SPE
SOCIETY OF PLASTICS ENGINEERS

CAD NEWS

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

SPRING 2014

Chairman's Message

Dear SPE Color and Appearance Division Members,

Welcome to the Spring Edition of CAD News…..well hopefully it is finally spring where you are after this past winter! I know I am ready for some warm, sunny days and am enjoying seeing the flowers bloom plus days being longer! Everyone is much happier!

Spring also means that it is time for ANTEC®! The event attracts more than 2,000 attendees, 600+ technical and business presentations, and an exhibitor floor. ANTEC®2014 will be held from April 28 – 30 in Las Vegas, NV at the Rio All Suite Hotel and Casino. For more information, please visit www.4spe.org. Doreen Becker and Sharyl Reid from A Schulman are the chairs for the CAD technical sessions on Monday, April 28, morning and afternoon. At the close of the afternoon session, CAD will hold a brief business meeting – please stop by to meet our board members! CAD will also be presented the Gold Pinnacle *(highest achievement that SPE recognizes for a division)* and the Communications Excellence *(a reflection of how CAD communicates and serves its members).* Awards at the SPE Leadership luncheon on Sunday, April 27. It will be an honor for me to accept these awards on behalf of our division and our communications committee headed up by Tracy Phillips and her team. Congratulations to everyone!

Do you or your friends/colleagues have any kids planning to attend college *(undergraduate or graduate)* or a 2 year technical program in 2014/2015? If so, CAD has scholarships of up to $4,000 each available for qualified individuals with a total of $20,000 awarded annually for a one year period. Applications must be received by June 2, 2014. Please visit www.specad.org for more details or contact George Rangos of Ferro Corporation – george.rangos@ferro.com with any additional questions.

One of the scholarships awarded is named after Bob Charvat. He used to joke that it was a strange feeling having this named after him since he was living and not as a memorial like the other two. This will be the first year Bob's scholarship is now a memorial as we got the sad news that Bob passed away unexpectedly on January 9, 2014 – two days after CAD's Winter Board meeting. This man,

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Color and Appearance Division

Chairman's Message (continued)

short in stature with a twinkle in his eye, was a GIANT in our Coloring of Plastics World. He was an SPECAD member for more than fifty years – on the board for most of that time - and instrumental in the process of CAD being a full division. He was a strong force in establishing the Coloring of Plastics Program at Terra Community College and continued to educate people within our industry by teaching the Coloring of Plastics Tutorial at RETEC® on Sundays. Please take the time to learn more about Bob's accomplishments at www.specad.org. Bob was the person who made me realize how fortunate I was to be a part of CAD. It was at the CAD Winter board meeting in 2010 – Bob had been surprised at the last CAD RETEC® with a CAD Excellence in Education award – he had tears in his eyes as he told our members how much that had meant to him. As I looked at Bob and then around the room at the people who have given so much of their time to working on bettering our industry - it hit home as to how lucky I was to be a part of this group. He was a very special man and made this world a better place – we will miss him!

I would like to thank Roger Reinicker of BASF for his dedicated efforts as head of the awards and technical content review committees as well as being a valued speaker at both ANTEC® and CAD RETEC® Conferences. Roger decided not to run for re-election to the board and his term will come to an end after ANTEC®2014. We wish Roger all the best in his new endeavors!

The end of ANTEC® also marks the conclusion of my term as CAD's chairperson. The time has gone by quickly and I learned a lot! Thank you for supporting our CAD organization and me this past year. Nobody knows what tomorrow brings but I hope being a part of CAD for awhile is in my future. Please welcome Betty Puckerin from Ampacet as your CAD chairperson for 2014-2015.

Thank you for taking time to read our CAD News!

Best Regards,

Ann Smeltzer
CAD Chairperson

Election Results

The election winners; there were 16 candidates:

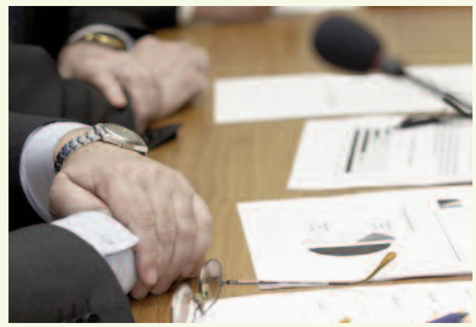
Thomas Chirayil	Sharon Ehr	Steve Esker
Mark Freshwater	Steve Goldstein	Jamie Przybyliski
Austin H Reid Jr.	Mark Tyler	Pete Zillitto

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 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

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@edmmillipore.com

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

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@edmmillipore.com

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Join SPECAD's Group On Linked In
to network with industry peers, participate in group discussions of industry and technical topics, find job opportunities, and get the latest division and conference announcements.

Group Name: SPE Color & Appearance Division
Group ID 152108

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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.

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

Councilor's Report

As Mother Nature turns the seasons from the warm days of green September to the crisp brown days of late October, so too must our season close on another successful CAD RETEC®.

The Fall 2013 Council meeting was held on November 16, 2013 in San Diego, CA with other meetings being held on the previous day. Normally, the first day of meetings includes both Sections and Divisions meetings as well as the Council Committee of the Whole (CCOW). For the last several years, there has been an option for remote participation in the Council meeting as well as the CCOW meeting. Due to poor on-site attendance, the Sections and Divisions meeting were not formally held.

For reasons primarily associated with events, the financial results for 2013 are expected to show about a $100,000 deficit. Several events in 2013, including ANTEC® and Eurotec fell short of expected revenue. The shortfall for ANTEC® was related to the increased venue expenses due to SPE being the sole host of ANTEC® *(as compared to 2012 where ANTEC® was co-located with NPE and many of the venue expenses* were covered by SPI). The sponsorship and exhibition at Eurotec was negatively impacted by the K show, even though the two events were separated by several months. Due to the predicted shortfall for the year, the decision was made by the Executive Committee to reduce the rebates to the member groups by 25%.

The budget for 2014 is designed with a $100,000 deficit which is related to depreciation of the recent investments in technology infrastructure. The proposed deficit budget generated significant discussion and dissent among the Councilors.

Overall, the membership numbers of the organization remain relatively steady around 14,000. The member retention rate for the organization remains in the low 70% which is not sustainable for the organization as the desired retention rate is greater than 80%. There continues to be a significant drop at the end of August as seen in past years as the members with June 30 member dates fail to renew.

In October, in conjunction with the K Show, SPE announced a new brand image. The new image has been visible on recent editions of the Plastics Engineering and incorporates either chartreuse or burgundy, with the burgundy being selected in recognition of the history of SPE.

Respectfully submitted,
Sandra Davis

Editor's Note

This past January we lost a colleague and a friend, Bob Charvat. I am sure most CAD members have met and known Bob sometime during his 50+ years of involvement with the CAD. In fact, he was one of its founding members. Bob has received many awards and has been recognized by the SPE for his major contributions to our industry by naming Bob a fellow of the SPE. But more important than his technical contributions, is the fact that he was a great friend and mentor to many in our ranks, including myself. I will miss him at the CAD RETEC®s and board meetings, they won't be the same without him.

I am sure each of us that knew Bob has many great memories of time we spent with him. The two memorials his family conducted for him, one in Cincinnati, and one in Cleveland, celebrated his life and how he touched so many lives in so many ways. After finally meeting his family, I can see why he was so proud of them. I felt as if I knew them from the many stories Bob told me when we roomed together during CAD events. We all will miss him dearly.

As I put this newsletter together I wanted to include as the technical article something Bob had contributed to the CAD. He certainly made many technical contributions to the industry and the CAD. I have known and worked with Bob since the beginning of the Terra's Coloring of Plastics Program. He was very instrumental in starting and developing the program, and for several years made the drive in from Cleveland to actually teach some of the classes. Because of Bob's association with the program, I was able to observe first hand his passion for teaching at Terra and also attend his CAD RETEC® Tutorials. To highlight this love for teaching, I chose a paper that Bob did not even write himself. I believe, without a doubt, that he was more proud of this paper than any of the ones he presented himself. It is actually a project that Bob conceived of and then recruited two Terra students to conduct the research and write the paper. It was presented at the 1998 CAD RETEC® in Cleveland. The paper is republished in this newsletter starting on page 11.

Bob was working on Volume II of his book when he passed away. The CAD Board has taken on the project and would like to complete it as a memorial to Bob. Bruce Mulholland is the contact person for anyone that would like to contribute a chapter to the book. See the article Bob wrote in a previous newsletter (and repeated on page 20 in this issue) for what is still needed to complete the book.

Online Plastics and Coloring of Plastics at Terra State Community College

A very distinctive feature of the Terra State 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 background. One aspect of Terra State'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 following three courses provide solid background knowledge for anyone working in the many segments of the Coloring of Plastics industry:

Introduction to Plastics

- Introductory course on plastics
- Polymer types, properties and processing

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 the Intro Class

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:

- Understanding of color terminology
- Accurate color communication
- 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

Distance Learning Courses Offered

Section VL **PET 1100 Introduction to Plastics** (3 Credits)
Fees: $450 Ohio students/*$700 out-of-state*
Books: Approximately $200
Offered Fall 2014 (August 20 – December 12)
Offered Spring 2015 (January 12 – May 7)

Section VL **PET 1240 Introduction to Color** (3 Credits)
Fees: $450 Ohio students/*$700 out-of-state*
Books: Approximately $200
Offered Fall 2014 (August 20 – December 12)
Offered Spring 2015 (January 12 – May 7)

Section VL **PET 2320 Colorants for Plastics** (4 Credits)
Fees: $600 Ohio students/*$900 out-of-state*
Books: Approximately $150
Offered Spring 2015 (January 12 – May 7)

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**

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Produced by the Office of Print Production of TSCC 03.26.14

ANTEC® 2014

SOCIETY OF PLASTICS ENGINEERS

Color and Appearance Division/ANTEC

M4 MONDAY MORNING — APRIL 28

8:30 VALUE CHAIN PARTNERSHIP KEYNOTE — *Mike Yockel, Eckart America*
The benefits of building relationships with your suppliers.

9:00 P.Y. 229: A NOVEL PIGMENT FOR LEAD AND DIARYLIDE REPLACEMENT IN PLASTICS — *Thomas Chirayil, BASF*
A new yellow pigment is developed to replace lead chromate and diarylide based yellow pigments in the plastics industry. Pigment Yellow 229 is a red shade yellow based on mono-azo chemistry and is free of heavy metals and halogens. This yellow pigment has high strength, heat stability, opacity, is non-warping, and non-bleeding in a masterbatch production. Formulators coloring plastics can select this pigment for indoor applications. This paper will discuss the properties of the new yellow pigment and compare the coloristic properties against lead chromate, diarylide and mono-azo based yellow pigments.

9:30 THE ROLE OF PIGMENTATION IN THE REDUCTION OF HEAT BUILDUP IN POLYMERIC MATERIALS — *Don Connolly, Dupont Titanium Technologies*
Discussion regarding the heat cycle build up of TiO_2 in various polymers.

10:00 ADVANCEMENTS IN LASERMARKABLE ENGINEERING RESINS — *Bruce Mulholland, Celanese*
Laser marking on plastics is growing in use. Bar codes and product lot data can currently be marked with lasers some commodity resins. However, of specific interest is the use of lasers to mark functional or decorative information on engineering resins. Because of their inert surface characteristics, these resins can be difficult to mark via printing using ink. This paper focuses on the development of specialty grades of engineering resins that yield excellent sharp, clear images when laser marked. Grades have been developed for laser marking white characters on black, dark characters on white, and other effects.

10:30 STANDARDS: EXPECTATIONS VERSUS REALITY — *Steve Goldstein, Clariant Masterbatches*
Discussion regarding what the OEM wishes to create versus the reality of what the market requires.

M24 MONDAY AFTERNOON — APRIL 28

1:30 DISINFECTION OF MOBILE DEVICES FOR USE IN A HEALTHCARE SETTING KEYNOTE — *Diane McLendon, Otter Box*

2:00 QUINACRIDONES – A HIGH ROLLING PERFORMANCE OVERVIEW AND WINNING STYLING OPTIONS — *Michael Willis, Sun Chemical*
Impact that product design has on pigments.

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M24 MONDAY AFTERNOON (continued) APRIL 28

2:30 SCRATCH VISIBILITY ANALYSIS OF POLYMER SAMPLES WITH AN OPTICAL MICROSCOPE

Gunter Moeller, Arkema Inc

Determination of scratch and mar performance is important for any application where maintaining surface integrity is important, ranging from coated surfaces to bulk polymers or composites. In this paper we outline a new and systematic empirical method for scratch visibility analysis with an optical microscope. Like many existing methods to quantify the visibility of surface scratches, it relies on differences in the intensity of light reflected off a scratch and an unscratched control area. We show that these differences may not always correlate with perceived scratch visibility and develop a method to overcome this limitation. Our method can be implemented using standard optical microscope technology and delivers reproducible, quantitative results. Results for five proprietary latex coatings are in good agreement with a qualitative scratch visibility assessment.

3:00 NEW TECHNOLOGY FOR THE COLORING OF ROTATIONALLY MOLDED PRODUCTS

Scott Aumann, EMD

New technologies for the coloring of rotationally molded products

3:30 CHEMICAL RESISTANCE OF PIGMENTS IN A PLASTIC SUBSTRATE

Inga Lesko, BASF Corporation

Plastics are used in numerous applications where they come into contact with acids, bases and chlorine containing chemicals, for example common bleach. These include packaging of all sorts, home and garden uses, and building and construction applications, for example. Chromatic pigments used to color these polyolefins may or may not be durable over time depending upon how the chemical penetrates the substrate and how resistant the pigments are to the chemical agent. One application of particular interest is also what colorants can be used in conjunction with recreational pools and pool chemicals. This paper will present data on the color change of pigments exposed in such situations. Emphasis will be on polyolefins, but data from synthetic fiber testing can also be illuminating. An attempt will be made to understand the results on the basis of pigment chemistry, concentration, and particle size.

4:00 DEVELOPMENT OF LOW GLOSS POLYACETAL

Matt Orlando, Mitshubishi

Nowadays low gloss Polyacetal (POM) materials are required for automotive interior parts. In this study, new low gloss POM was developed. Original organic particles having effective interaction with POM, was developed as the matting agent. Consequently, excellent low gloss appearance with a good balance of mechanical properties is obtained. In addition, weather resistant and low VOC (Volatile Organic Compounds) emission technology could be applied to this low gloss POM.

4:30 SPECTROPHOTOMETRIC ASSESSMENT: THE CHALLENGES OF 0/45 IN A D8 WORLD

Rex Petterson, Uniform Color Company

In making the determination of the pass or fail of colors (this discussion focusing on automotive interior parts) our route has typically been accomplished through visual consensus and spectrophotometric analysis. As many of us have experienced in this all too subjective pursuit, not only can three or more separate sets of eyes discern three or more totally diverse variations in color acceptability, our benchmark instruments of choice can offer distinctly different opinions also. Diversity in devices, innumerable surface-variation characteristics of the sample and inherent human imperfection in the repeatability of the manual "reading" process are all contributing factors to spurious spectrophotometric results. We will discuss what instrumental options we have available in order to have our electronic results correlate with what we see.

5:00 COLOR TRENDING IN 2014/2015 KEYNOTE

Doreen Becker, A. Schulman

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

A Tribute to Professor Robert Alan Charvat

March 2, 1930–January 9, 2014

Most knew him as Bob, but he was also known as Bobo to his brother's side of the family, and Baba or Grumpy Grandpa to the grandchildren. His work friends often referred to him as Papa Smurf. His effect was to shape everyone a little for the better with every encounter.

In his private life, he was a husband, father (3), grandfather (5), and as close to a saint as a man could be. Always a kind word, the voice of reason, or a shoulder to cry on if one was needed. He never met a stranger or spoke an unkind word; it just was not his way. His glass was always more than half full, and he wanted to know what he could do to help you fill yours a little more.

For his wife Nancy, he would do anything, because she was his everything. For his children Michael, Kathy and Laura, and his grandchildren Warren, Michael, Keight, Ries and Anna, he was the rock of stability and constant beacon of light to which they all could look to guide their paths, but also the playful silly guy known for the famous Charvat Shuffle. He appreciated everyone for who they were, and was glad he got to be a part of it all. His sincerity made you feel that you were the most important thing to him, his priority. He was a generous, giving person and his gifts were personal, well thought out and showed his insight and knowledge of his recipient.

In business, as in his private life, his sharing of time and talents had no bounds. He excelled in his chosen field of color in plastics, in thought leadership, and in his will to always impart as much as he could with as many as he could. He loved to see people learn and to learn from them, thus, lecture and teaching became a passion. He never ceased learning or teaching, conducting his final professional seminar 4 months before his death. Always eager for new ideas or technology, he embraced the internet and incorporated it's use in his professional and family life admirably for one of his generation. Because of his educational leadership, he was honored with the establishment of a plastics industry scholarship in his name. Other educational contributions include fostering and creating a color program at a community college and serving on its BOD, making his own contributions, supporting the work of others, and remaining active in the plastics industry family. Even now his "bible," the Coloring of Plastics, volume II, is taking final shape thanks to his friends and colleagues seeing it through.

MEMBERSHIPS

Lakewood High, Cleveland State University, Fenn College of Engineering (BME), Delta Sigma Phi, Veteran US Army 1950-52', Toy Designer 55-58, Past Masonic Temple 32 Degree Mason Scottish Rite / Valley of Cleveland - Past Master of RR Lodge 703 F& AM, Cleveland Shriners, Cleveland Yacht Club, Founding Member of Rocky River Power Squadron, Advanced Piloting Instructor, 50 Merit Point Award Winner, Society of Plastic Engineers (SPE)1957, Sr Member SPE 69', Achievement Award from SPE Color and Appearance Division 85', Honored Service Member 94', Elected "Fellow" in 2000, Emeritus status 2002. Who's Who in Plastics and Polymers, SPE BOD- 2003-06' Past CAD-BOD Chair, CAD Education Committee, Endowment Committee, Inter-Society Color Council. Detroit Colour Council, Fed of Societies for Coatings Technology, Cleveland Society, Terra Community College Color of Plastics Advisory Board, Terra Community College College Adjunct Faculty, Terra College Foundation BOD, CAD RETEC General Chair 1974 Cleveland, OH Ohio Firelands Section BOD Member , Ohio Firelands Section Councilor, Editor "Color of Plastics The Fundamentals Volume I (Sponsored by SPE CAD).

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

A SURVEY OF HOW SELECTED PIGMENTS SHIFT IN COLOR AS THEY RETURN TO AMBIENT TEMPERATURE AFTER INJECTION MOLD PROCESSING

By Jennifer Jakopak And Robb Twining, Terra Community College, 2830 Napoleon Road, Fremont, Ohio 43420-9670

FACULTY ADVISORS: Robert A. Charvat,
Jamie G. Przybylski, Charles C. Swearingen

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

INTRODUCTION

The demand for consistency of colors is increasingly growing. Not only does the way people perceive color alter from day to day, but also the properties of the color may change.

When color is introduced into plastics, there are some adjusting factors to consider One the opacity of the plastic and colorants can change the color when they are in combination. Two, the color of the plastic can cause a difference. Finally, heat can cause a change that may permanently alter the results in both the resin and the color. Therefore it is difficult to determine when a color has stabilized.

There have been numerous studies on polymers and their effects on pigments. There have not been many studies on how long it takes for the effects to stabilize This study attempts to determine the amount of time a colorant takes for stabilization to occur.

CONCLUSIONS

Throughout this study Organics and Inorganics were distinctive in behavior The Organics tend to take longer to stabilize than the Inorganics, which was expected the Organics took between 45 to 60 minutes to stabilize. The colors typically darkened during the cooling stage except for the Phthalocyanines, which moved in the opposite direction. The Inorganics tended to take a shorter time to stabilize except for the red shade Inorganics took about 30 minutes to stabilize. The red shades took up to 50 minutes to stabilize. The water-cooled samples did not speed up the stabilizing process. In fact, during the time of this research, some of the colorants never returned to the stabilized color. This research project can be used as a stepping stone for future research. There were some variables not included in this work making our conclusions none exclusive. This was a learning experience and a true eye opener for the changes that occur with a colorant during processing.

PROCEDURE

An overview of the procedure that was followed during testing is briefly described here. It will be discussed in greater detail in the following paragraphs. A liquid color concentrate was mixed with virgin resin at a 1.0 let down ratio. The resin and color concentrate were then molded in a Boy Injection Molding Machine. The first four chips were discarded and the next four chips were immersed in a chilled water bath for a specified amount of time. The fifth chip was set aside to be air cooled at room temperature. This fifth chip became the standard chip. All chips were read on the Spectrophotometer at predetermined times. The standard chip was read after the water cooled chips and left on the Spectrophotometer to stabilize. These times and readings were stored in the computer memory for further review.

In detail, the following procedure was used. First, a liquid color concentrate was chosen to provide complete dispersion of the color pigment. This eliminated incomplete pigment dispersion as an uncontrolled variable. It also permits the use of a lower let down ratio.

For inorganic masstone liquid dispersions, the concentrate was 50 vehicle and 50 pigment. The inorganic tints were 50 vehicle, 37.5 Titanium Dioxide and 12.5 Color Pigment (75/25 ratio). The letdown ratio used was 1.0.

For organic masstone dispersions, the liquid color concentrate contained 75 vehicle and 25 organic pigment. This is due to the fact that the organic pigments tend to have greater oil absorption and are stronger than inorganic pigments. The organic tint concentrates were 50 vehicle, 37.5 Titanium Dioxide and 12.5 Organic Pigment (75/25 ratio). The let down ratio continued at 1.0.

For a 200 gram resin batch, 2.2 grams of liquid color concentrate was added. To clarify, 2.2 grams of liquid color concentrate was added instead of 2.0 grams to make up for an approximate 10 loss of the concentrate during the mixing operation. The 10 additional material added, compensated for that loss.

The molding machine was then set up to run the chips. The total dwell time at heat for each batch was 2.0 minutes determined by timing each test run. The barrel was purged with virgin resin, and when the barrel appeared to be empty, the colored resin was fed into the hopper. From the time it took to remove all the remaining virgin resin, until the first fully colored chip was determined to be the dwell time. The temperature zones on the barrel were set to the following:

Zone One: 165.5°C/330°F
Zone Two: 173.9°C/345°F

continued on page 12

continued from page 11

Zone Three: IS7.S°C/3700^
Nozzle: lS7.S°C/370°f

The injection pressure was held at 12,500 psi. *(1,000 psi. Hydraulic)*. The back pressure was set at 6,250 psi. *(500 psi. Hydraulic)*. The shot size was approximately 40 of capacity. The mold temperature was set at 16°C/60.8°F.

Chips were run in a normal fashion, with the first four chips being discarded to insure that there was a good mix in the barrel to insure that there would be proper dispersion. The next four chips were submerged in a chilled water bath for the determined times of 3, 5, 7 and, 9 minutes. Each chip was patted dry with a lint free cloth and read on the Spectrophotometer. The water bath was monitored to a tolerance of plus or minus 4 degrees Fahrenheit with a digital thermometer that was accurate to the tenth of a degree.

The water bath was set at 4.4°C/45°F. To maintain this temperature the water bath was immersed in a separate ice bath that was kept just above freezing. After ten minutes, the air cooled chip was placed into the Spectrophotometer and read. It was repeatedly read in the exact same position at ten minute intervals until the chip stabilized to a Delta E reading of approximately A E = 0.02. At this time the position of the chip was marked on the back of the color chip, and the data was entered into a database for evaluation.

SELECTED PIGMENT LIST

ORGANIC PIGMENTS
1. Dioxazine Violet (PV-23)
2. Phthalocyanine Blue (PB-15:3)
3. Phthalocyanine Green (PG-7)
4. Diarylide Yellow HR (PY-83)
5. Disazo Condensation Yellow (PY-95)
6. Isoindolinone Yellow (PY-109)
7. Quinacridone Red (PV-19)
8. Perylene Red (PR-178)
9. Disazo Condensation Red (PR-220)
10. Diketo-Pyrrolo-Pyrole Red (PR-264)
11. Carbon Black (PB-7)

INORGANIC PIGMENTS
1.CIP Violet (PV-15)
2. Ultramarine Blue (PB-29)
3. Chromium Oxide Green (PG-17)
4. Chrome Yellow Medium (PY-34)
5. Iron Oxide Yellow (PY-42)
6. Cadmium Yellow (PY-37)
7. Molybdate Orange (PR-104)
8. Cadmium Red (PR-108)
9. Iron Oxide Red ((PR-101)
10. Iron Oxide Black (PB-11)
11. Rutile Titanium Dioxide (PW-6)

DISCUSSION

GENERAL

The polypropylene (PP) resin plus rutile titanium dioxide color stability was evaluated to help clarify what was a pigment color shift and what was a resin color shift. The PP plus Ti02 stabilized in 20 minutes. There was a slight color shift with the water-quenched chips versus the air-cooled. The water-quenched samples started as less yellow and less green. The air-cooled chips very slightly less yellow and less green. At the 20 minutes air-cooled time the sample was stabilized completely. The water-quenched Delta E was 0.13.

The vehicle in the liquid color was evaluated to help clarify what was a pigment color shift and what was a vehicle color shift. The chip stabilized in 30 to 40 minutes. There was a slight color shift with the water-quenched chip versus the air-cooled. The water-quenched was less yellow and less green. As with the polypropylene alone, the liquid color concentrate vehicle will have little or no effect on color change. The initial differences were larger than the polypropylene alone. The water-quenched Delta E was 0.88.

ORGANIC PIGMENTS

DIOXAZINE VIOLET (PV-23)

The Dioxazine Violet air-cooled masstone and tint chips had a similar stabilization time range of 10 to 20 minutes. The air-cooled color shifts were quite small. The color in the water-quenched chips moved from less blue to more blue before it stabilized in both the masstone and tint. The masstone chip increased in darkness whereas the tint increased in lightness. The water-quenched tint chips appeared to stabilize slightly redder than the masstone chip. The stabilized water-quenched masstone and tint chips did not match the stabilized air-cooled controls having a Delta E of 0.25 for masstone and a Delta E of 0.74 for the tint.

PHTHALOCYANINE BLUE (PB-15:3)

The Phthalocyanine Blue air-cooled masstone and tint chips had a similar stabilization time of 10 to 20 minutes. Color shifts were somewhat different. The color moved from less blue to more blue and then more red before it finally stabilized in both the masstone and tint. The tint chips appeared to adjust similarly to the masstone chips in color. The masstone chip increased in lightness whereas the tint became darker. The water-quenched chips moved similarly to the air-cooled chips, but had larger variations. Neither the masstone or tint water-quenched chips agreed with the stabilized air-cooled chips. The stabilized water-quenched masstone Delta E was 0.31 and the tint Delta E was 0.15.

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PHTHALOCYANINE GREEN (PG-7)
The Phthalocyanine Green masstone and tint chips had the same stabilization time of 40 to 50 minutes. Color shifts of the air and water-quenched samples were similar in direction. As they cooled, the chips darkened becoming less blue and greener. The water-quenched chip variations were greater than the air-cooled samples The water-cooled samples did not match the air-cooled controls. The stabilized water-quenched masstone Delta E was 1.11 and the tint Delta E was 0.34.

DIARYLEDE YELLOW (PY-83)
The Diarylide Yellow MR air-cooled masstone had a stabilization time of 10 to 20 minutes. The air-cooled tint had a stabilization time of 20 to 30 minutes. Color shifts for the air and water-quenched samples in masstone and tint were quite similar. As they cooled, they darkened, becoming less yellow and redder. This was more apparent in masstone. The water-quenched chips showed larger differences. The water- quenched chips did not match the color values of the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.67 and the tint Delta E was 0.25.

DISAZO CONDENSATION YELLOW (PY-95)
The Disazo Condensation Yellow masstone and tint chips had a somewhat different stabilization time. The air-cooled masstone chip stabilized in about 40 to 50 minutes.The air-cooled tint chip stabilized at 10 to 20 minutes. Color shifts for the masstones and tints were similar. As they cooled, they darkened, becoming less yellow and slightly redder. This was easier to observe in the masstone chip. The water-quenched chips showed an increased effect. The water-quenched sample color values did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.27 and the tint Delta E was 0.17.

ISOINDOLINONE YELLOW (PY-109)
The Isoindolinone Yellow air-cooled masstone and tint chips had the same stabilization time of 10 to 20 minutes. Color shifts were somewhat different. The air-cooled masstone chip moved darker, less red and slightly less yellow as it cooled. The air-cooled tint chip remained quite color stable as it cooled with only a very small color change. The water-quenched masstone moved darker, less yellow then more yellow and then redder. The water-quenched tint became less yellow, then yellower and less green. Neither the air nor the water-quenched tint chips showed significant changes in lightness or darkness. None of the water-quenched samples matched the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.58 and the tint Delta E was 0.32.

QUINACRJDONE RED (PV-19)
The Quinacridone Red air-cooled masstone had a stabilization time of 30 to 40 minutes. The air-cooled tint chip had a stabilization time of 20 to 30 minutes. The color shifts were different. The air-cooled masstone became less yellow and less red as it cooled. The air-cooled tint changed very little as it cooled. At the start of the water quenching the masstone chip moved lighter, was redder and yellower. As the chips cooled, the masstone water-quenched chips increased in darkness, became less yellow and less red. As it started to cool the air-cooled masstone was slightly less yellow and very slightly less yellow. Starting to cool, the air-cooled tint was very slightly blue and dark. The water-quenched tint chips started lighter, less red and bluer. The air-cooled masstone color changes were small. The water-quenched samples did not match the stabilized air-cooled control. The stabilized water-quenched masstone Delta E was 0.34 and the tint Delta E was 0.24.

PERYLENE RED (PR-178)
The Perylene Red air-cooled masstone stabilized around 30 to 40 minutes. The air- cooled tint stabilized at 10 to 20 minutes. The air-cooled masstone chips showed little change on cooling. The air-cooled tint was almost identical to the masstone showing very little change upon stabilizing. The water-quenched masstone was less red and less yellow. The water-quenched tint was yellower and redder. The water-quenched masstone and tint were lighter than the stabilized control. The water-quenched samples continued to darken over the cooling time. The water-quenched samples did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.67 and the tint Delta E was 0.10.

DISAZO CONDENSATION RED (PR-220)
The Disazo Condensation Red air-cooled masstone stabilized around 10 to 20 minutes, while the air-cooled tint stabilized at 20 to 30 minutes. The color shift was somewhat different between the masstone and tint. There was almost no color change in the air-cooled masstone chips. The air-cooled tint chips were primarily less yellow. The masstone water-quenched chips were redder and more yellow increasing in darkness with longer cooling times. The water-quenched tint chips were less red and varied between less too more yellow. Air and water-quenched lightness and darkness differences in masstone were very small. The water-quenched samples did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.90 and the tint Delta E was 0.20.

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DIKETO-PYRROLO-PYROLE RED (PR-264)

The Diketo-Pyrrolo-Pyrole Red air-cooled masstone chip stabilized quickly at 10 and 20 minutes. The air-cooled tint stabilized in approximately 10 minutes. Color shifts were different. As the air-cooled chips cooled, the masstone chip moved from less yellow to more yellow with almost no change in redness greenness. There was no change in masstone lightness darkness. The water-quenched masstone moved yellower and redder as it cooled over time. The water-quenched tint chip was less red and less yellow. The air-cooled chips were remarkably color stable compared to the water- quenched samples. The water-quenched samples did not match the stabilized air- cooled controls. The stabilized water-quenched masstone Delta E was 0.42 and the tint Delta E was 0.50.

CARBON BLACK (PB-7)

The Carbon Black air-cooled masstone chip stabilized around 10 to 20 minutes. The air-cooled tint stabilized between 20 to 30 minutes. There was a small color shift. The water-quenched masstone and tint chips lightened as they continued to cool. All other changes were minimal. The water-cooled tint chip was slightly less red and less yellow. The tint started lighter with very small color value differences. The stabilized water-quenched masstone Delta E was 0.06 and the tint Delta E was 0.18.

INORGANIC PIGMENTS

CIP VIOLET (PV-15)

The CIP Violet air-cooled masstone and tint stabilized at 10 to 20 minutes. There was a difference in color between air-cooled and water-quenched. The water-quenched masstone chips becoming less blue and slightly less red as cooling time proceeded. The water-quenched tint chips were generally darker, bluer and very slightly redder. The water-quenched masstone exhibited a significant difference. The water-quenched tint was considerably better, moving close to the air-cooled stabilized control. The stabilized water-quenched masstone Delta E was 2.68 and the tint Delta E was 0.21.

ULTRAMARINE BLUE (PB-29)

The Ultramarine Blue masstone and tint stabilized around 10 to 20 minutes. There was no significant color change with the air-cooled chips. There was a difference in color shift between air and water-quenched. The water-quenched masstone chips had scattered results. Short time water-quenched chips were darker, less red and less blue.

At longer water-quench times the masstone moved lighter, redder and bluer. The water-quenched tints were lighter, very blue and very slightly green. Upon longer water-quench times the tints moved close to the air-cooled stabilized control. The water-quenched masstone did not closely match the stabilized control. The Stabilized water-quenched masstone Delta E was 1.07 and the tint Delta E was 0.34.

CHROMIUM OXIDE GREEN (PG-17)

The Chromium Oxide Green air-cooled masstone stabilized around 20 to 30 minutes.The air-cooled tint stabilized between 10 to 20 minutes. The air-cooled chips were essentially equal in lightness darkness becoming less green during the cooling time.The color shift was similar for the masstone and tint. The water-quenched masstone chips were slightly yellow and greener during cooling. The water-quenched tint lightness/darkness varied with the sample-moving lighter as it continued to cool. The color values for the tints were scattered with the color being greener while moving toward the stabilized air-cooled control. The water-quenched masstone and tint did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.98 and the tint Delta E was 1.00.

CHROME YELLOW MEDIUM (PY-34)

The Chrome Yellow Medium air-cooled masstone stabilized around 40 to 50 minutes. The air-cooled tint stabilized in 10 to 20 minutes. The color shift was similar for the masstone and tint. The air-cooled masstone increased slightly in redness while there was essentially no hue change in the tint. The water-quenched masstones were scattered being lighter, less red and yellower. The water-quenched tints were lighter becoming darker with longer cooling times. The water-quenched tints were scattered varying from more and less yellow along with being less red. The water-quenched samples did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.72 and the tint Delta E was 0.70.

IRON OXIDE YELLOW (PY-42)

The Iron Oxide Yellow masstone and tint stabilized around 20 to 30 minutes. There was a slight difference in the color shift of the masstone and tint. The air-cooled masstone chip was equal in lightness darkness, redder and yellower. The air-cooled tint was very slightly darker, more red and equal in yellowness. The water-quenched masstone moved slightly darker, less red and less yellow with longer cooling times. The water-quenched tint moved darker, slightly less red and less yellow. The water-quenched samples did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.55 and the tint Delta E was 0.46.

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CADMIUM YELLOW (PY-37)

The Cadmium Yellow masstone and tint stabilized between 20 to 30 minutes. There were some differences between the masstone and tint color shift. The air-cooled masstone chip was essentially equal in lightness darkness, very slightly redder and less yellow. The air-cooled tint chip was equal in lightness darkness, and color values. The masstone water-quenched chip was slightly light, redder and scattered less too more yellow. The water-quenched tints were lighter, less red and scattered more to less yellow. The water-quenched samples did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was O.80, the tint Delta E was 0.35.

MOLYBDATE ORANGE (PR-104)

The Molybdate Orange masstone stabilized between 40 to 50 minutes. The tint stabilized between 10 to 20 minutes. There was a significant difference in the color shifts of the masstone and tint. The masstone air-cooled chip was lighter yellower and redder. There was no significant change in the air-cooled tint. The water-quenched masstone chips were yellower and redder. The water-quenched tints were lighter less red and scattered less too more yellow. The water-quenched samples did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.75 and the tint Delta E was 0.31.

CADMIUM RED (PR-108)

The Cadmium Red air-cooled masstone stabilized between 20 to 30 minutes The air- cooled tint stabilized in 30 to 40 minutes. Both the air-cooled masstone and tint were darker, yellower and scattered more and less red. The water-quenched masstone chips were slightly lighter, yellower and scattered more and less red. The water-quenched tint chips moved darker and scattered more and less red and yellow. The water-quenched samples did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0.49 and the tint Delta E was 0.20.

IRON OXIDE RED (PR-101)

The Iron Oxide Red masstone and tint stabilized between 20 to 30 minutes. The air- cooled masstone was essentially equal in lightness darkness, slightly redder and yellower. The air-cooled tint was very close in lightness darkness, slightly less red and less yellow. There was no significant difference in the color shift of the water- quenched masstone and tint water-quenched chips. Both were close in lightness darkness, yellower and redder. The water-quenched chips did not match the stabilized air-cooled controls. The stabilized water-quenched masstone Delta E was 0 45 and the tint Delta E was 0.16.

IRON OXIDE BLACK (PB-11)

The Iron Oxide Black air-cooled masstone and tint stabilized around 20 to 30 minutes There was no significant color shift or shade in either the air or water-quenched chips. In this trial the water-quenched masstone and tint were essentially equal or close to the air-cooled stabilized controls. The stabilized water-quenched masstone Delta E was 0.03 and the tint Delta E was 0.28.

FINAL THOUGHTS

First, this work should raise a clear warning sign to those involved in color matching and quality control work. Since most injection molded plastic production parts are air-cooled; it is a warning that water-quenched lab samples may visually and instrumentally never match their air-cooled production counter parts. This work suggests that water-quenching in the laboratory shortstops the cooling process thereby bringing unknown and uncontrolled variables into the sequence.

Second, this research studied a few selected organic and inorganic pigments individually. There are variations of these selected pigments and many other pigment chemistries not addressed in this research project.

Third, pigment blends appearing in color matches significantly complicates this issue and opens further areas for unexpected results.

Fourth, the water-quenching process in this research was very closely timed and temperature controlled. Water quenching in a laboratory without strict attention to time and temperature will bring additional unknown and uncontrolled variables into play.

Fifth, this work was done in one resin system. Whether the results would be similar in other resin systems remains for additional study.

Sixth, this work only addressed injection molding on a laboratory scale. Different processes and scales of operation should be anticipated as effecting the results. Only additional study can address this aspect.

Finally, this work should imply that identifying potential variables in this realm of processing are subtle, insidious and potentially devastating.

ACKNOWLEDGEMENTS

The authors would like to thank the following for their help, encouragement and support in this project.

- To Dr. John Standish, Ph.D. Technical Director of Colormatrix, Inc. for the supply of dispersed liquid pigment dispersions and technical support.
- Thanks to the Terra Community College family for their aid during this project.
- A special thanks to the faculty advisors who worked with us on the project; Robert A. Charvat, Jamie G. Przybylski and Charles C. Swearingen.

Society of Plastics Engineers Endowment Scholarship Program
For the 2014 – 2015 School Year

The Endowment Scholarship Program offered by the Color & Appearance Division of the Society of Plastics Engineers awards up to five scholarships each year to students who have demonstrated or expressed an interest in the coloring of plastics industry. The students must be majoring in or taking courses that would be beneficial to a career in this industry. This would include, but is not limited to, plastics engineering, polymer science, coloring of plastics, chemistry, physics, chemical engineering, mechanical engineering, industrial design and industrial engineering. All applicants must be in good standing with their colleges. Financial need is considered for most scholarships.

Undergraduate and graduate scholarships range up to $4,000 annually. Scholarships are awarded for one year only, but applicants may apply for a re-award for each year they are enrolled in school.

Scholarship Eligibility

1. Applicants for these scholarships must be full-time undergraduate students in either a four-year college or a two-year technical program or enrolled in a graduate program.
2. All applicants must be graduates of public or private high schools.

Scholarship Criteria

1. Applicants must have a demonstrated or expressed interest in the coloring of plastics industry.
2. Applicants must be majoring in or taking courses that would be beneficial to a career in the coloring of plastics industry.
3. An applicant must be in good academic standing with his or her school.
4. Preference is given to student members of SPE and also to students who have a parent(s) as a member of the Color & Appearance Division of the SPE.
5. Financial need of an applicant will be considered for most scholarships.

Application Procedure

To be considered for a scholarship from the Color & Appearance Division Endowment Scholarship Program, applicants must complete an application available at WWW.SPECAD.org and return it to the address specified on the application by June 2, 2014. All applications submitted must include:

1. A completed application form.
2. Three recommendation letters: two from a teacher or school official and one from an employer or non-relative.
3. A high school and/or college transcript for the last two years.
4. An essay by the student (500 words or less) telling why the applicant is applying for the scholarship, the applicant's qualifications, and the applicant's educational and career goals in the coloring of plastics industry.

Please feel free to contact George Rangos
at rangosg@ferro.com or
at 724 229 5371 with any questions.

Scholarship Opportunity!

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Color Mischief #11

CHANGING LIGHT SOURCES

The Color Mischief section of the CAD Newsletter is a collaboration of multiple authors. The authors of the articles choose to remain anonymous to preserve their dignity and well-being. In this rare instance, one of the contributors is revealed. That contributor, a Fellow of the Society of Plastics Engineers, was Robert Alan "Bob" Charvat, who died suddenly January 9, 2014 after a long battle with heart disease. Bob was a passionate energetic contributor to CAD and was very dedicated to coloring of plastics education. One topic he wanted us to touch on in this series of articles was the change from incandescent light as our predominant illumination source.

Bob was fully supportive of the energy conservation mandate to eliminate incandescent bulbs. His concern was the implications the change would have on color. Incandescent light has a color rendering index (CRI) of nearly 100 meaning its illumination can reveal colors very much like natural light. When they are new and when powered at exactly the designed level the CRI of Fluorescent lamps ranges from 50 to 90.

One of the more intensive UV exposure conditions occurs inside fluorescent bulbs and we all know what UV light does to the color of things. They fade, they deteriorate, and they change.

There are lighting condition standards we use when matching colors for use under halophosphate warm-white, halophosphate cool-white, halophosphate cool-daylight, tri-phosphor warm-white, and tri-phosphor cool-white fluorescent illumination. However, the next time you walk into an office or store, take a look up at the lights. We can almost guarantee there will be a mixture of those lamp colors simultaneously in use! Will your color match still be good under that real life environment? So what about the compact fluorescent bulbs? Are their equivalents the same as the 5 standard sources listed above?

Now take a look at LED illuminants. Every manufacturer uses a proprietary method to turn some combination of inorganic semiconductor materials into white appearing light. Their CRI is likely similar to fluorescent lamps ranging from 50 to 90. Conventional LEDs consist of the following types; 2 IR, 4 Red, 3 Orange, 3 Yellow, 4 Green, 3 Blue , 1 Violet and 4 UV any combination of which are mixed to make white light. In some cases they also use a blue UV diode with a yellow phosphor. Manufacturers efforts to increase the efficiency, intensity and lower the cost of white LEDs is an ongoing leapfrog dynamic that will go on for quite some time. Are they using the conventional LED types? How do you make non-metameric color matches for use under these conditions?

LOOK FORWARD TO MORE "COLOR MISCHIEF" ARTICLES IN FUTURE ISSUES!

The 52nd Annual Society of Plastics Engineers Color and Appearance Division RETEC® is quickly approaching. This year's conference will be held in New Orleans Louisiana, unarguably the most colorful city in North America. The Crescent City is the perfect setting for the theme of this year's CAD RETEC®, "It's A Colorful World". CAD RETEC® is the world's largest technical conference in North America that is specifically dedicated to the color and appearance of plastics.

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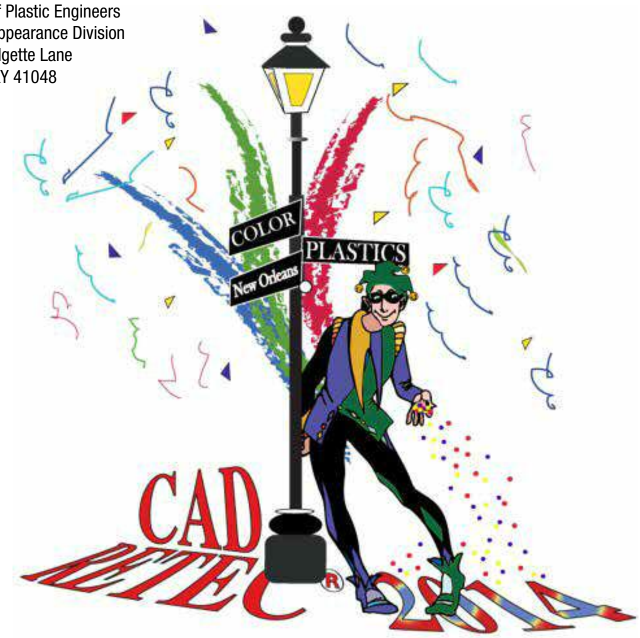

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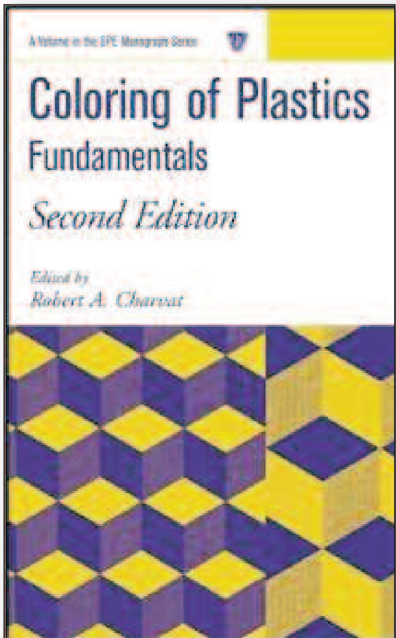
THE CAD NEEDS YOUR HELP!

THIS IS A PROGRESS REPORT FOR VOLUME II " COLORANT TECHNOLOGY"
A FOLLOW-UP TO VOLUME I " COLORING OF PLASTICS FUNDAMENTALS"
BOTH PUBLICATIONS ARE SPONSORED BY THE CAD.

By Robert A. (Bob) Charvat Editor



The "COLORING OF PLASTICS FUNDAMENTALS" Volume I, first published in 2004 has been very successful. Volume II complements Volume I, making these two volumes a complete set addressing coloring of plastics technology.

Progress to date on Volume II has been troublesome, due to many author career issues and particularly the current economy. Volume II will explore technical issues concerning coloring individual polymers on a chapter by chapter basis. Volume II will contain about 33 chapters covering many popular large volume and specialty polymers. A number of authors are already committed to specific chapters. Five completed chapters have been received by your Editor for editing, however, a number of important polymers do not have committed authors at the time of this message. This is why your Editor and the CAD are looking to our CAD members for help in completing this very important project.

I am sure there are CAD members ready and willing to step forward to write these chapters. An extensive and complete set of instructions are available to authors to make the chapter preparations as easy and trouble free as possible. Or, if you know anyone who could prepare any of the chapters listed below, please identify them for us and try to get them interested and/or committed! Authors who contribute to our CAD will leave a permanent record of their contribution and involvement in our CAD.

Won't you give the CAD and the Editor the help they need!

VOLUME II " COLORANT TECHNOLOGY"

We need CAD members to step up and commit to preparing a chapter for:

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Please contact Bruce Mulholland at Bruce.Mulholland@celanese.com if you are willing to author a chapter on one of the above materials.

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