally entitled to compensation for the sales of Halar Filament and/or Halar Powder as set forth in the agreement.

26.

By virtue of Ausimont's bad faith breach of the agreement, Cobale is entitled to all sums presently due and owing, with interest from the date of default. Moreover, Cobale is entitled to damages suffered by it pursuant to Louisiana Civil Code Article 1997, and, in the alternative, Louisiana Civil Code Article 1996.

PRAYER FOR RELIEF

WHEREFORE, Cobale Co., L.L.C. prays:

(a) That this Court issue preliminary and permanent injunctive relief pursuant to 35 U.S.C. § 283 against the continuing direct and/or contributory infringement of one or more of the claims of the ′337 and/or '600 patents by defendants Ausimont and PGI, and their officers, agents, employees, attorneys, representatives, and all others acting in concert therewith;

(b) That this Court order an accounting for damages sustained by Cobale and for profits realized by defendants Ausimont and PGI as a result of defendants' infringements of the ′337 and/or '600 patents, and that damages and profits in accordance therewith be awarded to Cobale, and that interest and costs further be assessed against defendants Ausimont and PGI pursuant to 35 U.S.C. § 284;

(c) That this Court order an accounting for damages sustained by Cobale as a result of defendant Ausimont's bad faith breach of its agreement with 4B Plastics (assignor to Cobale), and that any damages in accordance therewith be awarded to Cobale, and that interest and costs further be assessed against defendant Ausimont from the date of default;

(d) That this Court order defendants Ausimont and PGI to pay to Cobale its reasonable attorney's fees and costs, pursuant to 35 U.S.C. § 285, this case being exceptional;

(e) That this Court award such further and other relief to Cobale as this Court deems just and proper under the premises.

By Attorneys:

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UNITED STATES DISTRICT COURT

MIDDLE DISTRICT OF LOUISIANA

COBALE CO., L.L.C., *
Plaintiff *
* CIVIL ACTION NO.
versus *
*
AUSIMONT USA, INC. and POLYMER GROUP, INC. * JURY TRIAL DEMANDED
*
Defendants *

VERIFICATION

STATE OF LOUISIANA
PARISH OF EAST BATON ROUGE

BEFORE ME, the undersigned notary public, duly commissioned and qualified in and for the parish and state aforesaid, personally came and appeared:

THOMAS A. COLELLO

who, after being duly sworn, did depose and say:

(1) That he is an authorized representative of the plaintiff in the above captioned lawsuit; and

(2) That he has read the above Complaint, and that all of the allegations of fact contained therein are true and correct to the best of his knowledge, information and belief.

Thomas A. Colello
Thomas A. Colello

SWORN TO AND SUBSCRIBED before me this 15th day of March, 2002.

NOTARY PUBLIC

[redacted]

United States Patent [19]

Bailey, Jr.

[11] **Patent Number:** 5,534,337

[45] **Date of Patent:** Jul. 9, 1996

[54] **THERMOSET REINFORCED CORROSION RESISTANT LAMINATES**

[75] Inventor: **Edward D. Bailey, Jr.**, Baton Rouge, La.

[73] Assignee: **Cobale Company, L.L.C.**, Baton Rouge, La.

[21] Appl. No.: **43,200**

[22] Filed: **Apr. 5, 1993**

[51] Int. Cl.^{6} B32B 5/02; B32B 27/00; B32B 5/06

[52] U.S. Cl. 428/236; 428/286; 428/290; 428/302; 428/421; 428/422; 428/903

[58] Field of Search 428/286, 282, 428/288, 220, 298, 285, 903, 296, 297, 302, 236, 290, 421, 422

[56] **References Cited**

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4,505,971	3/1985	Martin, Jr.	428/216
4,539,113	9/1985	Tomita et al.	210/323.2
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4,770,927	9/1988	Effenberger	428/245
4,777,351	10/1988	Batliwalla et al.	219/528
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Plastverarbeiter vol. 39, #6, Jun. 1988, Speyer, De p. 24; N. J. Walker, "Neue Materialien und ihre Einsatzmoglichkeiten" (No translation available at present time—no translation forwarded from EPO).

ASTM Designation: C 582–87; Standard Specification for Contact–Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment.

ASTM C 582–87.

ASTM D 4097–88.

ASTM D 3299–88.

"Derakane Resins" Chemical Resistance and Engineering Guide by the Dow Chemical Company.

"Fabricating Tips" Derakane vinyl ester resins by the Dow Chemical Company.

"Expanded List—Chemical Resistance of Halar® Fluoropolymer" by Ausimont USA, Inc.

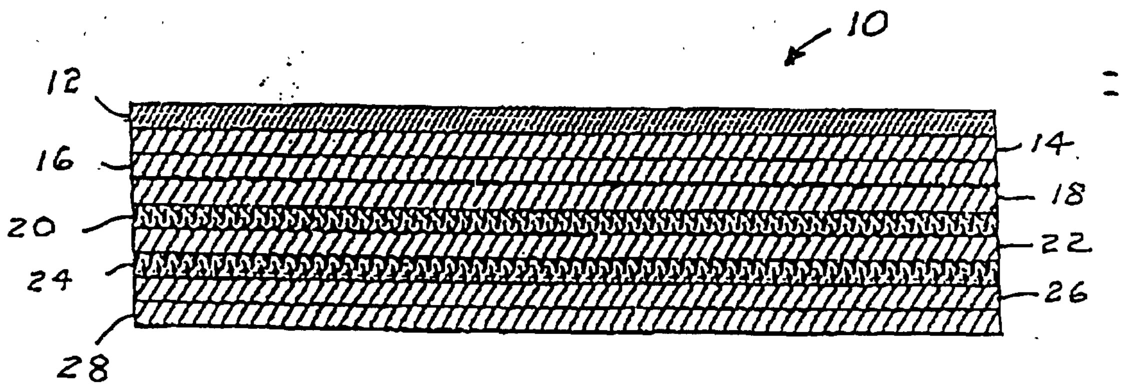
"Melt Blown Processing and Characterization of Fluoropolymer Resins" by Larry Wadsworth and Joseph Fagan.

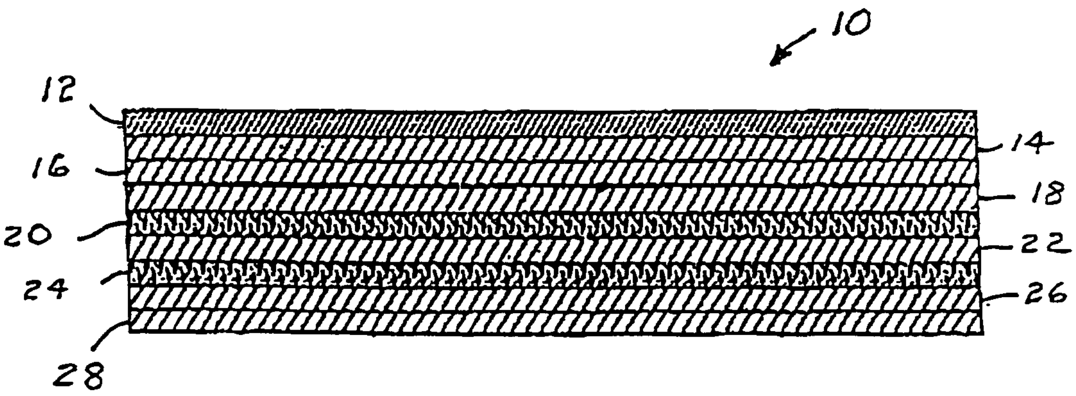
Primary Examiner—James D. Withers
Attorney, Agent, or Firm—David L. Ray

[57] **ABSTRACT**

In accordance with the present invention there is provided a corrosion resistant surfacing veil of a thermoplastic fluoropolymer, and corrosion resistant reinforced thermoset plastic laminates having a surfacing veil of a thermoplastic fluoropolymer.

20 Claims, 1 Drawing Sheet

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THERMOSET REINFORCED CORROSION RESISTANT LAMINATES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to reinforced polymeric laminates. More particularly, the present invention is related to corrosion resistant reinforced thermosetting plastic laminates, and a surfacing veil for incorporation in the laminates.

2. Description of the Related Art

The use of surfacing veil as the primary corrosion barrier in thermoset resin fiber reinforced laminates is well known in the glass fiber reinforced plastic industry.

In the American Society for Testing and Materials (hereinafter ASTM) C 582-87 entitled Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment, which is incorporated by reference, contact molding is defined in section 3.4 as ". . . a method of fabrication wherein the glass-fiber reinforcement is applied to the mold, in the form of chopped-strand mat or woven roving, by hand or from a reel, or in the form of chopped strands of continuous-filament glass from a chopper-spray gun. The resin matrix is applied by various methods, including brush, roller, or spray gun. Consolidation of the composite laminate is by rolling."

A surfacing veil or mat is defined in ASTM C 582-87, ASTM D 4097-88, and ASTM D 3299-88. A surfacing veil or mat is defined in ASTM C 582-87, section 5.2.1 of ASTM C 582-87 as "a thin mat of fine fibers used primarily to produce a smooth surface on a reinforced plastic." 5.2.1.2 of ASTM C 582-87 states that the requirements of acceptable surface veils are:

"(a) Resin compatibility.

(b) Uniform fiber distribution.

(c) Single filaments (not bunched)

(d) The veil layer(s) shall be a minimum of 10 mils in dry thickness producing a 10 to 15 mil resin saturated veil layer per 10 mils of dry veil, and

(e) Minimum fiber length shall be 0.5 in. Note 9—The chemical resistance of the RTP laminate is provided by the resin. In combination with the cured resin, the surfacing veil helps determine the thickness of the resin-rich layer, reduces microcracking, and provides a nonwicking chemically resistant layer.

Additional desirable considerations in choosing a veil for a specific application include:

(a) Drapability (surfacing veil should conform to mold shape).

(b) Dry and wet tensile strength.

(c) Binder solubility (if used)

(d) Uniform wetting.

(e) Surfacing veil shall wet-out completely without trapping air during laminating, and

(f) Surfacing veil should not inhibit resin cure."

The surfacing veil is a reinforcement material that when saturated with resin (sometimes referred to as "wet out") retains a high resin to reinforcement ratio. Thermoset resin is very chemically resistant and the surfacing veils of the prior art are in many cases susceptible to attack by the chemical being contained. If the surfacing veils of the prior art are exposed to the chemical contained due to a breach in the resin, attack of the reinforcement material may start, leading to a shortened service life and equipment failure.

Surfacing veils of the prior art are commonly made from monofilament glass or polyester fibers. The most commonly used monofilament glass fibers are known in the art as "C" glass. The most commonly used polyester fibers used for surfacing veil are sold by E. I. Dupont de Nemours & Co. under the trademark Dacron.

Exemplary of the related art are the following U.S. Patents:

U.S. Pat. No. 5,077,115 discloses thermoplastic composite material including a thermoplastic matrix which is highly filled with a coated ceramic filler. In an important feature of the present invention, the ceramic filler has been coated with a rubbery polymer that bonds to the filler. In a preferred embodiment, the thermoplastic matrix comprises a fluoropolymer, preferably a chlorofluoropolymer and the ceramic filler is a fused amorphous silica coated with a rubbery polymeric material. The thermoplastic composite material of this invention exhibits numerous advantages which makes it well suited for use as a bonding film, particularly a bonding film for producing multilayer printed wiring bonds.

U.S. Pat. No. 4,943,473 discloses flexible laminated fluoropolymer-containing composites including fire and chemical resistant, flexible composites made from flexible woven, non-woven and knitted substrates and fluoropolymer containing films. Adhesives, such as melt adhesives, may be used in making the composites. The composites are suitable for use in protective garments, and in other articles where flexible chemically resistant materials are needed. A seaming technique for use in protective articles is disclosed.

U.S. Pat. No. 4,886,699 discloses a glass fiber reinforced fluoropolymeric circuit laminate including one or more layers of fluoropolymer impregnated woven glass cloth sandwiched between one or more layers of "random" microfiberglass reinforced fluoropolymer. This composite of fluoropolymer, woven glass fabric and random glass microfibers may be clad on one or both outer surfaces with a suitable conductive martial such as copper or certain known resistive foils. The fluoropolymer impregnated woven glass layer or layers will be nested between microfiberglass reinforced fluoropolymer layers to provide the outer surfaces of the circuit with smooth surfaces for fine line circuitry. The circuit laminate of the invention exhibits good dimensional stability, smooth surfaces for fine line circuitry, good electrical properties, and strong foil and interlaminar adhesion properties.

U.S. Pat. No. 4,886,689 discloses a matrix-matrix polyblend adhesives and method of bonding incompatible polymers useful in an adhesive tie layer to bond incompatible polymer layers. The adhesives are a blend of the components making up the incompatible polymer layers themselves, or polymers substantially similar to these, and are melt processed to produce a matrix-matrix morphology with mechanical interlocking of the polymer components that is maintained upon cooling. Additives may be provided in one or both adhesive components to improve the cohesive strength of the adhesive formed by the mechanical interlocking.

U.S. Pat. No. 4,777,351 discloses devices including conductive polymer compositions. A number of improvements to electrical devices, particularly sheet heaters, including conductive polymer compositions, are provided the preferred heater has the following features (a) it includes a laminar resistive element and a plurality of electrodes which are so positioned that the predominant direction of current flow is parallel to the faces of the laminar element, (b) it includes a laminar insulating element adjacent to but not secured to the electrodes and the resistive element; (c) it includes a metallic foil, which acts as a ground plane and is positioned adjacent the insulating element but is not secured thereto; (d) it includes a dielectric layer intimately bonded to the resistive element and to the electrodes.

The invention also provides an electrical device including first and second members having different resistivities, and a thin contact layer of intermediate resistivity positioned between the first and second members.

U.S. Pat. No. 4,770,927 discloses a reinforced fluoropolymer composite which includes a substrate having a coating matrix including an initial layer of a perfluoropolymer and an overcoat including a fluoroelastomer, a fluoroplastic, a fluoroelastomer/fluoroplastic blend, or a combination thereof. The perfluoropolymer in the initial layer may be a perfluoroplastic, a perfluoroelastomer, or blends thereof. In a separate embodiment, the novel composite includes a substrate coated solely with one or more layers of perfluoroelastomer alone or as a blend with a perfluoroplastic. Where the substrate is not susceptible to hydrogen fluoride corrosion, the composite may include solely one or more layers of a blend of a fluoroelastomer and a hydrogen-containing perfluoroplastic. Cross-linking accelerators may be used to cross-link one or more of the resins contained in the coating layers. Each composite may be top-coated with a layer or layers of a fluoroplastic, fluoroelastomer, and/or a blend thereof. The composite is flexible, exhibits good matrix cohesion and possesses substantial adhesion to the material acting as the reinforcement or substrate. A method for making such a composite includes the unique deployment of a perfluoropolymer directly onto the substrate in a relatively small amount sufficient to protect the substrate from chemical corrosion without impairing flexibility, followed by the application of the overcoat layer.

U.S. Pat. No. 4,677,017 discloses coextrusion of thermoplastic fluoropolymers with thermoplastic polymers. The coextruded film includes at least one thermoplastic fluoropolymer layer and at least one thermoplastic polymeric layer adjacent to the to the thermoplastic fluoropolymer layer. There is preferably a coextruded adhesive layer between each thermoplastic fluoropolymer layer and each thermoplastic polymeric layer. The coextruded film can be oriented in at least one direction and/or embossed without delamination, fibrillating, or splitting.

U.S. Pat. No. 4,539,113 discloses a fluororesin filter made entirely of fluororesin having both a high corrosion and high heat resistance. A plurality of tubular filtering elements are arranged in a fluororesin container. Each tubular filtering element has a polytetraethylene tubular filtering film closed at one end and arranged over or inserted into a fluororesin tubular support. The tubular filtering elements are connected to a cover structure, on the inner surface of which is formed a groove for communicating the tubular filtering elements to one of the liquid inlet and liquid outlet provided in the cover structure.

U.S. Pat. No. 4,505,971 discloses a fluoroplastic and metal laminate having rubber compound bonded layers, and a process and composition for adhering a rubber compound to a fluoroplastic and/or to metal. The invention contemplates the use of separate sequentially applied adhesive layers to the fluoroplastic or metal substrate. The last applied layer, a rubber cement, allows the metal or fluoroplastic to be adhered to the uncured rubber compound which is subsequently vulcanized. The invention finds particular utility in securing a fluoroplastic and a rubber lining to steel or other metallic surfaces. A typical use is the lining of the interior of a railroad tank car, providing protection from corrosive or hostile environments experienced when the tank car is transporting acids or other caustic materials. Other uses include the lining of chemical process vessels and piping.

U.S. Pat. No. 4,163,505 discloses foldable liners for fluids holding storage tanks which are polyhedrical shaped liners, mounted vertically inside a cylindrical storage tank, and fixed to the inner top of the tank.

The lower portion of the liner is fixed to a rigid frame which is free to displace in the vertical direction.

Devices located on equidistant horizontal narrow strips of the liner, restrain the strips from displacing radially inward but allow them to move in the vertical direction.

Devices that apply forces directed vertically upwards over the rigid frame and of sufficient magnitude to produce critical compressive stresses in the liner are provided.

These critical compressive stresses induce buckling of the portions of the liner between successive narrow strips, and folding of the liner-in-situ is achieved.

U.S. Pat. No. 3,833,453 discloses a nonflammable, fiber-filled, cold-formable thermoplastic sheets which are glass fiber-reinforced ethylene chlorotrifluoroethylene composite sheets formable into shaped objects in a mold at ambient temperatures solely by moderate preheating of the sheet outside of the mold. This polymer including a high molecular weight, tough copolymer of ethylene and chlorotrifluoroethylene in an approximate 1:1 mol ratio is inherently non-flammable in air. A glass fiber of controlled length increases the mechanical properties of the composite structure and allows fabrication into suitable shapes without detracting from the nonflammable properties of the polymeric composite.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a surfacing veil for utilization in laminates made from reinforced thermosetting resins.

It is another object of the invention to provide a surfacing veil for utilization in laminates made from reinforced thermosetting resins which has enhanced chemical resistance, good abrasion resistance, and excellent interlaminar sheer strength between the surfacing veil and an adjacent lamina.

It is yet another object of the invention to provide a surfacing veil for utilization in laminates made from reinforced thermosetting resins which provides a corrosion barrier reinforcement which due to its chemical resistance would provide a longer service life for the laminates without substantial increases in cost of the laminates.

It is a further object of the invention to provide a corrosion resistant surfacing veil for utilization in laminates made from reinforced thermosetting resins which may be utilized with the application techniques commonly in use.

It is a yet further object to provide a surfacing veil which can be used with a wide variety of thermoset resins.

It is also an object of the invention to provide a chemically resistant surfacing veil that is also flame resistant.

In accordance with the present invention there is provided a corrosion resistant surfacing veil of a thermoplastic fluoropolymer, and corrosion resistant reinforced thermoset plastic laminates having a surfacing veil of a thermoplastic fluoropolymer.

BRIEF DESCRIPTION OF THE DRAWING

The single drawing FIGURE is an enlarged schematic side view of a multilayer laminate of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a surfacing veil made from a fluoropolymer, and contact molded reinforced plastic laminates utilizing the surfacing veil of the invention. Contact molding as use herein includes contact-molding as disclosed in ASTM C 582-87, ASTM D 4097-88, and molding or fabricating by filament-winding as disclosed in ASTM D 3299 -88. ASTM D 3299 -88 and ASTM D 4097 -88 are hereby incorporated by reference.

Surfacing veils of the invention are made from thermoplastic fluoropolymers such as chlorotrifluoropolymers, and the copolymers of tetrafluoroethylene and, perfluoroalkoxy resins, fluorinated ethylenepropylene, polyvinyl fluoride, and polyvinylidene fluoride.

The most preferred surfacing veil of the invention is veil made from copolymers of ethylene and chlorotrifluoroethylene (sometimes referred to as ECTFE) such as HALAR®, which is a copolymer of ethylene and chlorotrifluoroethylene sold by Ausimont USA, Inc. of Morristown, N.J. and described in *HALAR® FLUOROPOLYMER RESIN ADVANTAGE, EXPANDED LIST-CHEMICAL RESISTANCE OF HALAR® FLUOROPOLYMER*, hereby incorporated by reference, and is described in U.S. Pat. No. 3,833,453, hereby incorporated by reference. The most preferred surfacing veil of the invention is a melt blown thermoplastic fluoropolymer fiber filter media sold by Ausimont USA, Inc. of Morristown, N.J. and made from HALAR®.

Reinforcement materials include, in addition to the surfacing veil, chopped-strand mat, woven roving, and roving made from glass fibers. Other reinforcing fibers may be used if desired, but glass fibers are preferred.

The preferred laminates of the invention utilize a thermosetting resin. Suitable thermosetting resins include polyester or vinyl ester thermosetting resins, and other thermosetting resins made from phenols, furans, epoxies, and the like. ASTM C 582-87 section 1.1 states that "thermoset polyester, vinyl ester, or other qualified thermosetting resin laminates" may be utilized. Polyester and vinyl ester thermosetting resins which may be used in the present invention are defined in ASTM C582-87, section 3.2 and 3.3 as follows:

> "3.2 polyester—resins produced by the polycondensation of dihydroxyderivatives and dibasic organic acids or anhydrides, wherein at least one component contributes ethylenic unsaturation yielding resins that can be compounded with styryl monomers and reacted to give highly crosslinked thermoset copolymers.
>
> 3.3 vinyl esters——resins characterized by reactive unsaturation located predominately in terminal positions that can be compounded with styryl monomers and reacted to give highly crosslinked thermoset copolymers. Note 2—These resins are handled in the same way as polyesters in fabrication of RTP components."

Catalysts well known in the art are preferably used with the thermosetting resins used to form the laminates of the invention to initiate the chemical reaction which causes the thermosetting resin to cure. Typical catalysts include peroxides such as methyl ethyl ketone peroxide, cumene hydroperoxide, and the like. Promoters well known in the art are preferably used to shorten the curing time of the thermosetting resins. Typical promoters include cobalt napthenate, benzoyl peroxide and the like.

EXAMPLE

A flat sheet of corrosion resistant laminate was contact molded in accordance with ASTM C582-87 as follows:

A melt blown thermoplastic fluoropolymer fiber filter media sold by Ausimont USA, Inc. of Morristown, N.J. and made from HALAR® was used as a surfacing veil in preparing the corrosion resistant laminate of the example. The surfacing veil utilized in preparing the laminate of the example had a weight of 3 oz/yd^2 and exhibited good mechanical properties needed for application to a stationary or rotating mold. Surfacing veil having a weight of 1½ oz/yd^2 did not exhibit the mechanical properties required for application to a rotating mold and was not utilized.

The surfacing veil fibers had a mean fiber diameter of 7.9 to 8.5 μm, where "μm" is a micro-meter. Excellent saturation or wet-out of the surfacing veil was achieved as well as a high resin to reinforcement ratio. The surfacing veil allowed the entrapped air to be rolled out easily and passed the liner void inspection as easily as conventional surfacing veils.

The surfacing veil had two distinctive sides. One side was "smooth", and the other side was "fuzzy". In preparing the laminate of the example, the fuzzy side was placed toward the mold.

The thermosetting resin utilized in preparing the corrosion resistant laminate 10 of the example was a vinyl ester resin sold by the Dow Chemical Company under the trademark Derakane 470-36 and described in *Fabricating Tips-Derakane vinyl ester resins*, hereby incorporated by reference, *Derakane Resins-Chemical Resistance and Engineering Guide*, hereby incorporated by reference. Preferably promoters and catalysts are used with the vinyl ester resin. The vinyl ester resin Derakane 470-36 used in preparing the laminate 10 utilized cobalt napthenate as a promoter and methyl ethyl ketone peroxide as a catalyst as recommended by Dow Chemical Company. The promoter was mixed with the resin, and then the catalyst was added to initiate the exothermic reaction.

Chopped-strand mat used for reinforcing the laminate 10 was "E" type glass fiber, 1½ oz/ft^2, with sizing and binder compatible with the resin, as required in ASTM C582-87, section 5.2.2.

Woven roving used for reinforcing the laminate 10 was "E" type glass, 24½ oz/yd^2, 5 by 4 square weave fabric and binder compatible with the fabric, as required in ASTM C582-87 section 5.2.3.

Laminate 10 was prepared in accordance with ASTM C582-87, and in particular section 6 thereof, as outlined in the following steps:

Step 1: A coating of the catalyzed vinyl ester resin was applied to the mold surface. The mold is the side facing the process or corrosive chemicals in contact with the laminate 10.

Step 2: One layer of the surfacing veil 12 was applied with the fuzzy side toward the mold surface and was rolled into the catalyzed resin on the mold surface using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 3: A second coat of the catalyzed vinyl ester resin was applied.

Step 4: A first layer 14 of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 5: A third coat of the vinyl ester resin was applied.

Step 6: A second layer 16 of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 7: A fourth coat of the catalyzed vinyl ester resin was applied and the laminate was allowed to exotherm.

Step 8: A fifth coat of the catalyzed vinyl ester resin was applied.

Step 9: A third layer 18 of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 10: A sixth coat of the vinyl ester resin was applied.

Step 11: A first layer 20 of the 24½ oz/yd^2 woven roving was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 12: A seventh coat of the vinyl ester resin was applied.

Step 13: A fourth layer 22 of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 14: An eighth coat of the vinyl ester resin was applied.

Step 15: A second layer 24 of the 24½ oz/yd^2 woven roving was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 16: A ninth coat of the vinyl ester resin was applied.

Step 17: A fifth layer 26 of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 18: A tenth coat of the vinyl ester resin was applied.

Step 19: A sixth layer 28 of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 20: An eleventh coat of the vinyl ester resin was applied and the laminate was allowed to exotherm.

The laminate 10 was allowed to fully cure and was then prepared for testing. A plurality of specimens labeled A through F were cut from laminate 10 for testing. The cured thickness of the resin coated surfacing veil 12 was approximately 0.030 inches. The specimens A-F were tested in accordance with the ASTM testing procedure shown in each table, and the results recorded in the following tables 1-5.

The tensile properties as shown in Table 1 are similar to tensile properties achieved utilizing the surfacing veils of the prior art.

The flexural properties shown in Table 2 are greater than the flexural properties achieved using the surfacing veils of the prior art and indicate that the surfacing veil and laminates 10 of the invention have enhanced flexibility.

The in-plane shear strength shown in Table 3 was conducted between the layer 12 containing the surfacing veil of the invention and layer 14 containing the chopped strand mat. The average in plane shear strength between layer 12 and 14 was about 3,300 psi and was acceptable.

Abrasion resistance is shown in Table 4 and was acceptable, as were the compressive properties shown in Table 5.

Chemical resistance for the HALAR® fluoropolymer from which the surfacing veil is made is shown in Table 6.

TABLE 1

Standard Test Method for
TENSILE PROPERTIES OF PLASTICS
ASTM D 638

TEST SPECIMENS machined (X) cast ( ) SPEED of TESTING 0.20 in./min.
TYPE SPECIMEN III TEST TEMP./HUM. (69 deg. F/65%) GAUGE LENGTH 2.00 in

specimen	width (in.)	depth (in.)	area (sq. in)	max. load (pounds)	tens. strength (psi)	elong. @ break	modulus (psi)
A	1.007	0.230	0.232	3220	13,900	1.1%	1.90 E + 06
B	1.005	0.232	0.233	3470	14,900	1.2%	1.72 E + 06
C	1.006	0.234	0.235	3370	14,300	1.2%	1.74 E + 06
D	1.012	0.235	0.238	3320	13,900	1.1%	1.54 E + 06
E	1.013	0.232	0.235	3500	14,000	1.1%	1.52 E + 06
				AVG.	14,200	AVG.	1.68 E + 06
				STD. DEV.	424	STD. DEV	1.57 E + 05

TABLE 2

FLEXURAL PROPERTIES OF UNREINFORCED AND REINFORCED PLASTIC
AND ELECTRICAL INSULATING MATERIALS
ASTM D790

TEST METHOD/PROCEDURE = I/A SPAN/DEPTH RATION L/D = @16/1 SPAN = 4.00 INCHES
LOADING NOSE/SUPPORT RADIUS = .12/.12 RATE OF CROSSHEAD MOTION = 0.11 in./min.

specimen	width b	depth d	max. load P	flexural strength (psi)	slope m	flexural modulus (psi)
A	0.586	0.230	137.2	26,600	4370	9.81 E + 06
B	0.557	0.227	125.0	26,100	4330	1.06 E + 07
C	0.558	0.226	122.7	25,800	4000	9.94 E + 06
D	0.577	0.230	140.2	27,600	4290	9.78 E + 06
E	0.564	0.238	130.8	24,600	4620	9.72 E + 06
F	0.573	0.224	134.7	28,100	4120	1.02 E + 07

TABLE 2-continued

FLEXURAL PROPERTIES OF UNREINFORCED AND REINFORCED PLASTIC AND ELECTRICAL INSULATING MATERIALS
ASTM D790

TEST METHOD/PROCEDURE = I/A SPAN/DEPTH RATION L/D = @16/1 SPAN = 4.00 INCHES
LOADING NOSE/SUPPORT RADIUS = .12/.12 RATE OF CROSSHEAD MOTION = 0.11 in./min.

specimen	width b	depth d	max. load P	flexural strength (psi)	slope m	flexural modulus (psi)
			AVG. =	26,500	AVG. =	1.00 E + 07
			STD. DEV. =	1,270	STD. DEV. =	3.36 E + 05

TABLE 3

Standard Test Method for
IN-PLANE STRENGTH of REINFORCED PLASTICS
ASTM D 3846

TEST SPECIMENS machined (X) cast TEST TEMP./HUM. (68 DEG. F./65%)

specimen	width (in.)	depth (in.)	area (sq. in)	max. load (pounds)	SHEAR STRENGTH (psi)
A	0.494	0.248	0.122	399	3270
B	0.480	0.248	0.119	398	3340
C	0.487	0.248	0.121	371	3070
D	0.481	0.250	0.120	411	3420
E	0.482	0.250	0.120	411	3420
				AVG.	3300
				STD. DEV.	145

NOTE: In-plane shear test conducted at corrosion resistant/woven laminate bond interface.

TABLE 4

RESISTANCE OF PLASTIC MATERIALS TO ABRASION
ASTM D1242

TEST METHOD/PROCEDURE = A/FIXED ABRASIVE ABRASIVE: GRIT/BRAND = 80/3M

specimen	width in.	length in.	area sq. in.	load pds.	load p.s.i.	test duration	volume loss cu./cm.
A	1.935	2.915	5.64	10	1.77	1000 REV.	6.46
B	1.940	2.975	5.77	10	1.73	1000 REV.	6.30
C	1.990	2.940	5.85	10	1.71	1000 REV.	6.21
D	1.980	2.970	5.88	10	1.70	1000 REV.	6.27
E	1.920	2.940	5.65	10	1.77	1000 REV.	6.43
						AVG.	6.33
						Std. Dev.	0.11

NOTE: Abrasion test conducted on corrosion resistant side of laminate.

TABLE 5

COMPRESSIVE PROPERTIES OF ORIENTED FIBER COMPOSITES
ASTM D 3410

TEST SPECIMENS machined (X) cast ( ) TAB MATERIAL/ADHESIVE INTEGRAL
TEST TEMPERATURE/HUMIDITY (68 deg./65%) SPEED OF TESTING 0.15 in./min.

specimen	width (in.)	depth (in.)	area sq. in.	max. load (pounds)	compressive strength (psi)	elastic modulus (psi)
A	0.495	0.122	0.060	1999.8	33,330	3.24 E + 06
B	0.483	0.121	0.058	1994.2	34,380	3.49 E + 06
C	0.484	0.115	0.056	1794.1	32,040	3.66 E + 06
D	0.490	0.114	0.056	1939.1	34,630	3.58 E + 06
E	0.485	0.108	0.052	1659.5	31,910	3.63 E + 06

TABLE 5-continued

COMPRESSIVE PROPERTIES OF ORIENTED FIBER COMPOSITES
ASTM D 3410

TEST SPECIMENS machined (X) cast ( ) TAB MATERIAL/ADHESIVE INTEGRAL
TEST TEMPERATURE/HUMIDITY (68 deg./65%) SPEED OF TESTING 0.15 in./min.

specimen	width (in.)	depth (in.)	area sq. in.	max. load (pounds)	compressive strength (psi)	elastic modulus (psi)
F	0.488	0.101	0.049	1677.5	34,230	3.92 E + 06
				AVG.	33,420	3.59 E + 06
				STD. DEV.	1,202	2.23 E + 05

TABLE 6

MAXIMUM OPERATING TEMPERATURES FOR CHEMICAL RESISTANCE

		MAXIMUM ALLOWABLE TEMPERATURE F.°	
CHEMICAL	PERCENT	PREMIUM GRADE VINYL ESTER THERMOSET RESIN	HALAR ®
ALCOHOL METHYL	100	100	300
ALCOHOL BUTYL	100	120	300
AMMONIUM HYDROXIDE	10–20	150	300
ANILINE	100	70	73
ARSENIC ACID	ALL	100	300
BENZENE	100	100	150
BORIC ACID	100	210	300
BUTYL ACETATE	100	80	150
CARBON TETRACHLORIDE	100	180	300
CHLORINE GAS - WET	100	250	250
CHLORINE WATER	SAT'D	210	250
CHROMIC ACID	10	150	212
CHROMIC ACID	30	N/R	212
CYCLOHEXANE	100	150	212
DETERGENTS	100	180	300
ETHYL CHLORIDE	100	80	300
ETHYLENE DICHLORIDE	100	80	73
ETHYLENE GLYCOL	ALL	210	300
FORMIC ACID	98	100	250
FREON 113 SOLVENT		100	121
GASOLINE UNLEADED		150	300
HYDROCHLORIC ACID	37	180	300
HYDROFLUORIC ACID	10	150	300
HYDROFLUORIC ACID	20	100	250
SODIUM HYDROXIDE	15	150	300
SODIUM HYDROXIDE	25	180	250
SODIUM HYPOCHLORITE	5	180	250
SULFURIC ACID	25	210	250
SULFURIC ACID	75	120	250
SULFURIC ACID	93	N/R	150
TOLUENE	100	120	120
XYLENE	100	120	120

Although the preferred embodiments of the invention have been described in detail above, it should be understood that the invention is in no sense limited thereby, and its scope is to be determined by that of the following claims:

What is claimed is:

1. In a reinforced corrosion resistant laminate, the improvement comprising incorporating therein a surfacing veil of a thermoplastic fluoropolymer.

2. The laminate of claim 1 wherein said thermoplastic fluoropolymer is a copolymer of ethylene and chlorotrifluoroethylene.

3. A chemically resistant plastic laminate comprising:

a. an initial layer of a thermosetting resin having a surfacing veil or mat of fibers of a thermoplastic fluoropolymer therein, and

b. a second layer of a thermosetting resin having glass reinforcing fibers contained therein.

4. The laminate of claim 3 wherein said thermoplastic fluoropolymer is a copolymer of ethylene and chlorotrifluoroethylene.

5. The laminate of claim 4 wherein said laminate is contact molded.

6. The laminate of claim 5 wherein said thermosetting resin is a vinyl ester resin.

7. A chemically resistant contact molded plastic laminate comprising:

a. an initial layer of a thermosetting resin having a mat of fibers of a melt blown thermoplastic fluoropolymer therein, and

b. a second layer of a thermosetting resin having glass reinforcing fibers contained therein.

8. The laminate of claim 7 wherein said thermosetting resin is a vinyl ester resin.

9. The laminate of claim 8 wherein said thermoplastic fluoropolymer is a copolymer of ethylene and chlorotrifluoroethylene.

10. The laminate of claim 1 wherein said laminate is contact molded.

11. In a reinforced corrosion resistant laminate, the improvement comprising incorporating therein a surfacing veil of a melt blown thermoplastic fluoropolymer, said thermoplastic fluoropolymer comprising a copolymer of ethylene and chlorotrifluoroethylene.

12. The laminate of claim 11 wherein said laminate is contact molded.

13. The laminate of claim 1 wherein said laminate is made from thermosetting resin.

14. The laminate of claim 13 wherein said thermosetting resin is a vinyl ester resin.

15. The laminate of claim 11 wherein said laminate is made from thermosetting resin.

16. The laminate of claim 15 wherein said thermosetting resin is a vinyl ester resin.

17. A chemically resistant contact molded plastic laminate comprising:

a. an initial layer of a thermosetting resin having a mat of fibers of a melt blown thermoplastic fluoropolymer therein, wherein said thermoplastic fluoropolymer is a copolymer of ethylene and chlorotrifluoroethylene, and

b. a second layer of a thermosetting resin having glass reinforcing fibers contained therein.

18. The laminate of claim 17 wherein said thermosetting resin is a vinyl ester resin.

19. The laminate of claim 17 wherein said laminate is contact molded.

20. The laminate of claim 19 wherein said thermosetting resin is a vinyl ester resin.

* * * * *

[redacted]

US005688600A

United States Patent [19]

Bailey, Jr.

[11] **Patent Number:** **5,688,600**

[45] **Date of Patent:** ***Nov. 18, 1997**

[54] **THERMOSET REINFORCED CORROSION RESISTANT LAMINATES**

[75] Inventor: **Edward D. Bailey, Jr.**, Baker, La.

[73] Assignee: **Cobale Co., L.L.C.**, Baton Rouge, La.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,534,337.

[21] Appl. No.: **670,631**

[22] Filed: **Jun. 26, 1996**

Related U.S. Application Data

[63] Continuation of Ser. No. 43,200, Apr. 5, 1993, Pat. No. 5,534,337.

[51] **Int. Cl.^{6}** **B32B 27/00**

[52] **U.S. Cl.** **428/421**; 428/422; 428/903; 442/88; 442/218; 442/333

[58] **Field of Search** 428/236, 286, 428/290, 302, 421, 422, 903

[56] **References Cited**

FOREIGN PATENT DOCUMENTS

0194381	9/1986	European Pat. Off. .

Primary Examiner—Helen Lee
Attorney, Agent, or Firm—David L. Ray

[57] **ABSTRACT**

In accordance with the present invention there is provided a corrosion resistant surfacing veil of a thermoplastic fluoropolymer, and corrosion resistant reinforced thermoset plastic laminates having a surfacing veil of a thermoplastic fluoropolymer.

12 Claims, 1 Drawing Sheet

EXHIBIT
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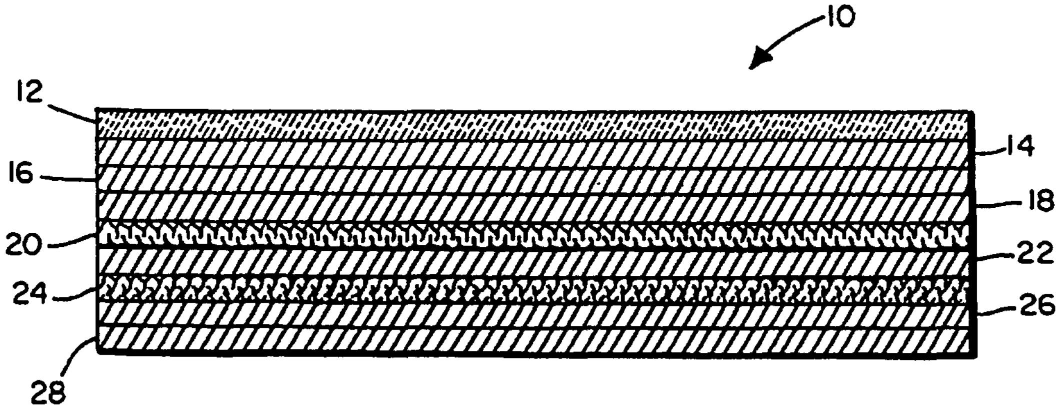
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THERMOSET REINFORCED CORROSION RESISTANT LAMINATES

This application is a continuation of Ser. No. 08/043,200, Apr. 5, 1993, now U.S. Pat. No. 5,534,337.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to reinforced polymeric laminates. More particularly, the present invention is related to corrosion resistant reinforced thermosetting plastic laminates, and a surfacing veil for incorporation in the laminates.

2. Description of the Related Art

The use of surfacing veil as the primary corrosion barrier in thermoset resin fiber reinforced laminates is well known in the glass fiber reinforced plastic industry.

In the American Society for Testing and Materials (hereinafter ASTM) C582-87 entitled *Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RIP) Laminates for Corrosion Resistant Equipment,* which is incorporated by reference, contact molding is defined in section 3.4 as ". . . a method of fabrication wherein the glass-fiber reinforcement is applied to the mold, in the form of chopped-strand mat or woven roving, by hand or from a reel, or in the form of chopped strands of continuous-filament glass from a chopper-spray gun. The resin matrix is applied by various methods, including brush, roller, or spray gun. Consolidation of the composite laminate is by rolling."

A surfacing veil or mat is defined in ASTM C582-87, ASTM D4097-88, and ASTM D3299-88. A surfacing veil or mat is defined in ASTM C582-87, section 5.2.1 of ASTM C582-87 as "a thin mat of fine fibers used primarily to produce a smooth surface on a reinforced plastic." 5.2.1.2 of ASTM C582-87 states that the requirements of acceptable surface veils are:

"(a) Resin compatibility.
(b) Uniform fiber distribution.
(c) Single filaments (not bunched)
(d) The veil layer(s) shall be a minimum of 10 mils in dry thickness producing a 10 to 15 mil resin saturated veil layer per 10 mils of dry veil, and
(e) Minimum fiber length shall be 0.5 in.

Note 9—The chemical resistance of the RTP laminate is provided by the resin. In combination with the cured resin, the surfacing veil helps determine the thickness of the resin-rich layer, reduces microcracking, and provides a nonwicking chemically resistant layer.

Additional desirable considerations in choosing a veil for a specific application include:

(a) Drapability (surfacing veil should conform to mold shape).
(b) Dry and wet tensile strength.
(c) Binder solubility (if used)
(d) Uniform wetting.
(e) Surfacing vet shall wet-out completely without trapping air during laminating, and
(f) Surfacing veil should not inhibit resin cure."

The surfacing veil is a reinforcement material that when saturated with resin (sometimes referred to as "wet out") retains a high resin to reinforcement ratio. Thermoset resin is very chemically resistant and the surfacing veils of the prior art are in many cases susceptible to attack by the chemical being contained. If the surfacing veils of the prior art are exposed to the chemical contained due to a breach in the resin, attack of the reinforcement material may start, leading to a shortened service life and equipment failure.

Surfacing veils of the prior art are commonly made from monofilament glass or polyester fibers. The most commonly used monofilament glass fibers are known in the art as "C" glass. The most commonly used polyester fibers used for surfacing veil are sold by E. I. Dupont de Nemours & Co. under the trademark Dacron.

Exemplary of the related art are the following U.S. Patents:

U.S. Pat. No. 5,077,115 discloses thermoplastic composite material including a thermoplastic matrix which is highly filled with a coated ceramic filler. In an important feature of the present invention, the ceramic filler has been coated with a rubbery polymer that bonds to the filler. In a preferred embodiment, the thermoplastic matrix comprises a fluoropolymer, preferably a chlorofluoropolymer and the ceramic filler is a fused amorphous silica coated with a rubbery polymeric material. The thermoplastic composite material of this invention exhibits numerous advantages which makes it well suited for use as a bonding film, particularly a bonding film for producing multilayer printed wiring bonds.

U.S. Pat. No. 4,943,473 discloses flexible laminated fluoropolymer-containing composites including fire and chemical resistant, flexible composites made from flexible woven, non-woven and knitted substrates and fluoropolymer containing films. Adhesives, such as melt adhesives, may be used in making the composites. The composites are suitable for use in protective garments, and in other articles where flexible chemically resistant materials are needed. A seaming technique for use in protective articles is disclosed.

U.S. Pat. No. 4,886,699 discloses a glass fiber reinforced fluoropolymeric circuit laminate including one or more layers of fluoropolymer impregnated woven glass cloth sandwiched between one or more layers of "random" microfiberglass reinforced fluoropolymer. This composite of fluoropolymer, woven glass fabric and random glass microfibers may be clad on one or both outer surfaces with a suitable conductive martial such as copper or certain known resistive foils. The fluoropolymer impregnated woven glass layer or layers will be nested between microfiberglass reinforced fluoropolymer layers to provide the outer surfaces of the circuit with smooth surfaces for fine line circuitry. The circuit laminate of the invention exhibits good dimensional stability, smooth surfaces for fine line circuitry, good electrical properties, and strong foil and interlaminar adhesion properties.

U.S. Pat. No. 4,886,689 discloses a matrix-matfix polyblend adhesives and method of bonding incompatible polymers useful in an adhesive tie layer to bond incompatible polymer layers. The adhesives are a blend of the components making up the incompatible polymer layers themselves, or polymers substantially similar to these, and are melt processed to produce a matrix-matrix morphology with mechanical interlocking of the polymer components that is maintained upon cooling. Additives may be provided in one or both adhesive components to improve the cohesive strength of the adhesive formed by the mechanical interlocking.

U.S. Pat. No. 4,777,351 discloses devices including conductive polymer compositions. A number of improvements to electrical devices, particularly sheet heaters, including conductive polymer compositions, are provided. The preferred heater has the following features (a) it includes a laminar resistive element and a plurality of electrodes which are so positioned that the predominant direction of current flow is parallel to the faces of the laminar element, (b) it includes a laminar insulating element adjacent to but not secured to the electrodes and the resistive element; (c) it includes a metallic foil, which acts as a ground plane and is positioned adjacent the insulating element but is not secured thereto; (d) it includes a dielectric layer intimately bonded to the resistive element and to the electrodes.

The invention also provides an electrical device including first and second members having different resistivities, and a thin contact layer of intermediate resistivity positioned between the first and second members.

U.S. Pat. No. 4,770,927 discloses a reinforced fluoropolymer composite which includes a substrate having a coating matrix including an initial layer of a perfluoropolymer and an overcoat including a fluoroelastomer, a fluoroplastic, a fluoroelastomer/fluoroplastic blend, or a combination thereof. The perfluoropolymer in the initial layer may be a perfluoroplastic, a perfluoroelastomer, or blends thereof. In a separate embodiment, the novel composite includes a substrate coated solely with one or more layers of perfluoroelastomer alone or as a blend with a perfluoroplastic. Where the substrate is not susceptible to hydrogen fluoride corrosion, the composite may include solely one or more layers of a blend of a fluoroelastomer and a hydrogen-containing perfluoroplastic. Cross-linking accelerators may be used to cross-link one or more of the resins contained in the coating layers. Each composite may be top-coated with a layer or layers of a fluoroplastic, fluoroelastomer, and/or a blend thereof. The composite is flexible, exhibits good matrix cohesion and possesses substantial adhesion to the material acting as the reinforcement or substrate. A method for making such a composite includes the unique deployment of a perfluoropolymer directly onto the substrate in a relatively small amount sufficient to protect the substrate from chemical corrosion without impairing flexibility, followed by the application of the overcoat layer.

U.S. Pat. No. 4,677,017 discloses coextrusion of thermoplastic fluoropolymers with thermoplastic polymers. The coextruded film includes at least one thermoplastic fluoropolymer layer and at least one thermoplastic polymeric layer adjacent to the to the thermoplastic fluoropolymer layer. There is preferably a coextruded adhesive layer between each thermoplastic fluoropolymer layer and each thermoplastic polymeric layer. The coextruded film can be oriented in at least one direction and/or embossed without delamination, fibrillating, or splitting.

U.S. Pat. No. 4,539,113 discloses a fluororesin filter made entirely of fluororesin having both a high corrosion and high heat resistance. A plurality of tubular filtering elements are arranged in a fluororesin container. Each tubular filtering element has a polytetraethylene tubular filtering film closed at one end and arranged over or inserted into a fluororesin tubular support. The tubular filtering elements are connected to a cover structure, on the inner surface of which is formed a groove for communicating the tubular filtering elements to one of the liquid inlet and liquid outlet provided in the cover structure.

U.S. Pat. No. 4,505,971 discloses a fluoroplastic and metal laminate having rubber compound bonded layers, and a process and composition for adhering a rubber compound to a fluoroplastic and/or to metal. The invention contemplates the use of separate sequentially applied adhesive layers to the fluoroplastic or metal substrate. The last applied layer, a rubber cement, allows the metal or fluoroplastic to be adhered to the uncured rubber compound which is subsequently vulcanized. The invention finds particular utility in securing a fluoroplastic and a rubber lining to steel or other metallic surfaces. A typical use is the lining of the interior of a railroad tank car, providing protection from corrosive or hostile environments experienced when the tank car is transporting acids or other caustic materials. Other uses include the lining of chemical process vessels and piping.

U.S. Pat. No. 4,163,505 discloses foldable liners for fluids holding storage tanks which are polyhedrical shaped liners, mounted vertically inside a cylindrical storage tank, and fixed to the inner top of the tank.

The lower portion of the liner is fitted to a rigid frame which is free to displace in the vertical direction.

Devices located on equidistant horizontal narrow strips of the liner, restrain the strips from displacing radially inward but allow them to move in the vertical direction.

Devices that apply forces directed vertically upwards over the rigid frame and of sufficient magnitude to produce critical compressive stresses in the liner are provided.

These critical compressive stresses induce buckling of the portions of the liner between successive narrow strips, and folding of the liner-in-situ is achieved.

U.S. Pat. No. 3,833,453 discloses a nonflammable, fiber-filled, cold-formable thermoplastic sheets which are glass fiber-reinforced ethylene chlorotrifluoroethylene composite sheets formable into shaped objects in a mold at ambient temperatures solely by moderate preheating of the sheet outside of the mold. This polymer including a high molecular weight, tough copolymer of ethylene and chlorotrifluoroethylene in an approximate 1:1 mol ratio is inherently non-flammable in air. A glass fiber of controlled length increases the mechanical properties of the composite structure and allows fabrication into suitable shapes without detracting from the nonflammable properties of the polymeric composite.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a surfacing veil for utilization in laminates made from reinforced thermosetting resins.

It is another object of the invention to provide a surfacing veil for utilization in laminates made from reinforced thermosetting resins which has enhanced chemical resistance, good abrasion resistance, and excellent interlaminar sheer strength between the surfacing veil and an adjacent lamina.

It is yet another object of the invention to provide a surfacing veil for utilization in laminates made from reinforced thermosetting resins which provides a corrosion barrier reinforcement which due to its chemical resistance would provide a longer service life for the laminates without substantial increases in cost of the laminates.

It is a further object of the invention to provide a corrosion resistant surfacing veil for utilization in laminates made from reinforced thermosetting resins which may be utilized with the application techniques commonly in use.

It is a yet further object to provide a surfacing veil which can be used with a wide variety of thermoset resins.

It is also an object of the invention to provide a chemically resistant surfacing veil that is also flame resistant.

In accordance with the present invention there is provided a corrosion resistant surfacing veil of a thermoplastic fluoropolymer, and corrosion resistant reinforced thermoset plastic laminates having a surfacing veil of a thermoplastic fluoropolymer.

BRIEF DESCRIPTION OF THE DRAWING

The single drawing FIGURE is an enlarged schematic side view of a multilayer laminate of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a surfacing veil made from a fluoropolymer, and contact molded reinforced plastic laminates utilizing the surfacing veil of the invention. Contact molding as use herein includes contact-molding as disclosed in ASTM C582-87, ASTM D4097-88, and molding or fabricating by filament-winding as disclosed in ASTM D3299-88. ASTM D3299-88 and ASTM D4097-88 are hereby incorporated by reference.

Surfacing veils of the invention are made from thermoplastic fluoropolymers such as chlorotrifluoropolymers, and the copolymers of tetrafluoroethylene and, perfluoroalkoxy resins, fluorinated ethylenepropylene, polyvinyl fluoride, and polyvinylidene fluoride.

The most preferred surfacing veil of the invention is veil made from copolymers of ethylene and chlorotrifluoroethylene (sometimes referred to as ECTFE) such as HALAR®, which is a copolymer of ethylene and chlorotrifluoroethylene sold by Ausimont USA, Inc. of Morristown, N.J. and described in HALAR® FLUOROPOLYMER RESIN ADVANTAGE, EXPANDED LIST—CHEMICAL RESISTANCE OF HALAR® FLUOROPOLYMER, hereby incorporated by reference, and in described in U.S. Pat. No. 3,833,453, hereby incorporated by reference. The most preferred surfacing veil of the invention is a melt blown thermoplastic fluoropolymer fiber filter media sold by Ausimont USA, Inc. of Morristown, N.J. and made from HALAR®.

Reinforcement materials include, in addition to the surfacing veil, chopped-strand mat, woven roving, and roving made from glass fibers. Other reinforcing fibers may be used if desired, but glass fibers are preferred.

The preferred laminates of the invention utilize a thermosetting resin. Suitable thermosetting resins include polyester or vinyl ester thermosetting resins, and other thermosetting resins made from phenols, furans, epoxies, and the like. ASTM C582-87 section 1.1 states that "thermoset polyester, vinyl ester, or other qualified thermosetting resin laminates" may be utilized. Polyester and vinyl ester thermosetting resins which may be used in the present invention are defined in ASTM C582-87, section 3.2 and 3.3 as follows:

"3.2 polyester—resins produced by the polycondensation of dihydroxyderivatives and dibasic organic acids or anhydrides, wherein at least one component contributes ethylenic unsaturation yielding resins that can be compounded with styryl monomers and reacted to give highly crosslinked thermoset copolymers.

3.3 vinyl esters—resins characterized by reactive unsaturation located predominately in terminal positions that can be compounded with styryl monomers and reacted to give highly crosslinked thermoset copolymers.

Note 2—These resins are handled in the same way as polyesters in fabrication of RTP components."

Catalysts well known in the art are preferably used with the thermosetting resins used to form the laminates of the invention to initiate the chemical reaction which causes the thermosetting resin to cure. Typical catalysts include peroxides such as methyl ethyl ketone peroxide, cumene hydroperoxide, and the like. Promoters well known in the art are preferably used to shorten the curing time of the thermosetting resins. Typical promoters include cobalt napthenate, benzoyl peroxide and the like.

EXAMPLE

A flat sheet of corrosion resistant laminate was contact molded in accordance with ASTM C582-87 as follows:

A melt blown thermoplastic fluoropolymer fiber filter media sold by Ausimont USA, Inc. of Morristown, N.J. and made from HALAR® was used as a surfacing veil in preparing the corrosion resistant laminate of the example. The surfacing veil utilized in preparing the laminate of the example had a weight of 3 oz/yd^2 and exhibited good mechanical properties needed for application to a stationary or rotating mold. Surfacing veil having a weight of 1½ oz/yd^2 did not exhibit the mechanical properties required for application to a rotating mold and was not utilized.

The surfacing veil fibers had a mean fiber diameter of 7.9 to 8.5 µm, where "µm" is a micro-meter. Excellent saturation or wet-out of the surfacing veil was achieved as well as a high resin to reinforcement ratio. The surfacing veil allowed the entrapped air to be rolled out easily and passed the liner void inspection as easily as conventional surfacing veils.

The surfacing veil had two distinctive sides. One side was "smooth", and the other side was "fuzzy". In preparing the laminate of the example, the fuzzy side was placed toward the mold.

The thermosetting resin utilized in preparing the corrosion resistant laminate **10** of the example was a vinyl ester resin sold by the Dow Chemical Company under the trademark Derakane 470-36 and described in *Fabricating Tips-Derakane vinyl ester resins,* hereby incorporated by reference, *Derakane Resins-Chemical Resistance and Engineering Guide,* hereby incorporated by reference. Preferably promoters and catalysts are used with the vinyl ester resin. The vinyl ester resin Derakane 470-36 used in preparing the laminate **10** utilized cobalt napthenate as a promoter and methyl ethyl ketone peroxide as a catalyst as recommended by Dow Chemical Company. The promoter was mixed with the resin, and then the catalyst was added to initiate the exothermic reaction.

Chopped-strand mat used for reinforcing the laminate **10** was "E" type glass fiber, 1½ oz/ft^2, with sizing and binder compatible with the resin, as required in ASTM C582-87, section 5.2.2.

Woven roving used for reinforcing the laminate **10** was "E" type glass, 24½ oz/yd^2, 5 by 4 square weave fabric and binder compatible with the fabric, as required in ASTM C582-87 section 5.2.3.

Laminate **10** was prepared in accordance with ASTM C582-87, and in particular section 6 thereof, as outlined in the following steps:

Step 1: A coating of the catalyzed vinyl ester resin was applied to the mold surface. The mold is the side facing the process or corrosive chemicals in contact with the laminate **10**.

Step 2: One layer of the surfacing veil **12** was applied with the fuzzy side toward the mold surface and was rolled into the catalyzed resin on the mold surface using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 3: A second coat of the catalyzed vinyl ester resin was applied.

Step 4: A first layer **14** of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 5: A third coat of the vinyl ester resin was applied.

Step 6: A second layer **16** of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 7: A fourth coat of the catalyzed vinyl ester resin was applied and the laminate was allowed to exotherm.

Step 8: A fifth coat of the catalyzed vinyl ester resin was applied.

Step 9: A third layer **18** of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 10: A sixth coat of the vinyl ester resin was applied.

Step 11: A first layer **20** of the 24½ oz/yd^2 woven roving was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 12: A seventh coat of the vinyl ester resin was applied.

Step 13: A fourth layer **22** of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 14: An eighth coat of the vinyl ester resin was applied.

Step 15: A second layer **24** of the 24½ oz/yd^2 woven roving was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 16: A ninth coat of the vinyl ester resin was applied.

Step 17: A fifth layer **26** of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 18: A tenth coat of the vinyl ester resin was applied.

Step 19: A sixth layer **28** of the 1½ oz/ft^2 "E" type glass fiber chopped strand mat was applied and was rolled into the resin using a serrated hand roller to eliminate air entrapment and to compress the layer into a uniform thickness.

Step 20: An eleventh coat of the vinyl ester resin was applied and the laminate was allowed to exotherm.

The laminate **10** was allowed to fully cure and was then prepared for testing. A plurality of specimens labeled A through F were cut from laminate **10** for testing. The cured thickness of the resin coated surfacing veil **12** was approximately 0.030 inches. The specimens A-F were tested in accordance with the ASTM testing procedure shown in each table, and the results recorded in the following tables 1–5.

The tensile properties as shown in Table 1 are similar to tensile properties achieved utilizing the surfacing veils of the prior art.

The flexural properties shown in Table 2 are greater than the flexural properties achieved using the surfacing veils of the prior art and indicate that the surfacing veil and laminates **10** of the invention have enhanced flexibility.

The in-plane shear strength shown in Table 3 was conducted between the layer **12** containing the surfacing veil of the invention and layer **14** containing the chopped strand mat. The average in plane shear strength between layer **12** and **14** was about 3,300 psi and was acceptable.

Abrasion resistance is shown in Table 4 and was acceptable, as were the compressive properties shown in Table 5.

Chemical resistance for the HALAR® fluoropolymer from which the surfacing veil is made is shown in Table 6.

TABLE 1

Standard Test Method for
TENSILE PROPERTIES OF PLASTICS
ASTM D 638

TEST SPECIMENS machined (X) cast ( ) SPEED of TESTING 0.20 in./min.
TYPE SPECIMEN III TEST TEMP./HUM. (69 deg. F./65%) GAUGE LENGTH 2.00 in

specimen	width (in.)	depth (in.)	area (sq. in)	max. load (pounds)	tens. strength (psi)	elong. @ break	modulus (psi)
A	1.007	0.230	0.232	3220	13,900	1.1%	1.90 E + 06
B	1.005	0.232	0.233	3470	14,900	1.2%	1.72 E + 06
C	1.006	0.234	0.235	3370	14,300	1.2%	1.74 E + 06
D	1.012	0.235	0.238	3320	13,900	1.1%	1.54 E + 06
E	1.013	0.232	0.235	3300	14,000	1.1%	1.52 E + 06
				AVG.	14,200	AVG.	1.68 E + 06
				STD.DEV.	424	STD.DEV	1.57 E + 05

TABLE 2

FLEXURAL PROPERTIES OF UNREINFORCED AND REINFORCED PLASTIC
AND ELECTRICAL INSULATING MATERIALS
ASTM D790

TEST METHOD/PROCEDURE =I/A SPAN/DEPTH RATION L/D = @16/1 SPAN = 4.00 INCHES
LOADING NOSE/SUPPORT RADIUS = .12/.12 RATE OF CROSSHEAD MOTION = 0.11 in./min.

specimen	width b	depth d	max. load P	flexural strength (psi)	slope m	flexural modulus (psi)
A	0.586	0.230	137.2	26,600	4370	9.81 E + 06
B	0.557	0.227	125.0	26,100	4330	1.06 E + 07
C	0.558	0.226	122.7	25,800	4000	9.94 E + 06
D	0.577	0.230	140.2	27,600	4290	9.78 E + 06
E	0.564	0.238	130.8	24,600	4620	9.72 E + 06
F	0.573	0.224	134.7	28,100	4120	1.02 E + 07
			AVG. =	26,500	AVG. =	1.00 E + 07
			STD. DEV. =	1,270	STD.DEV. =	3.36 E + 05

TABLE 3

Standard Test Method for
IN-PLANE STRENGTH of REINFORCED PLASTICS
ASTM D 3846

TEST SPECIMENS machined (X) cast ( ) TEST TEMP./HUM. (68 DEG. F./65%)

specimen	width (in.)	depth (in.)	area (sq. in)	max. load (pounds)		SHEAR STRENGTH (psi)
A	0.494	0.248	0.122	399		3270
B	0.480	0.248	0.119	398		3340
C	0.487	0.248	0.121	371		3070
D	0.481	0.250	0.120	411		3420
E	0.482	0.250	0.120	411		3420
					AVG.	3300
					STD. DEV.	145

NOTE: In-plane shear test conducted at corrosion resistant/woven laminate bond interface.

TABLE 4

RESISTANCE OF PLASTIC MATERIALS TO ABRASION
ASTM D1242

TEST METHOD/PROCEDURE = A/FIXED ABRASIVE

ABRASIVE: GRIT/ BRAND = 80/3 M

speci-men	width in.	length in.	area sq. in.	load pds.	load p.s.i.	test duration	volume loss cu./cm.
A	1.935	2.915	5.64	10	1.77	1000 REV.	6.46
B	1.940	2.975	5.77	10	1.73	1000 REV.	6.30
C	1.990	2.940	5.85	10	1.71	1000 REV.	6.21
D	1.980	2.970	5.88	10	1.70	1000 REV.	6.27
E	1.920	2.940	5.65	10	1.77	1000 REV.	6.43
						AVG.	6.33
						Std. Dev.	0.11

NOTE: Abrasion test conducted on corrosion resistant side of laminate.

TABLE 5

COMPRESSIVE PROPERTIES OF ORIENTED FIBER COMPOSITES
ASTM D 3410

TEST SPECIMENS machined (X) cast ( ) TAB MATERIAL/ADHESIVE INTEGRAL
TEST TEMPERATURE/HUMIDITY (68 deg./65%) SPEED OF TESTING 0.15 in./min.

specimen	width (in.)	depth (in.)	area sq. in.	max. load (pounds)	compressive strength (psi)	elastic modulus (psi)
A	0.495	0.122	0.060	1999.8	33,330	3.24 E + 06
B	0.483	0.121	0.058	1994.2	34,380	3.49 E + 06
C	0.484	0.115	0.056	1794.1	32,040	3.66 E + 06
D	0.490	0.114	0.056	1939.1	34,630	3.58 E + 06
E	0.485	0.108	0.052	1659.5	31,910	3.63 E + 06
F	0.488	0.101	0.049	1677.5	34,230	3.92 E + 06
				AVG.	33,420	3.59 E + 06
				STD.DEV.	1,202	2.23 E + 05

TABLE 6

MAXIMUM OPERATING TEMPERATURES FOR CHEMICAL RESISTANCE

		MAXIMUM ALLOWABLE TEMPERATURE F°.	
CHEMICAL	PERCENT	PREMIUM GRADE VINYL ESTER THERMOSET RESIN	HALAR ®
ALCOHOL METHYL	100	100	300
ALCOHOL BUTYL	100	120	300
AMMONIUM HYDROXIDE	10–20	150	300
ANILINE	100	70	73
ARSENIC ACID	ALL	100	300
BENZENE	100	100	150
BORIC ACID	100	210	300
BUTYL ACETATE	100	80	150
CARBON TETRACHLORIDE	100	180	300
CHLORINE GAS - WET	100	250	250
CHLORINE WATER	SAT'D	210	250
CHROMIC ACID	10	150	212
CHROMIC ACID	30	N/R	212
CYCLOHEXANE	100	150	212
DETERGENTS	100	180	300
ETHYL CHLORIDE	100	80	300
ETHYLENE DICHLORIDE	100	80	73
ETHYLENE GLYCOL	ALL	210	300
FORMIC ACID	98	100	250
FREON 113 SOLVENT		100	121
GASOLINE UNLEADED		150	300
HYDROCHLORIC ACID	37	180	300
HYDROFLUORIC ACID	10	150	300
HYDROFLUORIC ACID	20	100	250
SODIUM HYDROXIDE	15	150	300
SODIUM HYDROXIDE	25	180	250
SODIUM HYPOCHLORITE	5	180	250
SULFURIC ACID	25	210	250
SULFURIC ACID	75	120	250
SULFURIC ACID	93	N/R	150
TOLUENE	100	120	120
XYLENE	100	120	120

Although the preferred embodiments of the invention have been described in detail above, it should be understood that the invention is in no sense limited thereby, and its scope is to be determined by that of the following claims:

What is claimed is:

1. In a reinforced corrosion resistant laminate utilizing a thermosetting resin, the improvement comprising incorporating therein a surfacing veil of a thermoplastic fluoropolymer, wherein said thermosetting resin is a polyester resin.

2. The laminate of claim 1 wherein said thermoplastic fluoropolymer is a copolymer of ethylene and chlorotrifluoroethylene.

3. The laminate of claim 2 wherein said laminate is contact molded.

4. The laminate of claim 1 wherein said laminate is contact molded.

5. In a reinforced corrosion resistant laminate utilizing a thermosetting resin, the improvement comprising incorporating therein a surfacing veil of a thermoplastic fluoropolymer, wherein said thermosetting resin is phenol.

6. The laminate of claim 5 wherein said thermoplastic fluoropolymer is a copolymer of ethylene and chlorotrifluoroethylene.

7. The laminate of claim 6 wherein said laminate is contact molded.

8. The laminate of claim 5 wherein said laminate is contact molded.

9. In a reinforced corrosion resistant laminate utilizing a thermosetting resin, the improvement comprising incorporating therein a surfacing veil of a thermoplastic fluoropolymer, wherein said thermosetting resin is an epoxy resin.

10. The laminate of claim 9 wherein said thermoplastic fluoropolymer is a copolymer of ethylene and chlorotrifluoroethylene.

11. The laminate of claim 10 wherein said laminate is contact molded.

12. The laminate of claim 9 wherein said laminate is contact molded.

* * * * *

MAR 1 8 1994

Ausimont U.S.A., Inc./4B Plastics Development Proposal: FRP Composites of Halar® E-CTFE Melt Blown Fiber (MBF) Veil, E-CTFE Monofilament and E-CTFE Powder

1. Exclusivity

Ausimont U.S.A., Inc., agrees to work exclusively with **4B Plastics, Inc.**, or its assignee, in the development and sale of FRP (Fiber Reinforced Plastic) composites and coatings that utilize Halar MBF Veil, Halar Filament and Halar Powder.

These composites are used in a variety of process structures and vessels in the Chemical Process Industry.

Examples include, but are not limited to, FRP tanks, storage vessels, pipe, duct, as well as coatings for spillways, basins and reservoirs.

2. Sales and Audit

Ausimont U.S.A., Inc., will sell Halar MBF Veil directly to Distributors worldwide. These Distributors will be mutually agreed upon in writing by **Ausimont U.S.A., Inc.**, and **4B Plastics, Inc.**, or its assignee. (Hereafter, 4B Plastics is used to mean 4B Plastics or its assignee.)

Ausimont will allow a mutually agreed upon independent audit of Ausimont sales records of Halar MBF Veil for FRP composites to the designated Distributors.

3. Distribution

Ausimont U.S.A., Inc., and **4B Plastics** will consult and agree upon Distributors of Halar MBF Veil for FRP composites. Ausimont U.S.A. will guarantee distribution of Halar MBF Veil in Europe. This guarantee can be changed or modified by mutual agreement in writing between Ausimont U.S.A. and 4B Plastics.

Additional or different Distributors can be established through mutual agreement in writing by Ausimont U.S.A. and 4B Plastics.

4. Pricing, Payment and Terms

Ausimont U.S.A., Inc., agrees to pay **4B Plastics** a commission as follows:

1. **Ausimont U.S.A., Inc.**, will pay a commission to **4B Plastics** on all pounds of Halar MBF Veil sold to Distributors for FRP composite applications. The commission is based on price, as follows:

EXHIBIT
tabbies
C

PRICE	**COMMISSION**
$44.99/LB. and above	60% of the difference between the selling price and $30/LB., plus $2.55/LB.
$30.01 - 44.98/LB.	50% of the difference between the selling price and $30/LB., plus $2.55/LB.
$25.01 - 30.00/LB.	8.5% of the selling price
$20.00 - 25.00/LB.	7.0% of the selling price

The commission is based on price and is open-ended (i.e., no volume cap). Payment will be made quarterly to 4B Plastics. Amounts will be accrued, and payment made within 15 days of the month following the quarter.

5. **Joint Marketing and Promotion**

Any incentive or developmental pricing for the purpose of evaluation or trial of Halar MBF Veil in FRP composites will be mutually agreed upon in writing.

Any technical presentations or paper given at trade shows or industry meetings will be mutually developed and agreed upon.

6. **Agreement supersedes letters of October 13, 1993, and October 20, 1993.**

4B PLASTICS, INC.	AUSIMONT U.S.A., INC.
By: Carl L. Baker	By:
(Signature)	(Signature)
CARL L. BAKER	Vittorio Cianchini
(Name)	(Name)
PRESIDENT	President
(Title)	(Title)
3-18-94	3/10/94
(Date Signed)	(Date Signed)

EXAMPLE #1

SELL PRICE - $48.00/LB:

60% of ($48 - $30) + 8½% of $30.00 =

(.60) ($18) + $2.55 =

$10.80 + $2.55 =

$13.35 Commission paid to 4B Plastics per pound of Halar MBF Veil.

EXAMPLE #2

SELL PRICE - $40.00/LB:

50% of ($40 - $30) + 8½% of $30.00 =

(.50) ($10) + $2.55 =

$5.00 + $2.55 =

$7.55 Commission paid to 4B Plastics per pound of Halar MBF Veil.

EXAMPLE #3

SELL PRICE - $30.00/LB:

8½% of $30.00 =

$2.55 Commission paid to 4B Plastics per pound of Halar MBF Veil.

EXAMPLE #4

SELL PRICE - $20.00/LB:

7% of $20.00 =

$1.40 Commission paid to 4B Plastics per pound of Halar MBF Veil.

4B PLASTICS, INC.
By: Carl L. Baker
(Signature)
3-18-94
(Date Signed)

AUSIMONT U.S.A., INC.
By:
(Signature)
3/10/94
(Date Signed)