



inhance[®]

Inhance/Fluoro-Seal, Ltd.
16360 Park Ten Place, Suite 325
Houston, TX 77084 – 5046, USA
Ph: 281-600-1255 Fax: 281-578-3159
www.inhanceproducts.com

OVERVIEW

INHANCE[®] Ti POLYMER ALLOY

(See Fact Sheets for Ti-9000, Ti-9100 & Ti-9113)

INHANCE Ti additives dramatically increase the abrasion resistance of plastics, frequently making them outperform metal. By using this additive, the advantages of plastics – light weight, ease of fabrication, self lubricating, and corrosion resistance - can be experienced in performance parts that hitherto were made in metal. Furthermore, INHANCE Ti polymer alloy is very easy to work with, requiring little or no reformulation.

PRODUCT PROFILE

INHANCE Ti is a new family of materials in which titanium carbide (TiC) grains are chemically bonded to polymers. This is the first known example of the chemical union of a ceramic material to a polymer.

CHARACTERISTICS AND FEATURES

Titanium carbide is one of the hardest and most abrasion-resistant materials known. Diamond is the only substance that is harder. Unlike other super-hard carbides and nitrides, TiC grains are not cutting or abrasive because they have rounded shapes. Since TiC has a relatively low density, incorporation of INHANCE Ti particles into polymers increases the density only slightly. In comparison, most other metal carbides and nitrides are much denser.

CAPABILITIES

INHANCE Ti products can be combined with essentially all types of polymers, ranging from polar polyurethanes to non-polar fluoropolymers. Incorporation of INHANCE Ti products in various polymers dramatically increases abrasion resistance. In highly abrasive applications, these parts last much longer. For example, one type of plastic (UHMW PE), with 30% INHANCE Ti-9113, has sliding abrasion resistance that is fifty-eight times (58X) greater than steel. That means that in an abrasive application, approximately 58 parts made in steel would be worn out and replaced within the lifetime of one part made in an INHANCE hard phase polymer composite!

Use of INHANCE Ti products in various polymers generally maintains or improves other physical properties such as tensile strength, flexural modulus, temperature stability, and creep resistance. These qualities are noteworthy since materials generally must meet several property requirements to be acceptable for specific applications.

APPLICATIONS

There is a growing need for high performance plastics that have outstanding abrasion resistance and high temperature stability. These materials are being used in place of metal for the manufacture of gears, bearings, seals, impellers, pistons, rings, and protective jacketing. Today, more than 50% of newly designed mechanical moving parts are being made in high performance, engineering polymers. They deliver increased part durability, greater corrosion resistance, higher impact resistance, no need for lubrication, reduced part weight, and increased overall end-product performance.

As lifecycle cost analysis is more widely used in the materials selection process, highly durable parts are being specified. Lifecycle cost analysis considers all of the costs associated with a given part, including purchase, installation, maintenance, replacement, and disposal. When all of these cost elements are considered, highly durable parts become less expensive despite high purchase costs. To illustrate, it can cost as much as \$1 million/day to operate an oil well drilling project. When a \$3.00 seal fails, the entire operation is shut down for up to 2 days as the drill head is withdrawn and replaced. It is far more economical to replace those seals with seals made with INHANCE Ti particles, which last ten times as long, despite the added cost for each seal.

Two examples of high performance polymers used in very demanding applications are polyimide and polyaryletheretherketone (PEEK). Polyimide and PEEK are priced at approximately \$87/lb. and \$35/lb. respectively. Titanium carbide polymer alloy (INHANCE Ti -9113) increases the abrasion resistance of polyimide six-fold (6X) and increases the abrasion resistance of PEEK eleven-fold (11X). These laboratory results have been confirmed by end product testing. This means that polyimide and PEEK parts made with the titanium carbide polymer alloy additive will last 6X and 11X longer, respectively.

USE

To use INHANCE Ti materials in injection molding, the INHANCE Ti powder is either compounded with resin, added as a concentrated masterbatch compound, or metered in along with resin. Optimal performance requires homogeneous dispersion throughout a part. Mixing INHANCE Ti powder with matrix polymer pellets and feeding into injection molding feed hopper generally is not acceptable because it leads to inhomogeneity. Masterbatches with greater than 50% (by weight) INHANCE Ti particles can be made. By combining different ratios of masterbatch pellets and unfilled resin pellets, various compositions can be custom made by the molder.

Achievement of optimal performance sometimes requires experimentation with variables, such as compounding or molding temperatures; amount of shear employed, and resin grades. Uniform dispersion can be confirmed via high-powered optical microscopy.

INTERNATIONAL RECOGNITION

This product was recognized with an R&D 100 Award in 1998, when it was first commercialized under the VISTAMER Ti trade name. The R&D 100 Award is given to the one hundred most significant technological products world-wide that were commercialized during the past year. It has been termed the "Noble Prize of Industry". Products receiving the award have been judged exceptional in their establishment of new benchmarks against which other products can be measured, such as their impact on the quality of life, and their capacity to improve other products and processes.