



SOCIETY OF PLASTICS ENGINEERS  
COLOR & APPEARANCE DIVISION

## Chairman's Message

Dear SPE Color and Appearance Division Members,



Time seems to be accelerating as we race to the end of summer. The days are getting shorter and I wonder if I can sneak in a trip to the beach or short vacation before it is over. Very soon it will be time for CAD RETEC® 2014 in New Orleans. The CAD RETEC® 2014 conference chair, Earl Balthazar, and his committee are working on the final details to make sure the conference meets the needs and expectations of CAD members.

Past CAD RETEC® typically started with Bob Charvat's seminar on Coloring of Plastics. This year was to be Bob's final seminar; however, his passing earlier this year surprised and saddened many in the plastic community. We will have a small memorial set up for Bob Charvat so that messages and memories can be shared with fellow CAD members. The board has decided not to hold the color seminar this year in memory of Bob.

While in New Orleans, you will see many of the same activities as previous CAD RETEC®. The 2014 CAD RETEC® Golf Outing will be held Sunday, 14th September at TPC Louisiana, which serves as the home of PGA TOUR'S Zurich Classic of New Orleans. Golf enthusiasts will find the golf outing an enjoyable experience. Those looking for a more physical challenge and the opportunity to help the local community can participate in the 5K Fun Run/Walk at 7 am on Tuesday, 16 September. The proceeds from the 5K Fun Run/Walk will be donated to the local chapter of Habitat to Humanity. Since 2005, SPE CAD has donated more than \$25,000 Habitat to Humanity. Both the golf outing and 5K require registration prior to the corresponding event. Refer to the website ([specad.org](http://specad.org)) for more details. Those who prefer more social activities will be pleased that the Welcome and Network Receptions will be held on Sunday and Monday nights respectively.

Thanks to the highly favorable response, the panel discussion and New *continued on page 2*

CAD NEWS

PUBLISHED BY THE COLOR AND APPEARANCE DIVISION OF THE SOCIETY OF PLASTICS ENGINEERS

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Color and Appearance Division

## Chairman's Message (continued)

Technology forum will be included in the 2014 technical program. The panel discussion will be "Public Perception of Plastics." Audience response devices will be included so attendees can participate in the discussion. The New Technology Forum will end the presentations for Monday and play an excellent transition to the Network Reception, which will be held in the exhibit hall.

If you have not registered for CAD RETEC® 2014 in New Orleans, I recommend that you visit the CAD website (specad.org) and sign up.

I would like to close with an update on the CAD Board of Directors. I was responsible for the board elections earlier this year. We had sixteen excellent candidates. Unfortunately, there were only nine positions. This year, two new board members were elected; Tom Chirayil from BASF and Pete Zillitto from Sudarshan. Please join me in welcoming Tom and Pete as they begin their 3-year term on the CAD Board. Steve Goldstein, Sharon Ehr, Jamie Przybyliski, Austin H. Reid Jr., Mark Tyler, Steve Esker and Mark Freshwater were reelected.

Best Regards,  
Betty Puckerin  
CAD Chairperson



### Invitation to Attend Our Board Meetings

The Color and Appearance Division regularly holds Board of Director (BOD) meetings at the ANTEC® and the CAD RETEC®. In addition, a Summer BOD meeting is typically held about 6 weeks prior to the next CAD RETEC®.

The Summer meeting is scheduled in various locations. A Winter BOD meeting is held in January.

The Winter meeting is typically held at a site of a future CAD RETEC®.

Any SPE CAD members who wish to attend are welcome at these meetings. If interested in attending the next Board meeting, please contact the Division Chairperson for more information.

#### Disclaimer:

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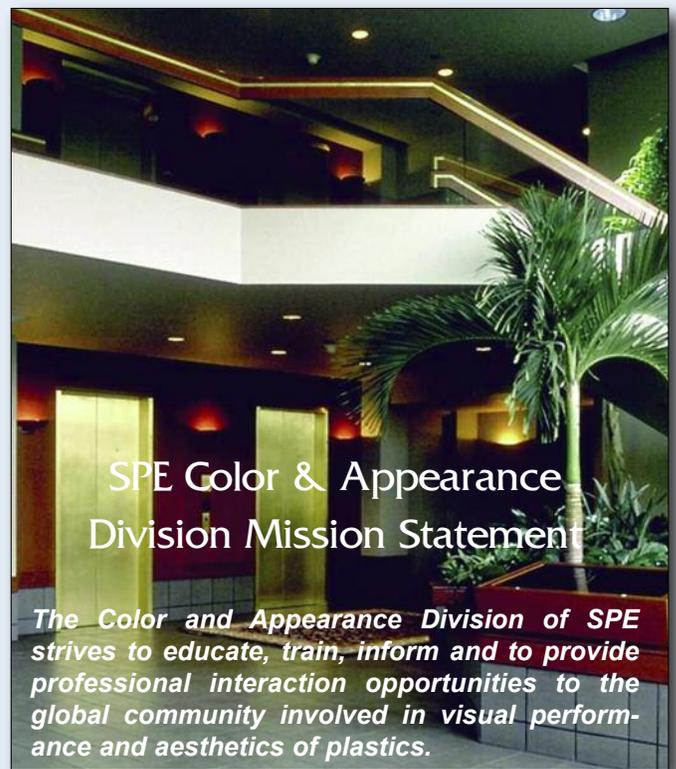
## Editor's Note



Welcome to the Summer 2014 Edition of the CAD newsletter. This edition should be hitting your mailboxes just before the CAD RETEC® which marks the first time since 1991 the conference has returned to New Orleans, Louisiana. Of course most of you will remember that Hurricane Katrina derailed our plans to visit the Crescent City back in 2005 and so I, for one, am really looking forward to this year's program.

This edition of the newsletter also marks my very first official action as a member of the CAD BOD which I am very excited about. Having been in this industry since 1989 and not knowing color from floor sweepings when I started (*and maybe I still don't depending on who you ask* 😊) this is a great opportunity for me to try and give something back to an industry that's helped me pay my bills all these years. I hope to see you all in The Big Easy next month!

Sincerely,  
Pete Zillitto  
Guest Editor



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The Color and Appearance Division (CAD) commits to the publishing of at least three newsletters a year (*four, if there is sufficient material to justify the extra issue*). Each newsletter is electronically distributed to our membership of nearly 1,000.

Each sponsor's art directly links to the company's website.

In addition, we print one of these newsletters on 80# gloss coated stock. All electronic versions are also posted on the SPE website where it is available for anyone to download.

For the small donation of \$300 per year, we offer a business card sized (2 x 3.5 inches) mention in our newsletter,

We currently have the following slots available for sponsorship:  
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The 52st Annual Society of Plastics Engineers Color and Appearance Division CAD RETEC® is located near New Orleans French Quarter and will serve as an excellent setting for the theme of this year's CAD RETEC®, "It's a Colorful World". CAD RETEC® is the largest technical conference hosted in North America that is specifically dedicated to the color and appearance of plastics.



If you have not already registered, there is still time to attend the conference. A special thanks to all our sponsors, organizers and participants for your involvement, creativity and talent.

**CLICK HERE to Register or see detailed informaton**



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Earl Balthazar  
Conference Chair  
2014 SPE CAD RETEC®  
ebalthazar@tx.rr.com

**CONFERENCE REGISTRATION**

- SPE Member Registration** \$440  
Must include valid SPE e-mail address with registration
- SPE Non-Member Registration - Includes 1 Year Membership** \$590  
Membership will be processed after RETEC.
- SPE Non-Member Registration Without SPE Membership** \$650  
Conference registration, but decline the One Year SPE membership.

**OTHER REGISTRATION TYPES:**

- Speaker/Moderator Registration** \$170  
Must be a speaker or moderator at the conference for this registration type. This does not include New Technology Forum Speakers.
- 2014 CAD RETEC® Conference Committee Member Registration** \$170  
Must be a member of the 2014 CAD RETEC® organizing committee to qualify for this registration type.
- Student Registration** \$ 50  
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- SPE Emeritus Member Registration** \$100  
Option available for SPE Emeritus Members
- SPE Membership Renewal** \$100  
Renew your existing SPE membership. Requires SPE membership e-mail address to ensure continued membership status. Note membership renewal may not be processed until after RETEC®.
- Tabletop Exhibit Space (if still available)** \$950  
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**EXTRA CONFERENCE LITERATURE:**

- Additional Copy Conference Proceedings** \$115 x \_\_\_\_ = \$ \_\_\_\_  
Additional CAD RETEC® 2014 conference proceedings download pass. *One copy is already included with each paid registration.*
- SPE CAD Archive DVD (1961 - 2007) and** \$175 x \_\_\_\_ = \$ \_\_\_\_  
Color Papers from 1961-2007 ANTEC & RETEC available on-site  
Special RETEC® Offer: \$175 (must also register for the RETEC® conference).  
\*Savings from the regular price of \$200 for SPE members and \$300 for non-members.

**OTHER EVENT REGISTRATION/RSVP:**

- Sunday Golf Outing** \$130 x \_\_\_\_ = \$ \_\_\_\_  
Sunday golf outing at TPC Louisiana. If registering more than yourself for golf, please include their names using the tabletop names & titles fields at the bottom of the registration page. This will allow you to list up to four names using those fields.
- 5K Fun Run/Walk** \$20 x \_\_\_\_ = \$ \_\_\_\_  
Sign up for Tuesday AM 5K Fun Run/Walk. CAD will match the \$20 donation for charity.

Total due from all items checked : \$ \_\_\_\_\_

\* Refunds less a \$30 fee August 16 to September 5, 2014  
\* No refunds after September 5, 2014  
\* SPE Memberships are processed after RETEC



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Is this your first CAD RETEC®? Yes No  
If no, have you attended a CAD RETEC® in the last five years? Yes No

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September 14, 2014



## GOLF OUTING INFORMATION

Course Location  
**TPC Louisiana**  
11001 Lapalco Blvd  
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Registration: 11:00 am (CST)  
Shotgun Start: 12 noon (CST)  
Awards: Will be presented at CAD RETEC®  
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**Price:** \$130.00 per golfer

**Includes:**

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Questions Contact:

**Mark Tyler**

mark.tyler@celanese.com 859.372.3221 or

**Mark Freshwater**

mark@pigments.com 201.665.0091



# CAD RETEC® 2014

## CONFERENCE HOTEL INFORMATION

Marriott New Orleans

To Reserve by Phone: 504-581-1000 or 1-888-364-1200

Request Group Rate: "Society of Plastics Engineers - Color & Appearance Division"

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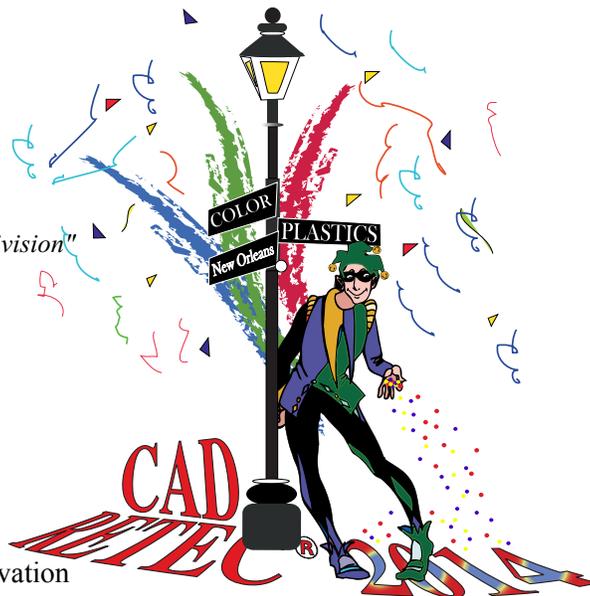
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Discounted Conference Room Rate: \$159/night-single occupancy

Room Block Dates: Sept 12-17

Rates will increase significantly after August 15, 2014 at 5pm or whenever the room block is full. Cancellation policy: Any hotel reservation canceled within 48 hours of arrival date will be charged for one (1) night's room and tax.



## SUNDAY

September 14

9:00 am - Golf Outing  
3:00 pm

1:00pm - Registration Desk Open  
6:00 pm

1:00pm - EXHIBITOR SET-UP  
5:30 pm

6:00 pm Welcome Reception  
8:00 pm (Pick up your registration packet prior to this event to get your complimentary drink coupons)  
Golf Outing Prizes will be presented at the Welcome Reception.



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## MONDAY MORNING (Mardi Gras Ballroom)

September 15

7:30 **BREAKFAST (Biffon A)**  
7:30 **Registration Desk Opens**

**Sponsor: Lansco**

### MORNING SESSION MODERATOR: BRUCE MULHOLLAND, CELANESE

8:15 **OPENING REMARKS:** Earl Balthazar

8:30 **KEYNOTE:** Public Perception of Plastics *Rudy Underwood, American Chemistry Council*

9:30 The Global Economy-Precariousness of Supply Chain, Globalization of Regulations, and How to Protect Yourself  
*Bruce Howie, Dominion Color*

10:00 **COFFEE BREAK**

**Sponsor: Clariant**

10:30 Fundamentals of Twin-Screw Extrusion- Color MB Processing: Common Pitfalls and How to Avoid Them  
*Paul G. Anderson, Coperion*

11:00 Influence of TiO<sub>2</sub> Feeding on Twin Screw Extrusion Compounding  
*J.D. Connolly, DuPont Titanium Technologies*

11:30 Dispersion of Pigments in Plastics Applications  
*Mahesh Metteloo, Sudarshan*

12:30 - 1:30 **LUNCH (on your own)**

**AFTERNOON SESSION MODERATOR: NATHAN KARSZES, NUBIOLA****1:30 Panel Discussion:**

Audience Response Devices will be available to each audience member for responding to poll questions during the panel discussion.

**3:00 COFFEE BREAK****Sponsor: Shepherd**

3:30 Pigments for Sensitive Applications

*Tom Chirayil, BASF*

4:00 Advances in Liquid Color Technology

*Inga Lesko, Clariant BU Masterbatch*4:30 New Technology Forum (pdf) **Moderator: Sandra Davis****5:00 NETWORKING RECEPTION***Sponsor: Nubiola*

## TUESDAY MORNING

September 16

**7:30 BREAKFAST** (*on your own*)**MORNING SESSION MODERATOR: AUSTIN REID, DUPONT TITANIUM TECHNOLOGIES**

9:00 Colorants for Plastics-Emerging Trends and Technologies

*Krishnamoorthy Sivakumar, PolyOne*

9:30 Iron Oxides/Inorganic Pigments for Plastics

*George Podolsky, Rockwood Pigments***10:00 COFFEE BREAK****Sponsor: DuPont**

10:30 Blue Undertone Enhancement of Black and Grey PP Injection Molded PP

*Nathan Karszes, Nubiola*

11:00 Lighter, Faster, Stronger: Additive Solutions for Automotive Plastics

*Emilie Meddah, Clariant BU Additives*

11:30 Gaining Competitive Advantage through Digital Appearance Technology in the Automotive Interior Supply Chain

*Phil Ruggiero, Datacolor***12:00 AWARDS LUNCHEON PRESERVATION HALL** (*Included with Registration*)**Sponsor: Tronox**

## TUESDAY AFTERNOON (Mardi Gras Ballroom)

September 16

**AFTERNOON SESSION MODERATOR: JIM FIGANIAK**

1:30 Inorganic Pigments: From Caveman to the 21st Century

*Mark Ryan, Shepherd Company*

2:00 Measurement Technology to Evaluate Light Protection: What You See May Not Be What You Protect

*Phil Miedenzu, DuPont Titanium Technologies***2:30 COFFEE BREAK****Sponsor: Munzing**

3:00 Effects of Disinfectant Grade Cleaner on Physical Properties of Cell Phone Cases

*Diane McLendon,  
Otterbox*

3:30 It's a Colorful World: Developing Technologies to Keep it that Way

*Joseph Fay, BASF*

4:00 **Closing Remarks** - Earl Balthazar, **Survey Raffle** - MC-Tracy Phillips, Uniform Color, **Grand Prize: TBD**  
Other Prizes: Archive DVD, Free Night at Westin, Free Registration at CAD RETEC® 2015, Emergency Radio  
CAD RETEC® Limited Edition Art

*Must be present to win*



# **NEW ORLEANS** **2014**

## **Retec 5k Fun Run**

September 16th @ 7 a.m.

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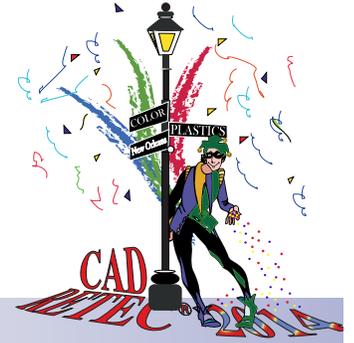
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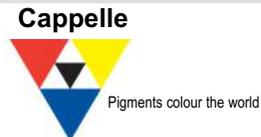
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# Technical Article

The following Technical Article was published in 1998 at The Color And Appearance Conference in September.

## High Performance Pigments for Demanding Applications: Rotational Molding

Joseph J. Fay, Ph.D., & Peter Zillitto  
Plastics Technical Center, Pigments Division  
Ciba Specialty Chemicals Corporation

### INTRODUCTION

Colorants for polymer applications are typically incorporated into the polymer by one of several common pathways. Color concentrates, which are widely used in industry, enable the end user to conveniently meter in the colorant at the prescribed ration with virgin or uncolored polymer in the manufacturing process. The benefits of concentrate used as compared to the direct use of powder pigment during final product conversion processes include: predispersion of the pigment in a suitable carrier system, elimination of the need to in-house compounding to incorporate the colorant uniformly and improved housekeeping, etc. Furthermore, color concentrates are available in a number of product forms including pelleted concentrates, liquid color systems and pastes, the latter used especially for PVC. For polymer conversion processes in which an extruder or melt mixing device is employed, these colorant preparations can be used very effectively. In some markets where high levels of functional fillers, modifiers or polymer blends are used, compounders may manufacture “precolored” polymer by direct addition of the colorant to their compounding line. In some cases, concentrates are used depending upon specific product and process capabilities.

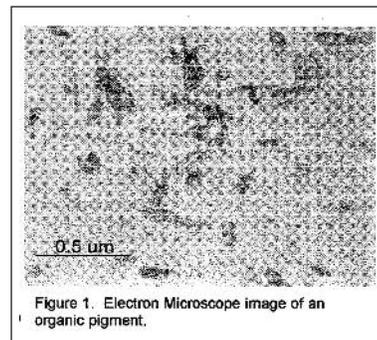
Rotational molding, in contrast, is a low shear process in which traditional pellet form color concentrates are not suitable. Coloration of rotomolding resin is commonly obtained by the use of dry color and liquid color, which can be added directly to the ground rotomolding resin. Alternatively, precolored resin, in which the pigment is compounded into the polymer and then ground before use, finds applications as well. More recently micropellet technology has been advanced as an alternative to the aforementioned methods. It is similar to precompounded color but the need for grinding the polymer into the appropriate mesh size is eliminated as the micropellets can be rotomolded without further processing. For each of these color incorporation methods, there are advantages and disadvantages, including economic factors (*process equipment and material cost*), ease of use, housekeeping and overall quality (*physical properties and aesthetics*) of the resulting part.

As a consequence of the myriad applications, the palette of pigments for rotational molding appears to be quite extensive, similar to that which is used in general purpose polyethylene application requirements. However due to the specific process conditions involved in preparing the pigment system, the temperature profile of the rotational molding process and the end use application requirement, the gamut of pigments is significantly reduced.

Pigment selection may also be affected by the method by which the pigment is to be delivered. Liquid colorant systems work best with pigments that have the potential to be loaded to high weight percentages while maintaining suitable viscosity. Pigments used in dry color require characteristics that impart dispersibility and minimize agglomeration during both dry color manufacture and blending with the rotomolding resin.

### DISPERSION

When pigments are manufactured, the smallest pigment particles formed are discrete units referred to as primary particles. As a result of their high surface energy, these particles randomly join together to form aggregates and agglomerates, the latter being formed primarily during subsequent filtration and drying processes. To achieve a speck-free system, the pigment must be effectively “dispersed” so that the individual pigment particles or aggregates are wetted by the polymer and discrete pigment particles are not visible to the naked eye. Rotomolding pigment systems (*liquid color and dry color*) need to be prepared in a manner that ensures visible agglomerates are eliminated and that during subsequent mixing with the rotomolding resin, the colorant system will be easily distributed. Furthermore, the dispersion of the pigment needs to effectively deliver a colorant that will provide a high color strength potential to maximize economic, while not adversely affecting other properties. **Figure 1** illustrates the particle size of the typical azocondensation pigment.



continued on page 12

Note that the particle size distribution that would be obtained in a polymeric system will be very dependent upon the effectiveness of the final dispersion.

### HIGH PERFORMANCE PIGMENTS

High performance pigments, HPP, can be defined as pigments that have either very good to excellent heat or light stability, and more commonly, pigments which offer a unique combination of both heat and light stability. The enhanced UV and heat performance attributes of HPPs set them apart from traditional or classical pigments such as the lithol rubines (P.R. 57.1) lake red C (P.R. 53.1) 2B toner (P.R. 48 types) monoazo yellows, such as P.Y. 62, and others which have only limited heat stability and mostly marginal to poor lightfastness.

The major types of high performance pigment chemistries can be described in a general fashion, as indicated in **Table 1**. Some individual pigments within these chemistries may have better or worse performance characteristics, depending upon the specific product, attribute and application being considered.

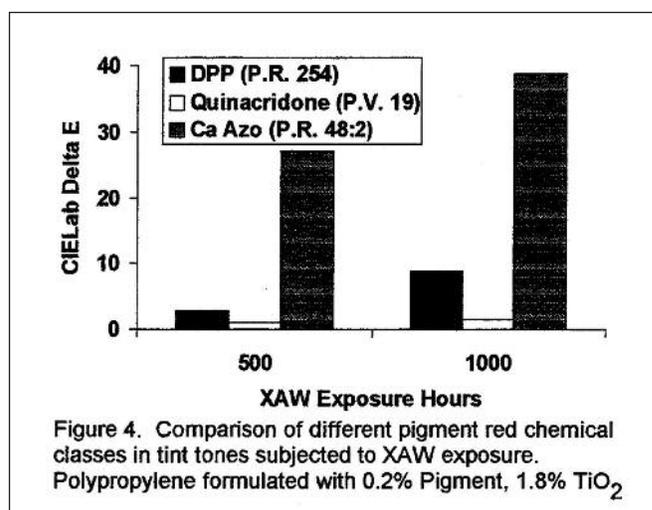
**Table 1** High Performance Chemistry Families

Quinacridone	Copper Phthalocyanine
Diketopyrrolo-pyrrole (DPP)	Anthraquinone
Tetrachloroisoindolinone	Indanthrone
Azochondensation	Perylene
Benzimidazole	Isoindoline

### HEAT STABILITY

Organic pigments are available not only with a wide variety of hues and chroma but also with considerable variation in performance characteristics. Rotational molding, with its combination of relatively long cycle times, high mold surface temperatures and abundance of oxygen, is more demanding upon the polymer, stabilization package and pigmentation in comparison to many other processes. As a consequence, many rotomolded product applications require the use of higher performance pigments to survive the molding process even though the pigment with regard to final product requirements may be viewed as “over engineered.” Classical pigments such as 2B reds (C.I. Pigment Red 48’s) with only limited thermal stability in high temperature olefin polymer applications, may not be suitable for even non durable articles as the color stability during molding may be insufficient. Figure 2 compares the heat stability of a calcium 2B toner with high performance diketopyrrolo-pyrrole (DPP) and quinacridone (QA) chemistries. In masstone applications, it is readily apparent that the 2B toner is quite deficient when compared with these high heat stability pigments. Furthermore, as pigment

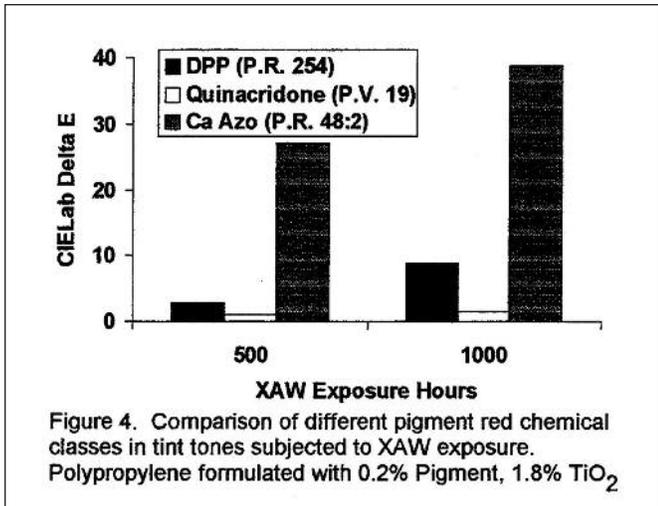
heat stability is generally related to concentration, at lower concentrations, the 2B toner would become even more prone to color change. In addition to pigment instability, color change during rotational molding may be affected by other factors. The stability of the base resin is an important consideration. The role of the antioxidant package is critical to controlling the initial color and maintaining the physical properties of the rotomolding resin. Judicious selection of a phenolic antioxidant and phosphite processing stabilizer package is essential for the base polymer. Depending upon specific circumstances, additional antioxidant might be added. The most effective stabilization is typically obtained when the antioxidant is added directly to the resin itself during manufacture, or during compounding when recolored resin is prepared. For specialty applications



where additional antioxidants are needed to attain the requisite performance, precolored or preformulated resin which is then ground provides additional benefit.

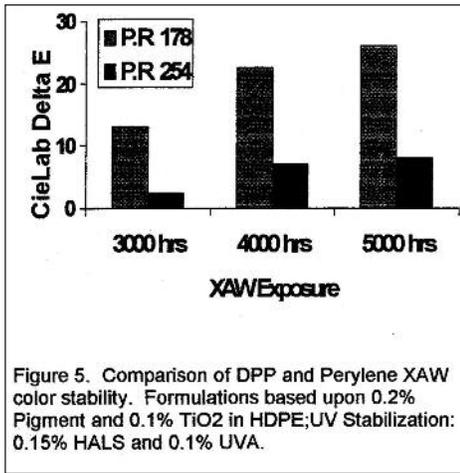
### LIGHT STABILITY

Many applications of rotationally molded articles find end uses which require UV durability. These UV performance applications encompass a broad variety of applications and markets: residential waste containers, children’s playground toys (*both for residential and institutional uses*), outdoor sporting goods (*kayaks and component of other recreational vehicles*) and oversize containers (*industrial containers and agricultural tanks*). For outdoor applications, careful formulation is required to achieve not only suitable color match but also a color combination which will have the desired weatherability. As delineated in **Figure 3**, Calcium 2B toners have limited light stability in polyolefin applications, and are not recommended for use where any significant UV exposure is intended. Although not reflected in the colorimetric data, the 2B toner sample surface was significantly marred by chalking and surface microcracking and is visible via low magnification optical

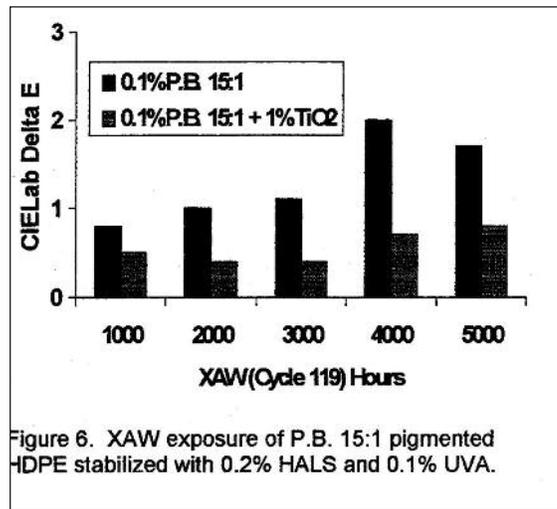


microscopy. Such microcracks may ultimately result in premature physical failures of the product. Therefore, visual inspection of samples following accelerated or real-time exposure testing is imperative to ensure complete performance analysis. As a consequence of the limited weatherability of many pigments, performance assessment is needed. Applications such as point of sale displays and related items and indoor applications where incidental UV exposure from lighting fixtures or nearby windows is possible, are best formulated with durable HPP pigments. Outdoor applications require the use of HPP pigments at levels that can provide sufficient levels of weather resistance.

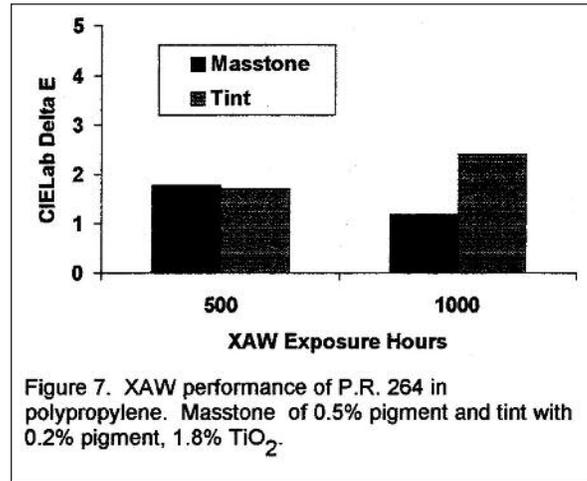
Figure 5 illustrates the difference in long-term UV stability that was obtained when a DPP red (P.R. 254) was compared with a perylene red (P.R. 178). Perylene pigments are prone to darkening when used in conjunction with hindered amine light stabilizers (HALS) whereas no such negative interaction has been observed for DPP chemistries.



Other high performance pigment classes, such as copper phthalocyanine blue pigments, may also be suitable for outdoor applications when properly formulated. P.B 15:1 and P.B 15:3 are widely used in rotational molding applications as a consequence of their outstanding performance properties, Figure 6 and tremendous value in use.



Inorganic and heavy metal pigments are also widely used in some rotational molding applications due to their generally good dispersibility characteristics, and in many cases the cleanliness of shade that may be obtained when using certain cadmium and lead chromate pigments. However, as will be discussed in greater detail, regulatory pressures have resulted in heavy metal deselection in several appli-



cation areas, including food packaging and many toy applications. These applications, however have not always been easily reformulated. The use of HPP products provides alternatives in many color space applications. Additionally, with the recent introduction of several new DPP products, P.R. 264 (Figure 7), P.R. 272; and P.O. 71, and P.O. 73 (Figure 8) into the polyolefin and PVC market areas, a greater breadth of high performance organics is available for formulating. In some case, differences in the performance of organic versus heavy metal pigments may result in additional raw material costs. Material selection and modification of base stabilization are required in some cases, and additional light stabilization packages are needed,

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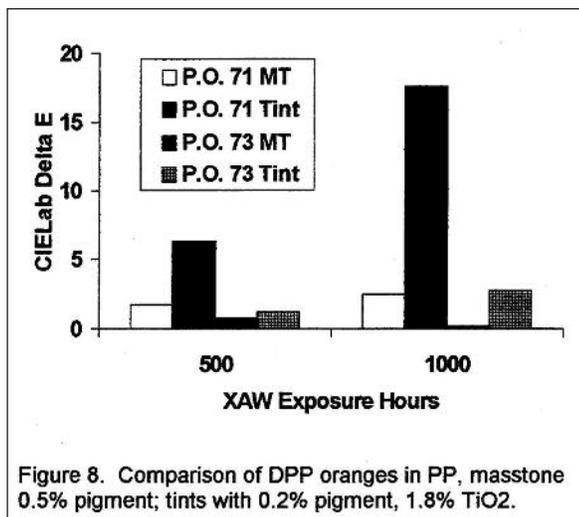


Figure 8. Comparison of DPP oranges in PP, masstone 0.5% pigment; tints with 0.2% pigment, 1.8% TiO2.

especially when formulating polyolefins for outdoor applications, to provide comparable alternatives. Nonetheless, consumers (*materials specifiers, manufacturers and the ultimate product purchaser*) choosing to avoid use of cadmium and lead pigments wherever reasonably possible remains a continuously evolving trend.

The formulation of rotationally molded articles for outdoor applications requires the use of both suitable pigments as well as the assistance of a well-designed light stabilizer package. The use of tetramethyl piperidine based hindered amine light stabilizers, especially oligomeric and high molecular weight types, in combination with benzotriazole based UV absorbers are recommended for use in a variety of applications. The total package loading should be tailored to meet the specified requirement of the application.

### DISTORTION EFFECTS

Distortion of rotomolded articles can be effected by several different variables. Resin choice and the particular material being used can affect warpage and shrinkage. Differences in cooling of the mold, thickness variations, overcuring and several other process parameters have been found to be related to warping. Since pigments (*and the systems used to deliver them*) may alter the flow characteristics of the polymer and also the cure characteristics, operation of a given mold with different pigments or colorant systems with a single cure cycle may result in differences in dimensional stability. The use of controlled heating and cooling as well as good control over the process itself will help to ensure consistent part manufacturing, as well as a good data and record keeping can be referred to in case of erratic part quality.

### IMPACT PROPERTIES

Impact properties are commonly tested as a means of assessing the quality and suitability of colorant systems, as well as for assessing the cure characteristics of the polymer and the properties of the final product. The ARM (Association of Rotational Molders) impact test is a common test that is used. Alternative, instrumented testing provides similar test result capabilities with the advantage of quantitative and qualitative data acquisition.

Impact properties of rotomolded products are important. Many toys, containers and other applications require assurances of product integrity, which can often be affected not only by the process conditions, but also by the incorporation of pigments and other additives. Since there is very little shear in the rotomolding process, pigments are likely to be located at the grain boundary between adjacent polymer granules. This localization of pigment and “additives” can adversely affect physical properties in several ways. Inhibition of polymer chain entanglements between particles, due to additives that form an interface between resin particles, can result in weak, distinct boundaries with poor mechanical properties. Also, pigment agglomerates which are not broken apart, or more troubling, when they are formed during premixing processes due to excessive mixing, may introduce point defects, effecting physical properties. Aesthetic properties may also be impacted if agglomerates are present in either significant size or number. Pigment loading, which is related to both the effectiveness in which the pigment can be dispersed as well as the color requirements of the part, is another factor to be considered in assessing the potential effect of coloration on physical properties.

### REGULATORY ASPECTS

With the variety of applications encountered in rotational molding, well-publicized legislation and public opinion have compelled many plastics processors and end-users to use alternatives to cadmium and lead based pigments. CONEG (COalition of NorthEast Governors) related legislation prohibits the sale of packaging materials to which cadmium, lead, mercury and hexavalent chromium or their compounds have been intentionally added. Reducing the amount of these elements entering the food chain via waste disposal sources and the extra precautions needed to dispose of post industrial wastes are issues to be addresses. Certainly, both lead and cadmium-based pigments possess a combination of desirable technical properties that makes them particularly useful coloring materials for polymers. Lead based pigments, furthermore are particularly economical in use. Nonetheless, public opinion and legislation have had and will likely continue to have a significant impact on their use, particularly in consumer goods.

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continued from page 14

Colorants for polymers that are suitable for food contact use according to 21 CFR178.3297 by the FDA (Food and Drug Administration), NSF (National Sanitation Foundation) listing for Potable water contact applications and ASTM toy specifications may further place limitations on which pigments may be used.

## CONCLUSIONS

Rotational molding presents specific performance requirement for colorants due to the process dynamics and end-user application needs. High performance organic pigments, in addition to inorganic pigments, provide useful solutions for designers and manufacturers of rotationally molded products. However, as this market continues to grow *due to the many unique product features attributed to the rotomolding process, advancements in pigmentation, stabilization, resin processes and ancillary products* should also grow as well. Active research and development in stabilization technology continues to advance new products and uniquely designed chemistries (*such as lactone and hydroxylamine process stabilizers*) into the market place. New pigment products, such as those based upon DPP chemistry also show promise in rotational molding applications. Moreover, these new products further broaden product development potential by providing ever increasing performance and greater value in use.

## ACKNOWLEDGEMENTS

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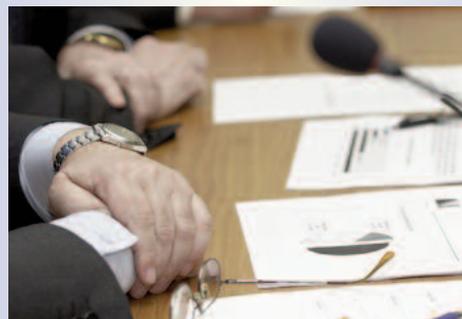
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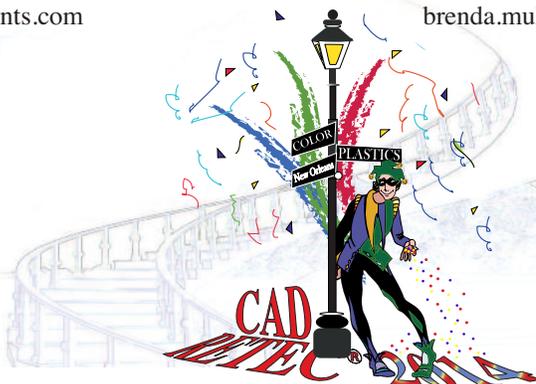
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