(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 April 2007 (19.04.2007)

PCT

(10) International Publication Number
WO 2007/044359 A2

(51) International Patent Classification:
C09D 5/44 (2006.01)

(21) International Application Number:
PCT/US2006/038697

(22) International Filing Date: 3 October 2006 (03.10.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/246,466 7 October 2005 (07.10.2005) US

(71) Applicant *(for all designated States except US)*: **PPG INDUSTRIES OHIO, INC.** [US/US]; 3800 West 143rd Street, Cleveland, Ohio 44111 (US).

(72) Inventors: **ORAVITZ, Jeffrey, J.**; 379 East Glen Eagle Drive, Highland Heights, Ohio 44143 (US). **ZIEGLER, Michael, J.**; 503 Rywood Court, Cranberry Township, PA 16066 (US). **AMBROSE, Ronald, R.**; 6307 Hampton Street, Pittsburgh, PA 15206 (US). **ESSARY, William, A.**; 118 Whitaker Drive, Saxonburg, PA 16056 (US).

(74) Agents: **MEYERS, Diane, R.** et al.; PPG INDUSTRIES, INC., One PPG Place, Pittsburgh, Pennsylvania 15272 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHODS FOR ELECTROCOATING FULL PANEL EASY OPEN ENDS

(57) Abstract: A method for electrocoating a surface of a full panel easy open end is disclosed. The surface is substantially uncoated prior to electrodeposition. Full panel easy open ends prepared by the methods are also disclosed.

WO 2007/044359 A2

METHODS FOR ELECTROCOATING FULL PANEL EASY OPEN ENDS

FIELD OF THE INVENTION

[0001] The present invention relates to methods for electrocoating full panel easy open ends, wherein a surface of the end is substantially uncoated prior to electrodeposition.

BACKGROUND INFORMATION

[0002] The application of various treatment and pretreatment solutions to metals to retard or inhibit corrosion is well established. This is particularly true in the area of metal food cans. Coatings are applied to the interior of such containers to prevent the contents from contacting the metal of the container. Contact between the metal and the food or beverage can lead to corrosion of the metal container, which can then contaminate the food or beverage.

[0003] Metal lids for food cans are typically produced by an operation in which the lids are stamped from a metal sheet that has already been painted and/or varnished. As a result of the stamping procedure, cracking or breakage of the coating(s) can occur. Electrodeposition is often used to "repair" these cracks or breaks; an electrodepositable coating is deposited on those relatively small areas in which bare metal is exposed.

SUMMARY OF THE INVENTION

[0004] The present invention is directed to methods for electrocoating a substantially uncoated surface of a full panel easy open end, comprising electrodepositing on the end an electrodepositable coating. Full panel easy open ends prepared according to this method are also within the scope of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0005] The present invention is directed to methods for electrocoating full panel easy open ends, comprising electrodepositing an electrodepositable coating

on the ends. A surface of the end is substantially uncoated according to the present methods.

[0006] A full panel easy open end will be understood by one skilled in the art as an end or lid in which substantially all (i.e. 90 percent or greater) of the lid is removed upon opening of the can; opening is effected by means of a pull tab, as opposed to a conventional can opener. A score substantially around the perimeter of the lid allows for easy opening or removing of the lid from the can, typically by means of a pull tab. A full panel easy open end is therefore distinguished from other lids or ends, which may be removed only by means of a can opener, or in which only a small portion of the lid is removed or otherwise opened, such as in the manner of a beverage can. It will be further understood by those skilled in the art that the coating of full panel easy open ends can often prove more challenging than other can ends or lids, because of the significant score area and other intricacies associated with the full panel easy open end. A rivet is also typically needed to hold the tab in place. Like the score, this rivet can often make the manufacturing of the end much more challenging.

[0007] According to the methods of the present invention, a full panel easy open end is coated by means of electrodeposition. A substantially uncoated surface of the end is coated according to the present methods. "Substantially uncoated" and like terms mean 50 percent or greater of a surface is uncoated. It will be appreciated, therefore, that the present invention is distinct from electrocoat "repair" known in the art, in which much less than 50 percent of the end's surface is uncoated prior to electrodeposition. Such lids are already substantially coated with one or more other layers. Moreover, in conventional lid repair methodologies, discussed above, only a very small percent of the lid is electrocoated. The present methods are therefore distinct from the art. For example, an end having a precoated exterior, such as some sort of print, with a clear overcoat, can be treated according to the present methods, in which any uncoated portion of the exterior, and/or the substantially uncoated interior of the lid will be electrocoated. It will be understood that an electrodepositable coating will not deposit on any portion of the

end that is coated prior to electrocoating, unless such coating is electrically conductive. In another alternative, an end having substantially no coating on the interior and/or the exterior can be treated according to the methods of the present invention. These alternatives are not intended to be exhaustive.

[0008] It will further be appreciated that "touch points" may occur on the ends, as a result of the device used to hold the ends in place during electro-deposition. The effects of the touch points are minimized, however, by "reflow" that occurs when the contacts are removed and the uncured electrocoat paint flows into the touch points, such as during the high temperature bake. In addition, the points on the end at which touch points occur often get crimped under during manufacture of the can, and will not be exposed to air or the contents of the can.

[0009] Any suitable electrodepositable coating can be used according to the present invention. Either cathodic or anodic electrodeposition can be used, with anodic typically being more suitable. Since the full panel easy open ends are typically used in conjunction with food cans, however, it may be desired to use components that are approved by the United States Food and Drug Administration ("FDA") for direct food contact and/or the European Inventory of Existing Commercial Substances ("EINECS"). The term "food can" is used herein to refer to cans, containers, or any type of metal receptacle for holding any type of food or beverage. For example, the coating can be any conventional epoxy-amine coating used in the industry that can be electrodeposited onto a conductive substrate.

[0010] Examples of polymers useful in forming the resin include hydroxyl or carboxylic acid-containing acrylic copolymers, hydroxyl or carboxylic acid-containing polyester polymers, isocyanate or hydroxyl containing polyurethane polymers, and amine or isocyanate containing polyureas. These polymers are further described in U.S. Patent No. 5,939,491, column 7, line 7 to column 8, line 2; this patent, as well as the patents referenced therein, are incorporated by reference herein. Particularly suitable film-forming resins are acrylic resins and epoxy-acrylic resins, such as those that are commercially available from PPG Industries, Inc., or otherwise reported in the art. Curing agents for these resins are also described in

the '491 patent at column 6, lines 6 to 62; particularly suitable crosslinkers, especially for epoxy-acrylic resins and acrylic resins, include melamine, benzoguanamine, and phenolic crosslinkers. "Phenolic" will be understood as referring to polymers made from one or more phenolic monomers, such as phenol, bisphenol A, t-butyl-phenol and the like reacted with formaldehyde.

[0011] In certain embodiments of the invention, the electrodepositable coating is epoxy free. "Epoxy-free" and like terms means that all components of the coating are substantially free from oxirane rings or residues of oxirane rings; bisphenol A; bisphenol A diglycidylether ("BADGE") or adducts of BADGE. In other embodiments, the coatings used according to the present invention can be epoxy free and/or free from polyvinylchloride and/or related halide-containing vinyl polymers.

[0012] In certain embodiments of the present invention, the coating is epoxy-free and comprises acrylic resin, such as an acrylic crosslinked with a phenolic. Acrylic polymers can be (meth)acrylic acid and/or hydroxy alkyl esters of (meth)acrylic acid, such as hydroxyethylmethacrylate or hydroxypropyl(meth)acrylate; alkyl esters of (meth)acrylic can also be used, such as methyl(meth)acrylate, ethyl(meth)acrylate, butyl(meth)acrylate, and the like, as can 2-ethylhexyl(meth)acrylate, acrylamide reacted with formaldehyde and butanol ("nBMA"), vinyl aromatic compounds such as styrene and vinyl toluene, nitriles such as (meth)acrylonitrile, and vinyl esters such as vinyl acetate. Any other acrylic monomers known to those skilled in the art could also be used. The term "(meth)acrylate" and like terms are used conventionally and herein to refer to both methacrylate and acrylate. In certain embodiments, combinations of acrylics can be used.

[0013] In certain embodiments of the present invention, the coating may comprise both an acrylic moiety and a polyester moiety. The two moieties can be combined, for example, by blending or by grafting. Suitable blends and grafts are described in U.S. Publication No. 2004/0044117A1, which is hereby incorporated by reference.

[0014] In certain embodiments, the coatings of the present invention are water-borne or aqueous coatings. Aqueous coatings are generally preferred over solvent-based coatings for environmental reasons. The term "aqueous" as used herein means that the coatings are predominantly water. Small amounts, such as 20 weight percent or less (based on the total weight of the volatiles) of conventional solvents, such as alcohols, can be included and still be within the scope of the aqueous composition of the present invention. Indeed, the inclusion of a small amount of solvent, such as alcohol, CELLOSOLVE, and the like, is clearly within the aqueous compositions of certain embodiments of the present invention.

[0015] It may be necessary or desirable to improve the water solubility of a resin to prepare aqueous coating compositions. For example, the acrylic resin and/or polyester/acrylic copolymers described in U.S. Publication No. 2004/0044117A1, which is hereby referred to herein, are suitable for use in the present invention and can have improved water solubility by neutralizing the acid with a suitable amine, such as dimethylethylamine. When the acid is sufficiently neutralized, it can then be slowly added to water.

[0016] Coatings used according to the present invention, whether epoxy free or not, will typically comprise a curing agent. In certain embodiments of the invention, the curing agent is a phenolic or mixture of phenolics. Suitable phenolics are commercially available from Cytec in their PHENODUR line. In certain embodiments the crosslinker comprises 30 weight percent or greater, such as 50 weight percent or greater, such as 60 weight percent or greater of the total solid weight of the coating.

[0017] The coatings used according to the present methods can also comprise a pigment. Any suitable pigment can be used including TiO_2, ZnO, and MgO. Pigments can be added for color and also for hiding and stain resistance in coatings for food cans that may contain high sulfide foods, such as meats.

[0018] The composition used according to the present methods may further comprise one or more additives standard in the art, such as coalescence solvents, plasticizers, dispersing agents, wetting agents, light stabilizers, surfactants and

catalysts. Such additives, if used, will typically comprise 0.001 to 5 weight percent, based on the total solid weight of the coating.

[0019] Any suitable electrocoating method can be used according to the present invention, such any of those well known in the art. Similarly, cure of the electrodeposited coating can be conducted using cure parameters known in the art and based upon a particular coating used. When using certain phenolics, for example, a cure of 3 minutes at 400°F may be suitable. The dry film thickness of the cured coating can range, for example, from 7 to 12 mgs/in^2.

[0020] It will be appreciated that the full panel easy open ends are comprised of a conductive substrate. Suitable substrates include any of those known in the can art, such as tin plated steel, tin-free steel, and black-plated steel.

[0021] The full panel easy open ends of the present invention can be used in conjunction with any suitable type of can, such as food cans. Suitable cans include two-piece cans and three-piece cans. A two-piece can will be understood by those skilled in the art as referring to a drawn and wall ironed can; a three-piece can will be understood by those skilled in the art as referring to one that is coated in flat sheet, fabricated and welded.

[0022] The present invention is further directed to methods for preparing a full panel easy open end comprising stamping an end from a metal sheet and electrodepositing on the end an electrodepositable coating. At least one surface of the end is substantially uncoated prior to the electrodeposition step. In certain embodiments, the metal may be lubricated prior to stamping, such as by using a commercially available lubricant. Suitable lubricants are available from PPG Industries, Inc. Typically, the lubricant is cleaned from the metal following stamping. Again, any conventional cleaner can be used to remove the lubricant, such as acidic or alkaline cleaners commercially available from PPG Industries, Inc. It will be appreciated by those skilled in the art that the lubricant does not constitute a "coating", and that a full panel easy open end having a lubricant and/or cleaner applied thereto and nothing else would still be regarded as being "uncoated". In certain embodiments, some portion of one or both of the surfaces of the end can

have some coating applied thereto prior to electrodeposition. For example, a print or other design may be applied to one or both sides of the end prior to electrocoating. The print can be covered with a clear protective coat. At least one surface of the end, however, is substantially uncoated prior to electrodeposition. The electrodeposition process, coating, and the like are as described above.

[0023] It may be desired, according to any embodiments of the present invention, to apply a second electrocoat following cure of the first electrocoat. A second electrocoat would be desired to minimize the possibility of any blister points or touch points that may have been created during cure of the first coat. Typically, however, a single coat of electrodepositable coating on the full panel easy open end will give suitable enamel rater test results. For example, the methods of the present invention can consistently result in ends giving enamel rater readings of less than 25 milliamps, such as less than 10 milliamps or even less than 5 milliamps. While a second electrocoat can be used according to the present invention, it is a feature of the present invention that no additional coat needs to be used over top of the electrocoat according to the present methods.

[0024] According to certain embodiments of the present invention, the need to do a repair on an end is minimized, if not eliminated, because the part is stamped prior to coating. Thus, the present invention represents a significant savings in both time and materials as compared with conventional methods, in which one, two or even three coats are applied to a metal sheet, the end is stamped, and repair of the coating is required.

[0025] The present invention is further directed to a full panel easy open end prepared according to any of the methods disclosed herein.

[0026] As used herein, unless otherwise expressly specified, all numbers such as those expressing values, ranges, amounts or percentages may be read as if prefaced by the word "about", even if the term does not expressly appear. Any numerical range recited herein is intended to include all sub-ranges subsumed therein. Plural encompasses singular and vice versa. For example, while certain

embodiments may have been described in terms of "an" acrylic resin, one or more acrylic resins can be used. Also, as used herein, the term "polymer" is meant to refer to prepolymers, oligomers and both homopolymers and copolymers; the prefix "poly" refers to two or more.

EXAMPLES

[0027] The following examples are intended to illustrate the invention, and should not be construed as limiting the invention in any way.

Example 1

[0028] This example illustrates the preparation of a polyester-graft-acrylic copolymer.

Part 1

Synthesis of Polyester "A" is carried out as follows:

Table 1

Ingredients	Parts by Weight
Charge #1	
1,3-Butylene Glycol	177.1
Ethylene Glycol	34.4
Charge #2	
1,4-Cylcohexanedicarboxylic Acid	259.6
Isophthalic Acid	107.2
Maleic Anhydride	18
Dibutyltin Oxide	1.19
Methyl Hydroquinone	0.054
Charge #3	
Xylene	27.2
Charge #4	
Xylene	188.7

[0029] Charge #1 was added to a round-bottomed, 4-necked flask equipped with a motor driven stainless steel stir blade, a packed column connected to a water cooled condenser and a heating mantle with a thermometer connected through a temperature feed-back control device. The reaction mixture was heated to 125°C. Charge #2 was added to the mixture and the resultant mixture was heated to react in a nitrogen atmosphere. At 130°C, water generated by the esterification process began to be collected. With continuous removal of water, heating continued to 200°C. The reaction temperature was maintained at 200°C until the distillation of water began to significantly slow. The reaction mixture was cooled to 180°C, the packed column replaced with a Dean-Stark and a nitrogen sparge was started. Charge #3 was added and the reaction was heated to 195°C for 7 hours at which time the acid value was less than 3.0 mg KOH/gram. The resin was cooled, thinned with Charge #4, discharged and analyzed.

[0030] The determined acid value was 2.1 mg KOH/gram, and hydroxy value was 20.9 mg KOH/gram. The determined non-volatile content of the resin was 69.9% as measured by weight loss of a sample heated to 110°C for 1 hour. Analysis of the polymer by GPC (using linear polystyrene standards) showed the polymer to have an M_w value of 10,115, M_n value of 2,798, and an M_w/M_n value of 3.6.

Part 2

Synthesis of polyester-graft-acrylic copolymer "B" is carried out as follows:

Table 2

Ingredients	Parts by Weight
Charge #1	
Propylene Glycol Monomethyl Ether	184.0
Charge #2	
Propylene Glycol Monomethyl Ether	43.2
t-Amylperoxy-2-Ethyl Hexanoate	16.2
Charge #3	
Butyl Acrylate	77.8
2-Hydroxyethyl Methacrylate	90.7
Methacrylic Acid	77.1
Styrene	16.2
2-Ethylhexyl Acrylate	32.4
Methyl Methacrylate	29.8
Polyester A	1080.0
Propylene Glycol Monomethyl Ether	48.6
Charge #4	
Propylene Glycol Monomethyl Ether	16.2
t-Amylperoxy-2-Ethyl Hexanoate	3.2
Charge #5	
Propylene Glycol Monomethyl Ether	16.2
t-Amylperoxy-2-Ethyl Hexanoate	3.2
Charge #6	
Propylene Glycol Monomethyl Ether	102.8

[0031] Charge #1 was added to a round-bottom, 4-necked flask equipped with a motor driven stainless steel stir blade, water cooled condenser and a heating

mantle with a thermometer connected through a temperature feed-back control device. The contents of the flask were heated to reflux temperature. The addition of Charges #2 and #3 were started simultaneously and continued over 3 hours. After the additions were complete, the reaction was held at 120°C for 30 minutes. Charge #4 was then added to the mixture and after 60 additional minutes, Charge #5 was added. After Charge #5 was added, the mixture was held for 60 additional minutes, and Charge #6 was added.

[0032] The reaction product was then cooled, discharged and analyzed. The determined acid value was 28.6 mg KOH/gram. The determined non-volatile content of the resin was 59.70% as measured by weight loss of a sample heated to 110°C for 1 hour. Analysis of the polymer by GPC (using linear polystyrene standards) showed the polymer to have an M_w value of 147,598, M_n value of 4,937, and an M_w/M_n value of 29.9.

Example 2

[0033] This example illustrates the preparation of a polyester-graft-acrylic copolymer.

Synthesis of polyester-graft-acrylic copolymer "C" is carried out as follows:

Table 3

Ingredients	Parts by Weight
Charge #1	
Propylene Glycol Monomethyl Ether	184.0
Charge #2	
Propylene Glycol Monomethyl Ether	100.9
t-Amylperoxy-2-Ethyl Hexanoate	37.8
Charge #3	
Butyl Acrylate	226.8
2-Hydroxyethyl Methacrylate	211.7
Methacrylic Acid	108.1
Styrene	37.8
2-Ethylhexyl Acrylate	75.6
Methyl Methacrylate	96.0
Polyester A	468.9
Propylene Glycol Monomethyl Ether	113.4
Charge #4	
Propylene Glycol Monomethyl Ether	37.8
t-Amylperoxy-2-Ethyl Hexanoate	7.6
Charge #5	
Propylene Glycol Monomethyl Ether	37.8
t-Amylperoxy-2-Ethyl Hexanoate	7.6
Charge #6	
Propylene Glycol Monomethyl Ether	136.4

[0034] Charge #1 was added to a round-bottom, 4-necked flask equipped with a motor driven stainless steel stir blade, a water cooled condenser and a heating mantle with a thermometer connected through a temperature feed-back

control device. The contents of the flask were heated to reflux temperature. The addition of Charges #2 and #3 were started simultaneously and continued over 3 hours. After the additions were complete, the reaction was held at 120°C for 30 minutes. Charge #4 was then added to the mixture and after 60 additional minutes, Charge #5 was added. After Charge #5 was added, the mixture was held for 60 additional minutes, and Charge #6 was added.

[0035] The reaction product was then cooled, discharged and analyzed. The determined acid value was 28.6 mg KOH/gram. The determined non-volatile content of the resin was 61.00% as measured by weight loss of a sample heated to 110°C for 1 hour. Analysis of the polymer by GPC (using linear polystyrene standards) showed the polymer to have an M_w value of 38,794, M_n value of 4,878, and an M_w/M_n value of 8.0.

Example 3

[0036] This example illustrates the preparation of an acrylic polymer.

Synthesis of acrylic polymer "D" is carried out as follows:

Table 4

Ingredients	Parts by Weight
Charge #1	
Propylene Glycol Monomethyl Ether	388.4
Propylene Glycol Monophenyl Ether	387.6
Charge #2	
Propylene Glycol Monomethyl Ether	43.7
Propylene Glycol Monophenyl Ether	20.7
2-Ethylhexanol	36.6
Di-t-Butyl Peroxide	25.5
Cumene Hydroperoxide	25.5
Charge #3	
Butyl Acrylate	1363.6
2-Hydroxyethyl Methacrylate	124.0
Methacrylic Acid	371.9
Styrene	124.0
2-Ethylhexanol	32.7
Propylene Glycol Monomethyl Ether	23.0
Charge #4	
Propylene Glycol Monomethyl Ether	13.8
Di-t-Butyl Peroxide	12.3

[0037] Charge #1 was added to a round-bottom, 4-necked flask equipped with a motor driven stainless steel stir blade, a water cooled condenser and a heating mantle with a thermometer connected through a temperature feed-back control device. The contents of the flask were heated to reflux temperature. The addition of Charges #2 and #3 were started simultaneously and continued over 3 hours. After the additions were complete, 1/3 of Charge #4 was added to the

mixture and after 60 additional minutes an additional 1/3 of Charge #4 was added and after 60 additional minutes the 1/3 of Charge #4 was added. After the final portion of Charge #4 was added, the mixture was held for 120 additional minutes, then cooled and discharged from the reactor.

Example 4

[0038] A coating composition was formulated from the polyester-graft-acrylic copolymer "B" of Example 1 (Part 2).

[0039] To a suitable container equipped with agitation was added 93.8g of polyester-graft-acrylic copolymer "B". To this was then added 40.0g of GPRI 7590 (Georgia-Pacific) phenolic resin solution. When completely mixed 6.8g of N,N'-diethylethanolamine was added under agitation followed by a very slow addition of 1859.4g of deionized water.

[0040] The resulting coating was electrodeposited on tinplated 207.5 easy open ends. The electrodeposition took place at a voltage of 245 volts over a 3 second dwell at a bath temperature of 77°F. The ends were baked in a gas fired oven at an oven temperature of 410°F for 3 minutes, to give a film weight of ~8 mg/in^2. The resulting ends were tested for film integrity using a Wilkens-Anderson WACO Digital Enamel Rater (See Table 5). Average Enamel Rater values less than 3 milliamps, with no single value greater than 5, were targeted.

Example 5

[0041] A coating composition was formulated from the polyester-graft-acrylic copolymer "C" of Example 2.

[0042] To a suitable container equipped with agitation was added 91.8g of polyester-graft-acrylic copolymer "C". To this was then added 40.0g of GPRI 7590 (Georgia-Pacific) phenolic resin solution. When completely mixed 9.5g of N,N'-diethylethanolamine was added under agitation followed by a very slow addition of 1858.7g of deionized water.

[0043] The resulting coating was electrodeposited on tinplated 207.5 easy open ends. The electrodeposition took place at a voltage of 245 volts over a 3 second dwell at a bath temperature of 77°F. The ends were baked in a gas fired oven at an oven temperature of 410°F for 3 minutes, to give a film weight of ~8 mg/in². The resulting ends were tested for film integrity using a Wilkens-Anderson WACO Digital Enamel Rater (See Table 5). Average Enamel Rater values less than 3 milliamps, with no single value greater than 5, were targeted.

Example 6

[0044] A coating composition was formulated from the acrylic polymer "D" of Example 3.

[0045] To a suitable container equipped with agitation was added 67.7g of the acrylic polymer "D". To this was then added 40.0g of METHYLON 75108 (Durez Corporation) phenolic resin. When completely mixed 10.2g of N,N'-diethylethanolamine was added under agitation followed by a very slow addition of 1882.1g of deionized water.

[0046] The resulting coating was electrodeposited on tinplated 300 full panel easy open ends. The electrodeposition took place at a voltage of 230 volts over a 30 second dwell at a bath temperature of 85°F. The ends were baked in a gas fired oven at an oven temperature of 410°F for 3 minutes, to give a film weight of ~8 mg/in². The resulting ends were tested for film integrity using a Wilkens-Anderson WACO Digital Enamel Rater (See Table 5). Average Enamel Rater values less than 3 milliamps, with no single value greater than 5, were targeted.

Table 5

	End#1	End#2	End#3	End#4	End#5	End#6	Average
Example 4	3.8	0.9	2.3	1.6	3.5	1.9	2.3
Example 5	0.5	0.4	1.2	1.7	0.1	0.1	0.7
Example 6	0.0	0.0	0.0	0.1	--	--	0.0

As can be seen from Table 5, excellent enamel rater readings were obtained with all three coatings.

[0047] Whereas particular embodiments of this invention have been described above for purposes of illustration, it will be evident to those skilled in the art that numerous variations of the details of the present invention may be made without departing from the invention as defined in the appended claims.

WHAT IS CLAIMED IS:

1. A method for electrocoating a substantially uncoated surface of a full panel easy open end comprising electrodepositing on the end an electrodepositable coating.

2. The method of Claim 1, wherein said method is effected by anodic electrodeposition.

3. The method of Claim 1, wherein the coating comprises epoxy.

4. The method of Claim 1, wherein the coating is epoxy free.

5. The method of Claim 4, wherein the coating comprises acrylic.

6. The method of Claim 5, wherein the acrylic comprises hydroxyethylmethacrylate.

7. The method of Claim 5, wherein the coating further comprises a phenolic crosslinker.

8. The method of Claim 7, wherein the crosslinker comprises at least 50 weight percent of the coating, with weight percent being based on total solids weight.

9. The method of Claim 7, wherein the crosslinker comprises at least 60 weight percent of the coating, with weight percent being based on total solids weight.

10. The composition of Claim 5, further comprising polyester.

11. The composition of Claim 10, wherein the acrylic and polyester are a graft copolymer.

12. The method of Claim 11, wherein the coating is aqueous.

13. The method of Claim 5, wherein the coating is aqueous.

14. A method for preparing a full panel easy open end comprising:

(a) stamping an end from a metal sheet; and

(b) electrodepositing on the end an electrodepositable coating;

wherein a surface of the end is substantially uncoated prior to step (b).

15. The method of Claim 14, wherein the metal sheet is lubricated prior to stamping.

16. The method of Claim 15, wherein the stamped end is cleaned prior to electrodeposition.

17. The method of Claim 14, wherein some portion of a surface has a coating applied thereto prior to electrodeposition.

18. A full panel easy open end prepared according to Claim 1.

19. A full panel easy open end prepared according to Claim 14.