



Blending Color Concentrates with Ryton® PPS

Introduction

Many current and potential Ryton® PPS (polyphenylene sulfide) customers have requested the material in a variety of colors. Natural and black colors are standard throughout the product line, but some demand exists for Ryton® PPS in other colors as well. For many applications, blending color concentrates with natural color Ryton® PPS compounds may satisfy this requirement. Pigments or concentrates may be mixed with Ryton® PPS pellets prior to or during the injection molding process. This approach can be considerably less expensive than resin suppliers producing compounds in a variety of colors, and allows the flexibility to adjust the color at machine side. This information has been compiled to address some of the common issues regarding the use of color concentrates with Ryton® PPS compounds.

Many of the natural color glass/mineral filled Ryton® PPS compounds have been successfully colored by blending with pigments or color concentrates. Ryton® R-7 Series compounds are economical, glass/mineral filled PPS compounds having an excellent balance of mechanical properties, thermal stability, and outstanding chemical resistance. The relatively low cost of the Ryton® R-7 Series compounds helps offset the additional expense of the color concentrate. Ryton® BR111 is a glass/mineral filled PPS compound that provides better mechanical strength at slightly additional cost, and also may be pigmented using color concentrates. Ryton® R-4 Series, 40% glass filled PPS compounds, are not generally suitable for pigmentation with color concentrates. The natural color Ryton® R-4 Series compounds are generally a dark brown color and do not lend themselves to pigmentation any color other than black. The lighter natural color of Ryton® BR42B, 40% glass filled PPS with PTFE surface lubricant, may make it more amenable to pigmentation.

Although coloring Ryton® PPS compounds is viable for part identification purposes, it is not generally

recommended for cosmetic or decorative purposes. The color and/or surface finish of the part may change over time in environments in which Ryton® PPS parts typically see service. Also, due to slight lot-to-lot variations in the natural color of Ryton® PPS compounds, slight variations in part color may result. It is often possible to compensate for these color variations to some degree by adjusting concentrate blend ratios at machine side, but exact color matching on an on-going basis may be difficult. If absolute color consistency is necessary, black color Ryton® PPS compounds are recommended, but outdoor weathering effects may even alter the surface appearance of black color compounds over time.

Powdered Pigment Blends

Ryton® R-7 has been successfully pigmented by addition of powdered pigments. About 1.5% by weight of dark green and dark blue pigment powders tumble blended with the natural color pellets achieved good results. Including about 0.1% by weight of mineral oil to “wet” the blend promoted adhesion of the powdered pigments to the pellets. These methods may also be employed to pigment any of the natural color Ryton® PPS compounds black by adding about 0.5% by weight of carbon black. “Wet” or “dry,” these methods are very messy, pigment is wasted in the process, and the dust from the powder is an irritant to the eyes and respiratory system. Therefore, powdered pigment blending is not recommended for long-term production of different color Ryton® PPS parts. The green and blue colored Ryton® R-7 specimens produced by these methods had tensile and flexural strength comparable to natural color Ryton® R-7 specimens, however, testing is recommended to ensure that pigmentation does not adversely affect part performance.

Color Concentrate Blends

Color concentrates are pigments blended with a carrier resin. Although a PPS carrier is preferred for blending with Ryton® PPS compounds, various other carriers including HDPE, hydrocarbon waxes, and polyamides may be used. Concentrates are available in a variety of physical forms including pellets, chips, flakes, granules, and liquids, generally intended to be mixed at three to five weight percent with white or colorless resins. Higher letdown ratios are typically required for pigmenting Ryton® PPS compounds due to their darker natural color. For molders with specialized metering equipment or hopper mixers, the letdown ratios can be adjusted as necessary during processing. However, dry tumbling of the concentrate with natural color resin is also an acceptable blending method. Most color concentrate suppliers have the expertise and ability to develop formulations that meet specific customer requirements. Contact information for some suppliers of color concentrates that have been used with Ryton® PPS compounds is provided in Appendix I.

Coloring Ryton® R-7-120NA

Among Ryton® PPS compounds, Ryton® R-7-120NA is most amenable to pigmentation due to its relatively light natural color. v 1 shows examples of Ryton® R-7-120NA parts colored using PPS-based color concentrates produced by RTP Company. In tests, specimens pigmented using these color concentrates at letdown ratios up to 8:100 generally exhibited at least 80% of the mechanical strength of the natural color compound, as shown in Table 1. Underwriters Laboratories (UL) determined that thermal and electrical properties of the compound are not significantly affected by addition of these color concentrates, and established an “All Color” listing for Ryton® R-7-120NA when used in combination with PPS-based color concentrates.

Figure 1: Ryton® R-7-120NA pigmented with RTP color concentrates



Table 1: Property retention of Ryton® R-7-120NA blended with RTP color concentrates

Color	Red	Green	Blue
Product no.	S-52336	S-62236	S-74374
Letdown ratio	6:100	8:100	4:100
Tensile strength	88 %	92 %	93 %
Flexural strength	81 %	82 %	88 %
Flexural modulus	89 %	87 %	92 %
Notched izod	83 %	83 %	91 %
Unnotched izod	78 %	88 %	93 %

Coloring Ryton® BR111

Ryton® BR111 has also been successfully pigmented using color concentrates. Table 2 and Table 3 show the retention of mechanical strength for specimens molded from Ryton® BR111 blended with color concentrates produced by Clariant. Specimens pigmented using these color concentrates at letdown ratios up to 10:100 exhibited at least 80% of the mechanical strength of the natural color compound. Although not as amenable to pigmentation as Ryton® R-7-120NA, Ryton® BR111 offers superior mechanical strength, even when pigmented.

Table 2: Property retention of Ryton® BR111 blended with clariant color concentrates

Color	Red	Green	Blue
Product no.	694689	993019	594271
Letdown ratio	5:100	5:100	5:100
Tensile strength	94 %	89 %	94 %
Flexural strength	94 %	83 %	93 %
Flexural modulus	92 %	92 %	94 %
Unnotched charpy	102 %	91 %	108 %

Table 3: Property retention of Ryton® BR111 blended with clariant color concentrates

Color	Red	Green	Blue
Product no.	694689	993019	594271
Letdown ratio	10:100	10:100	10:100
Tensile strength	90 %	84 %	94 %
Flexural strength	89 %	80 %	90 %
Flexural modulus	83 %	88 %	90 %
Unnotched charpy	97 %	90 %	104 %

Coloring Ryton® R-7

Darker color pigments were more effective at coloring the darker natural color Ryton® R-7 compound at lower letdown ratios. Consequently, the resultant specimens were darker in color. Figure 2 shows examples of Ryton® R-7 specimens pigmented using color concentrates produced by PMS Consolidated. As Table 4 shows, specimens pigmented using these color concentrates at letdown ratios of 4:100 exhibited at least 80% of the mechanical strength of the natural color compound. These blends also maintained Heat Deflection Temperatures (HDTs) over 260 °C (500 °F), as is typical for Ryton® PPS compounds.

Table 4: Property retention of Ryton® R-7 blended with PMS consolidated color concentrates

Color	Red	Green	Blue
Product no.	TC-1344	TC-3146	TC-4242
Letdown ratio	4:100	4:100	4:100
Tensile strength	85 %	92 %	97 %
Flexural strength	89 %	93 %	98 %
HDT, °C	>260	>260	>260

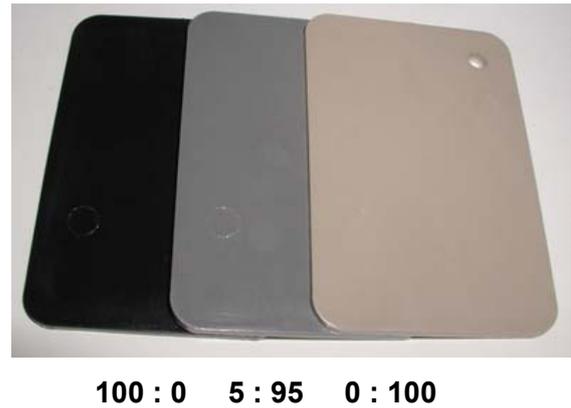
Figure 2: Ryton® R-7 natural color and pigmented with PMS consolidated color concentrates



Blending Natural and Black Color Compounds

Gray colors may be obtained by blending natural color glass/mineral filled Ryton® PPS compounds with up to ten weight percent of their black color counterparts, effectively using the black color compounds as “gray color concentrates.” Figure 3 shows an example of this method employing a 95:5 mixture of Ryton® R-7-120NA and Ryton® R-7-120BL. Mechanical properties should be at least as good as the typical performance of the black compound, and such blends will not alter the material composition enough to forfeit UL certifications.

Figure 3: Ryton® R-7-120BL : R-7-120NA



Underwriters Laboratories (UL) Considerations

UL 746B establishes a standard measure of long-term thermal stability, the UL Temperature Index. If the composition of a plastic compound is altered, the constraints outlined in UL 746B must be followed or the original UL Temperature Index for the compound (along with other UL certifications) will be forfeited. To receive a new rating, an altered compound must be tested, a process that is expensive and very time consuming. If inorganic ingredients are varied by more than $\pm 5\%$, or organic ingredients are varied by more than $\pm 0.3\%$, a two temperature thermal aging test may be required to maintain the original UL Temperature Index of the plastic compound. These constraints apply to all ingredients of the altered compound, including pigments and carrier resins, and should be observed when considering a particular concentrate formulation. Consult UL 746B for more detailed information. Ryton® R-7-120NA has “All Color” UL 94 and UL 746B ratings. Up to 8% of color concentrates based on PPS carriers may be added to Ryton® R-7-120NA without forfeiting the V-0 Flammability Rating, 220 °C/240 °C UL Temperature Index, or other UL certifications for the material.

Conclusion

Color concentrates offer a viable method of pigmenting Ryton® PPS compounds. A substantial level of mechanical strength can be retained when the original compound formulation is not significantly altered. It has been demonstrated that darker color pigments provide a sufficient contrast with natural color glass/mineral filled Ryton® PPS compounds to allow low letdown ratios to be used. Therefore, when choosing color concentrates for blending with any natural color Ryton® PPS compound, pigments darker in color than the natural color of the Ryton® PPS compound are recommended.

Appendix I

Color Concentrate Suppliers

Although specific color concentrates mentioned herein may no longer be in production, these manufacturers have the proven ability to formulate color concentrates for use with Ryton® PPS compounds and to meet the needs of specific applications.

Clariant

Masterbatches Division
Charlotte NC
704-331-7154
www.clariant.com

PolyOne*

Thermoplastic Colorants and Additives
Suwanee GA
1-800-551-7688
polyone.com

RTP Company

Winona MN
1-800-433-4787
507-454-6900
www.rtpcompany.com

* The former PMS Consolidated is now part of PolyOne

www.solvay.com

SpecialtyPolymers.EMEA@solvay.com | Europe, Middle East and Africa

SpecialtyPolymers.Americas@solvay.com | Americas

SpecialtyPolymers.Asia@solvay.com | Asia Pacific



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