Cool Colors™ Pigments
Infrared (IR) Heat and Energy Saving Pigments

Inspired by nature
INTRODUCTION

This handbook is a handmade guide to assist coatings and plastics manufacturers to select the best Cool Colors™ pigments for their individual requirements. The list presented here is not exhaustive but represents the main standard pigments promoted in Europe.

Most data sheets include a representative color chip, individual spectral curves for both the visible and near infrared wave-lengths.

Ferro Corporation has manufactured and supplied Complex Inorganic Colored Pigments (CICP’s) for coatings and ceramics since 1939 and for plastics since 1947. Today, Ferro is a global producer of CICP’s with plants in North America (Washington), South America (Americana), Europe (Colditz) and Asia (Suzhou).

Ferro’s total commitment to our customers is assured by outstanding technical service and product development capabilities as well as research personnel who specialize in color technology. Ferro Corporation is ISO9001 certified by DNV.

Complex Inorganic Colored Pigments are minerals that are the most heat stable, light stable, weather-proof and chemically inert pigments known to man. These pigments are manufactured by calcining an intimate mixture of metal oxides at temperatures of between 800 and 1300°C. The resultant product is then ground to a fine powder. Each product represents a unique chemical compound with its own crystal structure. The Complex Inorganic Colored Pigments are an important class of pigments used in the coloration of high-performance plastics and coatings and can be used in solvent or water-based systems.
CONTENT

Keep Cool ................................................. 4
How Does Infrared Reflection Work? ...... 5
Applications ........................................... 7
Pigment Portfolio ..................................... 9
Contact Information ................................. 11
It is one of mankind's most common daily experiences that black objects like asphalt driveways, shingle roofs and black car dashboards get quite hot on a sunny day. This is because the dark surface absorbs incident sunlight and converts it into heat. In contrast, light colored objects stay cooler in sunlight since they reflect more of the incoming energy from the sun.

This daily experience which associates dark colors with hot temperatures influences our color choices in everything from clothes to house paint and car colors.

Although this dark-hot association seems to be incontestable, innovative pigments from Ferro makes it possible to formulate dark colored surface coatings that reduce the heating effect in sunlight compared to surfaces with the same visual darkness. Along with the cooling effect comes other benefits of using Ferro pigments, such as less expansion and contraction, lower air conditioning bills, increased service life, less product degradation, and improved comfort levels for building occupants.
HOW DOES INFRARED REFLECTION WORK?

The electromagnetic radiation from the sun that strikes the earth consists of radiation in the wavelength of about 300 to 2500 nanometers (nm). The wavelength region below 400 nm is called ULTRAVIOLET (UV). The UV region can damage our bodies and skin, and as well as cause degradation to paints and polymers.

The VISIBLE (VIS) region, 400 to 700 nm, is the area where our eyes are attuned to see light in all its various colors. The final area, from 700 to 2500 nm, is the INFRARED (IR) region. These longer wavelengths are invisible to the eye, yet contain about half of the solar energy that strikes the earth (Figure below).

We see different colors by selective absorption and reflection in the visible region. In other words, we see a red color because the radiation in the red portion of the spectrum is reflected, the remaining radiation in the visible region is more or less absorbed. We can’t see in the UV and IR portion of the spectrum, so we really can’t visually determine what is occurring. But, we can feel the effects of this infrared energy in the form of heat.

This is the sun´s energy, by wavelength, that reached the earth´s surface. With in region 5% UV (250–400nm)-, 43% Visible (400–700 nm)– and 52% Near Infrared Reflection (700–2500nm).
Objects colored with Cool Colors™ pigments stay cooler. Other advantages include:

- Reduced air conditioning and energy consumption
- Increased building comfort
- Increased life guarantee of the roof system
- Offer additional value
- Stabilize your polymers outside and reduce cost of formulation

Touch asphalt driveway, climb on your shingle roof or place your hand on your black automobile on a warm sunny day. They will be hot! In fact, some dark colored roofing can attain a temperature of 90°C or more. Why? It’s because these materials absorb a large portion of the infrared radiation of the sun. The typical black pigment absorbs the radiation across the whole solar spectrum. The color appears black due to absorption in the visible portion of the spectrum, but reflects in the invisible infrared portion. This results in significantly less solar energy being absorbed, which means less heat being absorbed.

Therefore objects coated with Cool Colors™ pigments do not absorb as much solar energy and stay cooler. Of course every pigment has a different reflectance spectrum. The percent of solar reflectance is the important measure. Whereas carbon black has a solar reflectance of 5%, the solar reflectance of Ferro’s Cool Colors™ pigments is significantly higher.

These pigments are findings from basic research which are coming now to commercial application in such areas as coil and other coatings, automotive applications, vinyl siding, cool roofing and many other plastic and coating applications where reducing solar heat and the desire is to save energy and money. In addition, these pigments are the most durable and weatherfast pigments known.
Ferro scientists have been working on pigments with selective reflection and absorption for several years. Today, this exciting technology is yielding excellent results in an extensive range of applications.

Cool Color™ pigments are now used in a number building exteriors, “cool roofs”, vinyl siding, automobiles, industrial coatings – shortly: in all applications where solar heat reflection and energy saving properties are desired.

Several research studies have been conducted to investigate the level of energy saving in buildings with cool roofs. The studies show that the cooling energy used in buildings can be reduced by more than 15% when the solar reflectance is increased from a typical value between 10 % and 20 % to 50 % [2].
In a comparative study, different coatings on two otherwise identical elementary school buildings in Georgia, USA, were tested [3]. The infrared reflection of one of the buildings was increased from 12% to 29%. For this building, energy savings of more than 12% were stated [4].

In a study from Greece, the increasing heat island effect in urban areas was investigated [5]. The heat island effect caused discomfort, heavy energy demand and the smog formation. Infrared reflecting pigments were found to lower the surface as well as near surface air temperatures. The surface temperature was up to 10°C lower, and the air temperature up to 1.6°C lower. The pigments are incorporated into pastes or other coating materials. Alternatively, the pigments may directly be used in building materials.

In addition to the building sector, there is a strong demand in the automotive market for reflective coatings. Cool Colors™ pigments can have advantages in the coatings of car shells, seats and dashboards. BMW launched its 1 series convertible with infrared reflecting pigments in the coating of leather upholstery, to prevent excessive heat in seats. Cool Colors™ pigments can also enhance the comfort of leather clothing in summer.

[4] Cool Metal Roofing Coalition: Case study „Metal roofing goes to school for big energy savings”

4, Sept./Oct., 50-56.
# Pigment Portfolio

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Ferro GmbH

Pigments for Plastics and Paints

In the paints and plastics industry Ferro’s Pigment System unit is recognized globally for its high-quality coloring products. Our most important goal is to maintain a high level of product quality and to maximize customer satisfaction.

To ensure this, we emphasize dialogue and partnership with our customers, focusing on the challenges of their markets and on their suggestions and requirements, as well as on our mutual desire to protect the environment.

As a result, we are always ready to offer the most creative and ambitious new products to our customers. Ongoing research and development is the basis of the high quality of our pigments, as we continually improve not only their composition, but also our production technology and test methods. Our laboratory teams can provide a broad range of support, including measuring your panels, providing Cool Colors™ countertypes and non-IR colors. The production, technical advice and development of these pigments are located at our production sites in Colditz and Frankfurt am Main, Germany and in Washington, PA USA.