

CAD NEWS®

Winter 2019

A publication of the Color and Appearance Division of the Society of Plastics Engineers

Chairman's Message

Dear SPE Color & Appearance Division Members,

I hope that all of you had a nice Thanksgiving with family and friends. For those of you who live in the New York area, we were greeted with an early blanket of snow at the end of the holiday from which we are now digging out. Nonetheless, the end of the year and holidays are rapidly approaching and so I wanted to give you an update on our recent fall activities.



Mark Freshwater and Steve Esker did a spectacular job chairing our Our 57th Regional Technical Conference (RETEC®) which was held at the Renaissance Hotel in Cleveland on September 23-25 and was a resounding success! The **Rocking Color In Cleveland** total attendance was 451 registrants. We also had 24 participants for the Fun Run which is a charity event so CAD matched every \$25 donation with all proceeds given to the Habitat for Humanity. We had 14 participants for our **Plastics Tutorial** led by Bruce Mulholland and 69 tabletop exhibitors that were precisely organized by Brian West. Our opening ceremony was held at Cleveland's Rock and Roll Hall of Fame and we were entertained by our very own Color Eye Blind band along with some guest artists including George Iannuzzi and Mercedes Landazuri. We also had a command performance by Austin Reid. It's great to see this band stepping up their game and bringing in some new talent and old members! Mark Tyler also organized our golf outing on Monday at the Stonewater Golf Club in Highland Heights and had a good turnout. Thanks Mark! Scott Heitzman did a great job moderating our New Technology Forum on Tuesday afternoon where we learned about the exciting new products in our industry. This is a session that grows every year and a personal favorite of mine. Another favorite of mine – in addition to our wonderful papers and presenters – is the raffle that takes place at the end of our meetings. Scott Aumann always makes this a fun and entertaining event for all. We also want to thank all of our sponsors who keep us all well fed and hydrated (?) during these meetings and Cheryl Treat who diligently pursued and organized all of these sponsorships.

We will have our winter board meeting in Coral Gables, Florida on January 27th ahead of the AMI Thermoplastics Concentrate meeting on January 28-30 also in Coral Gables.

Our next big event is the ANTEC® meeting on March 30-April 2 in San Antonio, Texas at the beautiful Marriott River Center. We have many wonderful speakers lined up for this meeting. Mark Tyler and Jeff Drusda will be chairing this event for the Color & Appearance Division so feel free to reach out to them with comments or questions.



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Chairman's Letter - continued from page 1

Our next RETEC® will be in Orlando, FL on September 20-22 at the Renaissance Orlando at SeaWorld and the theme will be **Splash with Color**. Jeff Drusda and Cheryl Treat will chair this event. Alex Prosapio and Mark Tyler will be our Technical Program Chairs so feel free to reach out to Alex or Mark if you have a paper or topic you would like to present. We hope to see you there.

So now that we are up-to-date with all of the CAD activities, I would like to wish you and your family happy holidays and a healthy and prosperous New Year.

Doreen Becker

2019-2020 Chair

Color & Appearance Division

CAD RETEC® Donation Recognition

SPE CAD RETEC® has been supporting Habitat for Humanity (HfH) since 2005 when Hurricane Katrina struck the Gulf Coast causing catastrophic damage from central Florida to eastern Texas. That year the SPE CAD RETEC® was held in Charlotte, North Carolina and to support of the vast rebuilding, we donated 25% of the profits from the event to HfH. Since that time the relationship between the two organizations has continued to build.

For over 10 years, DCC LANSCO (formerly known as "Dominion Colour Corporation") has supported HfH in their mission to bring people together to build homes, communities and raise hope through sponsorship of the 5K Fun Run. During our most recent CAD RETEC® (September, 2019) DCC LANSCO once again hosted the annual 5K Fun Run where we raised almost \$1,280. We are grateful to the runners who helped make this possible, as well as the matched donation made by the Society of Plastics Engineers.



Pictured above, Dr. Bruce Howie (DCC LANSCO, Global Product Marketing Manager) presents the check to Peggy Sobul, Senior Director of Development & Marketing, Greater Cleveland Habitat for Humanity.

If you would like to contact Peggy regarding any type of contribution, her contact details are; psobul@clevelandhabitat.org, 2110 West 110th Street, Cleveland, OH 44102, Office: 216.278.7099, Cell: 216.970.0477

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COLOR & APPEARANCE

A special thank you to all our exhibitors who travelled and set up their company displays!

Editor's Note



Welcome to the Winter edition of the Color and Appearance Division Newsletter. Hope the transition from Fall to Winter hasn't been too tough and has been good to all so far. RETEC® 2019 in Cleveland was another great success with very good attendance and a spectacular technical program that demonstrated many relevant topics. Great job by Steve

Esker and Mark Freshwater and their committee for putting on another great RETEC®.

As 2019 is coming to a close, we would like to send out a huge thank you to all the sponsors to our Division. Without their continued support, we could not do all the things we do to make the Color and Appearance Division one of the best divisions of SPE. From supporting CADRETEC® to supporting this Newsletter, the sponsors really step up when it comes to us.

As we close out 2019, we look forward to 2020 and what will be happening: 2020 ANTEC® will be in San Antonio, Texas this year (March 30th to April 2nd), 2020 CADRETEC® will be in Orlando, Florida (September 20th to 22nd). Our CADRETEC® 2020 will return to its Sunday start with technical programs all day Monday and Tuesday, so save the date now. Scholarship opportunities will be available for the 2020/2021 school year so see the column on the right bottom of this page on how to obtain more information on these scholarship opportunities.

Last, but not least, please let us know your interest in sponsoring this Newsletter with an ad for your company. These sponsorship ads allow us to produce these Newsletters and help maintain a solvent division of the SPE as well getting pertinent information out to the division members. See page 21 in this newsletter showing the different sizes available and for contact information. Ads will run starting with our Spring issue in March through the Winter issue in December. We guarantee a minimum of three Newsletters being published; however, in the last three years we have been able to publish four issues per year. We would need to know your interest by the end of January and be in receipt of your sponsorship ad soon afterwards.

Hopefully, there is something for you in the Newsletter and, as always, if you have any suggestions or comments please let me or someone on the BOD know.

Mark Tyler

Color and Appearance Newsletter Editor
tylerm@xxxsilberline.com

2019 Terry Golding Outstanding Achievement Award

This year's recipient Brian West really has a remarkable history within the Color and Appearance Division. He has always been very active and involved in our Division but after looking back into the records it was even more than one thought.

- ♦ He has been on the CAD BOD for 31 years
- ♦ He has been elected to the Executive Committee twice and is the only person to serve as Division Chair two times in last 50 years
- ♦ He Chaired RETEC® twice: 1999 and 2010
- ♦ He Chaired ANTEC® in 2015
- ♦ RETEC® Tabletops for more than 20 years
- ♦ Current Color Advisory Group Chair which he has held for at least seven years
- ♦ Current International Committee Chair which he has held for at least seven years
- ♦ Color Eye Blind since its inception in 1998 so 21 years.

Well Done Brian and Thank you so much for your dedication and service to the Color and Appearance Division!



Scholarship Opportunities

This is an SPE CAD Scholarship Information Reminder for the 2020/2021 School Year. The Society of Plastics Engineers Color and Appearance Division have scholarships available for qualified individuals.



Each year, scholarships are awarded in honor of some of those who have influenced our industry through education of up to \$4,000 each.

Additional full or partial scholarships may be awarded based on available funding and on the number of qualified applicants.

Jack Graff Memorial Scholarship	up to \$4000.00
Gary Beebe Memorial Scholarship	up to \$4000.00
Bob Charvat Memorial Scholarship	up to \$4000.00
Steve Goldstein Memorial Scholarship	up to \$4000.00
George Rangos Memorial Scholarship	up to \$4000.00

For questions on applications or process please email [Ann Smeltzer](mailto:Ann.Smeltzer@spe.org), or call her at 412-298-4373

Milliken presents

Milliken introduces range of Keyplast™ RESIST colors for high-performance engineering polymers

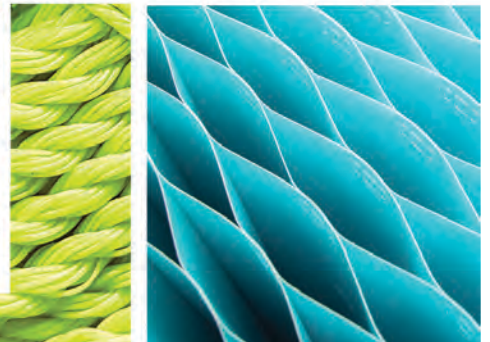
It's not easy to color high-performance engineering polymers with bright and vibrant hues. Not only are such materials subject to high-temperature processing, they also require steady, reliable performance properties when used, as is often the case, in demanding outdoor applications. Colors and additives cannot be allowed to negatively impact any of those properties.

As we continue to build our strong product portfolio and develop high performance colorants, Milliken is proud to introduce our new range of Keyplast RESIST products for coloring engineering polymers such as polyamides, polysulfones, PEEK, PPO and other high-heat resins and alloys.

Polyamides (aka nylon), in particular, have tended to provide significant coloring challenges in the past due to their chemical composition. Additives historically used to color many other resins did not prove effective in these resins. At first, many thought this problem to be related to the high heat processing requirements for nylons. But subsequent research revealed that normal colorants, both pigments and dyes, are reacted with the amide system and ruined by discoloration due to the loss of conjugation in the colorant molecule.

Nylon's toughness and other performance properties make the resin ideal for use in applications such as power tools, automotive components, gears, and appliance parts, many of which require precisely controlled coloration. But through continued research and development, Milliken has now developed Keyplast RESIST to allow it to be used effectively with all grades of nylon, including polyamide 6, 66, 46, 11 and 12.

Customers tend to choose these Keyplast RESIST for their brilliant colors and high-end properties. These materials offer improved weather resistance and light fastness, are high purity and perform well in the high-tem-



Keyplast™ RESIST colorants for high-performance engineering polymers

perature and chemically-reductive conditions typically associated with high-performance polymers.

Users of such colorants are all too aware of the severe product shortages currently impacting the market. Stricter enforcement in Asia of environmental regulations and manufacturing effluent limits has led to short supply primarily of key colorant intermediates, and even prompted plant closures or

drastic cutbacks in production. As a result, for the past few quarters, the colorants market globally has seen unprecedented cost increases, which are impacting all levels of the supply chain.

Milliken, of course, is not immune to these market pressures, but is working to take a proactive approach regarding customer's needs.

For more details and information please contact us or visit us online at chemical.milliken.com

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Chairperson: Jeff Drusda, The Chemours Company
jeffrey.drusda@chemours.com

Vice Chairperson: Cheryl Treat, BASF
cheryl.treat@basf.com

Technical Program: Alex Prosapio, Sudarshan
aprosapio@sudarshan.com

Mark Tyler, Silberline Manufacturing
tylerm@silberline.com



THE INFLUENCE OF ADDITIVES ON POLYMER DISCOLORATION

Tad Finnegan and R. E. King III

BASF Corporation, Tarrytown, NY



ABSTRACT

Managing the color of a plastic article requires not only the appropriate selection of the colorants, but also careful selection of the processing, thermal, and light stabilization additives. Improper selection and use of these additives can lead to the formation of chromophores and discoloration of the polymer after processing, during storage, or upon exposure to heat or light. These chromophores may be either transient or durable, leading to unexpected and difficult-to-manage changes in the article's color during storage and use. The use of recycled polymer or regrind can exacerbate the potential for discoloration by introducing chromophore precursor compounds formed by thermo-oxidative stress on the polymer system. In this paper, common causes of discoloration and strategies to manage them through additive selection are presented.

INTRODUCTION

Polymers undergo oxidation during processing and storage that can negatively impact their properties. This oxidation can impact the polymer's molecular weight, melt flow behavior, and color in addition to other properties. Discoloration, because it is immediately evident to an observer, can be of special concern^{1,2}.

Color is how we perceive the absorbance, reflectance, and transmission of wavelengths of electromagnetic radiation between ~400 nm to 700 nm from an object. The portion of the molecule responsible for absorbing light is the *chromophore*. In organic molecules, the chromophore is a usually a region of highly conjugated chemical bonds where the electrons are delocalized. When an electron in the chromophore absorbs a photon of the right energy, the electron is excited from the ground state into the excited state, as illustrated in Figure 1. The electronic band gap between the highest occupied molecular orbital (HOMO) and the lowest unoccupied molecular orbital (LUMO) shows us the energy required to excite the electron, and the wavelength of light required to provide that energy is given by Equation 1.

$$E = \frac{hc}{\lambda} \quad (\text{Equation 1})$$

where E is the energy of the photon, h is Planck's constant, c is the speed of light, and λ is the wavelength of the light.

Molecules with a low level of conjugation require higher energies (i.e., shorter wavelengths) to excite. As the level of conjugation increases, the energy required to excite the electron decreases until eventually the absorbed wavelengths of light will extend into the visible range. From Fieser-Kuhn rules for conjugated systems³, we can determine the absorbance will enter the visible spectrum for a linear, conjugated system with 8 or 9 conjugated double bonds. As an example, β -carotene (a naturally-occurring pigment) has 11 conjugated double bonds, as shown in Figure 2. It has an absorption of

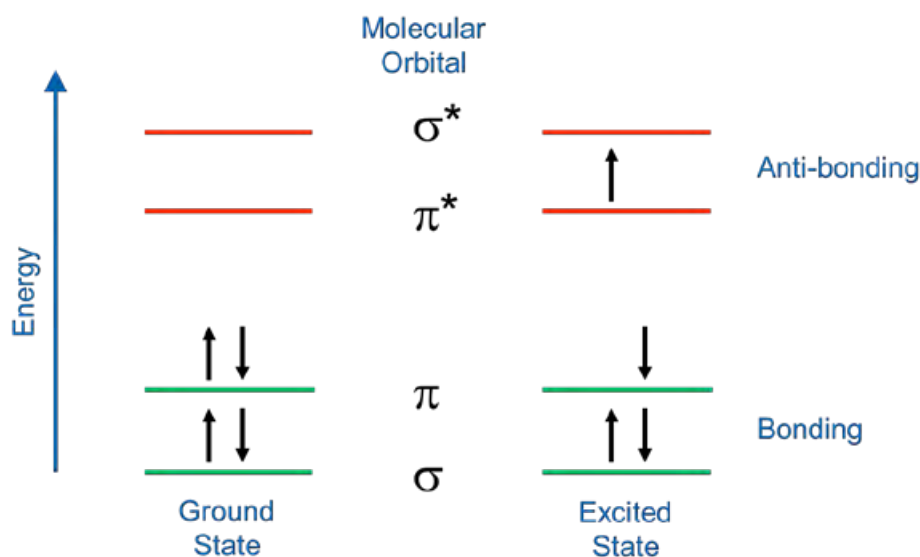


Figure 1. Ground state and excited state of electron in a conjugated chromophore

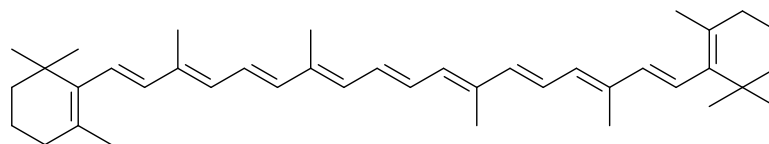


Figure 2. Molecular structure of β -carotene

452 nm. This value is well into the visible spectrum (400-700 nm) and corresponds to the absorption of blue light, giving the molecule its characteristic yellow/orange color.

In polymers, often the discoloration is not due to conjugation in the polymer itself; rather, it is other components in the polymer (e.g., antioxidants, light stabilizers, and impact modifiers) that lead to the discoloration. Furthermore, many of these ingredients are not inherently colored, but rather form chromophores as they are oxidized during processing, thermal aging, and weathering of the polymer in the autoxidation cycle.

Figure 3 shows the autoxidation cycle⁴. The process is started when the polymer is exposed to light (in particular, ultraviolet light), heat, or shear in the presence of oxygen. Improperly deactivated catalyst residues or the presence of transition metals can also initiate the process. In the initiation process, a highly reactive free radical ($R\bullet$) is formed by carbon-carbon or carbon-hydrogen bond scission. Cycle I illustrates the formation of hydroperoxides from the free radical. The free radical interacts with molecular oxygen present in the polymer to form a peroxy radical ($ROO\bullet$). This peroxy radical can abstract a hydrogen from the polymer or another molecular to form a new free radical ($R\bullet$) and a

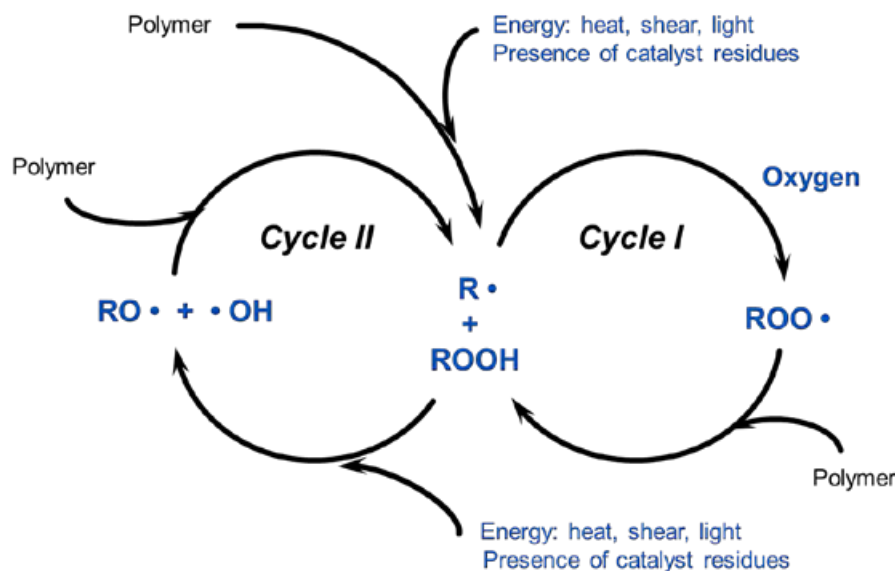


Figure 3. The autoxidation cycle

hydroperoxide molecule ($ROOH$). The newly generated free radical can then interact with molecular oxygen and repeat Cycle I.

Cycle II illustrates the breakdown of the unstable hydroperoxide to form additional free radicals. The hydroperoxide splits to form an alkoxy radical ($RO\cdot$) and a hydroxy radical ($HO\cdot$). These radicals can then interact with the polymer or other molecules to form new molecules (such as alcohols, ROH) and generate additional free radicals that can then enter Cycle I. The breakdown of the hydroperoxides in Cycle II increases the overall radical flux and accelerates the oxidation process.

Polymer additives, such as antioxidants and light stabilizers, are used to slow down and prevent autoxidation. Primary antioxidants, such as hindered phenol compounds, act as hydrogen donors and oxygen-centered radical scavengers, preventing the formation of hydroperoxides. Primary antioxidants are most effective in Cycle I, but also can act in Cycle II. Secondary antioxidants, such as hindered phosphite compounds, act to decompose the hydroperoxide without the formation of free radicals, slowing the creation of free radicals in Cycle II. Ultraviolet light absorbers can absorb ultraviolet light (UV) and dissipate the energy before it interacts with the polymer to form a free radical, preventing entrance into the autoxidation cycle.

While these additives can, and are intended to, reduce the discoloration of the polymer relative to unstabilized polymer, the additives can also *contribute* to color under certain conditions. As examples, three methods by which additives can contribute to color are

1. Over-oxidation of hindered phenols can lead to conjugated structures with strong color
2. Interactions between hindered phenols and oxides of nitrogen (N_xO_y) can lead to the formation of strongly-absorbing chromophores
3. High concentrations of ultraviolet light absorbers can begin to absorb short-wavelength visible light, directly discoloring the polymer

DISCUSSION

Over-Oxidation of Hindered Phenols

Hindered phenols, such as 2,6-di-*tert*-butyl-4-methylphenol (**AO-1**) or octadecyl-3-(3,5-di-*tert*-butyl-4-hydroxyphenyl)propionate (**AO-2**), have been long-established to act as antioxidants in polymer systems. Even at low concentrations, these molecules are very effective at preserving the architecture of the polymer. However, as the antioxidants donate hydrogen atoms to neutralize free radicals in the autoxidation cycle, they can undergo a variety of rearrangements and reactions that can lead to the formation of conjugated chromophores. AO-1, due to its simplicity as a molecule, offers a good model for examining how conjugated chromophores can arise from oxidation of the hindered phenol. Figures 4 and 5 illustrate the transformation of AO-1 into stilbenquinone and diphenoquinone respectively. The more complex conjugated chromophores for the oxidation of AO-2 are shown in Figure 6. Table 1 shows the wavelength of maximum absorption and the molar absorptivity of the transformation products relative to β -carotene.

As illustrated, chromophores do not arise from the loss of a single (or even second) hydrogen in the hindered phenol. To form a chromophore, the antioxidant must donate multiple hydrogens, undergo coupling reactions, and donate further hydrogens to conjugate the coupled molecule. This over-oxidation of the molecule is ultimately what results in the formation of the chromophore.

As polymer converters increase the use of regrind in their processes, and with a strong consumer focus on increasing the amount of recycled polymer used, there is a unique challenge relating to discoloration. In these cases, the starting material (i.e., the antioxidant) has already been partially oxidized or consumed. Each heat history applied to the polymer increases the level oxidation and consumes more

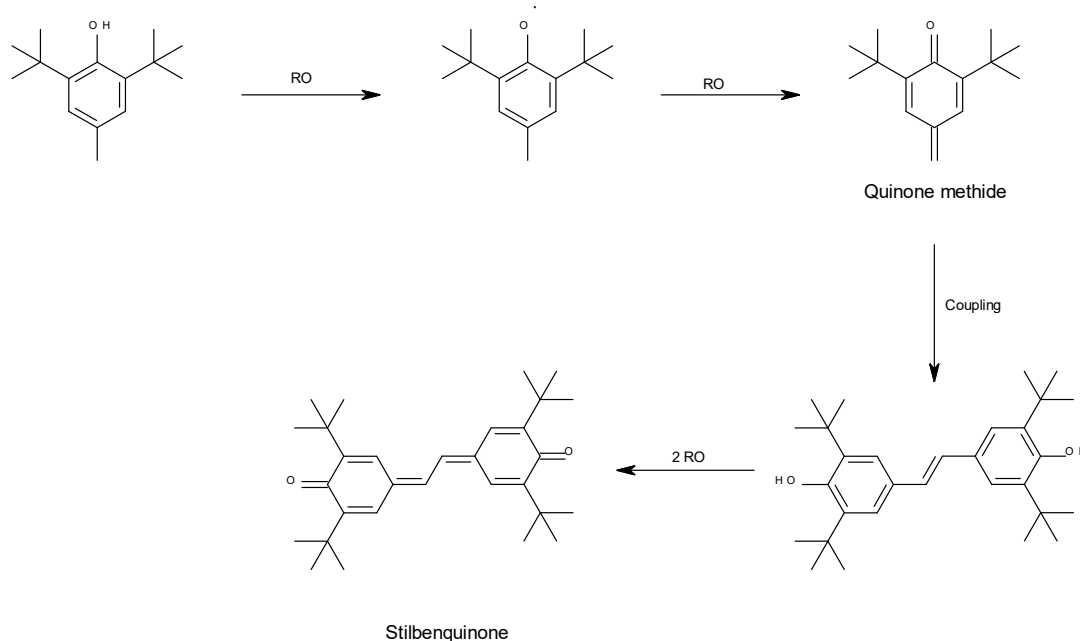


Figure 4. Oxidation of AO-1 to stilbenquinone

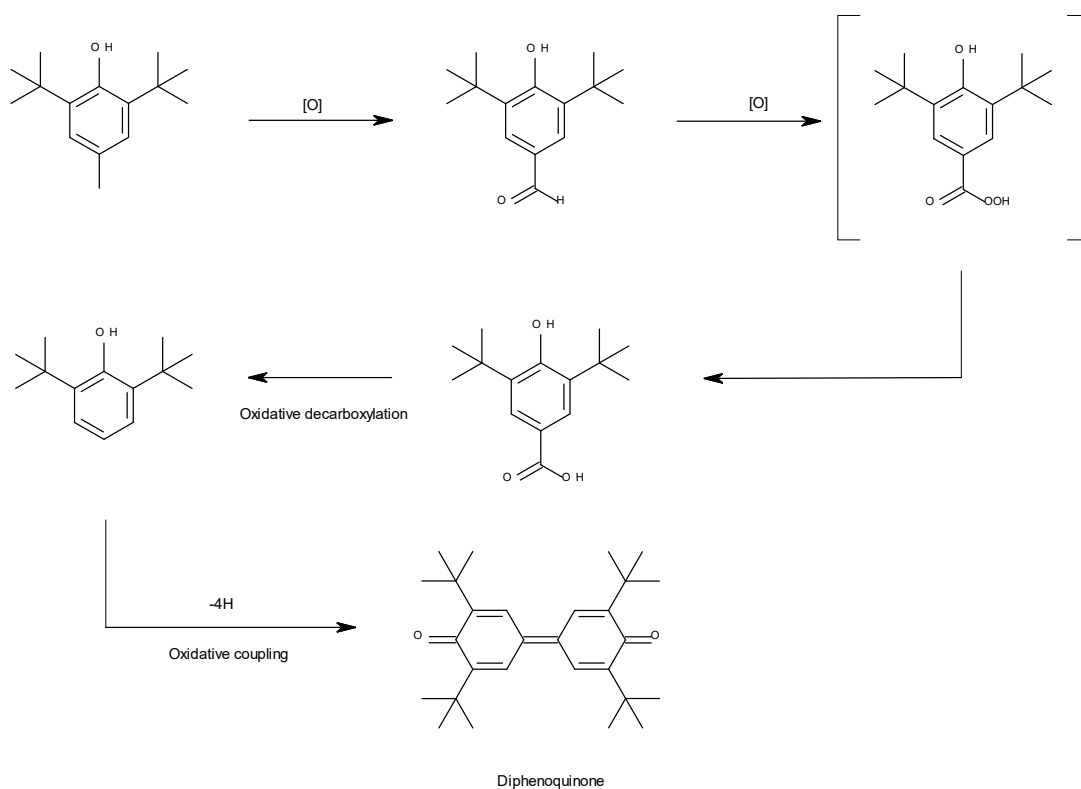


Figure 5. Oxidation of AO-1 to diphenoquinone

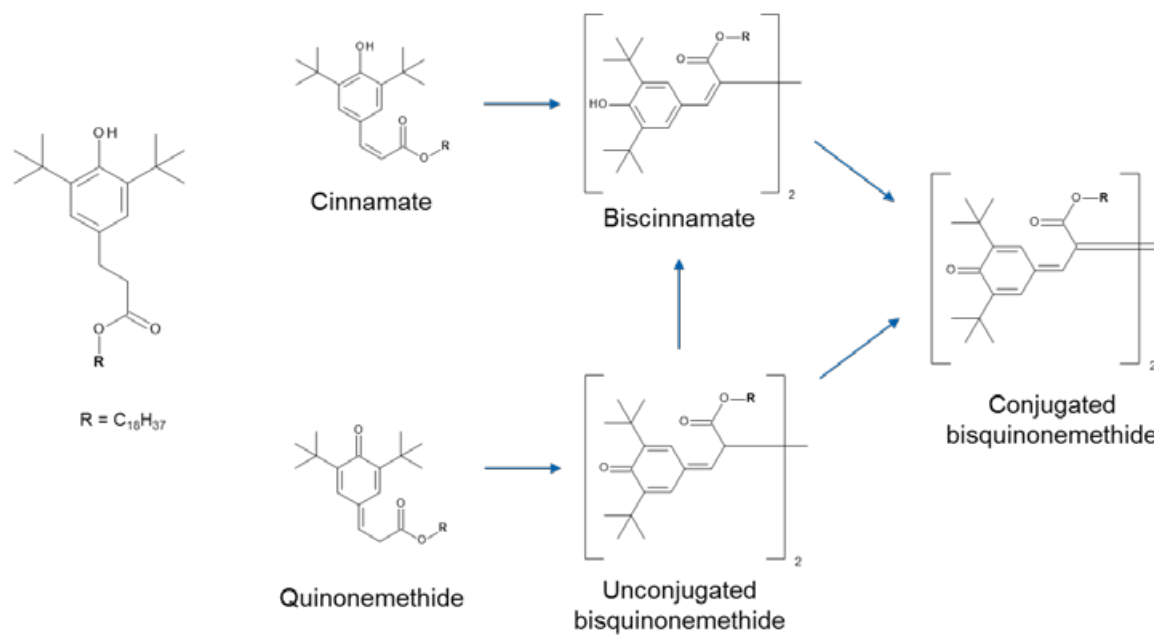
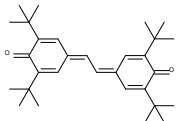
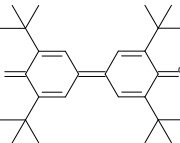
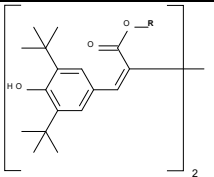
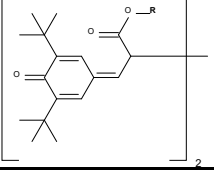
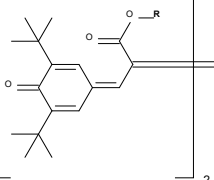
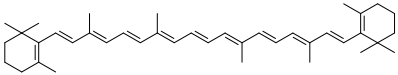


Figure 6. Oxidation products of AO-2

Table 1. Wavelength of maximum absorption and molar absorptivity of chromophores.

Chromophore	Structure	λ_{\max} , nm	ϵ , l/mol·cm
Diphenoquinone		423	72,700
Stilbenquinone		452	106,000
Biscinnamate		450	106
Unconjugated bisquinonemethide		420	116
Conjugated bisquinonemethide		440	34,800
β -carotene		452	152,000

antioxidant. If supplemental antioxidant isn't used at each processing step, the probability of forming a chromophore increases. And since many of the chromophore precursors are nearly colorless, there may be little warning to the converter or consumer that there is a problem until the next stress to the polymer creates discoloration.

To minimize the formation of chromophores due to oxidation of hindered phenols, there are several strategies that can be employed⁵.

1. *Select the correct hindered phenol (and concentration)*

As an example, the formation of chromophores can be reduced by increasing the difficulty of the coupling reaction. The steric hindrance to coupling provided by the C₁₈ fatty ester tail of AO-2 compared to the methyl group of AO-1 illustrates this principle. There are many phenolic antioxidants available commercially, with each product having strengths and weaknesses related to discoloration and melt flow control.

2. *Select and use secondary antioxidants (phosphite)*

The use of secondary antioxidants such as a hindered phosphite to decompose hydroperoxides can reduce the formation of free radicals in the autoxidation cycle, and reduce the burden on the hindered phenol.

3. *Optimize the ratio of hindered phenol to phosphite*

Because the performance of primary and secondary antioxidants is synergistic, finding the right ratio will ensure neither component is over oxidized or consumed disproportionately. It is recommended that the ratio of phenol to phosphite be in the range of 1:1 to 1:4, with 1:2 being a good starting ratio.

4. *Select and use an appropriate acid scavenger*

Since catalyst residues and certain types of acidic or alkaline species can accelerate reactions leading to discoloration, using an appropriate acid scavenger can help minimize the formation of chromophores.

5. *Consider employing phenol-free stabilization*

The use of alternative chemistries, such as hydroxylamines, in place of hindered phenols can reduce the likelihood of forming chromophores and provide better polymer color.

Gas Fading / Pinking of Hindered Phenols

Hindered phenols are known to interact with oxides of nitrogen (N_xO_y) to create chromophores^{7,8,9}, as illustrated in Figure 7. In this instance, the degree of discoloration is also related to the exposure surface and the surface area to volume ratio of the plastic part. Materials with high surface area to volume ratios, like polymeric fibers or films, have a higher exposure to N_xO_y during storage, leading to a higher rate of discoloration.

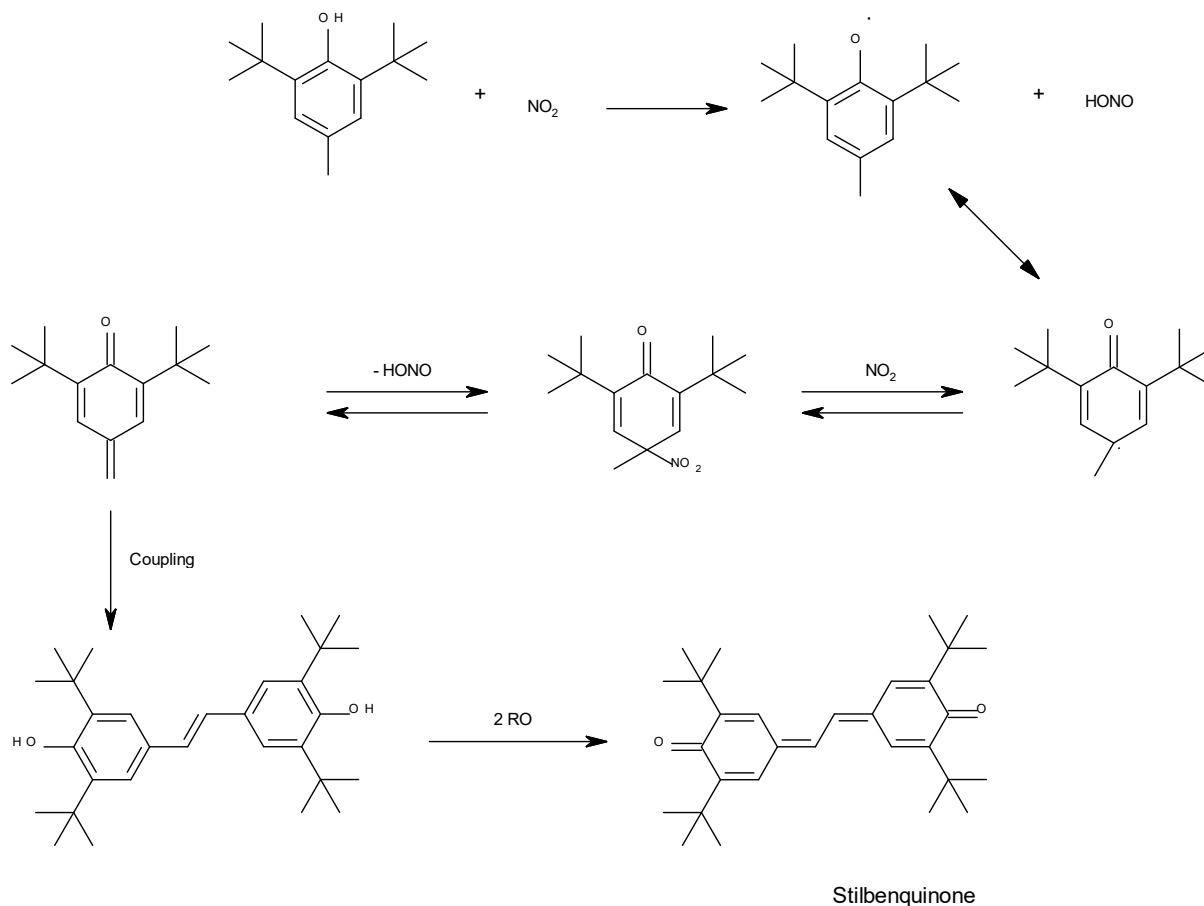


Figure 7. Gas fading reaction

To minimize the formation of chromophores due to gas fading, beyond limiting the exposure of the plastic part to N_xO_y , the strategies employed are similar to the strategies used to prevent over-oxidation of hindered phenols (see above). Selection of the correct phenol, phosphite, and acid scavenger, and using the appropriate concentration and ratio of ingredients can reduce the oxidation of the hindered phenol. The best option, however, may be moving to phenol-free stabilization systems, such as those based on hydroxylamine stabilizers.

Additionally, it should be noted that many polymer manufacturers include at least some hindered phenol in their polymers to provide melt processing stability. Phenol already present in the polymer cannot be removed and will always be prone to gas fading reactions. Selection of low gas fading grades of polymer may be required for sensitive applications.

Direct Absorbance by Ultraviolet Light Absorbers

Ultraviolet light absorbers are chromophores that prevent the photodegradation of polymers by absorbing ultraviolet light and dissipating the absorbed energy without breaking down or initiating oxidation. The mechanisms of absorption have been studied extensively⁵.

UV absorbers are governed by Beer-Lambert law, which equates absorbance of light to the concentration of the absorber, the pathlength the light travels, and the molar absorptivity of the molecule itself as given in Equation 2:

$$A = -\log_{10} \left(\frac{I}{I_0} \right) = \epsilon l c \quad (\text{Equation 2})$$

where A is the absorbance, I is the intensity of transmitted light, I_0 is the intensity of incident light, ϵ is the molar absorptivity (a measure of the attenuation of a particular wavelength of light), l is the pathlength, and c is the concentration of the absorber.

For absorbers that block longer-wavelength UV radiation, at high concentrations their absorbance can impinge on the visible spectrum and absorb blue light, introducing yellow discoloration into the polymer. This discoloration will be present in the polymer from the start, rather than forming over time as we saw in the previous two cases. According to Beer's law, this impingement will be concentration-dependent, with higher concentrations of absorber acting to absorb more of the visible light.

As an example, Figure 8 show the reflectance curves of three UV absorbers (BTZ-5, BTZ-6, and CYA-1) at different concentrations in polycarbonate relative to a control¹⁰. At the start of the visible spectrum (400 nm) all the UV absorbers show some absorbance, but BTZ-6 shows strong absorbance than BTZ-5 at equal concentration. CYA-1 shows a longer absorbance tail into the visible spectrum, giving it intermediate performance between BTZ-5 and BTZ-6 in this case.

To minimize the discoloration due to the absorbance of visible light by UV absorbers, there are several considerations to take.

1. Ensure the light stabilization package is well-designed

UV absorbers are only one class of light stabilizers. Other classes, such as hindered amine light stabilizers (HALS), may offer better protection in some polymers (such as polyolefins) without contributing significantly to discoloration. Optimizing the light stabilizer package will help

determine if a UV absorber is necessary in the formula, or if the same result can be achieved by a different mechanism.

2. *Minimize the concentration required for the UV absorber*

Since absorbance is directly related to the concentration of the absorber and pathlength the light travels, understanding how much UV absorber is required can help. For thick parts, like those found in rotational molded water tanks, only a few hundred parts per million of UV absorber may be required to provide a benefit in light stability. In contrast, in polycarbonate glazing, up to several percent of absorber may be required to meet the durability requirements. Understanding the relationship between durability, concentration, and part thickness will ensure the system is optimized for the end-use application.

3. *Consider alternate chemical families of UV absorbers*

Every UV absorber has its own absorption spectrum and characteristics. Every polymer has chemical bonds that are susceptible to absorption of UV light. By carefully selecting a UV absorber that covers the spectrum of concern for the polymer, one may be able to select a UV absorber that has less impingement into the visible spectrum while preventing photodegradation of the polymer.

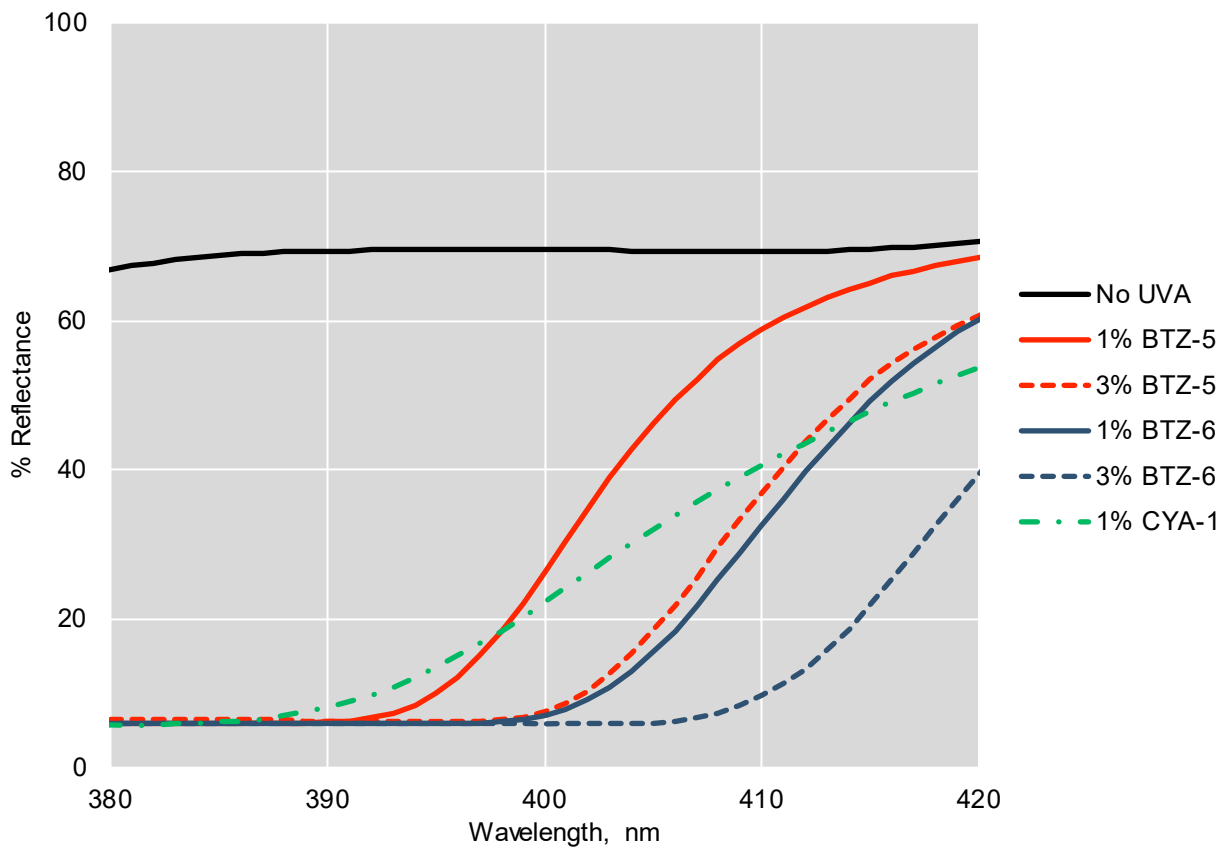


Figure 8. Reflectance curves for ultraviolet light absorbers in polycarbonate

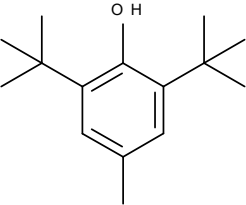
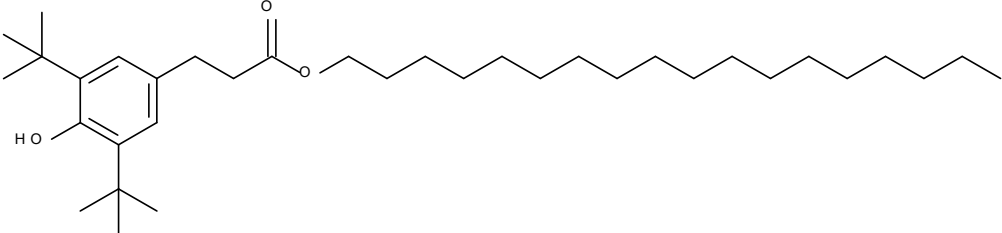
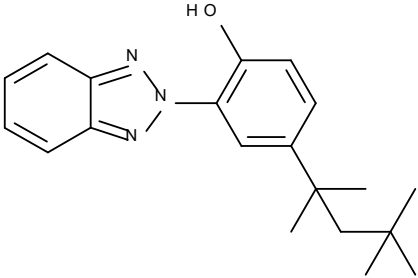
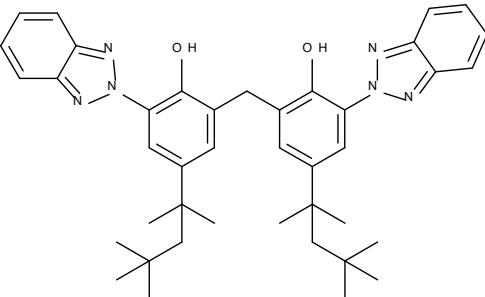
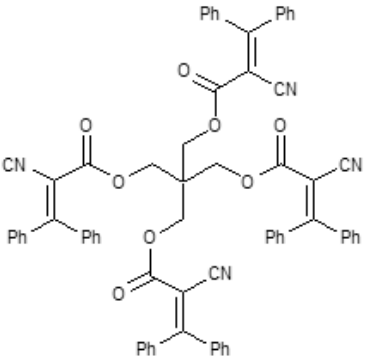
CONCLUSION

While many polymer additives are intended to reduce the discoloration of polymers and ensure the polymer's performance, they can under certain conditions contribute to discoloration. By ensuring that additive packages are well-formulated, one can help mitigate some of the most common discoloration problems. Starting with the antioxidant package, selection of the hindered phenol, phosphite, and acid scavenger is the first step to minimize discoloration. Optimizing the ratio of the phenol to phosphite can also reduce excessive oxidation that can lead to discoloration. Understanding the role UV absorbers can play in initial color is also important. Formulating a robust light stabilizer package, selecting the right UV absorber, and optimizing its concentration are crucial steps to ensure the discoloration is minimized.

REFERENCES

1. R. E. King III. "Polyolefin Discoloration: New Additive Solutions Solve Common Problems" *Plastics Technology*, Volume 63, Issue 8, p. 40-44 (2017)
2. R. I. Fenn "Yellowing problems cause retail problems." *Journal of Textile Progress*, Volume. 15, Issue 4, p. 37-39 (1987)
3. R. M. Silverstein, G. Clayton Bassler, and Terrence C. Morrill. *Spectrometric Identification of Organic Compounds, 5th Edition*. p. 298-299 (1991)
4. H. Zweifel, R. Maier, and M. Schiller. *Plastics Additives Handbook, 6th Edition*. Ch. 1, p. 3-19 (2009)
5. R. E. King III, "How to Avoid Post-Extrusion Discoloration in White Polyolefin Films," *Proceedings of the SPE Color and Appearance Division RETEC Conference*, Atlanta, p. 209-228 (2003)
6. H. Zweifel, R. Maier, and M. Schiller. *Plastics Additives Handbook, 6th Edition*. Ch. 2, p. 204-215 (2009)
7. S. B. Samuels, T. P. Steele, and A. H. Wagner. "Gas Fading on Paper and in Practice," *Proceedings of the SPE Polyolefins RETEC*, Houston, p. 671-686 (1995)
8. M. P. Makowski, S. B. Samuels, A. H. Wagner. "Effect of Environmental Pollutants on the Discoloration of Polyolefins," *International Conference on Advances in the Stabilization and Degradation of Polymers*, Lucerne. p. 259-273 (1995)
9. T. Tikuisis. "Improving the Gas Fade Performance of Polyethylene Film Resins by Addressing Over-Oxidation of Phenolic Antioxidants," *TAPPI Polymers, Lamination, Adhesive, Coatings, and Elastomers Conference*, Las Vegas. CD ROM Proceedings (2005)
10. T. Finnegan, "The Influence of Ultraviolet Light Absorbers on the Color of Plastics," *Proceedings of the SPE Color and Appearance Division RETEC Conference*, Indianapolis. Electronic Proceedings, (2015)

TABLE OF CHEMICAL STRUCTURES

Compound Identification	Structure
AO-1	
AO-2	
BTZ-5	
BTZ-6	
CYA-1	

Councilor's Report–Highlights of Councilor Meeting November 14-15, 2019, SPE Headquarters (Bethel, CT)



ROLL CALL (J. Lyons) With 53 Councilors, 9 of which are proxies in attendance, a quorum was established to conduct business.

FINANCIAL UPDATE (J. Dworshak)

Year to date (September), we are running a deficit operationally which is being offset by a strong investment portfolio, making us favorable to budget year to date. The 2020 budget was presented showing an operation deficit of \$492k. VP Dworshak noted that we continue to see declining membership, lower event revenue and higher expenses. We are surviving but not thriving and we have been negative operationally every year since 2013 (with the exception of 2018). VP Dworshak challenged Council as to what we can do as a whole to put SPE in a better financial position. There were

questions regarding investments and how they should not be the savior and everyone agrees. This begs the fact that we MUST drive top line growth of the Society. Exploring putting everyone in the Society on the same renewal schedule for their membership dues. Councilor Baumann suggested that we explore training as a form of revenue and Councilor Young proposed having SPE vet and recommend training that could be listed on the website that perhaps we could take a cut of the revenue. Councilor Gupta brought up the training that used to exist at ANTEC® and asked if something similar could be revived in the future.

CEO UPDATE (P. FARREY)

Chief Farrey discussed his trip to K and how he met with the chair of a European Division and asked him why they never show up to Council and the reply was difficult to stomach...that we are arguing about the same issues that we did years ago and that the answers will still be the same. There is clearly a disconnect in the communication channel between staff/EB/Council that needs to be addressed. CEO Farrey reminded us that every Councilor's name is on the 990 that is submitted to the IRS every year. He noted that we just saw and accepted a \$500k deficit budget and that no one asking a question about it is extremely disheartening. It is our (all of Council's) responsibility to help identify and more importantly implement solutions to this problem. CEO Farrey then introduced the new HQ building and commented that over 10 years, the new HQ will only cost \$10k more. He also noted the success at K and upgrades to our software programs including event apps and paper submissions. HQ Services update: He noted that this is one of the most difficult problems that he has had to tackle in his professional career and currently a second revision to the task force is being reviewed prior to being presented to Council. Farrey finished with discussion of Plastics for Life. The program commenced in 2014, recognizing plastics products that protect life, enhance the quality of life, and/or sustains life. The winners of the Chapter Awards will advance to ANTEC® for a final, global competition. To date, only 5 Chapters have competitions in place and staff has a goal of 12 (2 outside of the US) to hold annual competitions. The ask is for a Task Force (Councilors Czuba and Brosius) to be created to standardize the competition and define the criteria for becoming a champion.

GOVERNANCE TASK FORCE PHASE 2 Presentation (B. Mulholland)

VP Mulholland reviewed the proposal made by the Executive Board and summarized some of the comments that were mentioned on the Chain. Data that suggests that a smaller governing body is ideal for a Society of our size. He went on to suggest that decision making becomes sluggish due to the size of our 90 person governing board and the body's time is better spent discussing strategy rather than governance. Goals for today include: 1) the ideal number of Councilors, 2) how to assure that Council retains some level of control to prevent the governing body from going rogue and 3) the role of Council moving forward. Councilor Marginson reminded everyone that there may be possibilities that solve the issues identified by the Executive Board without necessarily selecting one of the two proposals that have been identified by EB. Councilor Brosius stressed the importance of Council focusing on strategic initiatives to reverse this trend less on governance. Councilor Haake motioned that the composition of the Executive Board remains the same and becomes the governing body of the Society per Bylaw 8.1.1 and other related bylaws as long as safeguards remain in place that enables Council the ability to reverse any bylaw change made by the Executive Board with a 2/3rd vote. Motion is seconded by Councilor Marginson. The motion passes with two oppositions (Councilors DeLuca and Wyer) and one abstention (Councilor Tarahomi).

COUNCIL COMMITTEE OF THE WHOLE RECAP (B. Kapur)

As related to sustainability, Councilor Kapur stressed that it is important to drive further and come up with actionable items. Some best practices were shared from sections that are reaching out to local universities and involving them in their Boards while other sections mentioned that they have more open meetings without obligations to lure people in, allowing them to discover the value by themselves.

Councilor's Report Highlights (continued)

ANTEC® Update (P. Farrey)

Per Council's suggestion, pre-conference workshops are back on the schedule on Sunday from 1-4PM before the awards reception that night. Due to several requests, student posters are back at ANTEC® and will be held in conjunction with the awards ceremony.

STUDENT CENTRIC EVENT UPDATE (J. Gomez)

President-Elect Gomez talked about the experience that students have at ANTEC® and he questioned whether it was living up to their expectations and providing the maximum value. As such, he wants to develop a student centric event, potentially held at HQ, which may include the following: A) Poster/presentation session for student, B) A chance for companies to present themselves C) Speed interviews. President-Elect Gomez captured other Councilor feedback via a brainstorming exercise that he will publish on the Chain for further comment.

VP MARKETING AND COMMUNICATIONS UPDATE (C. Carlin)

VP Carlin stated more people are getting involved as evidenced by the surge in activity on the Chain as it relates to sustainability. He also formed a global team passionate to the efforts of Sustainability to draft a positioning statement for SPE.

VP DIVISIONS UPDATE (J. Lyons)

VP Lyons took care of some housekeeping issues and motioned for Council to approve a charter to the Building and Infrastructure Division-in-formation. There was a question related to what they do and Councilor Gupta talked about pipes, siding, tanks and anything related to the building and construction industry. As there is overlap with several existing Divisions, they are focusing on joint sessions to enhance member value through collaboration. They have been a SIG for 7 years and are up to 70+ members. The motion was seconded and passed unanimously.

VP SECTIONS UPDATE REPORT (T. Haake)

Councilor Haake motioned that the following sections be moved to provisional status: Israel, Korea, New York, Kansas City, Smokey Mountain and Tennessee Valley and that the following sections move from provisional to abandoned: Toledo and Great Salt Lake and that Council approve the establishment of the Lakehead University Student Chapter. The motion was seconded and passed unanimously.

SPE FOUNDATION UPDATE (E. Vitale)

Eve talked about the primary focus of the Foundation which includes: scholarships, grants, Hopkits and PlastiVan. She noted that there is a 30% increase in scholarship applications across more than 20 universities. The statistics for PlastiVan were highlighted, showing favorable growth across the board. Director Vitale showed an increase of 18.2% for students served, 10.1% for schools involved, 19.0% for visits and 17.2% for sponsors. PlastiVan is introducing wonder to young students and changing the perception of plastics one class room at a time. In talking to students, you have to make it about them... "What do I give up if I give up plastics?" which opens their eyes quite a bit. Director Vitale is requesting Ambassadors to promote a *Giving Tuesday Campaign* in their areas. There were questions related to resources that are available, particularly videos and cheat sheets that enable a scientist to change their angle of approach to make more of an impact within the classroom. Additionally, there was a suggestion to create a list of references/resources/goodies that could either be shipped or downloaded by interested parties.

OLD BUSINESS / NEW BUSINESS (B. Landes)

Old Business, there was a question related to the mentorship program and CEO Farrey said the champion of the program resigned and staff is looking for a volunteer to help evaluate and move the program forward. **New Business**, there was a suggestion to evaluate having Council after ANTEC®.

Mercedes Landazuri

Color and Appearance Division, Councilor



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INVITATION TO ATTEND OUR BOARD MEETINGS

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

The Summer meeting is scheduled in various locations. A Winter BOD meeting is held in January. The Winter meeting is typically held at a site of a future CAD RETEC®.

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

Winter 2019



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