Activated Conductive Layer for POWDER COATING on Wood

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A metallic substrate is a conductor and the electrostatic application of powder coating can adhere quite easily. Wood, such as medium- and low-density fiberboard (MDF and LDF), are low conductivity substrates, which reduce dramatically application efficiency and inhibit a successful powder coating practice. For a powder coating processed at high temperature, metallic substrates can take the heat treatment, but wood would exude its moisture content and lose its structural value. In this article, we formulate an aqueous conductive emulsion of organic-inorganic hybrid that contains sol-gel coupling agents and a conductive nanomaterials dispersion. A single-coat application of this conductive emulsion on nonconductive substrates, followed by air-dry or a thermal drying at 65-80°C for 1 min, gives a thin (~ 1–5 μm), uniform, dense, and hard (2H–5H pencil hardness) conductive film that adheres extremely well (5B, ASTM D 3359) on a part's surface. The activated conductive emulsion film on nonconductive substrates offers excellent conditions for the applications of powder coating on MDF and LDF panels. The formulation chemistry of conductive emulsion will be described.

The quality and product performance of powder coated panels were assessed visually and by optical microscope. The results indicate that the conductive emulsion coating has a remarkable ability to attract coating powder to otherwise insufficiently conductive surfaces. On LDF and MDF panels, it can eliminate preheating for initial powder attraction. It is functional at coat weights below those that are typically measured by the paint and powder coating industries. At these coat weights there is little to no surface roughening by fiber raising, which avoids a sanding step. Also, air-drying is feasible except at high relative humidity. It may ensure that there is sufficient powder on well-smoothed sawn and routed panel ends to negate the need for a filling primer. Furthermore, it can ensure good coverage of low-charge powders, which gives formulators a great deal more latitude. When applied to other low- or non-conductive materials, comparable benefits and few drawbacks can be anticipated.

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INTRODUCTION

The volatile organic compound (VOC) issue is the most prevalent factor impacting the wood care segment today. California South Coast Air Quality Management District (SCAQMD) regulated the VOC levels for varnishes to 350 g/L effective July 1, 2006. Wood coatings manufacturers continue to develop new products and technologies for both interior and exterior applications, addressing DIYer demands and increasingly strict VOC regulations.[1] Powder coatings are the environmentally friendly, cost-effective alternative to liquid paint because of the very low emission and high application efficiency.[2] Companies in powder coatings are expanding their technologies and geographical reach to better serve their customers.[3]

Powder coatings applied by electrostatic spray can adhere quite easily on the conductive metal parts.[4-10] Wood (engineered composites or natural), plastics, and mineral fiber are low conductive and heat-sensitive substrates. When powder coating is applied on low-conductive parts, the charged powder particles display on the part's surface that have the same polarity as those applied to the charging electrode of a corona spray gun. Because the like charges repel each other, the accumulation of charges on a low-conductivity part's surface will dramatically reduce the application efficiency and inhibit a successful powder coating formation. The powder coating is normally required to process at high temperature—metal can take it but wood will exude its moisture and wood and plastics will lose their structural values.

Despite these limitations, there is still a gathering interest in powder coating materials that have low conductivity. The medium (or low) density fiberboard (MDF or LDF) is one of those materials. In Europe, MDF used for powder coating is manufactured to be conductive—it has conductive materials added to the fiber mix prior to pressing, but this raises cost substantially. In the United States, the MDF is preheated, which frees charge-bearing or charge-transmitting entities in the fiber and binders, which usually gives sufficient conductivity for the board to accept enough powder to make a useful product.

The faces of MDF panels are very smooth, and often sufficiently smooth that priming prior to powder coating is not necessary, provided that MDF is suitably conductive at the time of coating. However, any surface that is sawn or routed is rough and porous. Such surfaces need to be smoothed by first sanding and then priming or filling. This is usually done by priming with high-solids latex/clay formulations, or with separate primer powder applications. In each case, and especially with latex, there is a substantial roughening of the surface from fiber swelling and partial de-binding. This forces a sanding step so that the roughness is not passed onto the final product after top coating. Additionally, fillers and latex primers are generally insulating, and so do not contribute to the buildup of sprayed-on powder in the areas where they are applied, although they can trap moisture, and so maintain performance.

The recent advancements in powder coatings for low-conductive and heat-sensitive substrates have been focused on the thin-film powders, lower temperature cure powders, UV-cured powders, IR/UV ovens, and modern powder application and recovering systems. However, the deficiencies of the current industrial process for producing premium quality products from MDF by powder coating, by first priming the whole part with either powder or liquid primers, is that it forces a preheating step, it requires sanding of the primed areas, and it imposes limitations on the properties of the powders used. Technology options that can eliminate these process steps, or expand formulation options, are always of interest.

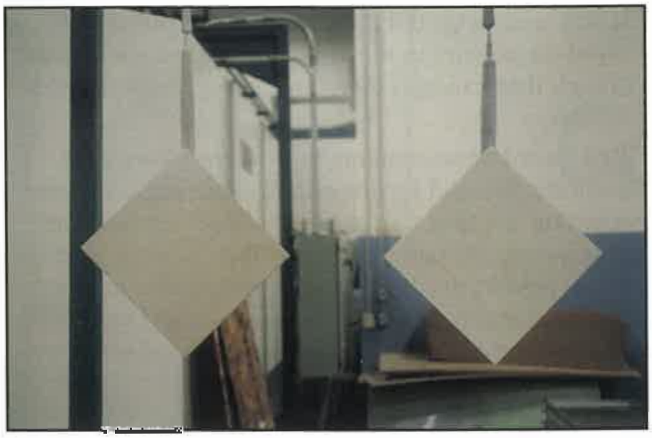
In this article, an innovative approach of formulating a conductive emulsion for preparing surface for powder coating on wood is illustrated.[11] For the first time, a semi-pilot plant application of the conductive emulsion on MDF and LDF substrates has been conducted to give a thin, uniform, and dense conductive surface layer. The formation of conductive layer on low conductive surface was used to activate the attraction of powder particles in powder coating. The experimental testing and product qualification were assessed to determine whether this conductive primer coating demonstrated benefits for powder coating on fiberboard, especially in comparison to standard industrial latex primer, and to powder primer.

EXPERIMENTAL SECTION

Materials: The formulation of conductive emulsion is composed of water (45–60 wt%) as solvent, acrylate, and/or polyurethane resins (15–20 wt%) in aqueous emulsion as binders, low temperature crosslinker for resins (0.5–2 wt%), co-solvents for the dilution of aqueous emulsion (HAPs-free, 8–12 wt%), a hybrid oligomer of functionalized silicon alkoxides (1–3 wt%) as coupling agent, conductive composites (clear and/or colored, 5–10 wt%), and a trace amount of pH adjusting agent, surface wetting agent, and deforming agent.

The fiberboards used for testing were: (1) softwood LDF (density: 35 lb/cu ft), (2) softwood MDF (Premium MDF, density: 47 lb/cu ft), and (3) mixed species MDF (Basic MDF, density: 47 lb/cu ft). The liquid primers used for preparing fiberboard for powder coating were: (1) our conductive emulsion as formulated above, and (2) Sherwin-Williams industrial wood

Figure 1—The primered fiberboard was grounded via a wire hanger inserted into a hanger hole on the corner of MDF and hooked onto a flight bar of the powder line chain.

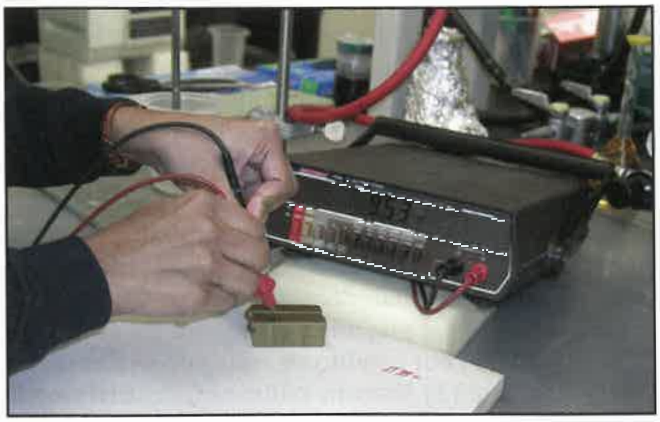


primer, a non-conductive primer that has been used on a commercial spray line to prepare MDF for high quality powder coating. The powder coatings applied were two types (TIGER Coating, Wells, Austria): (1) Tiger Drylac white primer 512/10006, smooth glossy; and (2) Tiger Drylac white topcoat 530/10601, medium textured.

Coating Methodologies: The fiberboard preparation and application of primers were done at Alberti Woodworking, Union, NJ. Fiberboard panels were cut into nominal 12 × 12 in. pieces. Ends were sanded with a table sander with a coarse (80 grit) belt running about 10 degrees from horizontal. The sander left a characteristic mark on the ends sanded. Two edges were lightly beveled or rounded, first with 180-grit, and then with 320 grit sandpaper. All parts were then wiped and blown clean of dust. The overall smoothness was deliberately prepared at the low end of acceptability for commercial powder coating.

Primer coating (our conductive emulsion or Sherwin-Williams latex primer) was applied to about three-quarters of one face and to at least one of the beveled ends, with a low-pressure high-volume spray gun. After air-drying for about 1 hr, the reverse face and the same ends were similarly primed. Again, the parts were allowed to air-dry before being lightly sanded on the faces with the 320-grit sandpaper, blown clean, and then packed in cartons with 1/8-in. foam interleaving. The priming was deliberately applied with variable thickness so that coat weight impact could be assessed from photographs and controls, not necessarily from actual measurements. Priming took place several days before powder coating.

Figure 2—Surface conductivity measurement system.



The applications of powder coating were carried out at MDF Powder Systems, Portsmouth, RI. A hanger hole, 1/8-in. diameter and about 3/8-in. deep, was drilled in the corner where the two rounded edges met. A wire hanger was inserted into this part and then hooked onto a flight bar of the powder line chain. This ensured good grounding as shown in *Figure* 1. Powder was applied to parts using ITW Gema hand-held guns in a spray-to-waste booth. Hand application was intended to mimic automatic process— the primer powder was applied with one application (like a single column of guns) while the topcoat was applied in two applications about 6 sec apart to mimic application from two columns of oscillating guns. Heating and curing were done with Vulcan Catalytic gas-fired catalytic infrared ovens, which have been determined most suitable for MDF powder coating. A preheat oven was operating at 250°F. It was used for preheating and for primer gel and flow (2 min dwell). The main oven for topcoat curing was operating at 270°F, with a dwell of 4.5 min. No process adjustment was made to improve product quality. Also, no process change, which would normally be made, was attempted to improve the ends.

RESULTS AND DISCUSSION

Surface Conductivity Activated on Wood

In practice, the conductive emulsion for priming wood should be formulated to have good surface adhesion and conductivity, and also to produce a thin, uniform, and dense film which will give little to no surface roughening by fiber raising and avoid a sanding step on the primed wood. The selective aqueous acrylate and/or polyurethane emulsions that have been chosen coupled the functionalized silanes to give a 5B (ASTM D 3359) surface adhesion rating in all primed MDF and LDF panels. In powder coating, when resistance "r" of the grounding circuit is small (less than 1 MΩ), the potential of the part is equal to zero or negligibly small. A strong electric field in the spray area attracts powder particles to the part. The surface conductivity was measured by a multimeter (Keithley 169) with two brass electrodes as shown in *Figure 2*. The surface conductivity was measured in the ranges of about 10 megaohms/cm^2 to 50 kiloohms/cm^2, depending on the priming coverage. The measurement of actual coating thickness was not made in this work. However, the dry conductive layer probably ranges from about 1–5 micrometers thick, as resulted from the low solid contents of aqueous conductive emulsion.

Figure 3 shows a set of optical micrographs (10×): top left: unprimed LDF panel, labeled 1 on top; bottom left: primed MDF panel with Sherwin-Williams latex primer, labeled 17 on bottom; top right: primed MDF panel with a very thin conductive emulsion, labeled 10 on bottom; and bottom right: primed LDF panel with a thin conductive emulsion, labeled 1 on bottom.

The surface smoothness of the unprimed wood panels (LDF as shown on the top left of *Figure* 3 and MDF) is clearly seen as acceptable for commercial powder coating. The wood panels primed with latex primer gives a thick coating with good coverage as shown on the bottom left of *Figure* 3, but a substantial roughening of the surface from fiber swelling and partial debinding is observed. A sanding step becomes necessary so that the roughness is not passed onto the final product after top coating. This problem is eliminated when the wood panels are primed with aqueous conductive emulsion as shown in the right hand portion of *Figure* 3. The panel surface is totally smooth and essentially free of lumps with a loop, independent of coat weights (very thin—top right; thin—bottom right). In conductive emulsion, the formulation compositions were designed to contain sol-gel precursors, which can be controlled to produce the desired hard and smooth films at low coat weights. The surface of primed wood is so hard that it is durable for a sanding step if needed, without having the problem of raising fibers. It will be shown in the following sections that the required thickness for the conductive primer to produce good powder acceptance was very low. The coat weight was lower than that would be measured by normal paint, powder thickness, or coat weight methods. The thickness of the conductive primer may be applied at a level where the primer filler properties were negligible.

Attraction of Low Charge Primer Powder and Coating Properties

The ability of conductive emulsion coating on wood to attract low-charge primer powder was tested by using Tiger Drylac white primer powder. The low-charge primer powder is less attracted to the panel than the topcoat powder as it is intended to be a thinner coating. The technology innovation of conductive emulsion for preparing surface for powder coating on wood will be illustrated below, and differentiated from the nonconductive primers.

Figure 3—Optical micrograph (10×): Top left—unprimed LDF panel, labeled 1 on top. Bottom left—primed MDF panel with Sherwin-Williams latex primer, labeled 17 on bottom. Top right—primed MDF panel with a very thin conductive emulsion, labeled 10 on bottom. Bottom right—primed LDF panel with a thin conductive emulsion, labeled 1 on bottom.

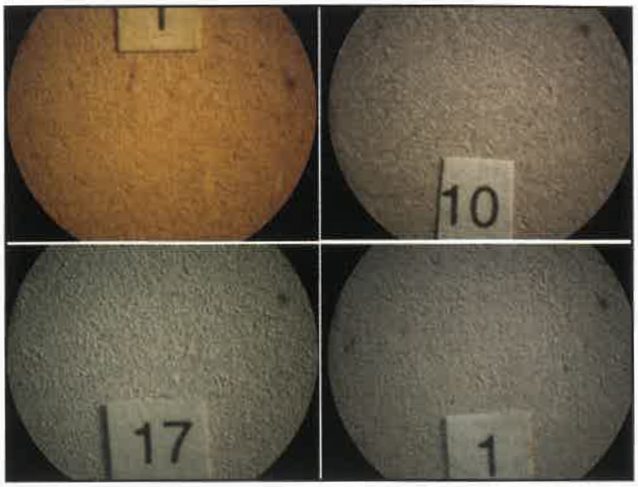


Table 1 lists the power coating products on LDF and MDF with primer powder or topcoat powder (column 6 gives the powder types). For each product trial, S1 through S15, the processing conditions were specified: (1) the primer pretreatment step: none, pretreated with conductive emulsion, and pretreated with non-conductive latex primer as indicated in column 3; (2) the preheating step at 121°C and the temperature control in powder spraying booth were marked in column 4 and 5, respectively; and (3) the general comments from product trials were described in column 7.

Figure 4—Optical micrographs (10×) of the primer powder coating products on LDF: Top two (labeled 2)—unprimed, no preheat, and spray booth at 20°C (left—near hanger, and right—far away from hanger). Bottom left (labeled 5)—unprimed, preheat at 121°C, and spray booth at 90°C. Bottom right (labeled 3)—primed with conductive emulsion, no preheat, and spray booth at 20°C.

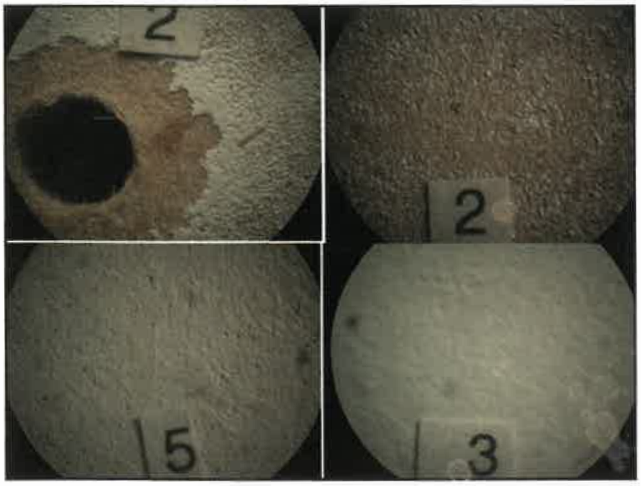


Table 1—Primer and Topcoat Powder Samples and Their Processing Conditions

Trial	Substrate	Primer Treatment	Preheat at 121°C	Temp. at Booth	Powder Type	Comments from Trial
S1	LDF	None	No	20°C	Primer	Powder drawn to corner with hanger, and built up around the hanger on the backside
S2	LDF	None	Yes	90°C	Primer	Standard process for control materials; took primer powder well except at the edges
S3	LDF	Conductive	No	20°C	Primer	Nice uniform deposition on cold wood
S4	LDF	Conductive	Yes	93°C	Topcoat	Small difference between conductive primed and unprimed areas
S5	LDF	Conductive	No	20°C	Topcoat	Very distinct differences between conductive primed and unprimed areas
S6	LDF	Latex	Yes	91°C	Topcoat	Quite good product
S7	LDF	Latex	No	21°C	Topcoat	Not functional
S8	Basic MDF	Conductive	Yes	80°C	Topcoat	Face of product good—edges satisfactory for process
S9	Basic MDF	Conductive	No	21°C	Topcoat	Smooth coverage—good on face
S10	Basic MDF	Latex	Yes	76°C	Topcoat	Primed parts satisfactory
S11	Basic MDF	Latex	No	21°C	Topcoat	Pattern in powder coating, coverage thin
S12	Premium MDF	Conductive	Yes	80°C	Topcoat	Good face and edges, smooth coating
S13	Premium MDF	Conductive	No	21°C	Topcoat	Good powder reception, smooth coating
S14	Premium MDF	Latex	Yes	70°C	Topcoat	Satisfactory
S15	Premium MDF	Latex	No	21°C	Topcoat	Did not take powder properly, coating poor

Table 2—Powder Coating Products—Quality Assessment and Coating Performance

Trial/ Powder Type	Primer Treatment	Face Roughness	Face Coverage	Face Uniformity	Bevel Edge	Ends
S1/Primer	None	Very poor	Poor—drawn to hanger	Very poor	Very poor	Very poor
S2/Primer	None	2	Good	Good—no substructure	Satisfactory—square edge dry	Too thick in center vs. edges
S3/Primer	Conductive	1	Good	Good	Satisfactory	Thin wrap
S4/Topcoat	Conductive	3	Good	Good	Good	Good
S5/Topcoat	Conductive	3	Good	Trace of substructure	Satisfactory	Thin
S6/Topcoat	Latex	3	Good	Good	Satisfactory	Thin
S7/Topcoat	Latex	4	Thin	Good	Thin	Thin
S8/Topcoat	Conductive	3	Good	Good	Good	Good
S9/Topcoat	Conductive	3	Good	Good	Good but light	Thin
S10/Topcoat	Latex	2	Good	Shows sanding marks	Good	Good
S11/Topcoat	Latex	4	Poor—drawn to hanger	Poor	Thin—poor	Thin—poor except close to hanger
S12/Topcoat	Conductive	3	Good	Good	Good	Good
S13/Topcoat	Conductive	3	Good	Good	Good	Moderate
S14/Topcoat	Latex	2	Light	Trace of substructure	Good	Good
S15/Topcoat	Latex	4	Thin	Good	Thin	Thin

The quality assessment and coating performance on the powder coating product trials, S1–S15, are summarized in *Table* 2. The face roughness rating is a relative tactile assessment that was rated 1 to 5. Rating 1 is totally smooth and essentially free of lumps visible with a loop. This is the goal for the top coating. The primer powder and the sanded liquid primed materials were all rated 1. Rating 2 is smooth with a few lumps. Ratings 3 through 4 were additional roughness ratings. Rating 5 was indicative of the raised grain caused by dilute water-based primer on MDF or LDF panel.

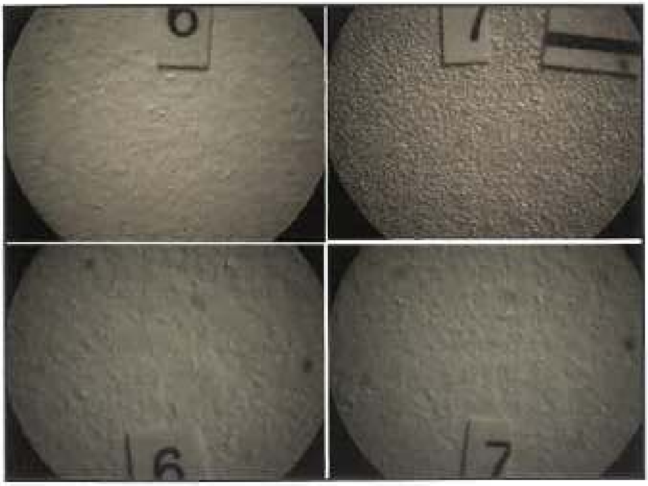
The face coverage rating is an assessment that was made based on experience in this work, in the absence of an actual coating thickness measurement. "Good" means about the thickness desired after powder coating applied on MDF or LDF. At this thickness there is no color transmitted from the base, there are no holes or cracks in the coating, and it is not porous. "Satisfactory" would mean that it appeared to be good, but an actual coat weight test should be made. "Thin" is the descriptor when the substrate shows through, there are holes in the coating, or the powder particles are too few to form a solid film when molten. The face uniformity is the normal interpretation for coating distribution. The bevel edge quality is a separate category for edge coverage as it is an issue with non-conductive panels. The ends quality is a subjective rating of the appearance of the ends. Good ends have a uniform coverage, uniform distribution of the powder, no holes, no cracks, and are relatively smooth. Ends are generally rougher than faces because the fiber is perpendicular to them, not horizontal. Also, they show the center of the panel, where the fiber density is much lower than at the surface. Grain-raising is a greater issue.

Figure 4 shows the optical micrographs (10×) of the primer powder coating products on LDF: top two (labeled 2) are samples of unprimed, no preheat, and spray booth at 20°C (left: near hanger, and right: far away from hanger); bottom left (labeled 5) is a sample of unprimed, but preheated at 121°C, and spray booth temperature at 90°C; and bottom right (labeled 3) is a primed sample with conductive emulsion, but no preheat and spray booth at 20°C. The labeled 2 sample was processed on a bare LDF, and was non-conductive with no preheating and a cold spray booth at 20°C; it did not accept powder, with only a trace amount (top right of *Figure* 4) and powder was drawn to corner with hanger (top left of *Figure* 4). The sample labeled 5 in *Figure* 4 is a standard process for control products, where panels were preheated and sprayed powder at a booth temperature of 90°C. The product has a good rating in face coverage and uniformity, and also a satisfactory rating on bevel edge and slightly thicker on primed ends. The bottom right micrograph (labeled 3) shows a nice uniform deposition of primer powder on cold wood. The product was pretreated with conductive emulsion, and processed with no preheating and a booth temperature at 20°C. It showed a remarkable difference on the cold panel between the conductive and non-conductive coated areas. The product has a good rating in face coverage and uniformity, and also a satisfactory rating on bevel edge and thin warp on primed ends. The results indicate that the conductive emulsion can be used to get good powder coverage on wood without preheating, although without preheating the end coating remains prone to cracking from out-gassing.

Attraction of High Charge Topcoat Powder and Coating Performance

The influence of the conductive primer on the application of topcoat powder may be analyzed by examining the quality of face coating and end coating as summarized in *Table* 1 and *Table* 2. In both cases, the effects of preheating, and/or pretreatment of conductive versus non-conductive primer, on powder application are illustrated. For face coating analysis, *Figure* 5 shows optical micrographs (10×) of topcoat powder coating products on LDF: bottom two images show the wood portion that has been primed with conductive emulsion, and the top two show the portion that was not; portion shown in the left two images was processed with preheating at 121°C, and spray booth at 90°C; and the portion shown in the right two was processed with no preheat, and spray booth at 20°C (cold wood). When LDF panels were preheated and powder coated in a spray booth at 90°C, both panels, labeled 6 (top—no conductive primer; bottom—with conductive emulsion), gave good face coverage and uniformity. When LDF panels were processed with no pre-heat and in a

Figure 5—Optical micrographs (10×) of topcoat powder coating products on LDF: Bottom two show the wood portion that had been primed with conductive emulsion, and top two show the portion that was not. Portion in left two was processed with preheat at 121°C and spray booth at 90°C and portion shown in right two was processed with no preheat and spray booth at 20°C (cold wood).



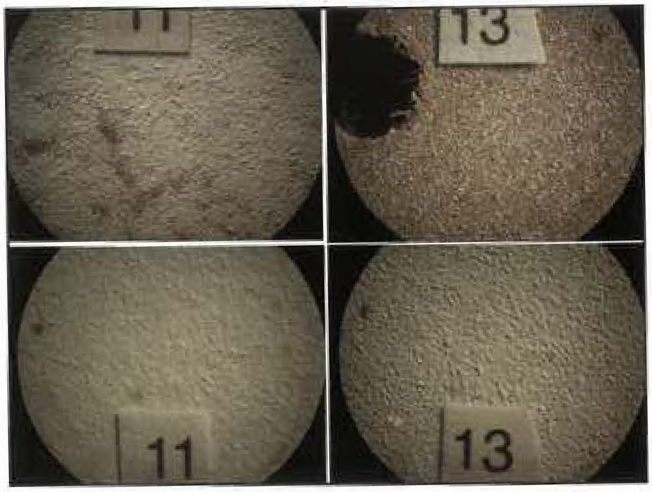


Figure 6—Optical micrographs (10×) of topcoat powder coating products on basic MDF: All panels were processed with no preheat and spray booth at 20°C (cold wood). Label 11: bottom wood portion was primed with conductive emulsion and top wood portion was not. Label 13: bottom wood portion was primed with non-conductive latex and top wood portion was not.

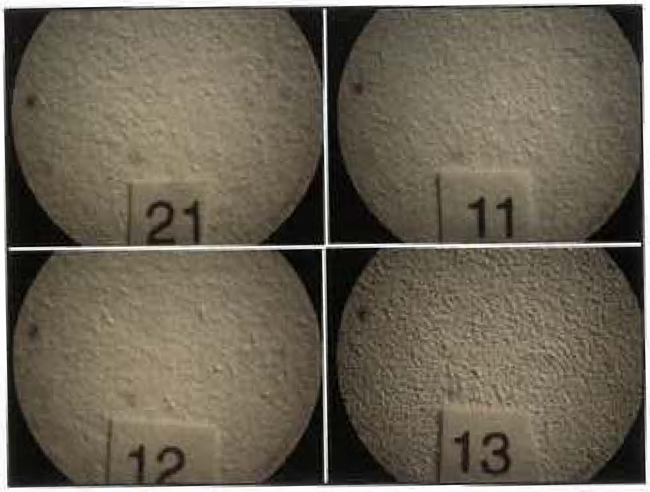


Figure 7—Optical micrographs (10×) of topcoat powder coating products on basic MDF: Portion shown in top two was primed with conductive emulsion and portion in bottom two was primed with non-conductive latex. Portion in left two was processed with preheat at 121°C and spray booth at 90°C and portion in right two was processed with no preheat, and spray booth at 20°C (cold wood).

spray booth at 20°C, the bottom right panel primed with conductive emulsion gave as good face coverage and uniformity as the bottom left panel. However, the top right panel without a conductive emulsion pretreatment did not take powder well and gave a poor topcoat powder application. The results suggest that the conductive emulsion can offer good coverage of the topcoat powder on cold panels. With a conductive emulsion coating, it had little effect on preheated panels.

On MDF and LDF panels, the conductive emulsion thin films can eliminate preheating for initial powder attraction (see *Figure* 6, where the topcoat powder was applied on cold wood for all panels). *Figure* 6 displays the optical micrographs (10×) of topcoat powder coating products on basic MDF. All panels were processed with no preheat, and a spray booth temperature at 20°C (cold wood). Label 11: bottom wood portion was primed with conductive emulsion and top wood portion was not; label 13: bottom wood portion was primed with non-conductive latex and top wood portion was not. It is clearly shown that the bottom left panel gave good face coverage and uniformity coating as it was primed with conductive emulsion. All other three panels gave poor powder coating. The bottom right panel, with a non-conductive latex primer, gave coating with a rough surface and a lot of pinholes. The non-conductive primer seems to have contributed to hiding power.

The influence of conductive versus non-conductive primer on the application of topcoat powder can be seen in *Figure* 7 (on basic MDF panels) and *Figure* 8 (on premium MDF panels). *Figure* 7 shows optical micrographs (10×) of topcoat powder coating products on basic MDF; the top two were primed with conductive emulsion and bottom two were primed with non-conductive latex. Left two were processed with preheat at 121°C and spray booth at 90°C and right two were processed with no preheat and spray booth at 20°C (cold wood). *Figure* 8 displays optical micrographs (10×) of topcoat powder coating products on premium MDF. The top two were primed with conductive emulsion and the bottom two were primed with non-conductive latex. Left two were processed with preheat at 121°C and spray booth at 90°C and right two were processed with no preheat and spray booth at 20°C (cold wood). For the panels primed with conductive emulsion, the top two in *Figure* 7 and also top two in *Figure* 8, the topcoat powder coatings are all good in face coverage and uniformity. With conductive primer, the powder coating can be applied on cold wood. It had little effect on preheated panels. For the panels primed with non-conductive latex, only the panel (bottom left in *Figure* 7 and also in *Figure* 8) with preheat at 121°C and spray booth at 90°C gave good powder coating, where those applied on cold wood (bottom right in *Figure* 7 and also in *Figure* 8) exhibited poor coating with pinholes. The results indicate that the non-conductive primer did not enhance powder attraction to any of the panels. It did, however, contribute to hiding powder. The latex primer may have trapped moisture in the sharp cut corners when it was able to form a solid film.

The quality evaluation of coating ends were in general relatively rough for powder coating, so finished item excess roughness is at least in part expected, as shown in *Table* 2. A secondary factor was that the

Figure 8—Optical micrographs (10×) of topcoat powder coating products on premium MDF: Portion in top two was primed with conductive emulsion and portion in bottom two was primed with non-conductive latex. Portion in left two was processed with preheat at 121°C and spray booth at 90°C and portion in right two was processed with no preheat and spray booth at 20°C (cold wood).

process in this investigation was not optimized for the powder—small powder clumps in the middle of the end did not completely flow out. If the powder was more free-flowing, or if the oven was about five degrees Celsius hotter, these should not have been so noticeable. Nevertheless, the following observations can be made: (1) Influence of the conductive primer: the conductive primer increased the deposition of topcoat powder on the ends of the parts. In many instances the amount that deposited was probably about the amount that on a suitably smooth end would be satisfactory. Under those conditions there were no holes; (2) Effect of preheat on end quality: panels that had not been preheated tended to show more micro-cracking in the cured powder coating. This is a known artifact and a second reason for preheating. On each heating cycle there is gas (hot air and steam) that builds pressure and attempts to escape. It does this primarily through the ends of the panel. Sealing the ends with coating would trap these gases. On the first heating, there is a greater volume than on subsequent heating. Hence, the pressure and expansion, if sealed, will be greater.

CONCLUSION AND REMARKS

An aqueous conductive emulsion has been formulated for preparing low-conductive surface for power coating on MDF and LDF panels. It was shown that the conductive coating has a remarkable ability to attract powder to non-conductive MDF at very low coat weights. It can be used to get good powder coverage on MDF and LDF without preheating, although without a preheat step the end coating remains prone to cracking from out-gassing. The required wet coating thickness of conductive emulsion is so low that there is negligible roughness from raised grain, an issue with all other aqueous primers. In many situations the coating can be applied with only air drying. A low-heat drying would be necessary only if ambient relative humidity is high. This coating will probably give good performance on very smooth MDF panel edges and ends without a high filling primer. It can be used to get good coverage on MDF with low-charge powders, and thereby extend the range of powders that can be used on this material. It can be expected to have value in specialty powder-coated MDF and related materials.

The conductive emulsion may be formulated with a large particle filler material that would then become suitable for priming moderately smooth routed and sawn areas. Moreover, there are other panel stocks (e.g., mineral fiber, plastics, synthetic paper) that are not inherently conductive, which cannot be made sufficiently conductive by a simple process like preheating, or for which preheating before the powder application is inappropriate. Results from studies on wood-fiberboard can be indicative of performance with them.

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