

TiO₂: A Critical Ingredient for Producing Super Durable Coatings in Today's High-Pressure Market





Today's paint producers and formulators creating durable coatings for industrial applications are under more pressure than ever before.

On one hand, their customers are demanding high-quality coatings options that provide maximum protection from the growing frequency and severity of bad weather, such as soaring temperatures, harsh UV rays, and other severe conditions. At the same time, many critical applications also demand greater efficiency via longer-lasting, more durable coatings that increase the length of service before recoating and reduce material and labor costs.

Compounding these issues is the fact that formulators are simultaneously being asked to help companies find ways to achieve ambitious sustainability goals. With aggressive timelines to reduce carbon emissions set by European regulators, there's been a wave of activity and innovation across all sectors, including building and construction, transportation, and manufacturing, to find new ways to reach carbon neutrality by 2050. These conditions reinforce the need for highly durable coatings that can better protect assets, promote longer service life, lower maintenance costs, and create advancements that lead to more sustainable solutions.

For paint formulators seeking super durable coatings that will help meet the cost, quality, and sustainability goals of their customers' most demanding and critical applications, it is important that they not underestimate the degree to which all the ingredients work together to achieve the optimal level of a paint's performance. As such, having a full understanding of titanium dioxide's (TiO₂) role and impact on other key ingredients within super durable coatings is essential to meeting these growing customer needs. With this understanding, formulators can better avoid pitfalls that can degrade the quality of their products and rest assured their products offer the highest levels of reliability, leading to greater performance, durability, and peace of mind.

The Complex Nature of Durability

Formulating a highly durable paint is far from simple. One key to achieving superior durability lies in the resin chemistry, but resins boasting superior weathering resistance and performance come at a premium. While that's not exactly news to formulators, many underestimate how much the effectiveness of this critical and expensive ingredient can be diminished without the right selection of other ingredients, like TiO₂.

After resin, TiO₂ is the second greatest contributor to a highly durable coating. TiO₂ has two opposing effects on paint durability, both of which are due to its very high UV light absorption efficiency.

The first effect has to do with what happens when the resin is exposed to the high energy of UV light. Most resins will degrade through the absorption of UV light photons. These photons are energetic enough to break chemical bonds in the resin and initiate changes in both appearance and physical performance (for example, peeling). One option formulators have to lessen the damage from UV light is to add UV light absorbers to the paint. The drawback is that these materials tend to be costly, and the levels at which they are added to paints tends to be limited by these costs.

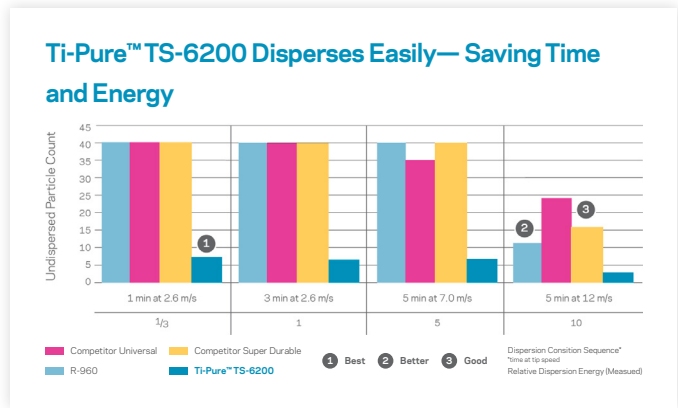
Thankfully, TiO₂ also absorbs UV light, and in fact is such a strong absorber that essentially all the UV radiation in sunlight is removed after striking a single 0.25-micron TiO₂ particle. This provides protection from UV degradation to the underlying resin molecules. The ability of TiO₂ to protect paints is determined primarily by how well it is dispersed in the film, with good dispersion giving higher paint durability. Therefore, formulators should partner with a TiO₂ manufacturer that can produce a pigment that disperses easily and completely for durable paint applications.





The second impact of TiO₂ on durability has to do with what happens after a TiO₂ particle absorbs a UV light photon. Since energy must be conserved, the energy of the UV photon must be transformed to another form of energy. In the vast majority of UV light absorption events, the energy absorbed by the TiO₂ is changed into heat, and the film gets warmer. However, the UV light energy is sometimes changed into chemical energy in the form of chemical radicals. These radicals form on the TiO₂ surface, but are mobile enough to travel to resin molecules, where they initiate a series of degradation reactions that ultimately lead to film failure.

Luckily, the rate at which radicals form and attack the resin is not the same for all grades of TiO₂. Super durable grades have a layer of silica, alone or in combination with other materials, on their surface that prevents these radicals from forming. This silica layer is applied by the TiO₂ manufacturer during production of the pigment. The fact that different grades of TiO₂ have different radical formation rates is reflected by the labeling of TiO₂ grades as being “non-durable,” “durable,” or “super durable.” Note that these designations do not apply to the pigment itself—TiO₂ is titanium metal rust and as such is thermodynamically stable—but rather to the effect that the TiO₂ grade has on film durability.



How Paint Formulators Can Choose the Right Super Durable Pigment

As consumers and regulators demand more from their architectural paints, pigment producers have responded in kind. Durable pigments are available in two broad categories. The first consists of more traditional grades, like Chemours' Ti-Pure™ R-960, which has provided well-known, consistent performance for more than 50 years. Traditional grades achieve their durability by greatly slowing the rate at which radicals form. Paint formulators are generally quite familiar with these grades and the durability performance they provide.

The second type of super durable pigments are more contemporary grades, such as Chemours' Ti-Pure™ TS-6200 that, in addition to retarding the rate of radical formation, also provide the added value of easier and more complete dispersion. As mentioned above, well dispersed TiO₂ particles offer the best protection for resin from UV light.

This two-pronged strategy — better dispersion and lower radical formation rates — provides a high level of durability, particularly with regard to gloss retention. These grades also have the advantage of being faster and easier to process, since they have been designed to disperse easily and completely. In general, the more contemporary TiO₂ super durable grades are gaining widespread acceptance in the industry. This is especially relevant for applications that require excellent gloss retention, since, all else being equal, well-dispersed TiO₂ particles have a higher gloss (and gloss retention) than poorly dispersed particles.

When seeking a coating that can provide all the benefits discussed above, formulators have a choice of ingredients to make when developing a new super durable paint or modifying a legacy one. The first choice is the correct resin, and super durable paints must use highly durable resin. Since these resins tend to be quite costly compared to their low durability counterparts, it is essential that the formulator select the other ingredients in a way that maximizes the durability performance and value of the resin. Selecting the



proper super durable TiO₂ grade is a critical aspect of this decision, and in this regard, formulators have the option of using familiar, traditional TiO₂ grades or newer, more advanced TiO₂ grades that combine low radical formation rates and a high degree of dispersibility.

Durability and the Path Toward Greater Sustainability

Customers are increasingly asking paint formulators for products that will help them reach their sustainability goals. One option is to produce higher-performing, more durable products that require less material to achieve peak results and coverage and increase an application's length of service, thus reducing maintenance costs and materials in the long-term.

Choosing the right TiO₂ grade for your super durable formulation can help you reach your and your customers' sustainability goals in the following ways:



Decreased dispersant cost

Using the highest quality TiO₂ grades can impact the amount of dispersant needed in the product formulation. This is because higher grades enable much faster dispersion. For example, compared to other super-durable TiO₂ pigments, Ti-Pure™ TS-6200 requires 50% to 75% less dispersant, thus cutting down on the amount of materials required to produce the end product.



Reduced energy usage through faster dispersion

Because of their efficient dispersion, high-quality TiO₂ grades, like Ti-Pure™ TS-6200, also enable a faster, lower energy grind. This reduction in grind time and elimination of unneeded milling operations can lower energy, operations, and maintenance costs by up to 1.1 euro cents/kilogram of pigment. And, through its advantages of more rapid grind-in, fewer grind steps, and flexibility to be formulated at higher solids grind base, Ti-Pure™ TS-6200 offers an extremely cost-effective means of increasing capacity at rate restricted coatings manufacturing facilities.



Higher gloss retention

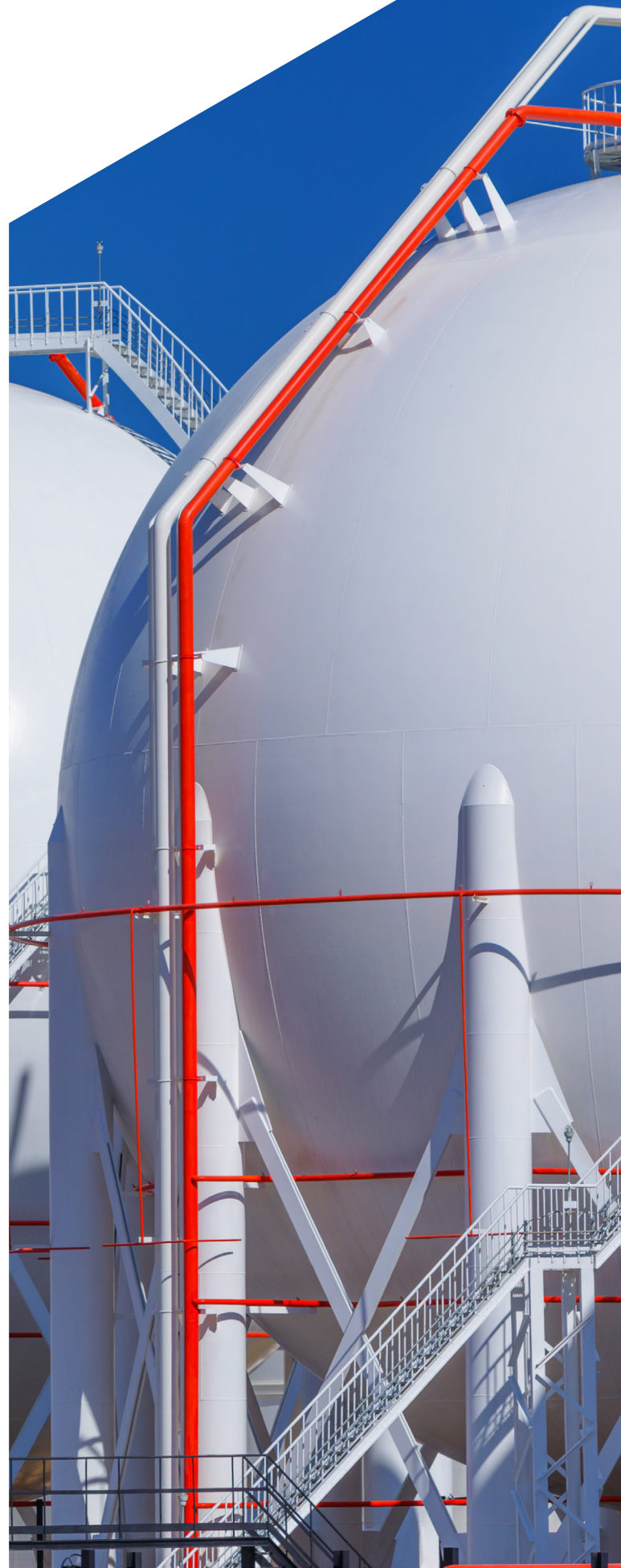
Exposed paints lose gloss because resin degradation roughens the paint film surface. Using high-quality TiO₂ grades can reduce the need to repaint down the line and cut back on the total materials needed to keep assets and equipment sufficiently coated. Further, the Ti-Pure™ TS-6200 surface is specially coated with two proprietary oxides that greatly minimize the rate of surface roughening.

As one of the world's largest producers of TiO₂, boasting nearly 90 years of experience, our high-quality pigments are specifically formulated to meet the needs of consumers, professional painters, and builders.

Leveraging A Systems Approach For Optimal Results

Procuring highly durable coatings is a complicated process that requires close attention to the materials and processes used in the paint's manufacturing. Doing so requires a systems approach — all components of the paint must be optimized. Anything less and paint formulators risk ending up with an inferior product, having wasted unnecessary time, money, and energy in the process.

Perhaps the most critical component of this systems approach is selecting the right TiO₂ provider. Their technical expertise and willingness to collaborate is just as important as the materials themselves. It's critical to partner with a TiO₂ supplier who can support your specific formulation development needs - ensuring performance effectiveness that meets customer and application expectations all while developing the paint with optimal manufacturing efficiency.



The right partner must also be able to deliver the highest quality TiO₂ available. Chemours has been providing this for nearly a century.

With a deep team of technical experts, we've led the charge on nearly every TiO₂ innovation since the earliest onset of the market. We continue to put that same proven science and careful collaboration into every project as we work side by side with customers to solve an ever-changing set of challenges and an evolving set of customer demands.

In today's business and regulatory environment, paint formulators and producers need every advantage and access to strong science to help them stay ahead of the curve. We're excited to be there with them every step of the way.





About Ti-Pure™ Titanium Dioxide from Chemours

Ti-Pure™ titanium dioxide (TiO₂) from Chemours strives to make the world brighter, more durable, and efficient by tackling some of society's greatest challenges through TiO₂ innovation and reliability. For nearly a century, we have produced and delivered high-quality TiO₂ for customers around the globe in coatings, plastics, and laminates applications. Guided by industry-leading innovation, technical expertise, and continued collaboration, we're committed to moving our customers and our planet forward.

[Watch a short video to learn more.](#)

Paints that contain Ti-Pure™ offer:

- ◆ **Better Processability:** High-quality Ti-Pure™ TiO₂ pigments ensure consistency from batch to batch.
- ◆ **Superior Hiding Power:** Creating brighter brights and whiter whites, Ti-Pure™ increases hiding power for uniform, one-coat coverage without needing to prime.
- ◆ **Ease of Application:** With fewer drips, smoother brush strokes, and faster drying times, Ti-Pure™ pigments boost paints' productivity.
- ◆ **Uncompromising Endurance:** The UV protection afforded by Ti-Pure™ leaves a durable, washable surface that resists fading, cracking, and discoloration over time.



For more information, visit [tipure.com](https://www.tipure.com) or contact us at [tipure.com/en/contact-us](https://www.tipure.com/en/contact-us).

The information set forth herein is furnished free of charge and based on technical data that Chemours believes to be reliable. Chemours makes no warranties, expressed or implied, and assumes no liability in connection with any use of this information. Nothing herein is to be taken as a license to operate under or a recommendation to infringe on any patents or trademarks.

©2022 The Chemours Company FC, LLC. Chemours and any associated logos are trademarks or copyrights of The Chemours Company FC, LLC. Chemours™ and the Chemours logo are trademarks of The Chemours Company.