Dear SPE Color and Appearance Division Members,

It is fitting for me to write my first chairperson’s message after enjoying the 4th of July holiday weekend with my family because our CAD organization is described by many - especially newcomers to our group – as a family. Think back - How did you become a member of CAD? What is the main reason you are reading this newsletter? Most likely it came about from attending a CAD RETEC®. When I was given the opportunity to work in the plastics industry fifteen years ago - I attended my first CAD RETEC®, and joined SPE as a member of the CAD. At that time, most of the people in attendance were just faces to me – but I remember being welcomed into this group by individuals who were willing to answer questions, offer support, and provide guidance as my career in the plastics industry evolved.

One such person was Terry Golding whom in 2007 lost his battle with cancer. Shortly after, CAD renamed its Outstanding Achievement Award to the Terry Golding Outstanding Achievement Award. Terry’s smile along with his firm handshake welcomed me that first CAD RETEC®. He is one of the people I consulted with about running for the Board of Director’s a few years later. Johnny Suthers, who retired in 2011 from Eastman Chemical, welcomed me that first CAD RETEC® as well. Upon being elected to the Board of Directors, Johnny became my official mentor and enabled me to grow into the various roles within CAD. I would like to thank Johnny for his service to CAD (he served out his last term this past Spring) and for being a good mentor as he continues to enjoy his new life in retirement. These are just two of the many individuals that made me want to be a part of CAD – Who inspired you?

So when is this next “family reunion”? Please mark your calendars and plan to attend this year’s CAD RETEC® on September 22 – 24 at the Baltimore Marriott Waterfront. Tom Rachal (Tronox) and Steve Esker (Paramount) are the co-chairs for the conference while Paul Bykowski (GB Consulting) and Brenda Mullins (Clariant Corporation) are technical program co-chairpersons. Please check out our website – www.specad.org for more details. I look forward to seeing you there!

The CAD Summer Board of Directors meeting was held this month (Aug.) in Indianapolis – a potential site of a future CAD RETEC®. At that time, we welcomed two new members to our Board – Nathan Karszes
Chairman’s Message (continued)

(Nubiola) and Jim Rediske (LanXess) and we look forward to their future contributions during their upcoming terms.

Finally time to say thank you to:
SCOTT HEITZMAN (Sun Chemical) for being the chairperson of CAD’s 2013 ANTEC® technical program. The program was well received and we appreciate his efforts!
SANDY DAVIS (DuPont) for being CAD’s overall RETEC® Technical Program committee chairperson for many years. Sandy has been a good advisor and resource throughout her time as the TPC plus most recently chaired the 50th anniversary CAD RETEC® in Louisville. Sandy continues in her Councilor role. We are grateful for her dedication to CAD!
JIM FIGANIAK for his service this past year as Chairperson of our Board of Directors. Jim provided excellent leadership during his tenure with successful ANTEC®/RETEC® programs. CAD was awarded both the SPE Gold Pinnacle Award and SPE Communications Excellence Award as well.

On a personal note, as Jim was the person preceding me through the executive committee chairs, his help has been invaluable. Jim will continue to serve our Board as the Past-chair and was also appointed to be the CAD RETEC® Technical Program Chair. Thanks Jim for your continued service!

My extended family wrapped up our vacation week by writing predictions of where the six grandchildren will be ten years from now along with overall predictions of what the world will be like then too and placed them into a time capsule. Our Board needs your help as we plan for the years to come. Please consider what your role could be throughout the next years to contribute to the continued success of CAD – our CAD family needs you!

Best Regards,

Ann Smeltzer
CAD Chairperson

Councilor’s Report

The Council meetings at ANTEC® were held on April 21, 2013 in Cincinnati, OH. Two meetings were held, the morning meeting being the completion of the 2012/2013 Council year and the afternoon meeting was the first meeting of the 2013/2014 year.

The biggest news at the ANTEC® Council meetings is the planned implementation of upgrades to the association management software used by SPE to drive the website and many of the member services, including member renewal. The long-planned upgrade is scheduled to take place at the end of May (the implementation has been completed on time). The upgrade will improve the experience of members and non-members as they join the society.

Membership in SPE continues to hover near between 14,500 and 15,000 with more than 75% of the members located in the United States. The implementation of the software upgrade will make it easier for people to join the society. The membership marketing strategy is changing with less emphasis on the direct mail campaigns and more on providing value through the internet.

Financially, the society finished 2012 with ~ $97,000 surplus based on the adjusted budget. The budget numbers were revised in June 2012 based on lower than expected income during 1H12.

The next Council meeting will be November 16, 2013 in San Diego, CA.

Respectfully submitted,
Sandra Davis
CAD Councilor

Your Company, Our Division

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”) 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.

If you are interested in helping to sponsor the SPE/CAD Newsletter please contact:
Scott Aumann, Phone: 912 210 0175
Email: Scott.Aumann@merckgroup.com.
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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 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:

(2) 2 x 3.5 inch or (1) 4 x 3.5 inch

If interested in learning more, please contact:
SCOTT AUMANN Phone: 912.210.0175
Email: Scott.Aumann@merkgroup.com

SPE CAD NEWS, Summer 2013

www.specad.org
SPE President John Raztlaff (Video Link Info)

John Raztlaff, the SPE’s Current president has produced a video for the membership. If you have not seen it, click on the following link to watch it: http://www.4spe.org/announcements/spe-presidents-video-jon-ratzlaff-2013-2014-spe-president

SPE Color & Appearance Division Mission Statement

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.

Introduction to the CAD RETEC® Conference

The 51st Annual Society of Plastics Engineers Color and Appearance Division CAD RETEC® is quickly approaching. Baltimore’s beautiful Inner Harbor District serves as an excellent setting for the theme of this year’s CAD RETEC®.

CAD RETEC® is the largest technical conference hosted in North America that is specifically dedicated to the color and appearance of plastics.

With attendees from all corners of the earth and from all areas of expertise within the plastics industries, myriad opportunities are available for professional networking. We’ll kick off CAD RETEC® with Bob Charvat’s day-long “Coloring of Plastics” tutorial scheduled for Sunday, September 22 (separate registration required). Say hello to old and new friends at our Sunday evening opening reception. Monday afternoon, tune in to the New Technology Forum, which allows exhibitors to showcase their companies and their products or services, followed by a networking reception to be held in the tabletop area. Throughout the conference listen to industry experts explain the latest innovations and developments related to the color and appearance of plastics. And be sure to stick around for a fabulous array of door prizes to be raffled off immediately after the last paper.

Tom Rachal
Conference Chair
2013 SPE CAD RETEC®

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 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:
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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Please visit the websites of the sponsors listed in this newsletter by clicking on web address included in their sponsorship space.

Thank you!
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 CAD 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 CAD RETEC® starts. This usually is a Sunday with the CAD 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 PERSONNEL 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 position
- 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?
- What is appearance? (It’s not the same as color)
- What is “Color is a matter of 3”?
- A discussion of additive and subtractive
- A brief description of how some colorants are made
- A discussion of lighting when viewing samples including LED’s
- Ever hear of ROy G. BIV?
- A discussion of the “CIE” and “L,a,b, system
- What constitutes a “sample”
- Colorant classes
- Definitions and understanding organic, inorganic, soluble dye and effect colorants and their properties
- A discussion of pigment physical properties and how they may affect products
- A discussion of important colorant terminology
- Colorant selection information
- Colorant incorporation and dispersion issues
- Discuss issues developed by attendees

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 22, 2013 at the Marriott Waterfront in Baltimore. Your presenter will be Bob Charvat.

To register for the tutorial, go to: http://www.specad.org/index.php?navid=110
Mountain Branch is the golf facility that delivers a complete golf experience: a challenging and satisfying design on a beautifully conditioned 18-hole golf course with engaging architecture featuring split fairways, rolling greens, rock and water features and breathtaking views, all the elements come together for an unforgettable day of golf.

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Tee times will begin at 11:00 am  
Registration: 45 minutes before tee time  
Includes:  
- Warm ups on the Range  
- Green Fees  
- Cart Fee  
- Scramble format Awards (hole prizes)  
- Box Lunch

Awards will be presented at the CAD RETEC® Welcoming Reception.

*(Lunch will be provided before teeing off)*

For More information contact:  
Mark Tyler, 859-372-3221  
mark.tyler@xxxticona.com  
or  
Mark Freshwater, 330-526-8833  
mark@xxxpigments.com  
remove xxx in email address if emailing
Fun Run/Walk to benefit Habitat for Humanity

Contact Noella MacLean, Dominion Color
noella_maclean@xxxdomcol.com
(remove xxx before emailing)

Fee: $20, register separately for this event.
Fee includes a t-shirt.

Your $20 donation will be matched by SPECAD.

Start your Tuesday morning off right. Join us for a fun walk/run around downtown Louisville. You’ll be back in time to catch the first paper.
7:00am - Meet in Marriott Lobby

Walk Route will be shorter than the Run Route.
Sponsored by: Dominion Colour

CAD RETEC® Exhibitor Space
Marriott
CAD RETEC® 2013 EXHIBITORS
as of 8/19/2013

Tabletop Exhibit Space is available to showcase your company. Space is limited, so reserve early. Each Exhibit includes 2 paid conference registrations. Inquire as to availability. A networking reception will be held in the exhibit area on Monday evening.

For reservations contact:
Brian West 865-457-6700
or fax your request to him at FAX: 865-457-3012.
Reference: 2013 CAD RETEC®

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On-Line Plastics and Coloring of Plastics at Terra State Community College

A very distinctive feature of the Terra plastics program is its ability to provide “distance learning” (online) courses to students who may reside too far from the Fremont, Ohio campus to participate in full time day or evening classroom activities. This distance learning program has successfully served students globally, as well as locally, for several years.

We all know people within the industry (technicians, sales staff, new hires, etc.) that have no color education to speak of. One aspect of Terra’s program that can benefit many of the newer, or under-educated, members of our industry is this internet based, three course certificate program. It is a relatively low cost, no travel, flexible program that the employee can complete anywhere, on their schedule. The three courses provide solid background knowledge for anyone working in the many segments of the coloring of plastics industry. The three courses are:

- **Introduction to Color**
  - Introductory course on color theory
  - Basic background knowledge for anyone working with color

- **Colorants for Plastics**
  - The study of colorant types and their incorporation into polymer materials
  - More in depth treatment than in Intro Class

- **Introduction to Plastics**
  - Introductory course on plastics
  - Polymer types, properties and processing

Courses are an excellent opportunity for newer color matchers, quality control technicians, production technicians, and others to learn more about the coloring of plastics. These courses are also good for people with industry experience, since many of them have learned on-the-job. This is a good opportunity for them to learn the theory behind what they do every day. Students completing this certificate can expect benefits including:

- Quicker color matches
- Better understanding of pigments and their use
- Prevention color problems
- Solve color problems quicker
- Quicker batch corrections in production
- Better understanding of color at processors
- Cost savings

For more information, contact Jamie Przybylski, Program Professor at 419.559.2459 or toll free 866.AT.TERRA, ext. 2459 or email jprzybylski@terra.edu

### Distance Learning Courses Offered

**Section VI  PET 1100 Introduction to Plastics** (3 Credits)
- Fees: $450 Ohio students/$700 out-of-state
- Books: Approximately $200
- Offered Fall 21013 (August 19 – December 13)
- Offered Spring 2014 (January 13 – May 8)

**Section VI  PET 1240 Introduction to Color** (3 Credits)
- Fees: $450 Ohio students/$700 out-of-state
- Books: Approximately $200
- Offered Fall 21013 (August 19 – December 13)
- Offered Spring 2014 (January 13 – May 8)

**Section VI  PET 2320 Colorants for Plastics** (4 Credits)
- Fees: $600 Ohio students/$900 out-of-state
- Books: Approximately $150
- Offered Spring 2014 (January 13 – May 8)
CAD RETEC® PRELIMINARY SCHEDULE & TECHNICAL PROGRAM

(SUBJECT TO CHANGE – CHECK WEBSITE FOR CURRENT DETAILS)

SUNDAY, SEPTEMBER 22

PRE-CONFERENCE SEMINAR: 8:30am – 5:00pm
Coloring of Plastics with Bob Charvat (Separate Registration required)

GOLF OUTING 10:00am – 3:00pm  (Pre-register for this event)
MOUNTAIN BRANCH GOLF CLUB
10:00am – Registration at course
11:30am – Tee Times begin with 9-12 minute interval tee offset, 4 person scramble format
$100 Fee (see page 8 for details). Golf Outing Prizes will be presented at the Welcome Reception.

MONDAY, SEPTEMBER 23

7:30am  Breakfast  Sponsor: Lansco Colors
7:30  Registration desk opens
8:15  Introduction & Welcome by Tom Rachal

MORNING SESSION
Moderator: Scott Heitzman, Sun Chemical
8:30  Keynote Address  Human Color Vision  Dr. Jeremy Nathans, Johns Hopkins Medical School
9:30  A Comparison of Dispersion Test Methods for Titanium Dioxide-containing Polyethylene Masterbatch  Sandra Davis, DuPont Titanium Technologies
10:00  Coffee Break  (Exhibits Open)  Sponsor: Clariant
10:30  Colorants and Food Contact Compliance – Where do we stand in 2013  Andreas Wacker, Clariant Corporation BU Pigments
11:00  Unlocking the Mysteries of the Pellet: Deconstruction Color Concentrate  William H. Lashway, Cristal USA
11:30  Regulatory Pressures  Eric Greenberg, Eric F. Greenberg, P.C.
12:00  LUNCH  Sponsor: DuPont Titanium Technologies

AFTERNOON SESSION
Moderator: Cheryl Treat, A Schulman Inc.
1:30  Panel Discussion: Future Trends
3:00  Coffee Break  Sponsor: Shepherd Color
3:30  Benefits of Real-Time Color Measurement in the Melt Stream  Lewis Baylor, Equitech Int'l Corporation
4:00  Discoloration of Plastics and Its Effect on the Color and Appearance of Plastics  Joseph J. Fay, Ph.D., BASF Corporation
4:30  Analysis of Organic Colorants in Plastics  Constantinos Nicolaou, Sun Chemical Corporation
5:00  New Technology Forum  Moderator: Bob Charvat
6:30  Networking Reception  Sponsor: Nubiola

TUESDAY, SEPTEMBER 24

7:00am  5K Fun Run/Walk for Habitat for Humanity Plastics  (Pre-register for this event)  Sponsor: Dominion Colour

MORNING SESSION
Moderator: Betty Puckerin, Ampacet Corporation
8:30  Keynote Address  The Impact of REACH in North America: Perspectives of a Global Supplier  Tad Finegan, BASF Corporation
9:00  Beauty Color Trends 2013/2014  Doreen Becker, A. Schulman, Inc.
9:30  Bring Polymers Into a Brighter Future Using High Performance Additives  Emilie Meddah, Clariant Corporation BU Additives
10:00  Break
10:30  The Role of Titanium Dioxide in Masterbatch Optimization  J.D. Connolly, Jr., Ph.D., DuPont Titanium Technologies
11:00  Black Rainbow: Different Material Strategies for Making IR Reflective Material  Mark Ryan, The Shepherd Color Co.
11:30  The Physical Properties of Synthetic Iron Oxide Pigment and How They Relate to Performance in Thermoplastic  Todd McHenry, LanXess Corporation
12:00  Awards Luncheon  Sponsor: Tronox

AFTERNOON SESSION
Moderator - Mark Freshwater, Lansco Colors
1:30  Fifty Shades of . . . Black  Thomas Chirayil, BASF Corporation
2:00  Cost and Performance Optimization of PVC Profile Formulations  Neil Macdonald, F-P Pigments Inc.
2:30  Break
3:00  Commercial Purge Compound Use Improves Color Change Efficiency  Graziano Pessarino, Moulds Plus International USA
3:30  Feed Enhancement Technology for Low Bulk Density Material  Paul G. Anderson, Moulds Plus International USA
4:00  Closing Remarks
Raffle- Grand Prize-Apple iPad mini (must be present to win)
REGISTRATION FEES: ON-LINE REGISTRATION
Available until Sept 18, After that, register On-site.

<table>
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<th>Advance (by 8/23)</th>
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*Each registration includes One Conference CD or flash drive containing all papers

EVENTS REGISTRATION
- Golf Outing *(Sunday)*: $100
- Welcome Reception *(Sunday)*: Included *(RSVP when you register)*
- Networking Reception *(Monday)*: Included *(RSVP when you register)*
- 5K Fun Run/ Walk *(Tuesday)*: $20
- Awards Lunch *(Tuesday)*: Included *(RSVP when you register)*

EXTRA CONFERENCE LITERATURE
- Extra Conference CD: $115
- SPE CAD Archive DVD- searchable compilation of conference papers from 1961-2007 *($25 discount for CAD RETEC® attendees)*: $175

EXHIBITORS AND SPONSORS ONLY
- Exhibit Space *(incl. 2 conference registrations)*: $950 *(by 8/23)*, $1,175 *(subject to availability)*
- Sponsor Donation: Platinum, Gold, and Silver levels available *(Inquire)*
- Pre-Conference Seminar "Coloring of Plastics" *(Registration Deadline-Sept. 1st)*: $490 *(separate registration required)*

OVERFLOW HOTEL
- Start date: 9/22/13
- End date: 9/25/13

*Last day to book by: 8/23/13

Marriott hotel(s) offering your special group rate: Courtyard Baltimore Downtown/Inner Harbor for $199 USD per night.
Book your group rate: CAD RETEC® 2013
Click here to book at Inner Harbor
Color Mischief #9

OPTICAL BRIGHTENERS, THE GOOD THE BAD AND THE AWFUL

What are Optical Brighteners? Optical Brighteners (OB) may also be known as Fluorescent Whitener Additives (FWA). All are actually broad spectrum fluorescent dyes. How do they work? Ultra Violet (UV) energy, humans cannot see, electro-chemically excites an OB molecule which then gives back a small portion as heat and the remainder as lots of lower energy light, usually blue we can see.

When a polymer reactor starts up, it normally makes nice clean transparent or white product. The longer the process runs, heat and catalysts start turning the product yellow. At some point the reactor must be shut down, cleaned and new catalyst added. This adds cost and reduces output. In comes the idea “the run can be extended by adding OB”. OB is relatively inexpensive and makes the product look nice and white so there can be longer runs between shut downs! This action results in an uncontrolled colored product batch to batch.

Consider the young engineer wearing a suit and tie coming and asking “do we have any OB?” Sure, in the lab. He picked up a jar of OB and headed to the walk-in light booth. He opened the jar and was puzzled because in its concentrated form under incandescent lighting OB looks pale yellow. When the fluorescent light was turned on the OB looked bright white. All excited he started to leave when the visible lights were turned off and just the UV light was left on. In the dark the OB covered his clothing, the table, the floor, his hands and even his nose. “This mess just created needs to be cleaned up!” I’ll bet this has happened many times over the years.

OB works great when making white products, especially if the base polymer turns yellowish during additional processing. A small amount of OB can make whites appear a clean blue white.

Want to make a bright red really pop? An inexperienced matcher will add some OB. However, adding OB to a deep red is like adding a white pigment! To punch up the red, add a small amount of a red fluorescent dye.

Another hidden issue may further bamboozle a color matcher. Some organic pigments exhibit a small amount of fluorescence when exposed to UV light, which normally goes undetected. This can confuse visual and measurement options. How about inorganic pigments? Some may phosphoresce, but that a story for another time.

This may be a good time to bring up the fact that fluorescence and phosphorescence are not the same phenomena. This subject may be addressed in future articles.

Trouble comes when there are two or more polymer suppliers provide materials that are supposed to be interchangeable! What if one uses OB and the other does not. Now when suppliers are changed, the material is off color!

Another troubling issue is instrumental color measurement. OB makes a tremendous difference in the comparison if the standard has no OB and the sample has OB or vice-versa. This problem may also come up if ordinary pigments that fluoresce slightly are present. Even if both standard and sample contain OB, measurement is an additional problem depending on whether the measurement instrument is set for UV included or UV is excluded.

Finally, one more thought that maybe an additional complication to all of the above. The UV component of light sources can vary substantially. It is well known that and incandescent light source is lacking in any UV component. Fluorescent sources have a well known and documented UV component. The up and coming Light Emitting Diode (LED) sources vary all over the place when it comes to the UV and visible component. In fact, most white emitting LED’s on the market today are made with a combination of visible blue/UV radiation. The UV excites a yellowish fluorescent inorganic material along with its visible blue component the result is observed as a white light. A companion issue today is the LED visible and UV components are not fully standardized which suggests the output of these LED sources vary unpredictably lamp to lamp.

The above should start some thinking about the subject your Anonymous Color Mischief author has chosen this time. As usual your Color Mischief author will remain hidden from criticism and other recriminations. If any have comments on articles so far and/or suggestions for future Color Mischief presentations please e-mail your thoughts to the CAD Newsletter Editor who will transmit them to my securely hidden location.

LOOK FORWARD TO MORE “COLOR MISCHIEF” ARTICLES IN FUTURE ISSUES!
Introduction

There has been a considerable amount of information published of late on the subject of “Halogen Free” plastic articles. This has driven recent demand for answers to questions about “Halogen Free” pigments. I have personally taken dozens of calls that start with the question, “do you have any halogen free pigments?” Turnabout is fair play, so my canned response was, “what is your definition of Halogen Free?” As you could imagine this was not the most efficient route to getting our customers, suppliers, brand owners the information they need. I am happy to report Mike and the Sun Chemical team changed my SOP (standard operating procedure). The following paper presented at the 2013 Cincinnati SPE ANTEC® provides all the information needed to start, organize and conclude (most of the time) a conversation surrounding pigment selection.

Enjoy! If you have questions or need more information, feel free to utilize the references for the paper provided below or reach out to one of the many suppliers of colorants. Find links and contacts for many resources at www.specad.org.

Abstract

Certain organic pigments contain aryl-halides and alkyl halides as part of the chromophore structure and in some cases unintentional halogenated byproducts from the manufacturing process. Halogenated compounds can be sources for persistent and bioaccumulative dioxins depending on end-of-life cycle processing and are the subject of certain electronic industry standards. Requests for non-halogenated pigments are also trending in the pigments industry. CI or CAS chemical structures provide an expedient way to determine if an organic pigment contains halogen atoms. Analytical testing is required to parenthetically characterize any organic pigment as halogen-free in accordance with established electronic industry standards. This paper does not provide any original work or experimental findings but is rather intended to provide the reader considerations for organic pigments in view of industry initiatives and legislation aimed at protecting the environment.

Background

Halogenated compounds are used in many consumer products such as electronics for purposes as flame retardants. Inevitably the consumer product finds its way into landfills, incinerators or other end-of-life cycle demise. At this stage halogenated compounds pose the greatest risk in forming dioxins, classified as hazardous pollutants to human health and the environment [1]. Selecting non-halogenated raw materials provides an obvious means to eliminate or reduce the source of halogenated compounds from becoming a component in any formulation. Included in this raw material selection are organic pigments.

Halogen atoms (fluorine, chlorine, bromine, or iodine) are electronegative atoms [2]. Of these four atoms, chlorine and bromine have a higher propensity in organic pigments. When covalently bonded to an aromatic ring(s) of the chromophore (aryl-halide), chlorine and bromine atoms are auxochromes. Auxochromes affect the conjugated pi-pi electron system through resonance allowing for a bathochromic shift thus intensifying absorption [3]. Other reported beneficial properties of halogens in organic pigments are increased fastness (heat, light, and solvent). This is generally accepted due to increased molecular weight and lowered reactivity through electron affinity [4], thus providing the purpose for producing halogenated pigments.

Pigment synthesis is carried out in a variety of solvent systems (water, hydrocarbon, halogenated organic, eutectic) depending on the pigment type [5]. Some pigments are prone to inadvertent halogenation during the manufacturing process and/or the formation of halogenated byproducts not intended to provide beneficial characteristics [6]. Detailed manufacturing schemes are beyond the scope of this paper. The point being, inadvertent halogenation and/or halogenated compounds might be present in a non-halogenated organic pigment. Other possible sources may occur during the finishing steps (isolation, drying and grinding) which would be considered inadvertent contamination from common equipment usage. For these reasons, analytical testing is considered necessary to determine total halogen content beyond a chemical structure review.

continued on page 16
CI and CAS Numbers

Colour Index (C.I.) and/or Chemical Abstracts Numbers (CAS) are reputable ways to begin your search [7,8]. In general, one specific identifying C.I. number and CAS number is assigned to one specific chemical compound. There are cases where this simplistic model falls short but for the purposes of this paper the unique numbering assignment will be upheld.

The Colour Index (C.I.) provides a generic name for the pigment, for example C.I. Pigment Blue 15:1 (Figure 1). An abbreviated name is commonly used such as PB for pigment blue and PR for pigment red, followed by a number which further identifies the colorants chemistry class such as 15 for phthalocyanine and 57 for lithol. A number extension then provides indication of crystall polymorph or metalizing salt, such as PB15:1 for α-form and PR57:1 for calcium salt. A C.I. Constitution Number is also available such as C.I. 74160 for PB15 and CI 15850 for PR57. The same number extension is added similarly as before in some cases (such as C.I. 15850:1). From these numbers one cannot readily see if a halogen atom is part of the molecular formula. However, one can use these numbers to look up and review the molecular structure. Figures 1 and 2 below, borrowed from the SD&C [9], exemplify this exercise.

A review of the line-bond formulas in figures 1 and 2 show no halogen atoms, therefore, would validate these pigments for analytical testing for actual halogen content.

Figure 1 [9]

Figure 2 [9]

Figure 3 demonstrates a case where halogen atoms are clearly present and would justify elimination from needed analytical testing. Two chlorine atoms are present at the 2 and 9 positions around the polycyclic structure, clearly a halogenated pigment.

Figure 3 [9]

The Chemical Abstracts Numbers (CAS) are also listed in figures 1, 2, and 3. Searching the SD&C data base under the CAS number will lead to the same figures. Table 1 [See page 18] provides a summary of some prominent pigment classes by C.I. and CAS with indication of halogen containing molecular formula.

In some instances a single CI number may represent both a halogenated and non-halogenated pigment. For example, PB15:1’s can be non-, mono- or tetra-chlorinated. Another frequently misleading case is with quinacridones. They are frequently solid solutions or mixed crystals comprising multiple CI numbers. In these cases, the supplier’s listing often lists only the major component. So a solid solution of 55% V-19 (unsubstituted QA) and 45% R-202 (dichlorinated QA) might simply be listed as PV-19. To avoid ambiguity in any case, the pigment manufacturer should be contacted for ensuring the proper pigment is used in accordance with the needed specifications.

Specifications & Standards

There are three prominent “Specifications & Standards” established within the electronics industry.

IEC (International Electrotechnical Commission) IEC 61249-2-21 [10]

900 ppm maximum Cl [chlorine]
900 ppm maximum Br [bromine]
1500 ppm maximum total halogens [Cl+Br]

IPC (Association Connecting Electronics Industries) 4101B has adopted the IEC definition of halogen-free [11]

900 ppm maximum Cl [chlorine]
900 ppm maximum Br [bromine]
1500 ppm maximum total halogens [Cl+Br]

JPCA (Japan Electronics Packaging and Circuits Association) JPCA-ES-01-1999 [12]

Br < 0.09wt% (900ppm) [bromine]
Cl < 0.09wt% (900ppm) [chlorine]

Note: fluorine, iodine, and astatine (other Group VIIA halogens) are not restricted in the industry definition of “halogen-free.”

Applying the above maximum limits for chlorine and bromine contents to an organic pigment requires analytical testing even though Cl or Br are not present in the line-bond chemical structure.
Conclusions

Analytical methods for determining the halogen content of an organic pigment can be generally divided into two categorical purposes. The first category is total halogen content and the second category is halogenated impurities such as PCBs (polychlorinated biphenyls).

Total halogen content is determined by using oxygen flask combustion to convert all organic halides into salt form, such as potassium chloride (KCl). This requires complete combustion of the pigment in an oxygenated closed system apparatus. From there, gravimetric analysis via silver nitrate titration or ion chromatography can be performed to quantify the halide amount. This method is a more sophisticated analytical procedure and provides total halogen content without indication of the starting form (halogenated pigment, halogenated impurity, inorganic salts).

PCB content is determined by solvent extraction followed by GC-MS analysis (gas chromatography-mass spectrometry). This method is a more common method for testing impurities and residual byproducts from manufacturing processes. However, this method does not provide total halogen content. Generally the solute is non-pigmentary and non-inorganic salt.

Analytical Testing

An organic pigments supplier must be able to correctly test a pigment to make a claim of compliance to certain electronic industry standards. Analytical work is tedious and requires experienced personnel to expertly analyze pigments. Costly analytical efforts can be avoided if first a review of the chemical structure shows the presence of halogen atoms. In that case, a colorant can readily be removed from consideration as meeting any halogen-free criteria such as the IEC 61249-2-21 directive. Colour Index (C.I.) and/or Chemical Abstracts Number (CAS) are ready sources for obtaining chemical and molecular formulas.

Consideration for what color spaces will be affected is also possible for the customer before requesting supplier compliance statements of select pigments. Together with chemical structure review and selecting appropriate pigments for analytical testing, halogenated pigments can be readily identified and use in customer’s applications.

I would like to thank Dr. Robert Mott (Manager, Global Regulatory Sun Chemical), Dr. Constantinos Nicolaou (Manager Technology Group Analytical Laboratories Sun Chemical), Dr. Yong Xu (Senior Analytical Scientist Sun Chemical), Kent Faubion (Advanced Applications Lab Manager), and Scott Heitzman (Business Development Manager Sun Chemical) for review and constructive editing of this document.

Disclaimer

Although the data and information presented above is believed to be correct, Sun Chemical makes no guarantee to its accuracy, completeness or reliability. It’s important to evaluate pigments in your specific test procedures, loadings and end use applications to assure “fit for use.”

References

1. Environmental Protection Agency (EPA), Persistent Bioaccumulative and Toxic (PBT) Chemical Program. April 18, 2011
8. Chemical Abstracts Service (CAS), a division of the American Chemical Society. 2540 Olentangy River Road, Columbus, OH 43202 U.S.A.
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Table 1 [9]
The Color and Appearance Division of SPE will be hosting our annual technical sessions during this conference. We invite you to attend the Color & Appearance Division Session at the largest plastics conference this year. Our sessions are dedicated to the coloring of plastics and can include topics on Color Trends, Test Methods, Effects in Plastics, Regulatory Issues, Color Measurement, Processing Equipment, Color Matching and Instrumentation.

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For more information about the Color & Appearance Division Sessions and presenting a paper at ANTEC® 2014, visit this link or contact Doreen Becker (doreen.becker@xxxaschulman.com) or Sharyl Reid (sharyl.reid@xxxaschulman.com) (remove the xxx from the email address before sending your email)

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**Board Minutes**

Dear Members:

Just a reminder that you can view past and current BOARD MINUTES on the SPECAD website.

We do not typically publish the minutes in the electronic versions of our newsletter, but they are always available for our members to view from our website. The site is is not completely current at this time, as we are in the process of giving it a makeover and new launch in January.

Click here for the link to view: http://www.specad.org/index.php?navid=28
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sandra.p.davis@xxxdupont.com

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Ticona
bruce.mulholland@xxxticona.com

Secretary:
Brenda Mullins, 678-237-2975
Clariant Corporation
Brenda.mullins@xxxclariant.com

DIRECTORS until 2014
Sharon Ehr, 616-494-7577
Uniform Color
sehr@xxxuniformcolor.com

Steve Esker, 614-679-4677
Paramount Colors, Inc.
sveesker@xxxhotmail.com

Mark Freshwater, 330-526-8833
Lansco Colors
mark@xxxpigments.com

Steve Goldstein, 508-829-6321
Clariant Corp.
steven.goldstein@xxxclariant.com

Jamie Przybylski, 419-559-2459
Terra Community College
jprzybylski@xxxterra.edu

Austin Reid, 228-255-2362
DuPont
Austin.h.reid-ju@xxxsusa.dupont.com

Roger Reinicker, 302-992-1252
BASF Corporation
roger.reinicker@xxxbasf.com

Mark Tyler, 859-372-3221
Ticona
mark.tyler@xxxticona.com

DIRECTORS until 2015
Earl Balthazar, 817-719-0224
SpectroTechs Color Solutions
ebalthazar@xxxtx.rr.com

Alan Bodi, 419-356-7308
PolyOne
Alan.Bodi@xxxPolyone.com

Hal Button, 330-535-2100
Akrochem
halbutton@xxxaacrochem.com

Jack Ladson, 267-981-7112
Color Science Consultancy
jack.ladson@xxxsverizon.net

Frank Laviere, 401-461-4100
Lansco Colors
Frank@xxxpigments.com

Bruce Mulholland, 859-525-4756
Ticona
bruce.mulholland@xxxticona.com

George Rangos, 724-229-5371
Ferro Corporation
rangog@xxxferro.com

Sharyl Reid, 864-968-2426
A. Schulman Inc.
sharyl_reid@xxxus.aschulman.com

Cheryl Treat, 419-483-1063
A. Schulman Inc.
Cheryl_treat@xxxus.aschulman.com

DIRECTORS until 2016
Scott Aumann, 912-210-0175
EMD Chemicals
scott.aumann@xxxedmmillipore.com

Doreen Becker, 914-772-5580
Americhem Corporation
dbecker@xxxAmerichem.com

Paul Bykowski, 219-331-6981
Finos, LLC
pbykowski@xxxfrontier.net

Scott Heitzman, 513-681-5950
Sun Chemical Corporation
scott.heitzman@xxxsunchemical.com

Nathan Karszes, 770-527-2409
Nubiola
n.karszes@nubiola.com

Tracy Phillips, 770-995-0887
Uniform Color
tlphillips@xxxuniformcolor.com

Tom Rachal, 405-775-5014
Tronox, LLC
tom.rachal@xxxtronox.com

Jim Rediske, 412-809-3777
LanXess
jim.rediske@xxxlanexx.com

Brian West, 865-457-6700
Techmer PM LLC
bwest@xxxtechmerpm.com

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OTHER USEFUL CONTACTS
SPE Headquarters:
203-775-0471 phone
customerservice@xxxx4spe.org

CAD Newsletter Publication
Peacock Graphics, Inc.
847-341-4066
peacock gfx@aol.com

WebSite Host/Designer
Becky and Jeremy Hodge
519-824-3434
info@xxxx-xyn.com

CDs /PerfectBinding
OmniPress
608-246-2600
twagner@xxxomnipress.com

ACE Chair Roberto Todesco
r.todesco@xxxiinternational.com

National Plastics Center
Museum & Collections Director:
Marianne Chalifoux
210 Lancaster Street
Leominster, MA 01453