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RECEIVED
SEP 29 2004
DIRECTOR'S OFFICE
DEP BUREAU OF AIR QUALITY

John W. Carroll
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September 29, 2004

Joyce E. Epps
Director, Bureau of Air Quality
PA Department of Environmental Protection
Rachel Carson State Office Building, 12th Fl.
P. O. Box 8468
Harrisburg, PA 17105-8468

Re: Varnish Variance Application

Dear Ms. Epps:

Enclosed with this letter is Sherwin-Williams' application for a variance from the VOC content limitations set forth at 25 Pa. Code §130.603 for Clear Wood Coatings – Varnishes for the products set forth in the appendix to the application. We request that the Department act upon this application within the next sixty (60) days. Please contact me if you have any questions or concerns regarding the content or format of this application.

Sincerely,

John Carroll

John W. Carroll

Enclosure

Sherwin Williams hereby files this variance request pursuant to 25 Pa. Code 130.306 for the varnishes listed in Exhibit A.

(1) The specific grounds upon which the variance is sought.

The products listed in Exhibit A do not meet the VOC content limits of Section 130.303, Table 1 of the AIM rule and cannot be formulated to meet those VOC limits without creating unacceptable safety hazards; application, handling and performance problems for non-professional users; or substantially decreasing the solids content and thus increasing the number of coats required to achieve equivalent dry film thickness. The products for which a variance is requested are often selected for application to bare, unstained wood because, when applied to bare wood (especially darker species of wood), solvent-based finishes provide better depth and warmth of appearance and better grain contrast than waterborne finishes (waterborne clear finishes for wood floors require the use of an oil-based clear stain before applying such products to achieve acceptable appearance).[1] Varnish, typically a solvent-based (mineral spirits) oil-modified polyurethane product, is the most widely used clear wood finish, with proven durability and appearance characteristics, which can be applied without stain or pre-treatment of the wood and is a superior product when applied by consumers to wood to provide a durable finish.[2]

There are three possible alternatives to current solvent-based products: exempt solvent products, high solids products and waterborne products. Each of these substitutes presents inherent problems.

Safety Hazards

The use of exempt solvents in lieu of the mineral spirits commonly used in oil-based varnishes creates two safety hazards – extreme flammability and dramatically increased inhalation toxicity. Acetone, an exempt solvent that is not likely to be used in varnishes due to its extremely high evaporation rate, is extremely flammable, having a flash point of -4F and vapor known to have the potential to cause flash fires. Above the flash point, which will always be the case during application, vapor-air mixtures are explosive within the lower and upper explosive limits. Vapors can flow along surfaces to a distant ignition source and flash back. Sealed containers may rupture when heated and acetone is highly sensitive to static discharge. Mineral spirits, having a flash point above 100F, does not present this extreme flammability hazard.

[1] When applied to wood that has been stained with a solvent-based product, the difference in appearance between solvent-based and waterborne clear finishes is diminished. However, if the stain used is waterborne, there will be a "muddy" appearance due to the poor grain contrast resulting from its use. Eliminating the use of stain results in overall fewer emissions of VOC in a flooring application involving bare wood finishing.

[2] While there are many waterborne clear finishes currently in the marketplace, only the two-component polyurethanes and solvent-based one-component oil-modified polyurethanes provide the expected level of durability in high wear applications (e.g., wood floors).

Another exempt solvent that might be used in "compliant varnishes" is parachlorobenzotrifluoride (PCBTF). In addition to creating noxious odors, this solvent presents inhalation toxicity much greater than that of mineral spirits. The exposure limit and lethal dose by inhalation are about one-fourth that of mineral spirits.

The use of waterborne varnishes can result in a third safety hazard, slip and fall risk. Studies of coefficient of friction of various clear finishes have reported that several waterborne finishes have demonstrated coefficients of friction below 0.5, resulting in an unacceptable risk of slip and fall. The results of such tests are included in Exhibit B.

Application and Handling Problems of High Solids Varnishes

High solids varnishes lead to application and handling problems and, as a result, to initial performance problems. High solids varnishes are too viscous to achieve the necessary and recommended coverage rates, leading to over-application, long cure times and films that remain soft and insufficiently cured for long periods, causing susceptibility to damage for many days after application. Such products have proven unacceptable to professionals and consumers alike in California, where the 350 g/L limit has been in place for many years.

Unacceptable performance of waterborne varnishes

Waterborne varnishes suitable for use by consumers cannot achieve the durability of solvent-based varnishes. An extended, side-by-side study of floor finishes comparing the gloss retention of six commercially available waterborne and solvent-based finishes showed that the waterborne finishes failed to sustain an acceptable level of their original gloss. The result of dulling of finishes leads to more frequent reapplication and resultant increases in VOC emissions over time. For example, the solvent-borne varnish in the test showed 70% retention of gloss over an 8-week period of time while the waterborne finishes retained as little as 30% of their initial gloss over the same period of time. A copy of the data chart from the study is attached as Exhibit C. The aziridine-crosslinked varnishes are not suitable for use by consumers for safety reasons and the best performing waterborne varnish, which retained about 57% of its gloss, has greater ozone-forming potential than the solvent-based varnish.

Additionally, due to the lower solids in waterborne finishes, more or heavier wet coats are required to achieve the recommended dry film thickness.

Finally, as has been previously detailed in oral and written comments during the rulemaking, unlike the varnishes in Exhibit A, waterborne formulations increase the risk of panelization or sidebonding in strip flooring, especially maple flooring, most commonly used in gymnasium construction. In maple flooring applications, as used in many of Pennsylvania's school and college gymnasiums, solvent-based clear wood finishes are required to prevent splitting of the wood in a phenomenon known as "panelization." Panelization occurs when waterborne clear coatings are applied in high humidity conditions during which the wood has naturally swelled. Waterborne clear coatings can cause cementing of the wood strips which, when the humidity is reduced such as in the winter heating season, causes the wood to split parallel to the wood grain. The variation in humidity common in Pennsylvania between summer and winter seasons is quite uncommon in the drier, less humid climate of California.

As the Maple Flooring Manufacturers Association advises:

> 'Panelization' is a condition where localized excessive cracks develop between some strip flooring boards while adjacent boards remain tightly bonded together with no apparent separations. "Panelization" (or "sidebonding") is definitely not a new problem. It has, however, gained increasing attention as new EPA V.O.C. regulations have begun to affect the availability of traditional oil-based floor finishing products in many areas of the country.
>
> While the development of "panelization" is certainly not limited to one brand of finish or to one particular subfloor design, the problem has been most closely associated with the use of water-based sealers and finishes on raw (untreated) maple strip flooring in areas of the country which experience distinctly different seasonal moisture conditions.
>
> MFMA cautions installers and end-users that the use of some water-based finishes has produced a sidebonding effect which can result in localized excessive and irregular separations ("panelization") between maple flooring strips. We strongly recommend that end-users, project architects and specifiers consult with their flooring installer and finish manufacturer to obtain approved procedures for sealing and finishing a raw maple strip floor with water-based products.

Recognizing the issue of differing climate, the OTC Model Rule contains a less restrictive limit for Industrial Maintenance Coatings than that applicable in most of California's air districts. The rationale for this departure was explained by the OTC thus:

> The narrow temperature and humidity window in the Northeast and Mid-Atlantic region for applying the low VOC coating could potentially create a situation where there would not be sufficient time in the year to perform all the necessary coating without taking extraordinary measures.

The problem created by sidebonding stems from the hydrophilic (i.e., water-loving) nature of wood. The dried wood used to create architectural surfaces is composed primarily of cellulose and hemicellulose, both of which are highly hydrophilic (by way of common example, most sponges are cellulosic in composition). In nature, however, up to 70% of a tree's mass is water, which is why the wood must be dried after the tree is harvested and cut into useful lumber. The wood never "forgets" that it was once primarily water, which is why it behaves so differently and undesirably when a waterborne product is applied to bare wood. Whereas a solvent based finish will not cause adjacent boards to swell together and result in a gluing effect, the waterborne finish will penetrate between the boards and, when it dries, will cement the swollen, tightly seamed boards together, bonding the two adjacent boards along this open seam.

Manufacturers of waterborne floor finishes have developed a solution to sidebonding, which calls for the application of a pre-finish treatment, which penetrates the seams, but which may not allow the waterborne varnish to adhere to it. Such pre-treatments commonly contain 250 g/L of VOC, thus their combined use may defeat any environmental benefit of using a 350 g/L waterborne varnish rather than a 450 g/L solvent-based varnish. Another detriment to using waterborne finishes is that they typically result in a thinner coat, thus requiring more coats to achieve equivalent dry film thickness.[3]

With the exception of a few exotic, oily wood species, most wood shrinks when it dries and swells when it gets wet, or when surrounding humidity causes it to absorb atmospheric moisture. The problems identified with respect to maple flooring are thus not unique to that species and sidebonding has been observed in residential applications in the Northeast Ozone Transport Region.

(2) The proposed date by which compliance with § 130.303(a) will be achieved.

Sherwin Williams is engaged in extensive ongoing research efforts to find suitable substitute varnish formulations that have the performance characteristics of the varnishes for which this variance is sought. Those efforts will continue, and Sherwin Williams will report the results of its research efforts to the Department annually. Since no one can predict the future or foresee all potential complications and their consequences, it is not known at this time when a suitable formulation will be identified, and thus it is not possible to propose a definitive compliance date, although our research and development efforts are directed towards a targeted January 1, 2010, compliance goal.

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[3] In nearly all cases, a solvent-based product provides higher film build per coat. This, of course, depends on the application rate and the solids content of the product being applied. The dried measurement of each coat of finish applied, whether it be water or solvent-based, is determined by dividing the square foot coverage of the product being applied into 1,604, which equals wet mil thickness. One mil equals 1/1000 of an inch. This total is then multiplied by the volume solids content of the product to calculate dry film thickness.

Water-Based Example: Water-Based Coating A is applied at approximately 700 sq. ft. per gallon and has a solids content of 28 percent by volume. 1604/700 = 2.29 (wet mil thickness) X .28 = .64 dry mil thickness per coat.

Solvent-Based Example: Solvent-Based Coating B is applied at approximately 700 sq. ft. per gallon and has a solids content of 43 percent by volume. 1604/700 = 2.29 (wet mil thickness) X .43 = 0.98 dry mil thickness per coat.

(3) A compliance report detailing the methods by which compliance will be achieved.

Sherwin-Williams markets both waterborne and solvent-based varnishes. Research will continue on exempt solvents. Research to date has demonstrated that waterborne varnishes, while suitable for many applications, cannot be easily used to coat strip-wood floors during periods of high humidity, especially in gymnasiums that do not have year-round HVAC systems to control temperature and humidity. Also, waterborne varnishes either do not currently have adequate durability or offer no air quality benefit relative to ozone-forming potential. To a large extent, this research involves trial and error methods in which coatings with various mixtures of compliant VOC content are formulated and tested for performance characteristics. Although it is possible to improve VOC content within the non-compliant range, this particular research project is directed at improving the performance of our waterborne varnishes to meet the specific performance characteristics of the varnishes listed in Exhibit A. Details of this research effort are considered business confidential information due to the significant competitive advantage which will be enjoyed by those manufacturers which are able to develop compliant varnishes with superior application, handling, appearance, safety and performance characteristics.

(4) It is technologically infeasible for these products to comply with the requirements of § 130.303(a).

Technological infeasibility has two components. The first is the technical feasibility of meeting performance criteria for the product, i.e., a product that can be applied under a wide range of humidity conditions to all types of wood within a reasonable application rate and curing time without causing undue safety hazards. The second technological issue is in formulation of a product that meets the performance criteria without undesirable side effects such as lack of durability, unacceptable toxicity, the need for pre-staining or application of additional coats, or panelization. While there are compliant products that perform well when applied to strip-wood flooring in uncontrolled environments during periods of high humidity, no manufacturer of waterborne varnish guarantees against sidebonding where there is no pre-treatment of the wood and where the humidity cannot be controlled. In addition, major manufacturers caution against the use of waterborne lacquers in high wear applications or disclose the possibility of more frequent reapplication.

(5) The public interest in issuing the variance outweighs the public interest in avoiding increased emissions of air contaminants that would result from issuing the variance.

As highlighted in section (1) above, the products for which variance is sought are less hazardous than some of the replacement products which consumers will switch to if these proven products are withdrawn from the market. Thus, the safety aspects alone justify issuance of the variance.

Also, from an environmental benefits basis, there are likely to be fewer net emissions if the variance is granted than if it is denied, therefore one public benefit is a direct benefit to the environment. Tellingly, the evidence suggests that waterborne varnishes will result in higher net emissions than solvent-based varnishes. This is due to the need to pre-stain some woods; the need to pre-treat strip flooring to prevent sidebonding; the need to apply additional coats to achieve desired film thickness; and the need for more frequent application. Each of these pre-coats or additional coats carries with it an emission factor for VOCs. Thus the net VOCs from additional coats of waterborne varnish and multiple coatings used along with a waterborne varnish may exceed the VOC from use of a solvent-based varnish. In addition to the net emissions increase potential from multiple coatings, there is also strong evidence that waterborne varnishes have higher ozone forming potential. A comparison of the ozone formation potential of waterborne varnishes and lacquers vs. solvent-based varnish thus illustrates another aspect of the environmental benefit of granting the variance. A reactivity comparison of the dominant waterborne and solvent-based chemistries is appended as Exhibit D.

There are also other public interests that will be enjoyed from the granting of this variance. Consumers and professional contractors demand quality wood finishes which do not require frequent reapplication and do not contribute to flooring damage, such as the sidebonding problem evidenced in strip-wood flooring systems coated with waterborne coatings. Contractors who finish or refinish gymnasium floors and commercial and residential strip wood floors rely on quality varnishes to achieve the durability and appearance demands of their customers.

Even if one ignored the multiple coating impacts (including the requirement for pre-finish treatment or solvent-based staining) of not granting the variance, one must consider that the variance will not result in an increase in emissions, but may result in less decrease in emissions than would be experienced if these products were no longer available. It is estimated that this "lost" decrease will be less than 0.3 tons of VOC emissions per day statewide if the products identified in the appended list are granted a variance. As stated above, however, because mineral spirits--based varnishes have lower reactivity, require no "pre-treatment" coating, and require fewer coats than waterborne varnishes, there may be no increase in ozone formation from granting the variance due to the increase in highly reactive VOC emissions from the additional coats required to safely utilize consumer waterborne varnishes that possess durability approaching that of the products that are the subject of this variance application.

(6) The compliance program proposed by Sherwin-Williams can reasonably be implemented and will achieve compliance as expeditiously as possible.

Sherwin-Williams is devoting a significant portion of its research and development budget in the wood care product line to development of coatings, including varnishes, which meet VOC content limitations in all its markets. As the performance characteristics of its waterborne varnishes increase, it is possible that the manufacture of solvent based varnishes for all but a few specialized uses will diminish. Thus this variance may be subject to limitations on use of these products in the future. Sherwin-Williams will continue to communicate with the Department in an effort to achieve progress in limiting, if not eliminating, the manufacture and sale of these products by the termination date of this variance.

Emissions Reductions with the AIM Rule

Sherwin-Williams incorporates into this variance request the detailed written comments it filed with DEP, IRRC and the EQB in conjunction with the AIM rulemaking. Sherwin-Williams believes that the background documents relied on by the Department to estimate the emissions reductions achievable from implementation of the AIM rule are seriously flawed, and that the Commonwealth will meet or exceed the overall emission reductions goal even with the granting of this variance request for varnishes. Out of the Department's projected 28-ton-per-day reduction in emissions to be achieved by implementation of the rule, this variance request amounts to less than 1% of the reduction (without considering the potential negative impacts of increased coatings usage when waterborne substitutes are employed). Sherwin-Williams has provided data demonstrating that the actual reductions to be achieved from implementation of the rule were underestimated by almost 50%. Sherwin-Williams stands ready to assist the Department in making a demonstration of rule effectiveness to EPA, which will document the underestimation of the currently projected emissions decreases. This demonstration will more than offset the modest emissions impacts associated with this request for variance and, when reactivity is considered, may even result in lower ozone levels.

EXHIBIT A
PENNSYLVANIA VARIANCE APPLICATION
Sherwin-Williams, Minwax® and Dura Seal® Varnishes

PRODUCT NAME	VOC CONTENT (g/L)
Minwax® Fast Drying Polyurethane:	
High Gloss	439
Semigloss	446
Satin	445
Minwax® Helmsman® Indoor/Outdoor Spar Urethane:	
High Gloss	431
Semigloss	438
Satin	441
Minwax® Clear Shield:	
Semigloss	438
Satin	440
Minwax® Super Fast-Drying Polyurethane for Floors:	
High Gloss	439
Semigloss	440
Satin	440
Dura Seal® Polyurethane:	
High Gloss	488
Semigloss	537
Satin	513
Dura Seal® Gymthane Finish:	
High Gloss	491
Dura Seal® Masterline:	
High Gloss	481
Semigloss	482
Satin	481
WoodClassics® Line:	
WoodClassics® Polyurethane High Gloss	447
WoodClassics® Polyurethane Hand Rubbed Satin	489
WoodClassics® Fast Dry High Gloss	496
WoodClassics® Fast Dry Hand Rubbed Satin	523
Pratt & Lambert®	
Clear Oil Finish Satin	540
Clear Oil Finish Gloss	513
Clear Oil Finish Dull	560
Clear Spar Varnish	424
Okene™ Danish Clear Antique Oil Finish	443
Varmor® Urethane Clear Finish Gloss	497
Varmor® Urethane Clear Finish Satin	511
Vitrallite® UVA Spar Varnish	399

Martin-Senour®	
Astro-Var® gloss	447
Astro-Var® Satin	489
Marine Spar Gloss	424
Do-It Best®	
Polyurethane Varnish Gloss	447
Polyurethane Varnish Satin	489
Alkyd Fast Dry Varnish Gloss	513
Alkyd Fast Dry Varnish Satin	540
Spar Varnish	424

EXHIBIT B

ABIC TESTING LABORATORIES, INC.

24 Spielman Road
Fairfield, NJ 07004

973-227-7060
Fax: 973-227-0172

To: Sherwin Williams
Mr. George Mayerhauser

August 25, 2004

From: Leonard Mackowiak

Subject : Static Coefficient Of Friction Testing
Project No 5173-20 (5158-20)

Introduction

ABIC Testing Laboratories, Inc. was authorized to test submitted samples of Bona Mega™ Gloss (Batch 0308WT1310053 0152), Bona Mega™ Semi Gloss (Batch 0422WT1313111 1037) and Bona Mega™ Satin (Batch 0414WT1316151 0634). The products were applied to maple wood flooring as per client directions. After drying the static coefficient of friction (SCOF) was determined on the applied coatings according to ASTM D-2047.

Results

Test Product	(SCOF) Values	Average
Bona Mega™		
.Gloss (Batch 0308WT1310053 0152)	.39, .38, .38, .38, .37, .39, .38, 37 .37, .36, .35, .35	.4
.Semi Gloss (Batch 0422WT1313111 1037)	.35, .33, .33, .32, .34, .38, .38, 34 .37, .38, .38, .39	.4
.Satin (Batch0414WT1316151 0634)	.34, .35, .33, .32, .32, .33, .31, 31 .31, .33, .33, .32	.3

Discussion

It is generally recognized that a walking surface must have a static coefficient of friction (SCOF) of 0.5 or greater to be considered slip resistant. In our evaluation all three products applied to maple wood flooring do not produce this minimum value.

Respectfully submitted,

Leonard Mackowiak
Vice President

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

ABIC TESTING LABORATORIES, INC.

24 Spielman Road
Fairfield, NJ 07004

973-227-7060
Fax: 973-227-0172

To: Sherwin Williams
Mr. Ben Glowacki

September 8, 2004

From: Leonard Mackowiak

Subject : Static Coefficient Of Friction Testing
Project No 5173-21

Introduction

ABIC Testing Laboratories, Inc. was authorized to test a submitted sample of Fuhr Waterborne Urethane Finish (Gloss-255GG5) and Minwax Fast Drying Polyurethane 450 VOC-Clear Gloss. The product was applied to maple wood as per client directions. After drying the static coefficient of friction was determined on the applied coating according to ASTM D-2047.

Results

Test Product	StaticCoefficient Of Friction Values(SCOF)	Average
Fuhr Waterborne Urethane Finish Gloss-255GG5	.30, .30, .30, .33, .25, .27, .23, 28 .24, .28, .24, .28	.3
Minwax Fast Drying Polyurethane 450 VOC-Clear Gloss	.58, .47, .53, .57, .45, .45, .55, 47 .50, .47, .51, .62	.5

Discussion

It is generally recognized that a walking surface must have a static coefficient of friction of 0.5 or greater to be considered slip resistant. In our evaluation the Fuhr Waterborne Urethane Finish Gloss-255GG5 product applied to maple wood flooring does not meet this static coefficient of friction value.

The Minwax Fast Drying Polyurethane 450 VOC-Clear Gloss meets this static coefficient of friction value.

Respectfully submitted,

Leonard Mackowiak
Vice President

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

EXHIBIT C

DATER SCHOOL FIELD TEST

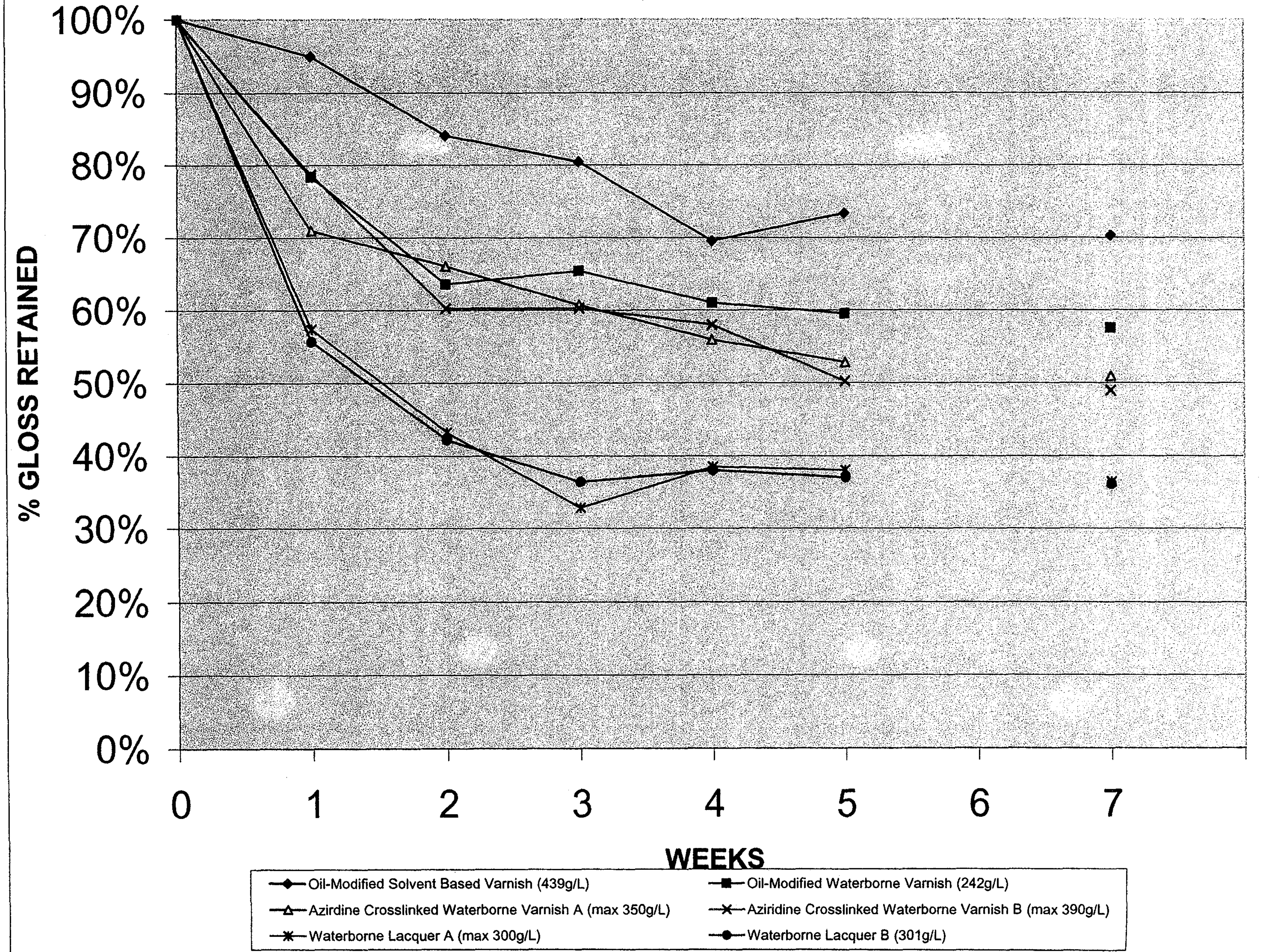

EXHIBIT D

OZONE-FORMING POTENTIAL OF WIDELY USED CLEAR WOOD FINISH CHEMISTRIES

	gO_3 /mil/ft[2*]
Two-Component (2K) Products (FOR PROFESSIONAL USE ONLY)	
• Dura Seal® X-Terra (160 grams/liter (g/L) actual VOC; MIR[1] = 0.43; NVV[2] = 31.7%)	3.32
o Waterborne, isocyanate-crosslinked polyurethane varnish	
• Dura Seal® 2000 ZC-2 (127 g/L actual VOC; MIR = 0.36; NVV = 28.8%)	3.06
o Waterborne, aziridine-crosslinked polyurethane/acrylic varnish	
One-Component (1K) Products (FOR CONSUMER OR PROFESSIONAL USE)	
• Minwax® Polycrylic® (125 g/L actual VOC; MIR = 0.39; NVV = 28.5%)	3.31
o Waterborne polyurethane/acrylic lacquer	
• Minwax® Water-Based Polyurethane for Floors (91 g/L actual VOC; MIR = 0.38; NVV = 28.1%)	3.27
o Waterborne, oil-modified polyurethane varnish	
• Minwax® Super Fast-Drying Polyurethane for Floors (439 g/L actual VOC; MIR = 0.65; NVV = 43.4%)	**3.09**
o Solvent-based (mineral spirits), oil-modified polyurethane varnish	

*grams of ozone per 1/1000 inch of dry film thickness per square foot coated

[1]Maximum Incremental Reactivity as calculated using CARB Method 310
[2]Nonvolatiles by volume

N.B. Solvent-based (mineral spirits) oil-modified polyurethane varnish that complies with current federal VOC regulations (maximum 450 g/L for varnish) has the lowest potential for ozone formation among the products listed that are suitable for consumer use.