PREMIUM TiOEX TiO_2 SOLUTIONS FOR PLASTICS

1 INNOVATIVE EXTRACTION PROCESS TiO_2 SOLUTIONS FOR HIGH PERFORMING, VISUALLY APPEALING PLASTICS

KUNCAI is committed to becoming a trusted partner for global customers in the fields of pearlescent pigments, titanium dioxide pigments, and iron oxide pigments, by providing products with high standards of quality, performance, reliability and service.

KUNCAI is the global market leader in pearlescent pigments and is also a major supplier of titanium dioxide and iron oxide pigments with global capacity and reach.

KUNCAI leads the industry trend through continuous investment in research and development, advanced process equipment technology, continuous innovation and improvement, and best practices, providing long-term value to global customers.

KUNCAI has established a full chain quality management system and other international standard management systems, including QMS, EMS, HSS, ZDHC, CSR authentication and audit certification management systems, providing comprehensive and systematic management guarantees for titanium dioxide products.

KUNCAI independently developed and innovated the world's first extraction process to produce rutile TiO_2 in 2019. We successfully achieved large-scale mass production and continuously improved quality, reduced energy consumption and carbon emissions, and minimized its impact on the Earth's environment. We collaborate with global customers and leverage the power of titanium dioxide innovation to help our customers develop the best titanium dioxide products among their peers.

KUNCAI TiOEX titanium dioxide includes various grades and product models, and is capable of meeting the application requirements of industries such as plastic master-batches, bubber, coatings, inks, papermaking, textile foot-ware materials, etc.

Plastics applications - including packaging, agricultural, transportation, medical, household appliances, interior and exterior plastic building components and more - maintain their appearance and strength with the help of TiO_2.
TiOEX solutions for plastics keep plastics products looking newer, longer and resist the damaging effects of UV light.

KUNCAI TiOEX plastic-grade titanium dioxide can bring a series of performance advantages to various plastic systems, including color lightness, undertone, tinting strength, opacity, dispersibility, heat resistance, light resistance, weather resistance, color retention, glossiness, mechanical strength, etc.
These TiOEX product models cover almost all applications of plastic master-batches.

For details, please refer to the following documents:

1) TiOEX plastic-grade TiO_2 – Solution
2) TiOEX plastic-grade TiO_2 – Selection Guide
3) TiOEX plastic-grade TiO_2 – TDS
4) TiOEX plastic-grade TiO_2 – SDS
5) TiOEX plastic-grade TiO_2 – Certificates, Reports, Declarations

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2 TITANIUM DIOXIDE FOR PLASTIC APPLICATIONS

In the plastic master-batch industry, titanium dioxide is one of the most widely used pigments. Depending on the type of plastic, processing conditions, and final performance requirements, each application has suitable grades of titanium dioxide available for selection.

Since the 1950s, the plastic industry has benefited from high-quality titanium dioxide products and services, which have addressed issues such as color lightness, undertone, tinting strength, opacity, dispersibility, heat resistance,

light resistance, weather resistance, color retention, glossiness, and mechanical strength. As the plastic industry continues to develop, titanium dioxide has continuously contributed to achieving thinner films, brighter colors, and higher reflectivity to meet market demands.

For a long time, titanium dioxide has been regarded as the highest-quality white pigment. Plastic master-batches are the most familiar application field of titanium dioxide. The value that titanium dioxide brings to the plastic industry goes far beyond the white and bright transparency. From a more fundamental perspective, titanium dioxide is a material that responds to light, and its value lies in its interaction with light. For example, this interaction can be the common scattering phenomenon that leads to a decrease in transparency, or it can be the absorption of ultraviolet energy, thereby protecting polymers from ultraviolet degradation. The application of titanium dioxide is constantly evolving, all based on the interaction between titanium dioxide particles and light.

With the continuous development of other applications of titanium dioxide, its coloring properties remain the most important. Titanium dioxide is the most widely used white pigment in the polymer industry. It is widely used because it can effectively scatter visible light, thereby giving white, brightness and opacity to plastic products. It is chemically inert, insoluble in polymers, and has thermal stability even under the most harsh processing conditions. Titanium dioxide has two crystal forms, namely anatase type and rutile type. Rutile type pigments are superior to anatase type pigments because they scatter light more effectively, are more stable, and are less likely to catalyze photo-degradation.

Few commercial titanium dioxide powders are purely composed of TiO_2. Most have inorganic and, in some cases, organic treatments deposited on the surfaces of the titanium dioxide particles by precipitation, mechanical blending, or via other routes. These surface treatments provide improvements in one or more performance properties of the pigment, such as ease of dispersion, weatherability, or discoloration resistance. A single prescription for surface treatment does not produce a pigment having maximum value-in-use for all plastic applications, and it is a continuing goal for KUNCAI to develop titanium dioxide grades to meet the changing needs of the plastic, coating, inks, paper making, textile and foot-ware industries.

3 OVERVIEW OF RESIN SYSTEMS FOR PLASTIC APPLICATIONS

Please refer to TiOEX plastic-grade titanium dioxide - selection guide or contact your sales representative for more information.

◆ Polyolefins (PE/PP, Polyethylene and Polypropylene):

With few exceptions, most polyolefin applications involve preparing a titanium dioxide concentrate by batch or continuous compounding before reducing the concentrate into the finished product.

In this regard, ease of dispersion, resistance to yellowing, and optical properties are important performance properties. For thin-film and extrusion coating applications, dispersion performance and resistance to lacing and discoloration at elevated processing temperatures are of major concern.

◆ PVC (Polyvinyl Chloride):

Selecting the optimal grade of TiOEX titanium dioxide for rigid vinyl applications depends on the intended use of the product and the type of heat stabilizers used in the PVC compound to protect the resin. Exterior applications such as building siding and window profiles may require controlled chalking, primarily in tin stabilized systems. Other exterior applications require excellent gloss retention and non-chalking performance. For exterior colored products, strong colors that resists fade are desirable. Recommended TiOEX grades excel in a variety of performance requirements, and can enable color toner cost savings in some cases.

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◆ ABS and ABS Blend Polymers (Acrylonitrile-Butadiene-Styrene):

Among titanium dioxide pigment's key performance attributes, optical properties, dispersibility, thermal and UV stability and mechanical property retention are considered to be most critical. Higher tinting strength and bluish-white undertone color help to produce brighter and whiter appearance and can also positively impact the mechanical properties. Because higher tinting strength titanium dioxide can be used at lower loadings, the mechanical property degradation of the polymer is minimized and the titanium dioxide pigment economy is improved, resulting in raw material cost savings.

◆ PET/PBT (Polyethylene Terephthalate/Polybutylene Terephthalate):

PET and PET-PBT blends are used for a wide variety of extruded and injection-molded articles. Key requirements of titanium dioxide used in these resin systems are optical properties, resistance to light discoloration, and reliable mechanical performance.

◆ PMA/PMMA (Polymethylacrylate/Ppolymethylmethacrylate):

Titanium dioxide is used to pigment the acrylic polymethylacrylate (PMA) and polymethylmethacrylate (PMMA) for both opaque and semi-opaque applications. Appliances, communication, industrial, and construction applications use opaque whites. Back-illuminated advertising and signboards depend on translucent formulations.

◆ PPS (Polyphenylene Sulfide):

Because the natural color of polyphenylene sulfide (PPS) is brown, the bluish undertone of TiOEX titanium dioxides supports bright white color development in PPS applications. Suitable for mass-tone and tint-tone white applications, it provides bright color and good stability in thermal, mechanical, and rheological properties and offers excellent processibility.

◆ PA (Polyamide):

Like other high-performance engineering polymers, polyamide resins demand pigments with a bluish white undertone and a hydrophobic surface. Excellent mechanical, thermal, and rheological performance stability and low amounts of metallic impurities (like iron) are also required.

◆ PC and PC Blends (Polycarbonate):

Polycarbonate (PC) and PC blends need a blue pigment undertone to deliver a bright white color in end-use applications. The titanium dioxide also needs adequate surface chemical modifications and a thermally stable organic coating to preserve the thermal, rheological, and mechanical properties during processing.

◆ PS/HIPS (Polystyrene):

Recommended TiOEX grades can be used to color polystyrene, including high impact polystyrene (HIPS), for non-durable applications requiring a maximum bluish white undertone, high tinting strength, thermal stability during processing, and resistance to light discoloration; as well as applications requiring durability.

4 THE TiOEX ADVANTAGES

◆ Quality Assurance in Product Manufacture

KUNCAI is committed to maintaining its leading position in product quality and uniformity. TiOEX titanium dioxide pigments are routinely tested according to inspection plan for properties that are appropriate for the intended application of the product. The results of the quality testing are collected and reported using statistic control tools. The testing can include color lightness, tinting strength, undertone, PSD, oil absorption, volatile, dispersibility and reliability tests etc.

The products are subject to regular compliance testing and verification for relevant restricted or/and limited substances by qualified external institutions.

Meanwhile, KUNCAI has established and maintained complete systems of certification and auditing for quality, health and safety, environment, social responsibility, and zero emissions of chemicals (QMS, EHS, CSR, ZDHC), providing systematic management guarantees for product manufacturing.

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◆ Product Stewardship:

KUNCAI defines **Product Stewardship** as: An integrated business process for identifying, managing, and reducing safety, health, and environmental risk throughout all stages of a product's life in the best interest of our four stakeholders: customers, employees, shareholders, and society.

KUNCAI places high value on **Product Stewardship** as a vehicle to differentiate our products and services. We firmly believe that proactive product management results in improved product performance and is responsible business management that positively affects our stakeholders.

The objectives of our Product Stewardship program are to use advantages of technology and our understanding of our products to protect our customers, employees, the community, and the public; to anticipate and respond to societal expectations and requirements; and to minimize resource and energy consumption (the environmental "footprint" of our products).

5 TiOEX TiO_2 PRODUCTS FOR PLASTIC APPLICATIONS

TiOEX Product	Main Plastic Applications
TiOEX 803	• Colored and white automotive interiors • Footwear • Chalking profiles for siding, windows, decks, and fences
TiOEX 804	• High-quality rigid and flexible packaging • Reflective films • Thermoplastic masterbatches
TiOEX 805	• Exterior plastic building products including composite/vinyl siding, window profiles, decks, and fences • Cool roofing membranes • Exterior polyethylene or polypropylene films
TiOEX 860	• Colored exterior building products, including windows, gutters, decks, and fences • Stadium /Park seats • High-end patio furniture • Automotive body panels
TiOEX 801	• Designed specifically for PC polycarbonate plastic systems applications • Ensure good dispersion, whiteness, preserve thermal, rheological and good mechanical properties during processing in PC

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