Chairman’s Message

Greetings from your new Chairman! Please join me with a special thanks to our outgoing Chair, Earl Balthazar.

Most of you have seen the June Issue of Plastics Engineering. Our new SPE President (Russell C. Broome) published a thought provoking message on “Embracing Change”. Mr. Broome goes on to note the importance of engaging our industries younger professionals and SPE’s focus to evolve. We as a division are on the same path!

The SPE has a little more history than our division. It was founded in 1942 and our Color and Appearance (TAG) sub group originated in 1960. The division as we know it now (CAD) did not originate until 1970. Though the wording has changed our general mission has changed little over the years - The Color and Appearance Division of SPE strives to educate, train, inform and to provide professional interaction opportunities to the global community involved in visual performance and aesthetics of plastics. What has changed is our method and effort to keep you involved both professionally and as members to our division:

- Our Conference (RETEC®) is still anchored with a strong technical program but we have added the New Technology Forum and scheduled social networking opportunities.
- Our Web page is all inclusive. If you have not seen it recently, check it out! www.specad.org.
- Our Newsletter now provides technical articles, minutes from the board meetings, opportunities to advertise and info on upcoming events. We get it to you, the way you want it, in print (Summer Issue), sent to you electronically and on the web page.
- Our new Social Media forums on Twitter and Linked In provide the ability to interact, instantly with members of the SPECAD group!
- Our Reference Materials like the SPE CAD Conference Archive DVD allow you to have decades of information at your fingertips.

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continued on page 2
Our management of Endowment Funds offers the ability to provide scholarships and support to students who plan to embark or have interest in the coloring of plastics.

The “take away” is... we know we need to “Embrace Change” in order to remain relevant. Your CAD Board is committed to keep the evolution in motion! We invite you to get involved in the process! Pick up the phone or should say Tweet or Email myself or a BOD member your idea for advancing the relevance of CAD.

Best Regards,

Scott Heitzman
CAD Chairperson

The Color and Appearance Division of SPE strives to educate, train, inform and to provide professional interaction opportunities to the global community involved in visual performance and aesthetics of plastics.

Invitation to Attend Our CAD 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 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:

The information submitted in this publication is based on current knowledge and experience. In view of the many factors that may affect processibility and application, this data/information does not relieve processors from the responsibility of carrying out their own tests and experiments, neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose. It is the responsibility of those to whom this information is supplied to ensure that any proprietary rights and existing laws and legislation are observed.
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Contact: Charles Chum
704-708-4249
Charles.Chum@2Lintech.com

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SPE CAD NEWS, Summer 2011
CALL FOR PAPERS

Abstract Deadline: October 19, 2011 – 5:00pm E.S.T.

ANTEC® is the world’s largest plastics technical conference. SPE-ANTEC® 2012 will co-locate with SPI’s NPE 2012 in Orlando, FL, U.S.A. at the Orange County Convention Center. The conference will take place April 2-4, 2012.

The Color and Appearance Division (CAD®) of the Society of Plastics Engineers (SPE®) will be hosting our annual technical session during this conference and would like to encourage you and your company to participate by presenting a paper. We would consider any paper related to the color and/or appearance of plastic and the following categories would be typical topics:

- Color Trends
- Decorative or Special Effects
- Color Measurement
- Color Matching Techniques
- Materials (Colorants, Additives, Plastics)
- Instrumentation/Test Methods/Quality Control
- Property Retention/Durability
- Regulatory Issues
- Processing and Equipment
- Other Color/Appearance Related Topics

Plastics industry professionals who submit papers at ANTEC® 2012 have a choice between two tracks: technical or commercial. The technical track includes more traditional ANTEC® papers, which address new technologies and techniques currently in development in the plastics industry. The commercial track is for papers that speak to commercial applications of these technologies and techniques, and can be similar to a case study.

Papers can be submitted on the ANTEC® website at www.antec.ws. For more information visit the site or contact Scott Aumann at (912) 210.0175 or scott.aumann@merckgroup.com.

Scott Aumann
ANTEC® 2011 CAD® Technical Program Chair
(912) 210.0175
scott.aumann@merckgroup.com
Keystone Aniline Corporation offers a comprehensive range of high quality products to satisfy your specific color needs and applications.

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- Product certification (FDA, CONEG, AP89, EN71, REACH ready etc.) as required

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- Security tags and taggants

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Published by The Color and Appearance Division of The Society of Plastics Engineers

SPE CAD NEWS, Summer 2011
The annual CAD RETEC® Conference is a technical and industry event for OEMs, specifiers, processors, testing and auxiliary equipment suppliers, raw materials (color, additive, polymer) suppliers, masterbatch and compound producers, or market data and service suppliers involved in the coloration or appearance of plastic.

Join us and see what benefits this 49 year old conference can provide you and your business.

EXHIBITOR INFORMATION
Contact: Brian West
865-457-6700
bwest@techmerpm.com

SPONSOR INFORMATION
Contact: Sharyl Reid
864-968-2426
sharyl.reid@us.aschulman.com

ADDITIONAL INFORMATION
Contact: Howard Kennedy
416-253-4297
hikennesy@dominioncolour.com

Transportation:
This hotel does not provide airport shuttle service.

From Chicago-O’Hare Airport (ORD)
Directions-15 miles SW, approx. 25 minutes by car
Take 190E then 294S then 88W.
Exit at Highland Ave.
Right on Butterfield.
Left on Yorktown Mall Dr.

From Chicago Midway Airport (MDW)
Directions-25 miles W, approx. 36 min.
by car
Take 55S then 294N the 88W.
Exit at Highland Ave.
Right on Butterfield.

Alternate transportation from ORD or MDW:
Estimated taxi fare: $50-60 USD
(one way)
Shared Shuttle-Windy City Limo-
Tel 866-949-WNDY - $26 plus gratuity
Airport Transportation
Reservation with
Windy City Limousine.

Windy City Limousine
866-949-4639

Westin Lombard Parking:
Valet parking-$10 USD daily
Onsite Parking - Self Parking - no charge
COLORING OF PLASTICS TUTORIAL
PRESENTED BY: THE COLOR AND APPEARANCE DIVISION

The Color and Appearance Division of the Society of Plastics Engineers has been presenting the Tutorial for a number of years at the start of the Division’s annual RETEC®. Many members and non-members of SPE have benefited from this program. Have you or a colleague benefited? If not why not?

The Tutorial is a major starting and/or improvement opportunity for many just beginning a career or wanting to add to their base knowledge of coloring of plastics. A refresher or new up-to-date fresh look at your own career may be the order of the day. This Tutorial has historically been held the day before the Annual RETEC® starts. This usually is a Sunday with the RETEC® officially starting the following day.

The Tutorial requires a full day, 9:00 am till about 5:00 pm. It is full of practical information embellished and enlightened by active participation of all the attendees. The attendance is limited to 20 persons. So register soon.

Who might benefit from participating? Past Tutorial records show colleagues already pursuing careers in coloring of plastics, new graduates from community colleges, four year colleges and vocational technical schools who have participated in the CAD Tutorial give the Tutorial presentation high marks for improving their understanding of coloring of plastics. A few examples are,

EXECUTIVES NEEDING TO BETTER UNDERSTAND THEIR COMPANIES COLORING ISSUES
MANAGERS NEWLY APPOINTED AND/OR DESIRING TO COMMUNICATE MORE EFFECTIVELY WITH PEERS AND SUBORDINATES
SALES FIELD PERSONAL HOPING TO GAIN MORE TECHNICAL KNOWLEDGE TO BETTER SERVE THEIR CUSTOMERS
MARKETING STAFF ADMINISTRATORS NEEDING TO IMPROVE THEIR COMMUNICATION SKILLS WITH THEIR HUMAN RESOURCE STAFF IMPROVE ABILITY TO EVALUATE POTENTIAL CANDIDATES FOR COLOR RELATED POSITIONS
PRODUCT DESIGNERS THOSE WISHING TO BETTER UNDERSTAND THE COLORING DECISIONS THEY MUST MAKE WHEN SELECTING AND/OR APPROVING COLORS FOR THE PRODUCTS BEING DESIGNED
PLANT MACHINE OPERATORS NEEDING TO BETTER UNDERSTAND THE ISSUES NEEDED TO EFFECTIVELY OPERATE PLASTICS PROCESSING MACHINES MAKING PRODUCTS REQUIRING COLOR CONTROL
QUALITY CONTROL STAFF THOSE NEW TO THE QC POSITION OR THOSE THINKING A REFRESHER WOULD BE HELPFUL IN OBTAINING A BETTER UNDERSTANDING OF COLOR AND APPEARANCE JUDGMENT ISSUES
OTHERS/ATTENDEES NOT ALREADY IDENTIFIED

A number of coloring of plastics subjects will be covered during the Tutorial. Active participation by attendees is strongly encouraged! We will all learn together! And! We have fun doing it. Here are just some of the items that will be addressed during the session including a colorful, take home, manual for you work place reference. Here are some, but not all, of the subjects included.

WHAT IS COLOR?
A DISCUSSION OF ADDITIVE AND SUBTRACTIONAL COLOR
EVER HEAR OF ROY G. BIV? AND WHY
WHAT CONSTITUTES A “SAMPLE”
COLORANT INCORPORATION AND DISPERSION ISSUES
A DISCUSSION OF IMPORTANT COLORANT TERMINOLOGY
A BRIEF DESCRIPTION OF HOW SOME COLORANTS ARE MADE
A DISCUSSION OF PIGMENT PHYSICAL PROPERTIES AND HOW THEY MAY AFFECT PRODUCTS
DEFINITIONS AND UNDERSTANDING ORGANIC, INORGANIC, SOLUBLE DYE AND EFFECT COLORANTS AND THEIR PROPERTIES

WHAT IS APPEARANCE? (IT IS NOT THE SAME AS COLOR)
WHAT IS “COLOR IS A MATTER OF 3”?
A DISCUSSION OF THE “CIE” AND “L,A,B, SYSTEM
DISCUSS ISSUES DEVELOPED BY ATTENDEES
COLORANT SELECTION INFORMATION
COLORANT CLASSES
A DISCUSSION OF LIGHTING WHEN VIEWING SAMPLES INCLUDING LED’S

All of the above will not result in anyone being the “best in the nation” color technologist. However, the 20 attendees will leave the presentation with a better understanding of their careers and be much more effective in their careers. The attendees will be able to interact with each other and the presenter in open discussions of issues and problems they are experiencing in their day to day activities. I hope to see 20 bright eyed and participating people on Sunday September 25, 2011 at the Westin Hotel Lombard, Illinois. Your presenter will be Bob Charvat. Go to www.specad.org for Tutorial, RETEC and Hotel Registration information, forms and additional information.
Discounted Conf. Room Rate:
$149/night-single occupancy  $149/night-double occupancy
Room Block Dates: Sept 22-29.
Rates will increase significantly after Sept. 10, 2011 at 5pm.

To Reserve by Phone:
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Request Group Rate:
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To Reserve Hotel Online: ONLINE HOTEL RESERVATIONS

Hospitality Suite Reservations:
Please contact Howard Kennedy at 416-253.4297 or hkennedy@dominioncolour.com for hospitality suite reservations.

Important Note to Attendees:
Be sure to stay at the conference hotel if possible. Meeting our contracted number of rooms helps defer the cost of meeting space and registration fees and helps us obtain lower room rates for the attendees. Make sure your room and hospitality suites are part of the CAD RETEC 2011 room block. Thanks for your support and cooperation.
### Sunday September 25

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30am – 5:00pm</td>
<td>Pre-Conference Seminar: Coloring of Plastics with Bob Charvat (Separate Registration required)</td>
</tr>
<tr>
<td>5:00pm – 8:00pm</td>
<td>Registration Desk Open</td>
</tr>
<tr>
<td>1:00pm – 5:00pm</td>
<td>Exhibitor Set Up</td>
</tr>
<tr>
<td>8:00pm – 11:00pm</td>
<td>Welcome Reception – Westin Sponsored: EMD Chemicals</td>
</tr>
</tbody>
</table>

Pick up your registration packet prior to this event to get your complimentary drink coupons.

### Monday September 26

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00am</td>
<td>Breakfast Sponsored: Lansco Colors</td>
</tr>
<tr>
<td>7:15</td>
<td>Registration desk opens</td>
</tr>
<tr>
<td>8:00</td>
<td>EXHIBITS OPEN</td>
</tr>
<tr>
<td>8:15</td>
<td>Introduction &amp; Welcome            Howard Kennedy, Dominion Colour</td>
</tr>
</tbody>
</table>

**MORNING SESSION**

**Moderator:** Mark Tyler, Ticona

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30</td>
<td>A Case Study: the Role of Market Research in Market Driven Development, A Market Study of TiO2 Requirements for the Masterbatch Industry</td>
</tr>
<tr>
<td>9:00</td>
<td>Coloration and Function of Bioplastics Using Certified Standard &amp; Natural Pigments &amp; Additives</td>
</tr>
<tr>
<td>9:30</td>
<td>New Developments in Fluorescent &amp; Non-Fluorescent Polymeric Colorants Dan Tyson, Day Glo</td>
</tr>
<tr>
<td>10:00</td>
<td>Coffee Break Sponsored: Clariant</td>
</tr>
<tr>
<td>10:30</td>
<td>How to Use Iron Oxides and Zinc Ferrites to Create Cost Effective and High Performance Solutions in Plastics</td>
</tr>
<tr>
<td>11:00</td>
<td>Film &amp; Fiber Properties that Impact Transparency Paul Merchak, Sun Chemical</td>
</tr>
<tr>
<td>11:30am-1:00pm</td>
<td>Lunch (On your own)</td>
</tr>
</tbody>
</table>

**AFTERNOON SESSION**

**Moderator:** Betty Puckerin, Ampacet

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00</td>
<td>Panel Discussion: Color Delivery Forms: Single Pigment Dispersion, Liquid Color, Color Masterbatch, Compound, Dry Blend</td>
</tr>
<tr>
<td>2:30</td>
<td>Coffee Break Sponsored: DuPont Titanium Technologies</td>
</tr>
<tr>
<td>3:00</td>
<td>&quot;Formulating for the Invisible Using the Visible.&quot; Tad Finnegan, BASF</td>
</tr>
<tr>
<td>3:30</td>
<td>Formulating for Global Regulatory Compliance in Food, Drug, and Cosmetic Markets. Wylie Royce, Royce Associates</td>
</tr>
<tr>
<td>4:00</td>
<td>New Technology Forum NTF Moderator: Bob Charvat</td>
</tr>
</tbody>
</table>

### Tuesday September 27

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30am</td>
<td>Speaker's Breakfast (Speakers and Moderators Only)</td>
</tr>
<tr>
<td>7:00</td>
<td>5K Fun Run/Walk for Habitat for Humanity Plastics (Pre-register for this event)</td>
</tr>
</tbody>
</table>

**MORNING SESSION**

**Moderator:** Doreen Becker, Americhem

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30</td>
<td>Color Management within Fast Moving Supply Chains. Bob Karpowicz, Datacolor</td>
</tr>
<tr>
<td>9:00</td>
<td>Panel Discussion: Supply Chain Risk Assessment</td>
</tr>
<tr>
<td>10:00</td>
<td>Coffee Break Sponsored: Sun Chemical</td>
</tr>
<tr>
<td>10:30</td>
<td>Overview of the Plastics Technology Program at Terra Community College. Jamie Przybylski</td>
</tr>
<tr>
<td>11:00</td>
<td>These Browns are Green!            Robert Seeley, Clariant</td>
</tr>
</tbody>
</table>

12:00 Awards Luncheon included with registration Sponsored: Tronox

**AFTERNOON SESSION**

**Moderator:** Larry Nitardy, ComAssist

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00</td>
<td>Trends in Special Effect Pigments</td>
</tr>
<tr>
<td>2:00</td>
<td>Viscosity Behavior Description of TiO2 Masterbatch</td>
</tr>
<tr>
<td>2:30</td>
<td>Coffee Break Sponsored: Shepherd Color</td>
</tr>
<tr>
<td>3:00</td>
<td>The Filter Pressure Test DIN EN 13900-5 for Pigment Masterbatch Dispersions. Roger Reinicker, BASF</td>
</tr>
<tr>
<td>3:30</td>
<td>Regulatory &amp; Performance Advances in Complex Inorganic Colored Pigments</td>
</tr>
<tr>
<td>4:00</td>
<td>Re-evaluation of Effect Pigments Processing Concerns</td>
</tr>
<tr>
<td>4:30</td>
<td>Survey Raffle</td>
</tr>
<tr>
<td>5:00</td>
<td>Conference Ends</td>
</tr>
</tbody>
</table>

**SPE CAD NEWS, Summer 2011**

www.specad.org
TECHNICAL ARTICLE- INTRODUCTION

The following paper, written by Jim Rediske, won the best paper award for the CAD RETEC® held in Savannah, Georgia. Jim has presented several papers at CAD RETEC’s through the years and is very deserving of this award. It is a fine example of the high quality of papers that are typically presented. We are anticipating that many more excellent papers will be presented at this year’s RETEC® in Chicago. Check out the details in this newsletter and be sure to attend.

Jamie Przybylski
CAD Editor

PIGMENT PERFORMANCE AS A FUNCTION OF PHYSICAL PARAMETERS AND RESIN SELECTION

By: James Rediske, LANXESS

INTRODUCTION:

As we develop as “Color Professionals” we all at one time or another have learned the lesson that not every colorant behaves the same way in every resin system. Unfortunately we usually discover this the first time after providing a customer a test formulation for evaluation. We put together a very nice color match, using our own in house screening polymer, and the customer screened it in his in house screening polymer. Unfortunately they are two different polymers. Or perhaps the customer has registered a complaint about product performance suggesting that your material is off specification. You insist that the sample that he has returned is spot on in your test in flexible PVC. Unfortunately the customer is making nylon fibers and is testing in nylon. In both cases, no one has done anything wrong other than to fail to consider that colorants may behave differently in different resins, and probably for a variety of reasons. This paper makes an effort to look at some popular colorant families in relation to several different resin families. Our goal is to identify predictability of performance. Or at the very least improve our understanding of the parameters to be aware of in our product selection.

SAMPLE SELECTION:

The first order of business is to identify a standard color and resin system for comparison. Based on experience it was decided to use fPVC (flexible polyvinyl chloride) as the control resin and a spherical red iron oxide as the control pigment. Experience demonstrates that fPVC is an effective screening resin when evaluating colorants for the sake of color alone. The red oxide at about 200nm diameter is chemically stable, easy to disperse and specifically not soluble in any of the systems to be explored. The only concern with the fPVC system is that dyes will tend to be soluble in the plasticizing component. The only concern with the fPVC system is that dyes will tend to be soluble in the plasticizing component. However practical experience indicates that for short term screening, color development of dyes in fPVC is acceptable.

The next question is what resin systems to investigate. After consideration it was decided that in addition to fPVC, that GPPS (general purpose polystyrene), PC (polycarbonate), and PA (polyamide) would be examined. The structures of these resins are shown in Figure 1. (Note that for proprietary reasons, the PA structure shown is for PA 6,6.)

continued on page 11
Finally it was decided to examine yellow, red, and magenta pigments that were easily available. It was also decided to include solvent dyes that offered similar color to the pigments with, if possible, structural similarities.

The tested red iron oxide, PR101, is a spherical particle manufactured by the aniline process. It has a diameter of about 200nm and offers easy dispersion, good opacity and hiding characteristics. This pigment was chosen as control specifically.

The point of this is that it is anticipated that much of the unusual visual performance that is observed may be related to the relative solubility of the pigments in the polymers of interest. The selected colorants are PR149, PY147, PR122, SR179, SV59, SV93, and of course the control PR101. The colorants selected are shown in the figures below as they are discussed.

**TABLE 1 CONTRAST RATIO**

<table>
<thead>
<tr>
<th></th>
<th>POLYSTYRENE</th>
<th>POLYCARBONATE</th>
<th>POLYAMIDE</th>
<th>T-POLYVINYL-CHLORIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear, no color</td>
<td>0.4526</td>
<td>0.4544</td>
<td>0.4337</td>
<td>0.4374</td>
</tr>
<tr>
<td>PR101 0.01%</td>
<td>0.5733</td>
<td>0.6053</td>
<td>0.4616</td>
<td>0.4696</td>
</tr>
<tr>
<td>PR101 0.1%</td>
<td>0.9821</td>
<td>0.9922</td>
<td>0.7434</td>
<td>0.9991</td>
</tr>
<tr>
<td>PR101 1.0%</td>
<td>1</td>
<td>1</td>
<td>0.7307</td>
<td></td>
</tr>
<tr>
<td>PR149 0.01%</td>
<td>0.5675</td>
<td>0.5984</td>
<td>0.6579</td>
<td>0.4603</td>
</tr>
<tr>
<td>PR149 0.1%</td>
<td>0.7267</td>
<td>0.8026</td>
<td>0.8857</td>
<td>0.6023</td>
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<td>PR149 1.0%</td>
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<tr>
<td>SR179 0.005%</td>
<td>0.5177</td>
<td>0.5715</td>
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<td>SR179 0.05%</td>
<td>0.5936</td>
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<td>SR179 0.1%</td>
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<tr>
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<td>0.5555</td>
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Observer, D-65 Illuminant, Spectral Component Included, large area view. Readings were taken in transmission and reflectance. Reflectance was measured over a white and a black tile. The contrast ratio (Cr) was determined using the L* value determined above when the chip was read over a white and then a black tile. The L* of the black tile is divided by the L* of the white tile. This value provides the Cr.

**RESULTS:**

Because in this forum our interest rests with the colorants, the data will be evaluated from the view of the individual colorants, how they perform in the individual resin systems, and how they relate to each other. The data when taken in aggregate provides an interesting picture. All of the samples were consistent and unchanged throughout the experiment. It is therefore possible to suggest that the data and observed behavior is a result of the inter-action of the colorants with the various polymers.

The Cr data can be found in Table 1. The various polymer structures can be found in Figures 1-4 (see page 10). The colorant chemical structures can be found with their respective discussions. The reflectance curves of interest can be found in Figures 5-9 (see pages 12 & 13).

**CONTROL:**

The tested red iron oxide, PR101, is a spherical particle manufactured by the aniline process. It has a diameter of about 200nm and offers easy dispersion, good opacity and hiding characteristics. This pigment was chosen as control specifically.

**SAMPLE PREPARATION:**

Pigment samples were compounded as single pigment dispersions at the desired loadings of 0.01%, 0.1%, and 1% by weight. Dispersion was accomplished making one pass through a Leistritz twin screw extruder. Samples in fPVC were prepared on a two roll mill at the same loadings using a hot mill - cold mill approach. Dyes were prepared at loadings approximately one order of magnitude lower by weight. This varied also based on polymer and relative strength intensity of the dye in polymer. Generally speaking the dyes were examined at 0.01%, 0.05%, and 0.1% by weight. In one instance in PA the SV59 was evaluated at 0.005% as a minimum. The dyes were prepared in fPVC using the same two roll mill approach as the pigments. However in the other resin systems the dyes were prepared using a simple “shake and bake” technique. In all instances of hydroscopic resins, the resins were dried prior to compounding and again prior to injection molding.

**Experimental:**

The fPVC samples were compression molded to approximately 25 mils thickness. All other samples were injection molded to approximately 125 mils, 1/8th inch. Color measurements were made on a Macbeth ColorEye 7000A configured in CIELab*, 10 deg.
because it would not dissolve. Comparison of the Cr, Table 1, of the PR101 to any of the other colorants evaluated shows very high values even at loadings as low as 0.1%. Even at 0.01% loading in the PS and PC chips the Cr = 0.6 units, and the sample chips are visually cloudy or translucent as a result of the PR101. Only in the fPVC does the PR101 display a low Cr and transparency however this is attributed directly to the very thin layer that is evaluated at a low loading. This simply results in a small relative particle population.

It is interesting to review the reflectance curves shown in Figures 5-7 (see right). It is immediately clear that iron oxide even at low loadings has a small but identifiable impact. This is seen in the difference in reflectance when measured over white and black tiles. Of equal value is the high level of opacity that is demonstrated in the nearly identical reflectance curves of the red oxide when the loading exceeds 0.1%. To most intents and purposes the color is subsequently the same regardless of loading or substrate.

MAGENTA:
For this first evaluation a PR122 and a SV59 were selected. The structures are shown below. In the comparison of these two colorants the structural similarities are quickly apparent based on the backbone alone. The PR122 is clearly symmetric in effectively every axis. While there are functional sites that might be expected to offer a polar moment, they are offset by an equivalent site directly opposite. For this reason, the PR122 would not be expected to have any polar dipole moment. By comparison, the SV59 is not symmetric and with the amine and phenoxy groups all on the same side of the two carbonyl groups, it seems that a dipole moment could exist in this molecule. Using the old axiom that, “like dissolves like”, it might therefore be expected that the PR122 would exhibit little or no solubility in any of the resins tested. The SV59 however would be expected to be soluble.

A visual and instrumental evaluation of these two products provides no surprises. A comparison of the contrast ratios of the two products suggests that the PR122 is less transparent at equivalent loadings. The PR122 with a Cr = 0.85 at 0.1% suggests more scatter and opacity than does the SV59 at Cr = 0.76 at the same loading. This of course varies with resin but is directionally consistent throughout.

A review of the reflectance curves of the PR122 in relation to the SV59, Figures 11-13 (see next page), shows very similar shaped curves in the same general color space. Comparison between over white/over black curves particularly at higher loadings shows the greater opacity of the PR122.

Based on this discussion and the suggested lack of a dipole moment in the PR122 it is possible to suggest that the PR122 has little or no solubility in the polymers investigated and therefore there is no observed difference in color performance attributed to performance in the polymer.

YELLOW:
For this comparison a PY147 and a SY93 were selected. (See right) Again a review of the structure of these two products suggests that there may be a polar moment to the PY147. This product is known to be soluble to some extent in polar polymers, particularly PET. The SY93 is also of a nature as to suggest a small polar moment. This could perhaps help to explain the relatively good solubility that this dye demonstrates.

continued from page 11

continued on page 13
As with the PR122 and SV59, neither of these products initially shows any performance different from what might be normally anticipated. However on closer inspection of the Cr in various resins, it might be suggested that the PY147 exhibits a greater level of solubility than might be expected. In the PS and PVF2 tests, the PY147 was compounded, in the PC and PA tests a simple shake and bake mixture was taken directly to the injection molder. This approach still resulted in low Cr (0.46 in PC and PS, 0.55 in PA) values for the PY147 even at loadings as high as 0.1%. This is consistent with the SY93 that provided a Cr ≤ 0.46 across all resins. Above 0.1% loading, the PY147 continues to provide a lower Cr, however the sample chips become visually translucent with un-dispersed pigment clearly present.

A review of the reflectance curves, Figures 14-16 (see next page), supports the high degree of transparency of the PY147. This is clearly demonstrated in comparing the reflectance of white versus black. However the decrease in transparency is also demonstrated at concentration increases. This relative solubility is seemingly confirmed when compared to the SY93 where transparency is unquestionable.

Taking the above discussion into account is seems reasonable to suggest that the PY147 demonstrates uncharacteristic pigment behavior by offering a high degree of solubility in a variety of polymers. Is it therefore accurate to characterize this as a pigment, should it be considered a dye with low solubility limits?

RED:
This evaluation provides us with our most interesting comparison of variable performance. The red colorants selected are PR149 and SR179. The structure of the selected colorants is shown below.

While it may not be immediately apparent, there is a small structural similarity between the two products. The PR149 is symmetric, but with slightly electronegative species at both ends. It would not be expected to have a large dipole moment as a molecule, but might have a relatively small electronegative character at each end. By comparison, the SR179 is smaller and relatively symmetric around the N and O bonds. The electronegative components are central to the smaller structure. Therefore it seems unlikely that the SR179 will have any polar characteristic. This discussion is important when the behavior of the PR149 is considered.

In evaluating the PR149 in the PC and in the PA resin systems it is found to provide a fluorescent orange color at very low loadings of 0.01% by weight. This is also observed in the PC instrumental data showing a clear peak in reflectance at about 580 nm wavelength where %R > 100%. Increasing the loading to 0.1% still shows some visual fluorescence but the instrumental data no longer exceeds 100%. This suggests that there is sufficient particulate material present to almost completely quench the fluorescence. The PA reflectance curve does not exceed 100% however the fluorescence is visually apparent. When the loading reaches 1%, both the PC and PA are effectively opaque and there is no visual or instrumental evidence of fluorescence. The development of opacity at levels as low as 0.1% by weight is supported by evaluating the contrast ratios, approaching values of almost 0.9 in both resins. In PS and PVF2 the PR149 offers similar behavior in opacity however there is no fluorescence observed and the color is always red.
By comparison, the SR179 acts only as a dye at the concentrations examined, appearing to offer 100% solubility. Making use again of the contrast ratio it is observed that the SR179 at a loading of 0.1% has a ratio of only 0.65 in the PA compared to 0.88 for the PR149. The same comparison in PS yields 0.62 and 0.72 respectively, again showing a higher level of opacity for the PR149. This demonstrates the higher level of opacity of the pigment compared to the relative transparency of the dye at equivalent loadings. The performance of the dye is uniform regardless of the resin system.

It is also informative to compare the reflectance curves, Figures 8-10, of the dye and pigment simply for the sake of color comparison. It becomes quickly apparent that opportunities exist for the dye to provide the same general color space as the pigment, frequently at a loading level one order of magnitude lower. While an exact match is not available, it is clear that the colors may be close enough to allow interchangeability in multi-component blends.

continued on page 15
Finally using the old axiom that “like dissolves like”, it is then suggested that the polar nature of the PC and PA resins is resulting in a low level of solubility of the PR149. And that once solubilized, now acting as a dye, the manner in which the PR149 behaves relative to the incident light has changed. The pigment effectively becomes a fluorescent dye.

CONCLUSIONS:

We have evaluated four pigments and three dyes. We have been able to suggest that like the dyes, at least two of the pigments demonstrate solubility in one or more of the resins. In one instance with the PR149, a change of color is observed, acting more like a fluorescent dye than a pigment. These changes in behavior appear to be associated with the chemical structures of the pigments and the polymers in question. It therefore seems possible to suggest the following conclusions;

1) Use of the contrast ratio in combination with reflectance curves and visual observation provide useful tools in trying to understand unexpected performance.

2) Evaluation of the chemical structure of the colorant and resin system with regard to active sites and relative polarity may be similarly useful.

3) The axiom of “like dissolves like” may be relevant when evaluating the behavior of a pigment in various polymer systems.

4) Products that seem to have a dipole moment or offer polar characteristics may be more susceptible to unexpected performance.

5) Even low levels of solubility may be sufficient to result in unexpected color performance.

6) It may be possible by using the above tools to predict or at least suspect unusual product performance in different resins.

It is suggested that future work may involve a reversal of this approach to take a colorant species and using the above tools attempt to predict what if any unexpected performance might be experienced.
COLOR MISCHIEF #4

SHORT-SIGHTED?

When customers shop for an expensive item, they are concerned about price and quality. Color and appearance are the first indicators that the item they're considering is well made. Therefore, producers of plastic containing items make special efforts to assure that the molding compound they purchase is consistent lot to lot. They require color measurement data and have quality control staffs that compare certification chips to their color standards.

Efforts to "right size" staffing levels at some companies has on a number of occasions resulted in assigning the job of making the visual inspection to someone who has never been tested to determine if they have normal color vision. There have been occasions where this oversight has caused considerable delay and cost to the company, in addition to making life difficult for the supplier.

Also, just because the staff was tested isn't quite enough. If the testing was done improperly or the staff haven't been trained on how to properly describe what they saw, the results could be inaccurate. One example, for instance, was a case where the Farnsworth Munsell 100 Hue vision test was done under Cool White Fluorescent illumination. The instructions for the Farnsworth Munsell 100 Hue test clearly instruct the lighting for the test should be done using only Illuminant C. There is more to this story! Some people have taken the 100 Hue test under incandescent, warm white fluorescent, halogen lighting, and light emitting diodes (LEDs). LEDs are particularly objectionable since the light emitted from individual lamp(s) most likely will emit a slightly different spectrum than the spectrum emitted from any other LED's. Why is this important? The cap like color chips viewed during the 100 Hue Test are very carefully calibrated from one another to detect detrimental vision issues of the participant(s). Uncontrolled lighting may affect the test results in unanticipated ways.

Many 100 Hue Test monitors/givers manually calculate the test taker’s score. Big mistake! Manually calculating the 100 Hue Test scores, in almost every case, leads to scoring calculation errors. These calculation errors may favor or punish the test taker. The calculation of 100 Hue Tests should always, always be calculated using the 100 Hue Test software. Hope this provides some thoughts on how to correctly judge potential candidates for positions where visually judging colors is critical.

Till next time. Look for "Color Mischief" in the next issue of the CAD Newsletter.

As usual, this article is submitted anonymously to protect/hide the guilty!

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The Color and Appearance Division (CAD) is committed to the publishing of at least three newsletters a year (four, if there is sufficient material to justify the extra issue). To that end, we would like you to think about the financial side of sponsorship of the newsletter. For the small donation of $300 per year, we offer a business card sized (2 x 3.5 inches) mention in our newsletter, which goes out to the nearly 1,500 members of the CAD as well as other SPE division members. These are people active in every aspect of plastic coloring and additive technology. Larger sized spots are available at a commensurate increase in rate.

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