Tire Rubber Composite Alloys and Coloration in Polyolefins and Polyamide Recycled Plastics

State of the Art using recycled cryogenically ground tire rubber side wall or thread rubber has become reality!

The problems associated with Odor have been resolved.

The problems associated with compatibilization of the tire rubber with polyolefins or condensation polymers such as polyamides have been solved.

The problems with notched and unnotched or Dart Impact properties of tire rubber composites have been solved.

The problems of providing any final color other than Black have been resolved with a broad range of light and dark colors.

The problems with long term Ultraviolet stability have been solved.

Tire rubber odor problems have been a problem for many years. The solution was not forthcoming due to the poor analytical and poor approaches to dealing with the complex problem. Identifying the key components of odor is both an objective and subjective problem and both needed to be dealt to solve the core problem and to find a viable solution. The approach involved both odor panels and extensive GCMS and HPLC to identify the species responsible for odor and to subsequently provide a solution.

The foundation to solve this problem is currently being used to solve other odor problems globally.

Compatibility of tire rubber crumb up to 50 weight percent in both polar and non-polar substrates was a challenge. Previous assumptions based on both academic and independent research were regarded as flawed due to not having proper controls in the study and poor preparation and testing protocols to reach their conclusions.

Today the problem has been solved based on IPN networks which is a proven technology developed from work done in the early seventies.

SEM and ASTM testing of both polar and non-polar resins based on recycled resin containing a control (no tire rubber), 10,20,30,40 and 50% wt. showed

Excellent alloy blends and impact properties comparable or better than Santoprene rubber.

Tire rubber compounds are Black! If you want a black pigmented polyofefin or polyamide the color was black. Today using OMPF technology (organo-mineral pigment fillers) to replace traditional pigments the cost is lower and the control of nucleation and impact properties and flexural modulus is now possible.

Photos of Coloration of Tire Rubber Composites:

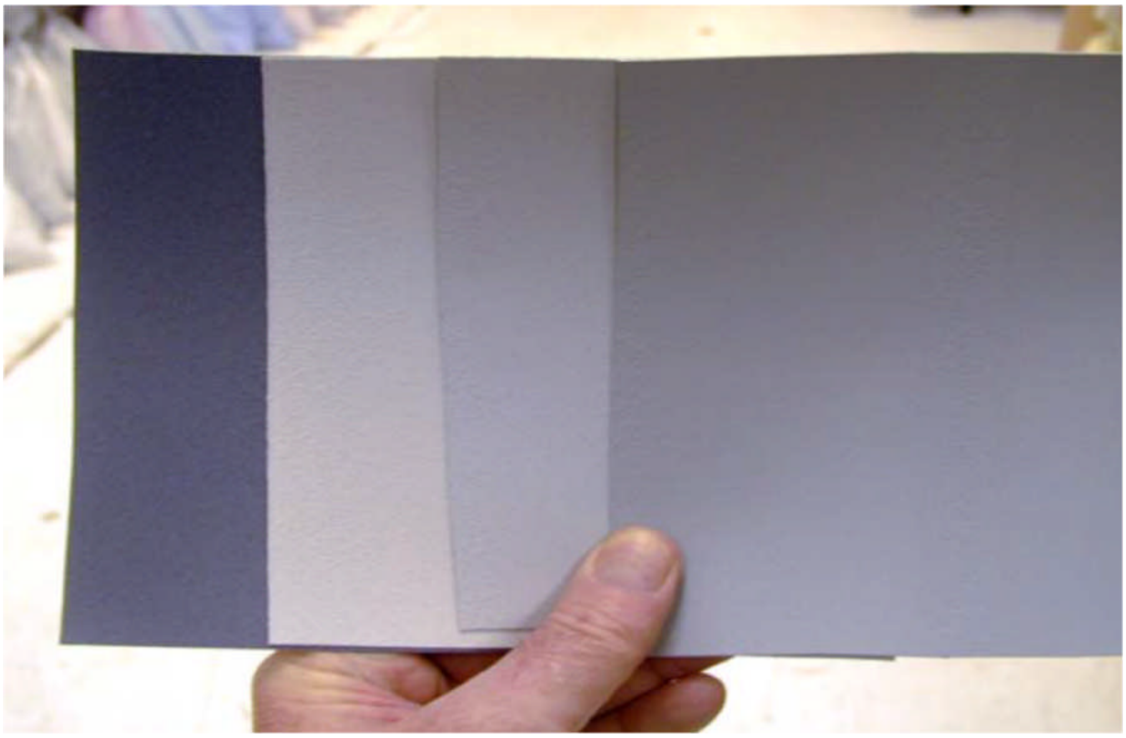
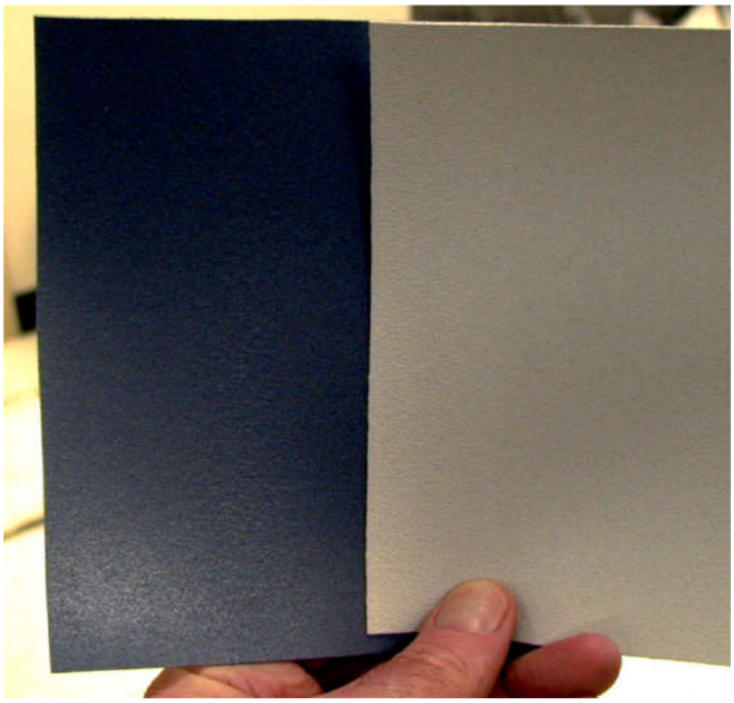


Figure1: Black and Gray Shades



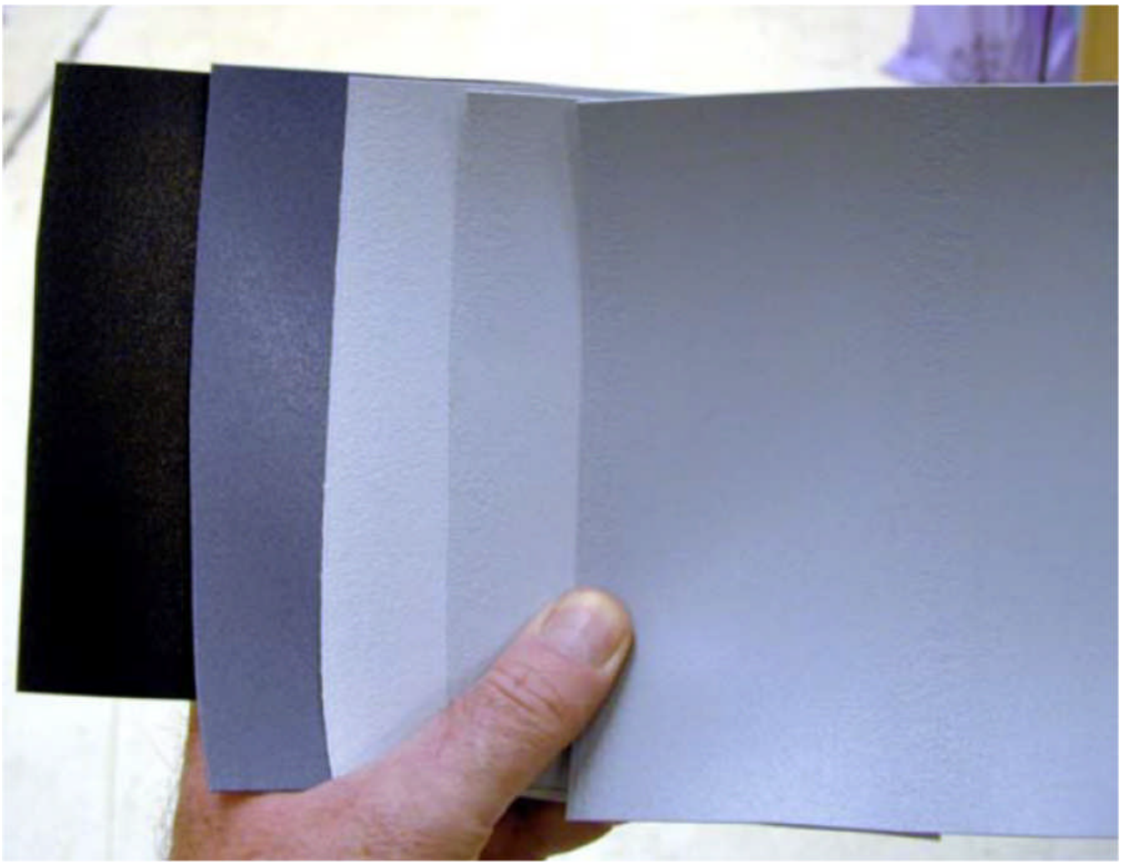


Figure 2: Black and Gray Shades-continued

Figure 3: Coloration

Figure 4: More Shades of Color

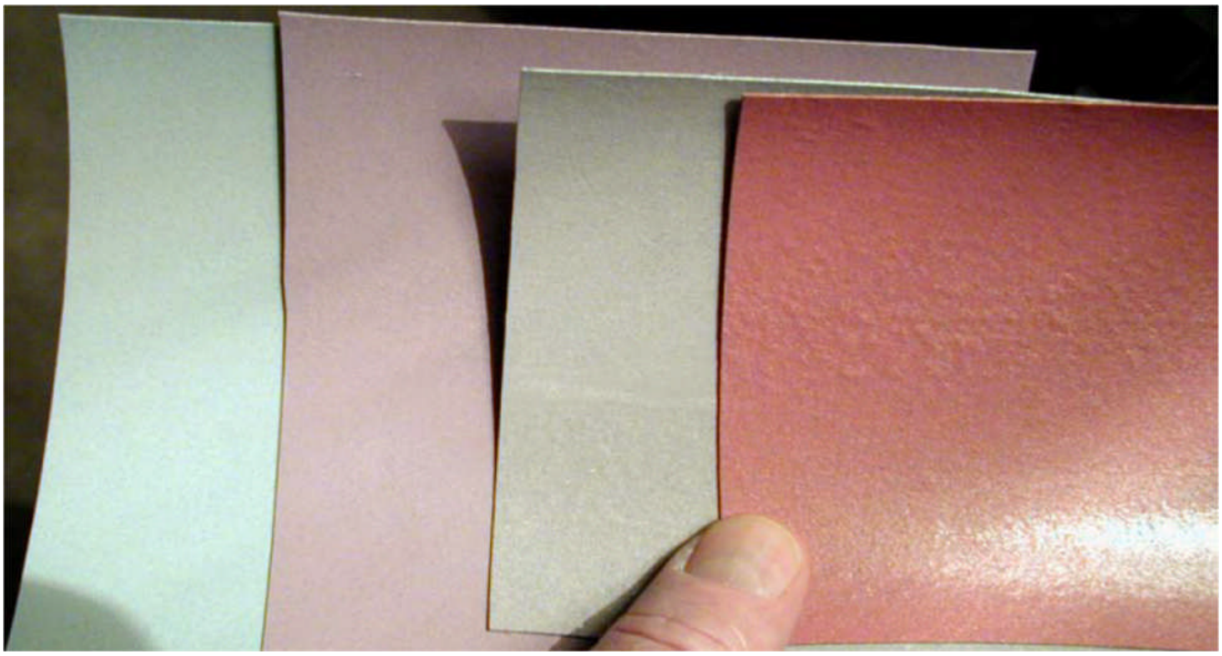


Figure 5: Blue Shades

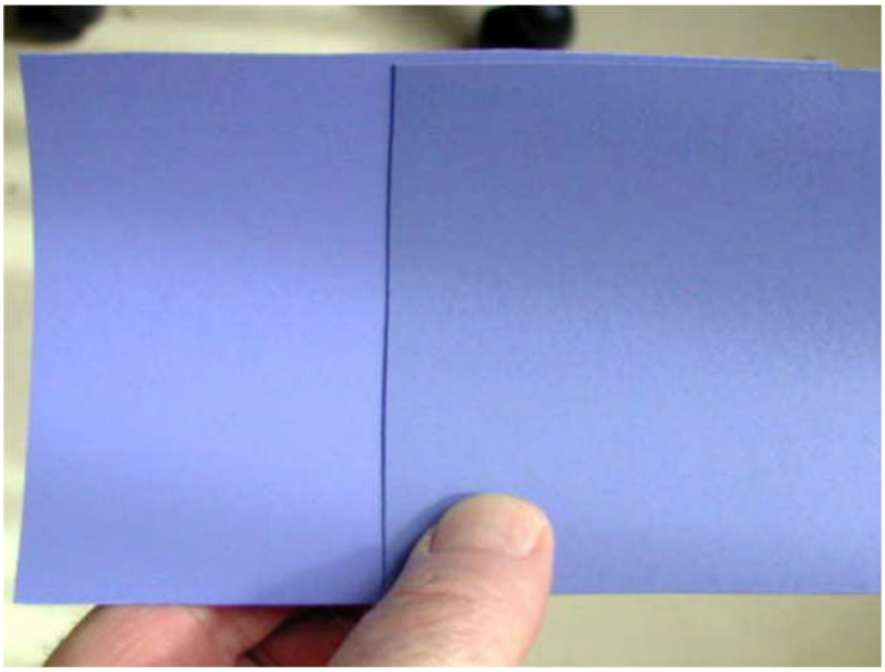


Figure 6: Purple Shades

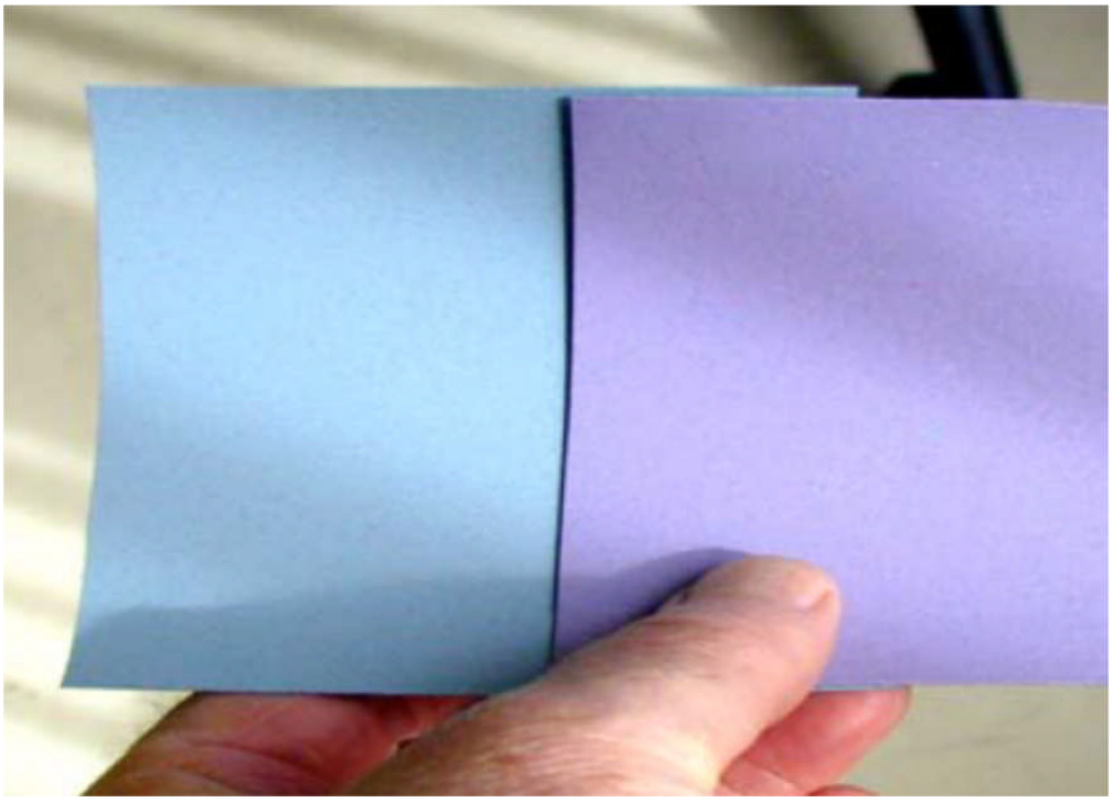


Figure 7: Green Shades/Tan Flesh Coloration

OMPF Technology uses encapsulation of cationic paper and tissue dyes into the cavities of a clathrate structure to provide thermal and photo stability to the dye while giving coloration to the matrix at significantly lower economics of scale.

Figure 8: OMPF BLUE with only 300 ppm final colorant in the HDPE molded beverage crate holder.

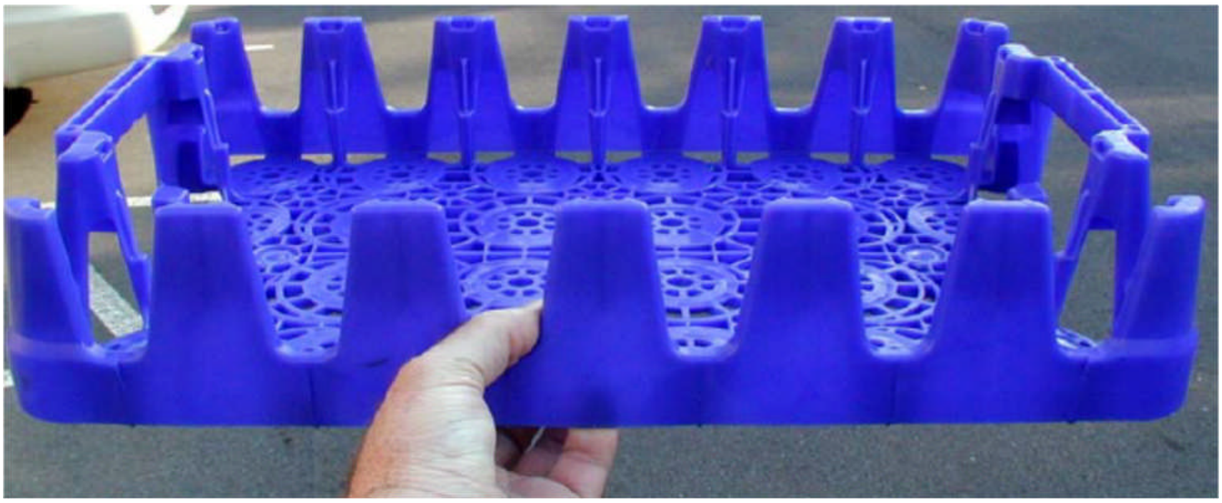
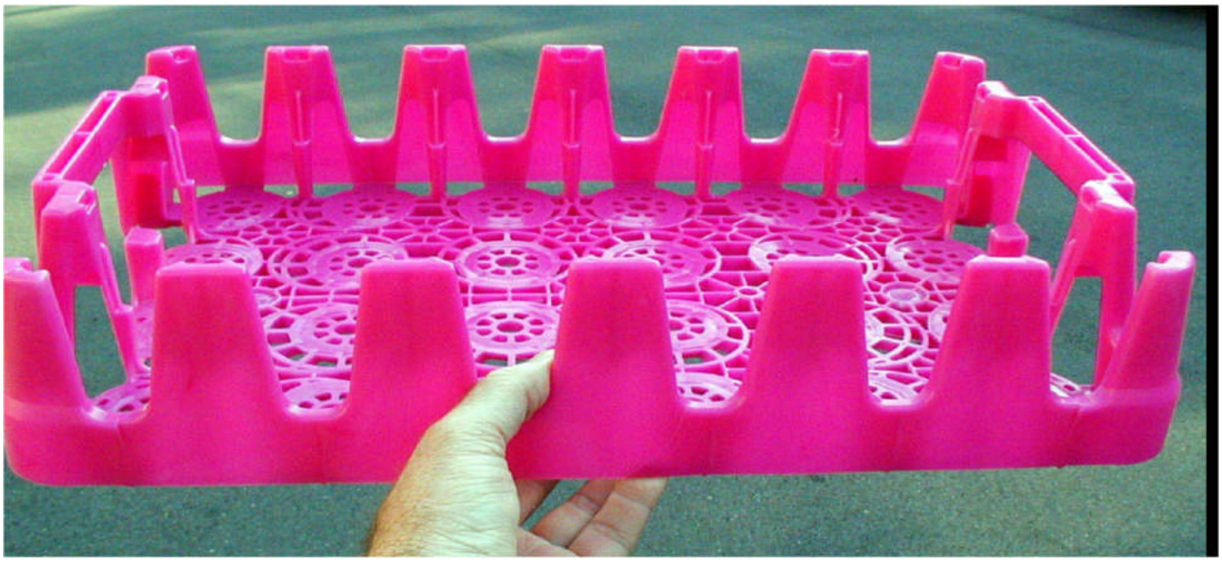


Figure 8: Blue Injection molded container HDPE

Figure 9: Pink Beverage Holder for Latin America



Unlike conventional pigments the shades and colors of most OMPF colorants are red and green shades and very vivid mass tones. Final loading of the dye in the polyolefin or condensation polymer ranges from 100 to 400 ppm. Unlike most dyes their use in polyolefins is considered non-existent for obvious reasons known to color chemists. However, when you integrate the dye into the clathrate structure the negative issues disappear. Economics of scale are inexpensive and no toxic solvents are used in the process. Furthermore, OMPF is sustainable chemistry and provides for a broader range of new colors to choose.

Figure 10: OMPF Yellow

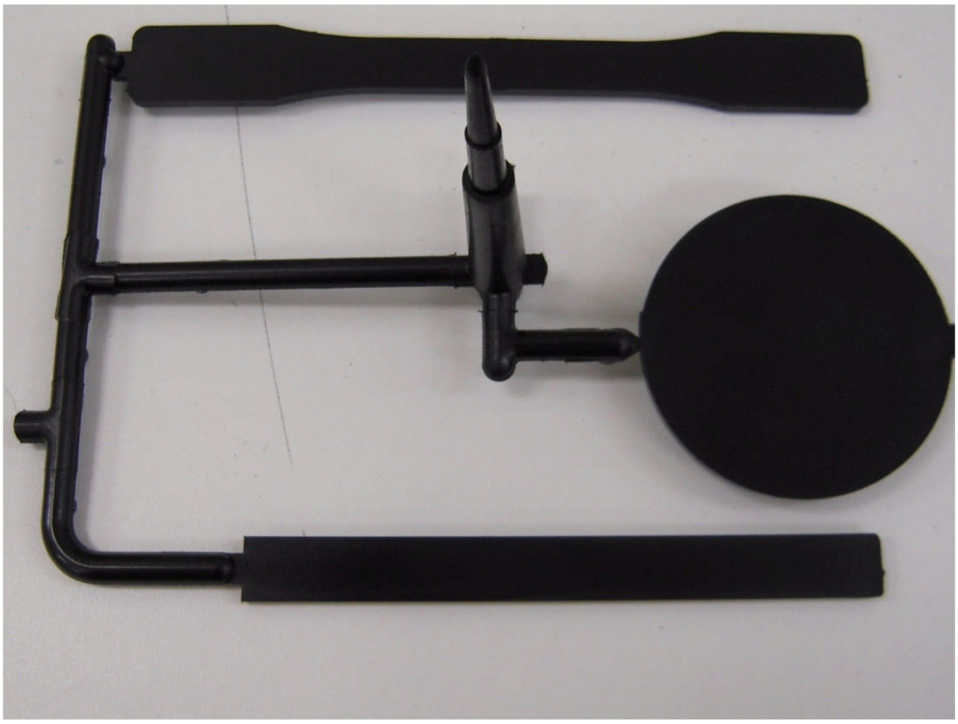
Garbage lid cut from larger piece containing final levels of 200 ppm colorant.

Figure 11: OMPF powder

Figure 12: Recycled Nylon Carpet Waste Coloration with OMPF.

Figure 13: Tire Rubber Alloys ASTM Molded Parts

30% Tire Rubber



Highly flexible and High Impact Strength!

Ultraviolet Stability of Tire Rubber Composites have been addressed by multiple routes depending on the composition of the system. For example polyolefins with tire rubber and compatibilization are based on the polyolefin carrier and the intrinsic stability of each component in the system.

Traditional and new technologies are being implemented to address long term goals for outdoor stability.

Condensation polymers are entirely different in the approach needed to provide long term photo-stability for the long term especially for roofing and hostile environments above 40C. These challenges are being met with molecular modifiers and plasmonic additives which address many factors.

Besides the UV durability of the polymer matrix consideration is made for long term photo stability and color changes that occur in pigmented systems. The proper broad and permanent UVA plasmonic materials are combined with organic UVA to change both the bathochromic shifts but hyperchromicity that provides for slowing down of in-situ changes in organic UVA during UV exposure. This significantly extends the life of fugitive organic UVA.

Overall, the perception of what has been done with tire rubber blends and composites in the literature differs dramatically from reality. The multiple challenges with tire rubber sustainable blends for use globally is now possible. The use of a total systems approach in dealing with these challenges is currently being used in the latest developments in solar roofing, geomembranes, Construction, and automotive today.
