

“Success is not about
being the first to do
something, but in
continuing to build in
order to do it better and
differently”

KRION[®]
Unlimited Surfaces

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PORCELANOSA Grupo

PORCELANOSA Grupo is present in almost 150 countries

Today, PORCELANOSA Grupo is a leading company in both domestic and international markets, built upon sound values such as innovation and quality, but above all on the trust placed in its extensive workforce of nearly 5,000 people, and the care given to their social environment.

With over forty years of experience, PORCELANOSA Grupo is present in nearly 150 countries around the world, thanks to a unique business model, which forms the foundation of a strong corporate strategy. Today, it is one of the most internationally recognized Spanish companies, according to a study published by the Pricewaterhouse Coopers consultancy and the Financial Times, and is also considered by consumers as a strong and robust company, according to another study completed by the Reputation Institute.

Diversification in production has been a major building block in the growth of a business group that began exclusively in tile manufacturing. At present, the eight companies of the Group offer an extensive range of products, from kitchen or bathroom equipment to hi-tech materials and advanced building solutions for modern architecture.

PORCELANOSA Grupo has experienced constant growth in its manufacturing thanks to its proper economic and financial administration. This has meant that the company has prevailed as one of the strongest in the market, both nationally and internationally.

Company

KRION is a company of the Porcelanosa Group that designs, produces and markets new generation solid surfaces as sheets, semi-finished products from Krion®, adhesives and bathroom devices.

Through constant commitment to improvement and innovation, it has an excellent **R+D+i** team and facilities who always seek to improve the quality of the end product, bringing in new properties and features to existing ones, converting the material into one of the most advanced, resistant and hard-wearing on the current market.

Owing to its mineral and natural origin, the solid surface developed by KRION sets new standards in sustainability and commitment to the environment, and is a leader in the construction and development of new premises around the world with a daily commitment to reducing the impact on the ecosystem. The pursuit of improvement and innovation of our products has given us global level recognition and support from organizations and companies through certificates that guarantee the environmental responsibility of our solid surface.

With the backing of the Porcelanosa Group and an impressive **logistics** and **distribution network** around the world, KRION has established itself as a international benchmark in first level projects in several countries. The **quality of our human team, our materials and our commitment to nature** stand like flags marking the course the company takes to guarantee a sustainable future and improve the quality of life of the wider community.





Pacto Mundial
Red Española



Since the creation of Krion® we have worked to maintain a strong **moral commitment** and corporate responsibility in constant search of excellence. Our philosophy sets out the principles and standards under which the business is governed and which drive and ensure success in all our areas of activity.

To meet our goals we have committed ourselves from the beginning to working and operating in accordance with our values. As a company that is part of the Porcelanosa Group, an **honest ethical culture** is fundamental for daily growth and achieving all our goals, creating a comfortable and fulfilling working atmosphere.

Our commitment and responsibility to nature is one of the key factors in our growth and, as with our product, we are involved in obtaining, optimizing and improving all the properties that support **environmental sustainability** and the search for an improvement in the quality of life of society, through concrete and tangible actions that reduce the impact of production on the environment.

We are constantly evolving, trying to find perfection both in the development of our product and in the treatment of our fellow man. Innovation and high performance can only be turned into success if our reputation is in line with these principles and if our customers, suppliers and business partners associate our name with confidence and commitment; our interactions and everyday actions are key to the success of the company.





KRION

Unlimited Surfaces

Krion® is a compact, homogeneous new generation mineral, a material developed by Porcelanosa Group that is composed of a high percentage of natural minerals such as Alumina Trihydrate (ATH) and a low percentage of high strength acrylic resins.

It is a material for surfaces, with a pleasant feel and aesthetically similar to natural stone, non-porous, and is highly durable and robust against wear. Very hard and resistant to most impacts, excellent performance outdoors under extreme conditions and it does not deteriorate over time and its everyday wear is minimal. Consequently, it requires only low maintenance and is easy to clean.

It is a material that is produced in the form of sheets of varying sizes, thicknesses, colors and decorations, which work similarly to wood, allowing it to be cut and bonded with Krion® adhesive, creating almost invisible joints and seamless spaces.

Environmentally friendly



Once its life cycle is completed, the mineral can be re-used, recycled or discarded without posing any danger to the environment as it is considered an inert substance.

It can also be re-processed and used again in the production cycle, creating new series containing recycled material. Krion® is a mineral that is 100% recyclable, and is manufactured to very strict quality standards to reduce consumption of energy resources and ensure minimal impact on the environment. . We have certification such as the environmental product declaration (EPD), SCS RECYCLED CONTENT and we contribute towards achieving certifications such as LEED, BREEAM, VERDE, WELL... All this endorses the environmental commitment of Krion® and our preoccupation with it.

Furthermore, Krion® is a non-toxic material when used by end users and when handled by transformers. It has a very low number of volatile organic compounds (VOCs) under normal conditions of temperature and it does not emit harmful gases over time. It has achieved the best results in accreditations such as the GREENGUARD, A+, and it has certifications such as the REACH, BISFENOL FREE, SIO₂ FREE, ISO...

Product lines



SHEETS

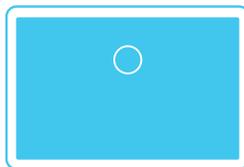
Krion® is available in sheets of varying sizes and thicknesses, with 3680x76 mm and 12 mm thickness as the most common measurements. Depending on the color we can find thicknesses of 3, 6, 9 and 19 mm as well as the sheet size that can be served in 3680x1520 mm, 3680x1350 mm, 3680x930 mm, 3680x760 mm, 2500x1350 mm, 2500x930mm and 2500x760 mm.

The sheets are available in a broad range of colors and decorations, such as solids, translucents, studded, with inlays, with grains, terrazzos, recycled, marbled... that can be combined to create fantastic compositions. Some of them, such as the translucents, enhance the scope for design and are a strong inspiration for architects and interior designers the world over. It is such a versatile material that it can be textured and can even bear images on its surface. Krion® can be used for both coverings and to create independent furnishings, inlays, decorative elements, signage and an infinity of designs.



ADHESIVE

Thanks to the innovative and non-conformist spirit of our company, Krion® manufactures its own adhesive which results in full compatibility with the color of each sheet and in a high performance in each joint, making design without visible joints a reality.



SEMI-MANUFACTURED BY CASTING

To create unique spaces, KRION provides its customers with a large number of washbasins, sinks, shower bases and baths, manufactured by casting, fully compatible with Krion® sheets, creating the perfect union, both on a physical and an aesthetic level, between these elements and the sheet as it is the same material.

A photograph of a modern clothing store interior. The ceiling features a grid of white and light green slats with recessed lighting. The walls are white, and the floor is light-colored. On the left, there are clothing racks with various items including floral dresses, white tops, and blue jeans. Below the racks are white shelves displaying several pairs of brown high-heeled sandals. On the right, a staircase with white steps and a white railing leads up. The steps have blue text on them, including 'HARM', 'HARM', and 'ON AIR'. In the background, more clothing racks and a brown handbag are visible.

Perfect for
the Contract
market

Applications

Krion® is a surface devised for creation, and thanks to its exceptional performance qualities it is suited to the commercial and residential sectors. That is why Krion® is the choice of professionals when creating all kinds of furniture, work surfaces, countertops, outdoor and indoor coverings for use in projects in commercial premises, hotels, restaurants, hospitals, clinics, public buildings, airports, public transport stations, not forgetting that Krion® is an excellent option for everyday living in our homes.

The confidence of professionals in Krion® is thanks to the continuous developments in the improvement of properties like durability, functionality and the great efficiency/cost ratio, as well as its ease of repair and low maintenance, making it the ideal material for high traffic/usage areas, meaning that projects completed with Krion® shine like new.



COMMERCIAL
FURNITURE AND
AND EQUIPMENT



WORK SURFACES
AND WORKTOPS



OFFICE
FURNITURE AND
EQUIPMENT



FOOD SERVICE/
CATERING
FURNITURE AND
EQUIPMENT



FOOD SERVICE/
CATERING
FURNITURE
AND EQUIPMENT



BATHROOM
EQUIPMENT



CLINICAL AND
LABORATORY
FURNITURE
AND EQUIPMENT



INTERIOR
COVERINGS



EXTERIOR
COVERINGS



SIGNAGE



FLOORING



INDUSTRIAL
PRODUCTS

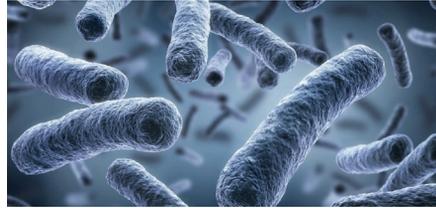
Value proposals of the material

Krion® possesses qualities that make it a perfect candidate for meeting the highest demands of aesthetics, safety, functionality and durability required by any commercial or residential project.



High fire resistance

The high mineral composition of Krion® means the material is a product that does not contribute to the propagation of fire without any kind of halogenated additive, and if burned, produces only faint smoke free of toxic gases. All Krion® series have excellent fire performance and are certified with the Euroclass: B-s1-d0. Krion® also has prestigious certifications, both european and emerican, with respect to the material's reaction to fire.



Aseptic

Krion® is a full-bodied material, homogeneous, non-porous, capable of being bonded and transformed with no visible joints, which makes it easy to clean. Having imperceptible joints and non-existent porosity does not allow the proliferation of bacteria, fungi and microbes, which makes it an aseptic material, ideal for hospital areas or food contact zones. It has important certifications proving its hygiene, such as HPD, NSF, CSA, UL, ASTM, ISO...



Resistant to bending and compression

Krion® shows high bending strength which makes it easier to work with and transport. Unlike many solid materials, Krion® withstands huge forces and does not crack. Furthermore, the high compressive strength places us next to materials such as stone, which withstand rupture or deformation superbly when subjected to a compressive force.



Resistant to the passage of time and renewable

Krion® undergoes very little wear with the passing of time and is resistant to cuts and scratches. It is very easy to clean and repair. If the material is subjected to heavy staining or superficial burns, it can be returned to its original condition with very little maintenance, by following our cleaning and restoration instructions. As it is a full bodied and homogeneous material throughout its entire thickness, in the event of worse damage Krion® can be repaired or restored by a professional to bring it back to its original condition without requiring the full replacement of the item created with Krion®.



Excellent performance in extreme environments and against solar radiation

The composition of Krion® makes it a material with high performances against solar radiation, with no porosity and therefore no water absorption, granting it special features such as resistance to cracking, splitting or weathering that occur in extreme conditions such as in marine environments, or those with severe frosts, high moisture or deserts... Therefore, the environment is not a handicap for Krion® as it possesses extraordinary stability and is therefore used as facade covering in a large number of projects.



Imperceptible and thermoformable joints

The cast shapes and sheets from Krion® can be joined to each other with Krion® adhesive, which ensures a perfect joint with respect to aesthetics, safety and durability. Using Krion® products such as the sheets, cast shapes and adhesive enables the creation of large spaces or surfaces with no visible joints. Another of the virtues of the material is its thermoformability, which, through the thermal heating process, can be molded into extreme curves formed both in 2D and 3D, and when the material cools it recovers the physical properties it had before being heated. Thanks to these properties, the designs and applications are infinite.

How it is worked



Krion® can be worked like wood, which means sheets can easily be cut and joined, and thermoformed to create exclusive designs. Moreover, it has no dangerous substances in its formulation and the dust from cutting is inert, therefore it is safe to use and transform. All workshops which use Krion® have been trained in the peculiarities of the material and can continue using woodworking tools.

KRION offers you the possibility to link up as an associate workshop through the **Affinity** program, in which case you will then become part of the extensive network of Krion® transformative workshops. These companies can become part of the **Associate Fabricator** program that provides a variety of benefits through which it will form part of the preferred network of KRION. To achieve this status, the company has to be assessed in order to find out its effective working capacity.

Design possibilities

Krion® will be transformed in a different way depending on the hands that work it; each creative professional sees something different in Krion® that can turn their ideas into reality and convert that sheet into something unique, making the material their own through transformation. Krion® is endowed with innumerable features that architects and interior designers use in their projects and which are the true reasons as to why Krion® is the choice for their projects.

Seamless surfaces

The large sheet sizes, the opportunity to create monolithic structures with no visible joints, and, of course, the ease for hygiene, cleanliness and restoration make the material the ideal element for creating any type of commercial furnishing, from displays, tables, countertops, work surfaces, etc.

Surface finishings

Krion® sheets are considered as a raw material that presented unfinished and it is the transformer who carries out the final sanding process. The solid surface can obtain different types of finish: matte, satin, gloss, high gloss and any that are listed in the Transformer Manual for each material model.

One of the developments introduced is a new type of finish that gives a sandblasted texture with three degrees of hardness: Sabbiato Sottile, Sabbiato Sereno and Sabbiato Intenso, which give the solid surface a rough feel, very similar to natural stone but keeping all the properties and features of Krion®.

Lastly, the sublimation technique, through which a digital impression is created in the material, enables any color of image to be added to the material very easily, creating a finish of maximum graphic quality.

Curves

Krion® is a compact mineral of the latest generation that enables curves to be made that are normally impossible to achieve with other materials, thereby achieving continuous volumes of gentle curves.

Backlighting

Krion® enables the creation of backlit environments. Combining different thicknesses and colors of the material can achieve spectacular lighting effects. In addition, there are exclusive series from Krion® with grains and decorations that, on being backlit, allow new designs and shapes to be discovered.

In addition to the high functionality that can be obtained thanks to its unparalleled properties, KRION also has a large A&D department made up of architects, engineers and designers who provide solutions on the aesthetic, functional and economic aspects, assisting with project implementation and ensuring finishes of the highest quality. It is further complemented with a team responsible for the continuous training of transformers across the world in the correct use and treatment of the material, and a quality and fidelity program that keeps professionals in constant contact with the company.



Study nature,
love nature, get
close to nature.
It will never let
you down

Frank Lloyd Wright,
American architect

NATURE INSPIRATION

Since ancient times, nature has been the model of inspiration par excellence of the human being. Architecture, technology, medicine and many other fields of thought and creation have taken nature and its behaviors as a faithful reflection for creating objects aimed at improving our lives. Nature Inspiration is not focused solely on the application of engineering or a particular architecture, but is also trying to understand the working principles of natural life and its different levels, and apply them in order to solve problems in the same way that Nature does.

In the R+D+i department some vitally important tasks are being undertaken for the proper development and control of the solid surface of KRION. For years, methods to understand and better define the material have been implemented, in addition to constant investments in the acquisition and modernization of equipment that can better monitor quality and ensure that it is one of the best solid surfaces on the market.

Since its birth, the material developed by KRION has been evolving in terms of performance and in gaining properties thanks to numerous studies and improvement projects carried out at the R+D+i laboratory, where there is an ambitious vision of the future, always defined by our principle of understanding Nature, implementing it and adapting it for the benefit of our clients.

THE R+D+I TEAM TIRELESSLY CARRIES OUT ITS WORK TO CONSTANTLY IMPROVE THE SOLID SURFACE FROM Krion and therefore provide one of the best products in the sector, thanks to the innovations and advances incorporated into the material in each new series and line.

How does Nature eliminate pollution

There are innumerable sources of pollution, such as traffic in large cities, industry, chemical products from agricultural activity, solid waste from domestic activities... When exposed to sunlight, part of this **pollution degrades naturally** through photodecomposition, however this is not enough due to the large amount of pollution that exists. Thanks to plants and **photosynthesis**, a large amount of pollution can also be eliminated through their leaves, using the light and water they absorb through their roots, converting carbon dioxide into organic matter and oxygen. But there are other methods of decontamination such as **photocatalysis** in which light, water and other components operate, without producing oxygen, yet effectively contribute to the elimination of pollution.



Photocatalysis. Origin and scientific evidence

Photocatalysis is a phenomenon that arises spontaneously in Nature. As occurs in photosynthesis, light and the humidity of the environment take a major role in eliminating certain pollutants present in the air we breathe.



In 1972, professors **Akira Fujishima** (1942 -) and **Kenichi Honda** (1925 – 2011) focused their studies on a peculiarity of certain minerals that react to light and that same year they wrote a groundbreaking publication entitled *Electrochemical Photolysis of Water at Semiconductors Electrodes* (*Nature* 238, 37-38), in which they revealed the mechanism of action of titanium dioxide (TiO_2), a known photocatalytic mineral, in the decomposition of water by the action of sunlight. This discovery started a revolution in the ceramics, glass and other industries.

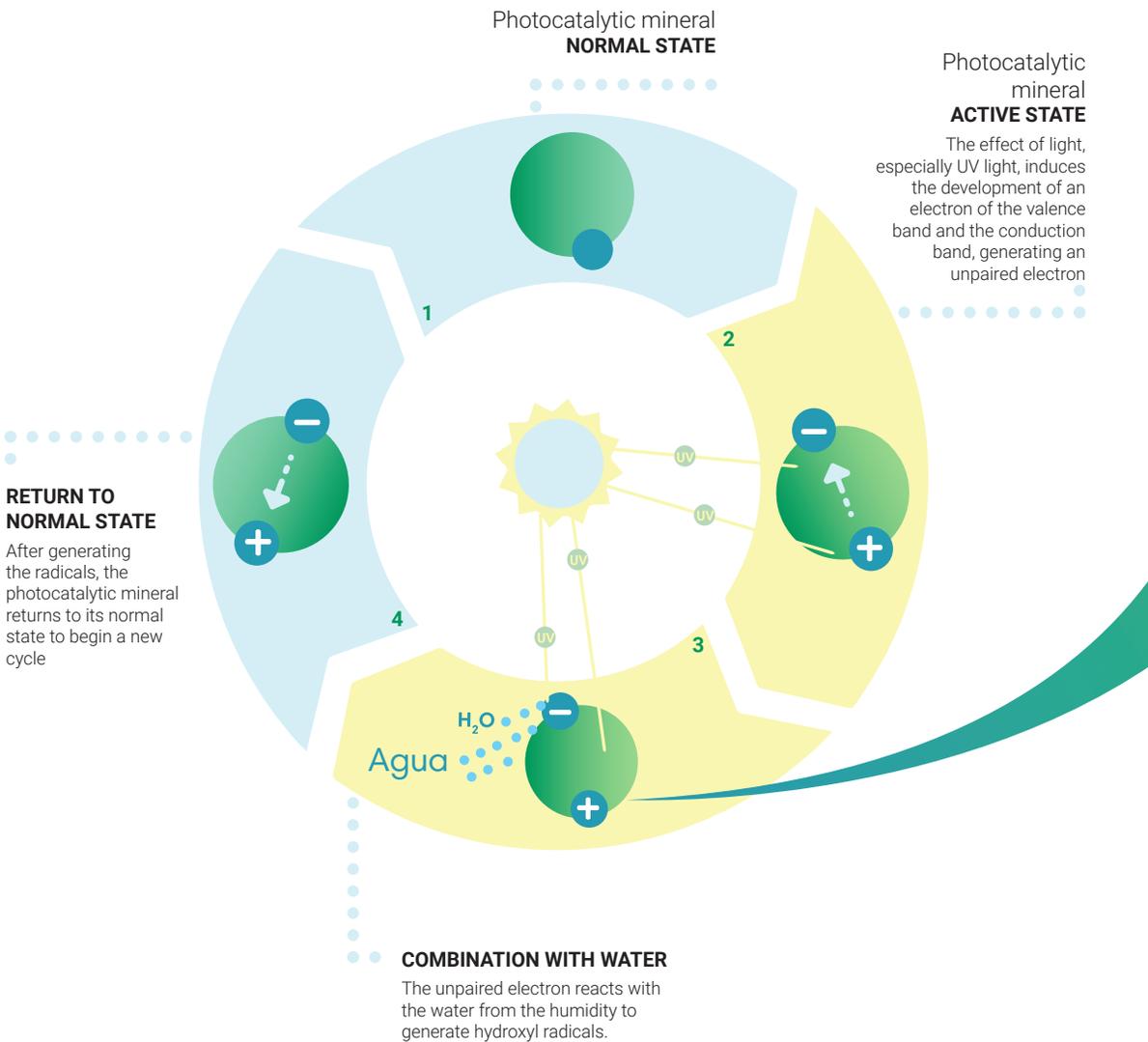


From this study, endless surface applications have been developed in several sectors with various results.

Arising from the wide diversity of applications, and **with the aim of standardizing the processes for verifying photocatalytic activity, several ISO standards have been emerging to regulate the verification procedure that proves the photocatalytic activity of a mineral.**

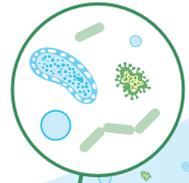
Photocatalysis, how does it work?

Photocatalysis is a phenomenon that takes place in some minerals present in Nature which have the ability to react to light. When a beam of light shines on the surface of this mineral, the energy of this beam is capable of altering part of the molecular structure of this material, making it combine with the humidity and oxygen present in the environment. As a result of this combination, molecules are produced (hydroxyl radicals) which, due to their nature, join with extreme ease to other particles close to them, forming molecules/stable particles, not harmful to humans.



What is in the air we breathe

Air is composed of gases that are beneficial to our development, but we also find other components such as bacteria, pollutant compounds, fungi or pollens that can harm us..



Hydroxyl Radicals

These radicals generated are very reactive and are compounds that will cause degradation reactions on coming in contact with air pollutants, staining, VOCs or bacteria.



+

NOx

Nitrous oxides are released into the air from motorized vehicle exhausts (above all from diesel and poor mixtures), and from the burning of coal, petroleum or natural gas.



+

VOCs

Many **VOCs** are hazardous air pollutants. They contribute to the formation of photochemical smog when reacting with other airborne pollutants (such as nitrogen oxides) and sunlight. They are formed by microscopic particles such as fungus spores, pollens, and also isoprenes.



+

Bacteria

Bacteria are present in our environment, tending to form colonies and growing in any spaces favorable to them, as happens in porous materials or in joints or surfaces difficult to clean, leading to the development of diseases dangerous to our health.



+

Stains



Nitrates
(mineral salts)



CO₂
H₂O



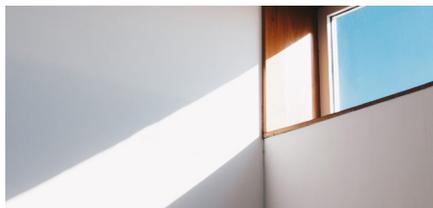
Bacteria



CO₂
H₂O

Factors on which the photocatalytic activity depends

The magnitude of photocatalytic activity is determined largely by:



First of all, and in a significant way, we have **radiation**. Usually, and due to the energy required by photocatalysts, we need energetic radiation such as ultraviolet light (UV-A or UV-B) or solar. Thus, according to the range of wavelengths that reach the surface of the material, there will be a greater or lesser activation of the photocatalysts.



We then have parameters related to the catalytic process. Highlighted among them is **exposure time**. It is logical to assume that, for a given material, the longer that material is exposed the better will be the percentage results of the photocatalytic activity.



Regarding the radiation, we have its **intensity** (measured in W/cm^2). Depending on the intensity of the radiation indicated previously, there will be a greater amount of energy arriving at the surface and consequently greater activation of the photocatalysts. This increased activation brings better results for activity.



In relation to this point, we have the exposed **surface** of the material, since it is evident that a larger surface of active material will contribute to some better results in terms of percentage, when talking about photocatalytic activity.



For the degradation tests in the liquid and gas phases, this could prove crucial to determining the flow or **movement** of the dissolution or gas in the degradation process. It has been possible to demonstrate and, in fact, the ISO standards refer to the need to homogenize and shake the dissolution of, for example, methylene blue every 20 minutes for the proper process.



On the other hand, there are environmental factors that influence the process greatly, such as **humidity** in the air. It has been found that greater humidity means there is more water available for the formation of reactive species, which carry out the degradation processes.



Depending on the **type of compound** that is being eliminated, as well as the level of activity, the degradation will be either faster or slower. Not all compounds can be degraded by photocatalysis nor do all compounds degrade at the same speed. This is why each case requires an independent study of the kinetics of degradation.



The higher **the concentration of pollutant organic compounds** that are found at that time, the greater the activity that occurs in the material.



The **quality of the triggers** will depend on the performance of the activity, better activators will improve the speed of decontamination.

Photocatalysis in industry

Following the discovery of this technology, there has been much progress made in the field of photocatalysis. The main efforts have been aimed at the development of materials that benefit people's quality of life. In this line of research, progress has begun in various fronts that photocatalysis can offer as a tool: **air purification, self-cleaning material, degradation of chemical and antibacterial products.**

Companies related to photocatalytic products have launched various materials to the market with these properties. If we had to find a beginning to the marketing of these materials, we would need to look back to TOTO company in Japan at the end of the 1990s, with a ceramic product with photocatalytic properties that were patented. After that, properties and performances were improving and there have been 350 related patents across the world..

There are a variety of products with photocatalytic activity such as:

- Cement-based materials: The photocatalyst forms part of the mixture, and is not a surface application. They may become vertical applications (linings, walls, structures...) and horizontal (floors and roofs).
- Floors: Can be continuous, such as mortars, grouts, surface treatments on floorings; or discontinuous, such as prefabricated tiles with surface treatments.
- Asphalt sheets: particularly for waterproofing of roofs.
- Ceramics: The photocatalyst impregnates the surface of the tiles, providing decontaminating and self-cleaning properties. Activa is an industrial-scale brand that has developed the patent as the manufacturing process.
- Textiles: Very useful in tarpaulins, parasols or home textiles. There are also some cases of advertising companies or textiles that cover buildings under construction/maintenance, that is, temporary treatments.
- Painting: Can treat interior or exterior surfaces. Very useful for application to existing building facades.

The majority of these products can be very active, resulting from priming the surface with the photocatalyst, their useful life varying depending on the wear of this surface application. The properties of the material on which the application is placed may change and may prevent it from being transformed or restored when necessary.



What have we invented?



Initial approach

At Krion®, as the material is changing and constantly evolving, we are always trying to improve its properties, listening to the demands and needs of the customers and the environment. In the tradition of evolutionary leaps that have occurred in the world of photocatalysis, applying it to those fields where there was a demand in society, at KRION we decided to bring it into the world of the solid surface.

Before this development, the R+D department was always aware that in order for the project to see the light of day they had to fulfill **3 primary objectives**. These 3 assumptions were:

- 1 Preserve the intrinsic properties of Krion®.** In no way could we give up the work that has been done so far, so if this new improvement meant the variation in any property that Krion® currently has, the project would be discarded.
- 2 The photocatalytic activity must be maintained over time regardless of its final shape and finish.** Whether cut, sanded, restored, thermoformed or drilled, the final product must have its photocatalytic properties intact. Differing from photocatalytic products for surface use. Although the activity was less than for other photocatalytic products.
- 3 Provide photocatalytic activity to the current material.** At no time was competing with current photocatalytic materials considered, simply provide our material with this activity as so far no solid surface had included this property.

Background to the invention

With the exception of photocatalytic cement, the construction and decorating materials do not effectively include photocatalytic particles in the body. They succeed in having photocatalytic properties thanks to coatings applied to them such as: additives or paints.

The application of a photocatalytic additive in superimposed layers results in many problems. They are applied with aerosols and solvents such as volatile organic compounds, which are environmental pollutants and have other effects harmful to health.

The product that is added must be compatible with the base material, however; in certain cases the primer may lack compatibility in its components, on the surface exposed to wear or having pores. The application of the photocatalytic layer is also associated with the visible face of the piece, and under no circumstances with the lateral or reverse faces. The construction materials usually have joints or changes of material wherever the added material does not reach.

Over time, the layers added tend to lose their effectiveness due to adhesion problems, wear, abrasion or alteration of their thickness and need renovation. This may be associated with a distribution or homogeneity problem given that aerosol applications are not usually recurrent, which makes these processes inflexible and unrepeatable. The amount of material applied or the thickness of the outer layers is often difficult to reproduce and there is too much variation from one application to another.

The result of all the above is that the materials to which an additional photocatalytic layer is applied are deficient in photocatalysis and their reproducibility in industrial production is often difficult. In addition, the application of the layer implies a modification of the end product which brings additional associated costs, usually high.

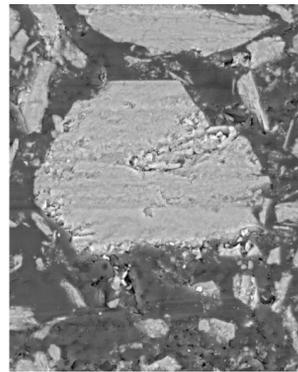
Implementation of the activity

In order for Krion® to be a material with photocatalytic activity it must include in its composition a set of activator minerals and additives that will react to light. A selection was made taking into consideration the efficiency and the compatibility of the latter with the formulation of Krion®.

The creation of this new photocatalytic feature of the material does not consist of simply implementing these new components into the Krion®, formula, but the development of a new production process for that purpose. Thus achieving a photocatalytic activity never seen before on a solid surface.

As this process was an evolutionary leap in the world of the solid surface, it has enabled us to patent it at national level in the interests of extending it to international level as soon as the times established by the PCT (Patent Cooperation Treaty) are met.

Our invention



The present invention is a procedure for **obtaining a photocatalytic polymer through the development of a photocatalytic additive. When this additive is added to the acrylic resin and polymerization, the solid surface with photocatalytic activity is obtained.**

Another aspect of the invention is that the resulting polymer has high catalytic homogeneity, with the photocatalytic particles operating on all surfaces of the material with the same activity.

Generally, during the process developed, white-colored photocatalytic minerals for more decorative purposes such as the TiO_2 rutile, ZnS, SnO_2 or ZnO are mixed with a more active photocatalyst such as TiO_2 anatase. TiO_2 rutile and TiO_2 anatase are two distinct photocatalysts with different activation energies. This mixture of minerals is dissolved along with aluminum trihydroxide and a siloxane to increase the photocatalytic activity and create an additive that can be subsequently incorporated into the productive process of Krion®.

One preferable aspect of the invention includes the elimination of particles smaller than $0.5 \mu\text{m}$ before adding the silane and siloxane, more preferably again by sieving. The mixture is sieved to remove that size of particle and prevent any that may be harmful if inhaled.

The resulting polymer is the most preferable aspect of this invention. It has high catalytic homogeneity, with the photocatalytic particles operating on all surfaces of the material with the same activity. The result is that there may be reactions on the surface of the base polymer that give the material properties of degradation of volatile organic compounds (VOCs), degradation of toxic gaseous compounds (NO_x , SO_x ...), of organic solvents (benzene, toluene...), of pollutant compounds (formaldehyde, acetaldehyde...) and with bactericidal properties against surface bacteria. In addition, it is a surface that is easy to clean due to the creation of superhydrophilic liquids, as when it is in contact with a liquid such as water or oil the photocatalytic process modifies the angle of contact of the drop, that does not easily stick to the surface. All this is a definite advantage with respect to the technique.

The polymeric material of the invention can be used indoors and outdoors, and is easy to clean, renewable, has color stability over time, maintains the hardness of the base material, is hygienic, resistant to impact, heat, staining, thermal shock, and its photocatalytic activity is not reduced over time or due to wear.

This patented invention is valid for 20 years from the date of the presentation.



Krion® Eco Active Solid Technology

Agilent 5977B GC/MSD

Agilent Intuvo 9000 GC System

300.0 °C 201.0 °C

KEAST Technology

The name of this new technology that explains the patented process refers to:

K for **Krion**, because the main purpose, and that has prevailed during the development, was that there is no variation or reversal in the advanced properties of the material, as may happen in the majority of developments of similar materials (K-LIFE is the fruit of continuous improvement that was incorporated into our existing 1100 Snow White reference), so that now any customer who uses Krion® will benefit exclusively and without restrictions.

E due to its **ecological** aspect, given that the strong commitment to sustainability of the company that is added to the existing certifications (GreenGard, Reach, Hpd, Bisphenol Free,..) and those acquired by the photocatalytic activity represented by the DAP (EPD).

A as it is an **active** material and therefore produces the added benefit in its life span (or use of the material). It fulfills a dual role: on the one hand, it has the function of an object or project and on the other hand it contributes to the benefit and improvement of the quality of life through being an active photocatalytic material.

S as it is a **solid** photocatalytic material throughout the body. This makes such an activity last with the passing of time regardless of the wear and/or transformation of the material.

T as it is the exclusive **technology** developed, patented and employed in the production process to reach the outcome of the material.

At KRION we have gone one step further in the excellent material available to us, the result of its continuous evolution over the last few years. With high performances of an advanced material incorporating those that come from the photocatalytic effect. On a photocatalytic level the results are getting better with the development of new technologies, as we have seen previously. Our objective has always been **to maintain the intrinsic properties** developed by Krion® itself and to implement new ones giving an activity to the material, not comparable to products expressly developed for photocatalysis. Nevertheless our R+D department continues to work in the research areas that improve all the features of Krion®.



Krion[®]

Eco

Active



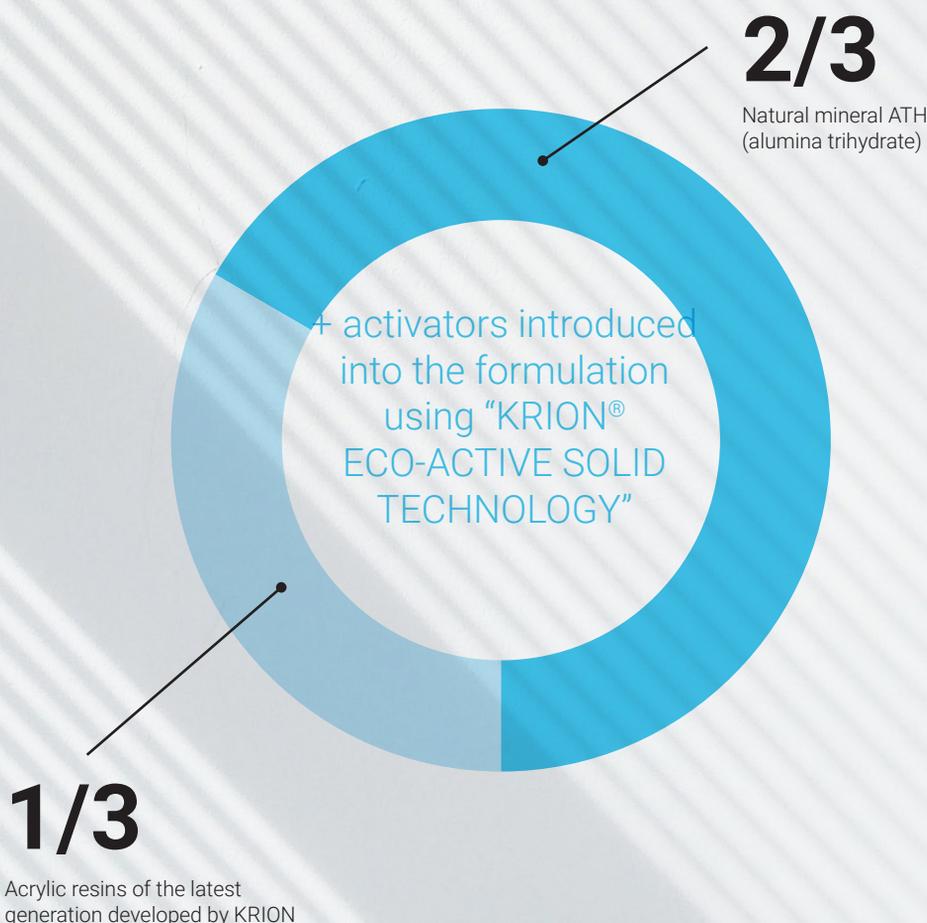
Solid

Technology

Krion® K·Life 1100

Krion® K·Life 1100 is the result of the application of technology known as KEAST. It consists of 2/3 parts of natural mineral ATH (alumina trihydrate), 1/3 part of latest generation acrylic resins developed by KRION and a series of activators chosen both for their efficiency and for their compatibility with Krion® introduced into the formula using "KRION® ECO-ACTIVE SOLID TECHNOLOGY®" KEAST.

Krion® K·Life 1100 is a product manufactured and marketed exclusively by KRION Porcelanosa Grupo. **The exclusive composition of Krion® K·Life 1100, enables the material to inherit the technical and aesthetic features of the mineral and combine them with the technical features** of the polymers and the photocatalysis, with clear and exclusive features: such as the **air purification**, the non-proliferation and **disposal of bacteria** with no type of additive, hardness, resistance, durability, **disposal of chemical products**, ease of repair, low maintenance and **easy cleaning**. For more information please read the safety sheets, technical notes and other related documents.



K·Life Properties

The new and revolutionary Krion® K·Life 1100, is the same old Krion®, with the same old properties, but incorporates the exclusive advantages of a surface with photocatalytic activity, all without losing any of the performance of the same old Krion®.



Air purification



Bactericide



Disposal of
chemical products



Easy
cleaning



Ultra-white



Resistant to compression



Resistant to impact



Resistant to solar radiation



Low thermal conductivity



Backlighting



Anti-spalling



Ecological / 100%
recyclable



Acoustic insulation



Suitable for food use



Imperceptible joints



Thermobending



High resistance to
chemical influences



Low weight



High fire resistance



Resistant to bending



Resistant to
extreme environments



Non-porous



High mineral content



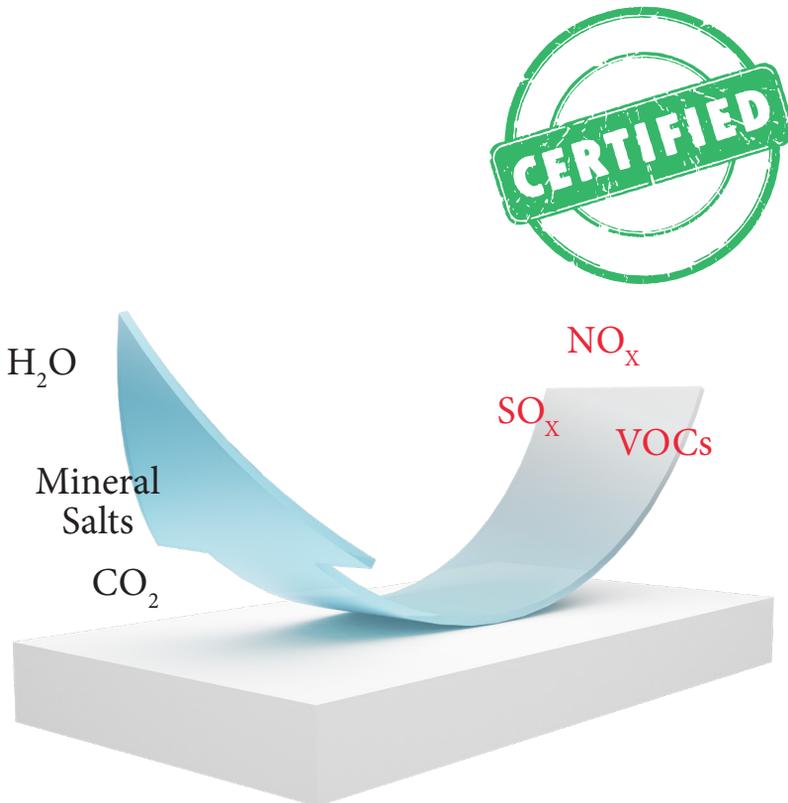
High durability



Air treatment

In the atmosphere and in our homes, there are certain gases which, due to pollution, are dangerous to humans and the environment itself. These gases are, specifically, the nitrous oxides (NO_x), sulphur oxides (SO_x) and volatile organic compounds (VOCs).

It is usual in photocatalytic products to assess their activity by the degradation of air pollutants. One of the main pollutants studied in this chapter is the degradation of the nitrous oxides (NO_x) in photocatalytic conditions.



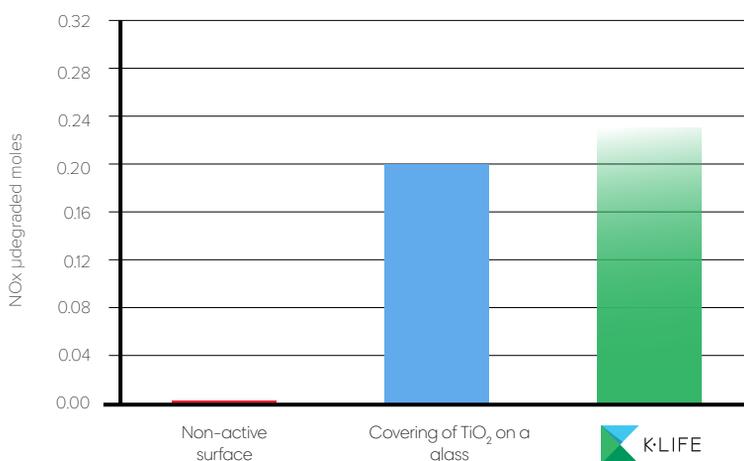
Accreditation of NO_x degradation

ISO 22197-1:2007

A test for disposal of nitrous oxides has been carried out in accordance with **ISO 22197-1:2007 “Test method for air-purification performance of semiconducting photocatalytic materials, removal of nitric oxide”**, in various technology centers and accredited laboratories such as the **International Photocatalyst Standards Testing Centre and the SunCatalyst Laboratories.**



The test conditions are those required by the regulations, both in temperature, relative humidity, air flow, irradiation and amount of NO_x supplied. To be able to contextualize and visualize the effect of the capacity for disposal of NO_x, the tests on the samples presented are compared to a covering of TiO₂ on glass and a non-active material. In this rule-based test the amount of micromoles of NO_x is assessed that are disposed by the material during the test.



The photocatalytic covering of TiO₂ on glass manages to remove, in all the tests, 0.21 μmol of NO_x. Krion® K-Life 1100 has been tested in different occasions providing mean values higher or equal to **0.21 μmol of NO_x**.

All the **Krion® K-Life 1100** results in the different tests carried out have given the result that the material **is ACTIVE** against the removal of Nitrous oxides in accordance with the applicable regulations.

Decontaminating capacity of Krion® K·Life 1100



Introduction

The ISO tests are carried out under standardized ISOs but understanding these data is at times complex and previous training is required, which is why we decided to subject Krion® K-life 1100 to more up-to-date tests that occur on a regular basis in our daily lives and so we are able to show, in a more understandable way, how and how much K-life can contribute to our lives.

To demonstrate the decontaminating capacity of Krion® K-life 1100 we have carried out an experiment in a controlled atmosphere where we use pollution values closely related to those we tend to suffer in our cities, and we find Krion® K-life 1100 transformed into something as commonplace as a table and some chairs. To carry out this test we have counted on CEAM, a center with much experience in assessing photocatalytic materials and with a EUPHORE reactor to carry out these tests with guarantees.

Focus and scope

The main objective is to find out the difference in the reduction of NOx in one environment and under equal conditions when we use Krion® K-Life 1100 and a solid conventional surface.

The main objective of this experiment is to assess the decontaminating effectiveness of 4.4 m² of Krion® K-life 1100 solid surface, contained in a life-size table and 8 chairs, in an atmospheric simulation chamber of 200 m³, using natural light, and introducing initial concentrations of 110 ppb of NO and NO₂, typical of a very polluted atmosphere in a big city. The assessment will be performed by comparing the two substrates of equal size and shape, one of them performed under the KEAST technology and another not, studying only the reduction of NOx.

Description of the experiment.

With the objective of studying the reducing power of nitrogen oxides (NO_x) of Krion® K-life 1100, three experiments were carried out over six days in one of the EUPHORE simulation chambers

Experiment 1



DAY 1

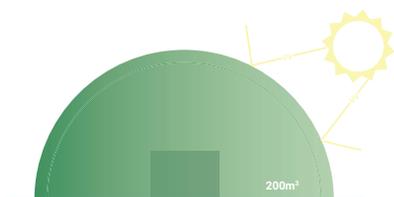
Installation of **photocatalytic material** in the thoroughly clean simulation chamber, conditioned with purified air, dry and free of pollutants. The table top and 8 chairs made with Krion® K-life 1100 are installed, with a total surface area of 4.4 m², of which 2.2 m² corresponds to the exposed surface of the table, and the rest to the surface of the chairs (backrests and seat). The outer dome is closed to shut out daylight.



DAY 2

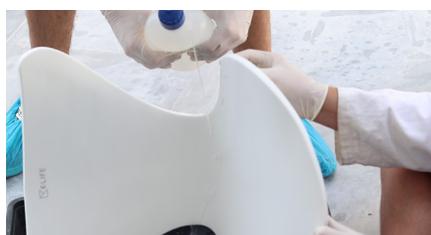
Experiment with the **photocatalytic material**. Introduction of 110 ppb NO_x (50 ppb NO and 60 ppb NO₂) into the chamber to create a similar pollution scenario to one in a big city. The outer dome is opened and the material for assessment exposed to sunlight. The initial relative humidity is at 50%. On completion of the experiment the outer dome is closed.

Experiment 2



DAY 3

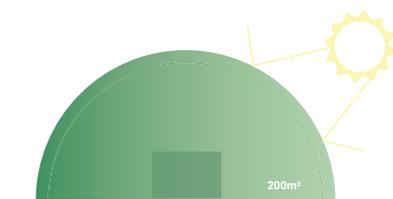
Experiment with the **photocatalytic material** (Replica). Introduction of 110 ppb NO_x (50 ppb NO and 60 ppb NO₂). The outer dome is opened and exposed to sunlight. Initial relative humidity 50%. On completion of the experiment the outer dome is closed.



DAY 4

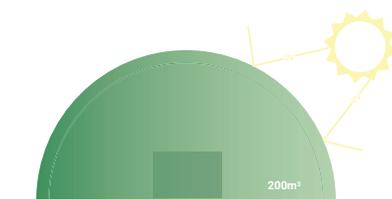
Washing is performed with Milli-Q water by sprinkling the **photocatalytic material** and collected for further analysis of nitrites and nitrates in the water. The photocatalytic material is removed and the table and chairs made of a conventional, non photocatalytic solid surface installed. Once installed a general cleaning is carried out of the chamber, leaving it in conditions of purified air, dry, free of pollutants and with the outer dome closed to prevent light from entering.

Experiment 3



DAY 5

Experiment with the **non photocatalytic material**. Introduction of 110 ppb of NO_x (50 ppb NO and 60 ppb NO₂). The outer dome is opened and the material to be assessed is exposed to sunlight. Initial relative humidity 50%. On completion of the experiment the outer dome is again



closed.

DAY 6

Washing is performed with Milli-Q water by sprinkling the **non photocatalytic material** for further analysis of nitrites and nitrates in the collected water. Removal.

Technical description

As a general rule **organic compounds, when exposed to sunlight, end up breaking down due to photodegradation**, and in this case, as it is a closed environment and there is no extra intake of "pollution" as would occur in real life, the amount of NO_x will become degraded naturally.

Relative humidity (RH)

The relative humidity is maintained for all the experiments at around 45-47% on average. The relative humidity depends on the temperature. On exposing the simulation chamber to sunlight, an increase in temperature occurs as the day progresses, which causes a reduction in the relative humidity. This is why water was re-introduced throughout the experiment to compensate for these losses.

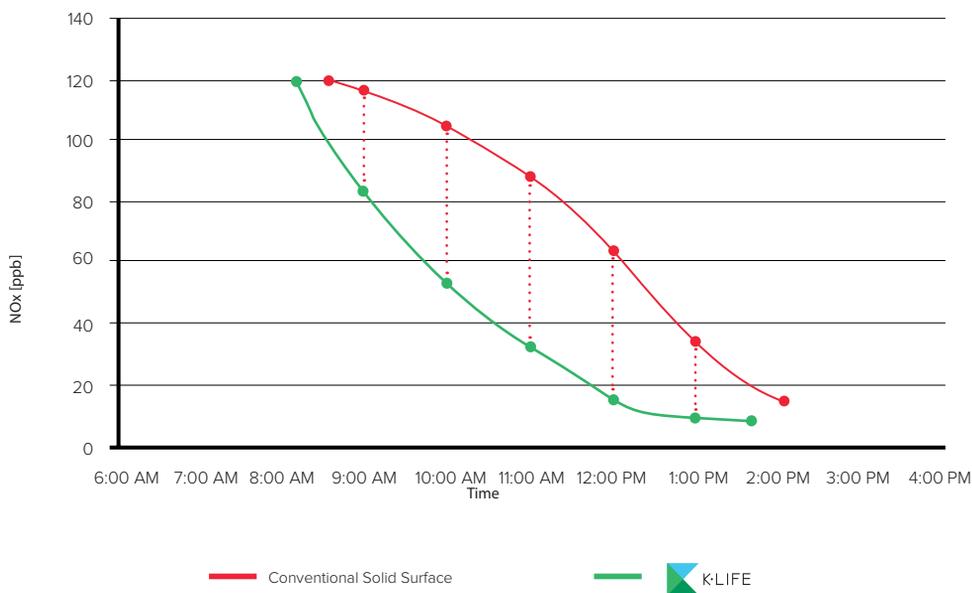
Radiation

The radiation during the experiments was determined by a filter radiometer. The difference in the average of radiation during the time over which the different materials were exposed did not exceed 2% and therefore can be considered equivalents.

Results

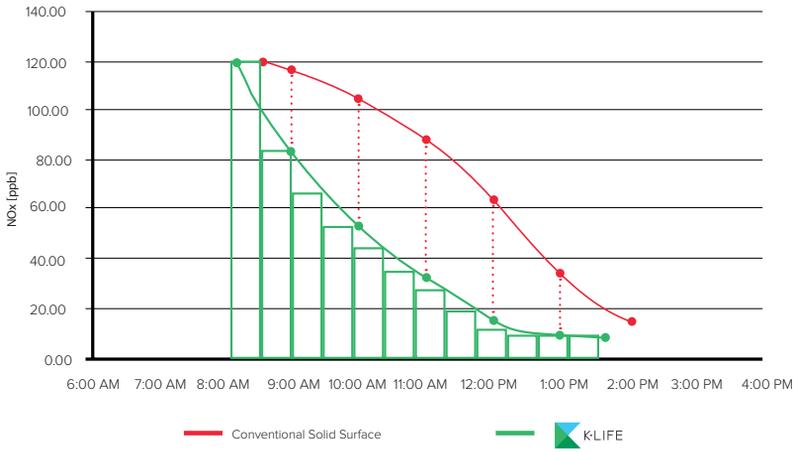
Development of total nitrogen oxides (NO_x)

The performance of degradation of the nitrogen oxides was analyzed, in both scenarios, and the result is given in the following graph.



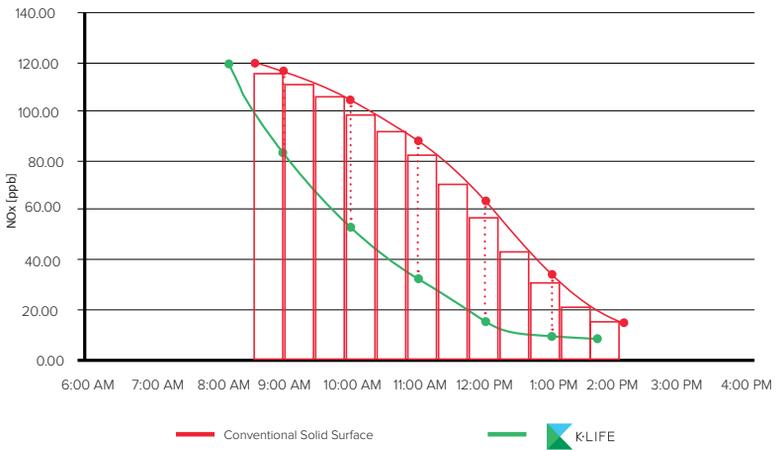
Conclusions

From the data obtained we can conclude that there is a greater reduction of nitrogen oxides in the chamber with the Krion® K-life 1100 compared with the chamber that had a conventional solid surface. **The reduction of NO_x observed per hour is an average of 12.3% higher for the photocatalytic materials compared with the non photocatalytic materials.**



100%

58%



Interpretation of data

From one test (Krypton® K-life 1100) to another (conventional solid surface) we conclude that in the same scenario and conditions, in a period of 6 hours Krypton® K-life 1100 accelerates the decontamination by 42% versus the non photocatalytic conventional solid surface.

Technical annex.

The installation where the assessment was performed consists of two twin photochemical simulation chambers in real urban conditions, located inside the CEAM Foundation building. Each one consists of a hemispherical structure of Teflon with a volume of about 200 m³. The chambers are constructed with a 013 mm thick sheet of fluoro-ethylene-propylene (FPE) made up of 32 individual solid segments so that it achieves the hemispherical shape. This sheet has the capacity to transmit more than 80% of the solar radiation in the range between 280 nm and 640 nm (next UV-visible). These bands of the spectrum constitute the ranges of radiation that greater power supplies to the chemical reactions that take place in the photo-oxidation processes of the troposphere. In addition, Teflon is a chemically inert material and constitutes the best option for preventing uncontrolled reactions of the trace gases inside the walls of the chambers.



To reduce the effects of the wind on the walls of the reactor, the chambers operate within a pressurized enclosure of 100-200 Pa. Also, an internal structure made of epoxy resin pipes maintains the hemispherical shape of the Teflon sheet in the absence of this overpressure as well as a collapsible outer dome to allow light to pass through it or not, as well as protect the chamber from adverse weather conditions. The floor of the chamber consists of 32 symmetrical aluminum panels covered with a sheet of FPE which is sealed with the hemispherical bag using a rubber cord. The ports of entry of the reagents and the sample collections for the different analytical instruments are located on the floor of the chambers.

One of the technical innovations included in this installation is the integrated cooling system on the floor of the chambers, which compensates for the heating of the internal air which induces the incoming solar radiation. Furthermore, it has two large fans which enable correct homogenization of the pollutant compounds inside the chamber.

The simulation chambers are equipped with a large number of analytical instruments

that can analyze the volatile organic compounds (VOCs), ozone (O₃), nitrogen monoxide (NO), nitrogen dioxide (NO₂), hydroperoxides, aldehydes, ketones and organic carboxylic acids. For in-situ measurements, the installation has very sensitive and selective technologies such as LP-FTIR and the DOAS LP-UV/VIS spectroscopy.

For detailed and highly sensitive analysis of the trace gas reaction products, we can use different ozone and nitrogen oxide (NO_x) monitors, as well as formaldehyde (HCHO) and nitrous acid (HONO) monitors, as well as the LOPAP monitor, GC-MS chromatographs and GC-MS/MS systems that directly show the gas phase, using pre-concentration or capture technology. In order to measure the OH and HO₂ radicals, the installation is equipped with a Laser-induced Fluorescence (LIF) that has excellent performance in studying the formation of radicals and the cyclical processes responsible for the formation of ozone and photo-oxidants.

In order to measure the formation of aerosols from volatile organic compounds (VOCs), biogenic or anthropogenic precursors, during their oxidation, the EUPHORE installation is equipped with an SMPS system and a tapered element oscillating monitor (TEOM) that determines the particle size distribution and the mass concentration of aerosols. There are also other off-line technologies available such as HPLC and LC-MS or GC-MS for the analysis of different compounds, both in the gas and particle phase.



Bactericide

The bacteria are usually present in our environment, tending to form colonies and growing in any spaces that favor them, as happens in porous materials, in joints or surfaces difficult to clean, which may lead to the development of diseases dangerous to our health.

Until now, Krion® and its low porosity, low water absorption and absence of any joints has meant that bacteria, fungi and micro-organisms do not grow in the material... These properties are key to determining aseptic environment, such as those in kitchens, clinics, bathrooms...

Nowadays, thanks to its photocatalytic properties, the material has become active against bacteria and their elimination.



Accreditation of anti-bacterial activity

ISO 27447:2009

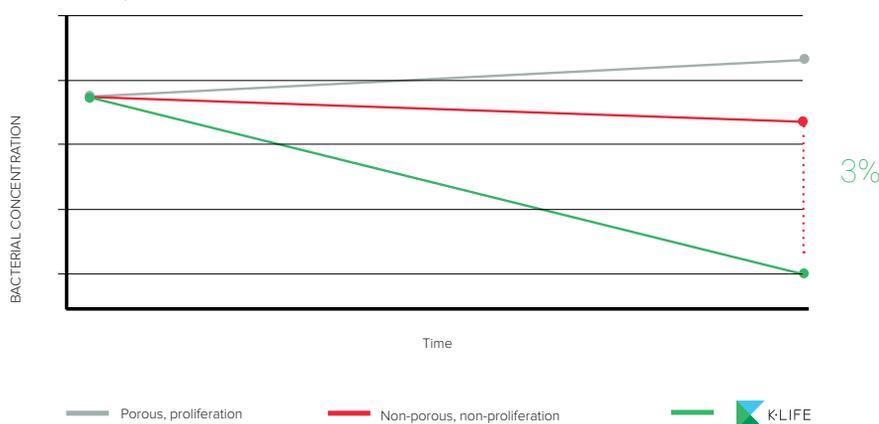
Test **27447:2009 “Test method for antibacterial activity of semiconducting photocatalytic materials”**, has been performed in different laboratories such as the Valencian Institute of Microbiology (IVAMI) or at the Technical University of Liberec through the assessment of the Escherichia coli.



Experimental conditions

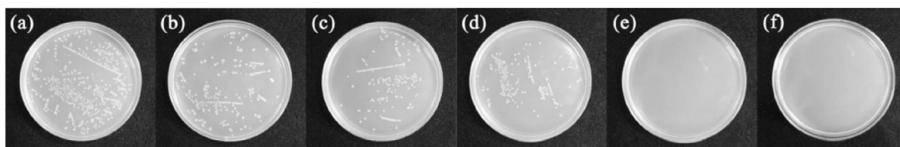
The procedure was carried out on Krion® K-Life 1100 and on a conventional solid surface during a contact time of 8 hours. The intensity of radiation is 0.25 mW/cm² from a fluorescent lamp BLB, at a controlled temperature in the range of 18 - 25 °C and an incubation temperature of 35 °C.

Three replicas for each test were carried out. The loss of micro-organisms due to darkness and the effects of the UV radiation were assessed as a final step for the contextualization of the photocatalytic results. After the test a greater removal of bacteria was observed in the case of Krion® K-Life 1100 in comparison with a conventional solid surface. This result is attributable to the photocatalytic effect provided by Krion® K-Life 1100 in comparison with the conventional solid surface.



Specifically, it was an additional elimination above **3 % for the case of Staphylococcus aureus** and higher than **2.4 % for the Escherichia coli**.

The following image shows a simulation of the reduction in micro-organisms on a specimen during the duration of the test.



Conclusion

Following the test and with the data obtained, the photocatalytic activity of the material could be verified. Concluding that the material with **Krion® K-life 1100 is ACTIVE** against the acceleration in the elimination of micro-organisms following standard **ISO 27447:2009**



Disposal of chemical products

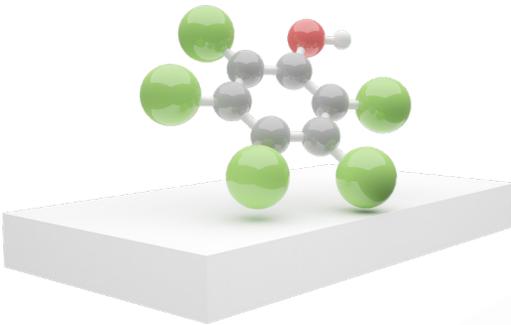
Chemical products are everywhere nowadays: in our air, in our water, in our food, in our furniture... In some cases they are highly dangerous and every time and are increasingly shown as the cause of diseases such as Parkinson's, leukemia, myeloma, neurological disorders, cancer).

Using the new technology present in Krion® K-Life 1100 it has been possible to eliminate a large number of compounds dangerous to our health such as pesticides and chemical products present in our environment and especially in the food we consume.



100%

It has been proved that the new new Krion® K-Life 1100 can degrade up to 100% of these dangerous compounds.





Degradation of organic compounds

ISO 10678:2010

Degradation of methylene blue and rhodamine B.

The methylene blue is a colorant originally for the textile industry, and is currently the compound used to carry out various photocatalytic activity tests according to standards **ISO 10678:2010 "Determination of photocatalytic activity of surfaces in an aqueous medium by degradation of methylene blue"**.

Rhodamine B is a colorant with the special characteristic of having fluorescence and is used for marking and monitoring liquids. It can be used to assess the photocatalytic activity of a material under standard **ISO 10678:2010**.

It is usual for the photocatalytic activity of a material to be assessed through the degradation of these chemical products. These compounds are used because they are likely to be eliminated under photocatalytic conditions and because they go from having a very intense color to being transparent when they are fully eliminated.

These tests have been carried out in:

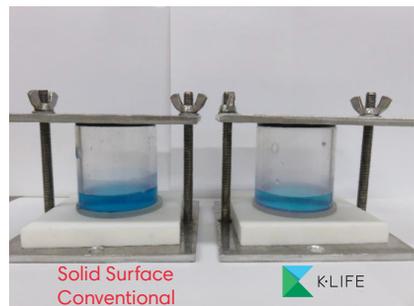
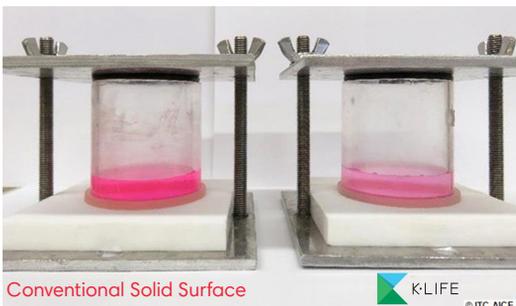


Experimental conditions

For the correct study of the degradation of Rhodamine B and methylene blue, the same process was carried out in parallel, but using a conventional solid surface. The objective of this test is to quantify the effect of photolysis present for both cases.

Photolysis is the process of degradation of organic compounds due to the presence of radiation, especially UV. This effect can be observed in the loss of coloration of the sample without any other type of agent present than that of the UV radiation. In the results, this will be reflected in the loss of linearity in the concentration of the compound over time.

The dissolutions were among those located on the surface of the Conventional Solid Surface and on the Krion® K-Life 1100. They were left for 2 hours in the darkness to bring about surface adsorption. After this time, the light was switched on and the aliquots collected every 30 minutes to measure the evolution of concentration of Rhodamine B and methylene blue.

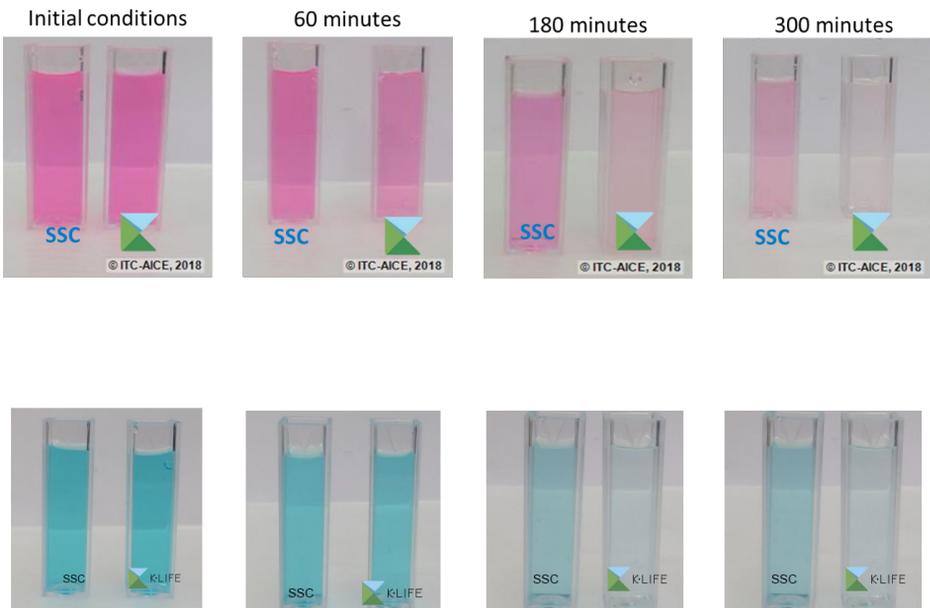




Spectrometer UV-VIS

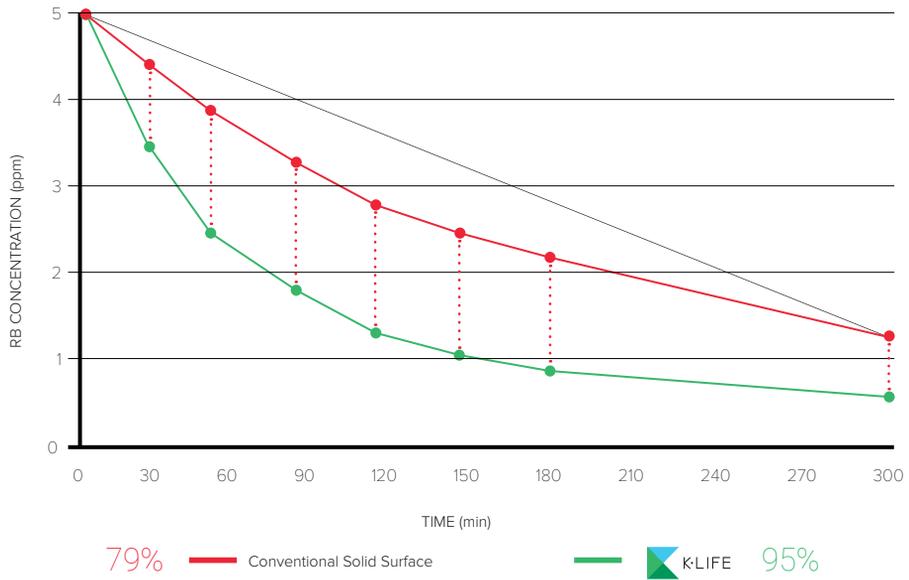
Results

While extracting the aliquots it was possible to see with the naked eye the variation in the concentration both of Rhodamine B and methylene blue due to the loss of coloration, which is more advanced for the case of Krion® K-Life 1100.

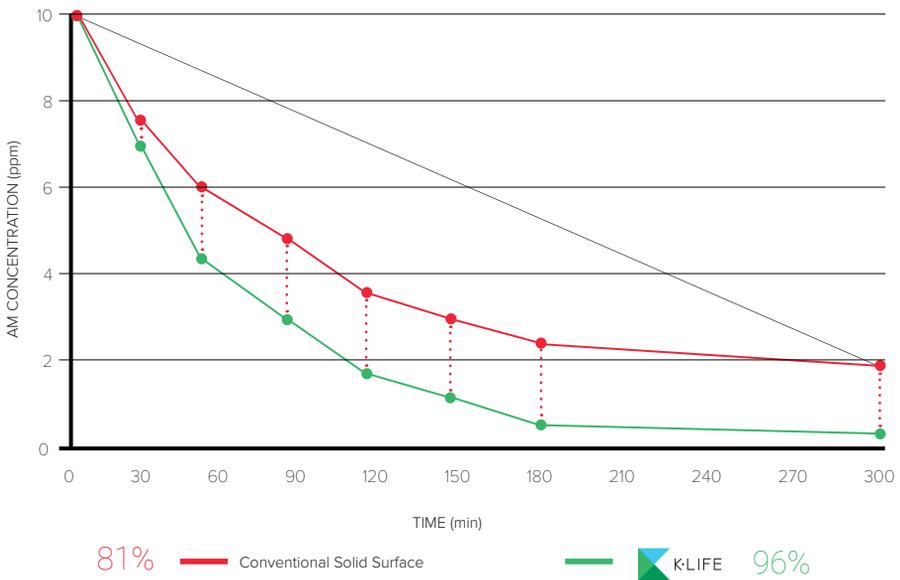


After collecting the aliquots for 300 minutes and analyzing them with a UV-VIS spectrometer, the variation of the concentration in ppm against the time in minutes could be represented graphically.

Variation in the concentration of Rhodamine B with the exposure time



Variation in the concentration of methylene blue with the exposure time



Conclusions

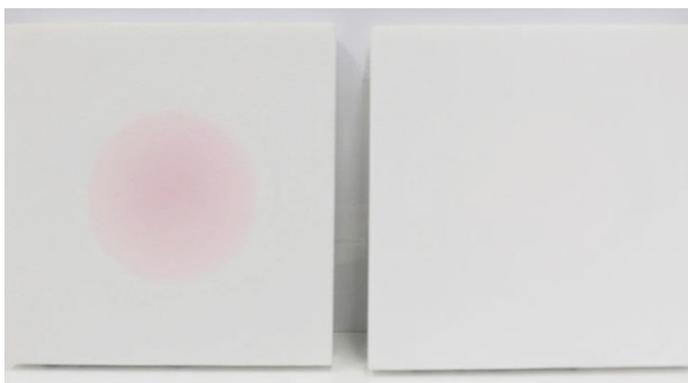
Following the experiment carried out we can draw a number of conclusions:

An increase in photocatalytic activity was shown to present in **Krion® K-Life 1100 with KEAST technology**, being an **ACTIVE** surface against a conventional solid surface.

This technology and strategy followed by the KEAST technology is valid for developing photocatalytic activity of the material.

This photocatalytic activity has demonstrated in this study, through degradation of organic dyes through activation by ultraviolet light.

As it is a photocatalytic material, we can say that it has the properties of these materials such as self-cleaning, antibacterial and degradation of compounds in liquid and gas phase.



Solid Surface
Conventional



Degradation of Pesticides

Pesticides are compounds that help prevent the presence of pests in food crops. These compounds are completely necessary for maintaining a productive and prosperous system, but are also chemical compounds requiring monitoring. These compounds may also be harmful to people.

For this reason, the European Chemicals Agency (ECHA), has drawn up a list of substances approved and non-approved for control. This is why it is necessary to have these chemical products within some parameters commensurate with the safety of individuals.

In agri-food control laboratories, the analysis of fruits and vegetables for consumption is carried out. In them, checks are made to ensure that none of these compounds is present in the food or that their concentrations are within the permissible limits.

At KRION we have carried out a pioneering study of degradation of pesticides as a result of the photocatalytic effect. To date, the ISO standards do not include a methodology or procedure for this determination. From KRION, we think it is important not only to have control of the list of substances and their concentrations, but also that it is necessary to reduce the concentration of these compounds present in fruits and vegetables of everyday use.

In an adaptation of the standard ISO 10678:2010 "Determination of photocatalytic activity of surfaces in an aqueous medium by degradation of methylene blue", in the accredited laboratory International Laser, it was possible to quantify the reduction of the concentration of these pollutants by the action of Krion® K-Life 1100.

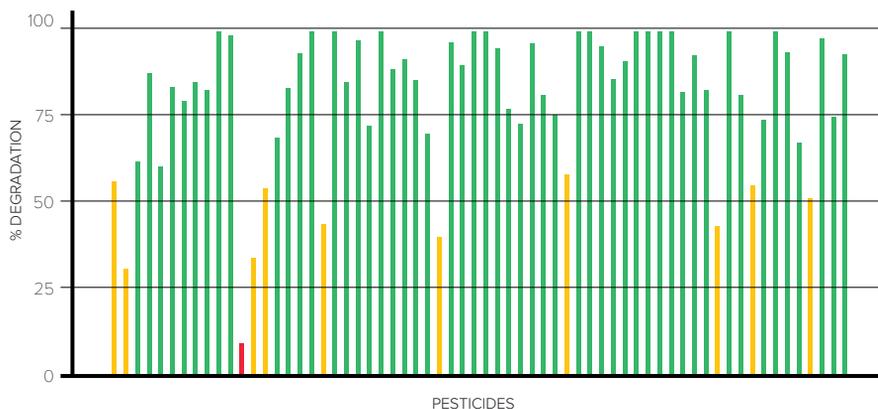


This is why we base ourselves at all times on the rest of the ISO standards relating to photocatalysis and applying it to the whole range of common pesticides, an exhaustive degradation study was carried out.

The pesticides were deposited superficially and through activation using photocatalytic light the power of degradation was assessed for each one of them.

Results

In this study, it could be observed that, on exposing Krion® K-Life 1100 under photocatalytic conditions, the reduction in the concentration of a large number of pesticides assessed was over 60%, sometimes reaching 100%.



Conclusions

For these conditions and, depending on the photolysis and resistance to each compound to be degraded, some varied but very positive results are generated in the majority of cases.

From among the long list of pesticides studied, compounds in common usage stand out and are present in many cases in food samples. These are compounds like **Aclonifen (63 %)**, **Chlorpyrifos (98 %)**, **Endosulfan (66 %)**, **Malathion (54 %)**, **Metalaxyl (69 %)** and **Sulfotep (43 %)**.





Easy cleaning

The property of easy cleaning or self-cleaning as set out in ISO 27448:2009, understood as the increased ease in removing a pollutant on the surface of a photocatalytic material in comparison with another that is not.



Test for calculating the drop angle

ISO 27448:2009

To exemplify this property, the test of the drop angle calculation was carried out on Krion® K-Life 1100 in consistent with ISO 27448:2009 “Measurement of water contact angle”, at the accredited international laboratory Photocatalyst Standards Testing Centre (IPS). According to international standards.



The property of easy cleaning or self-cleaning as set out in ISO 27448:2009, understood as the increased ease in removing a pollutant on the surface of a photocatalytic material in comparison with another that is not. Through the measurement of the water drop angle.

Drop angle

Conditions of the experiment

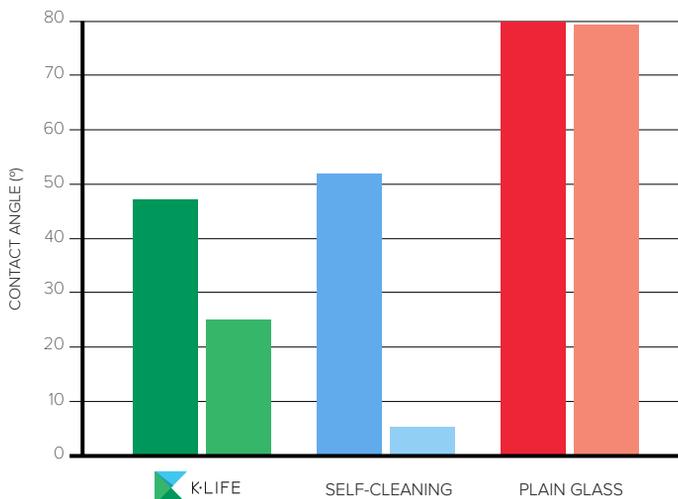
According to the regulations we can assess the photocatalytic effect of a material if it is capable of modifying the drop angle on its surface on irradiating UV light. The effect is due to the change in wettability on the surface due to the effect of the radiation.

This change is known as the superhydrophobic effect due to photoinduction. This effect defines the photocatalytic activity of a material on modifying the angle of a drop deposited on the surface as a function of time.

In the test performed, the initial drop angle is measured and the then again after 48 hours. In this rule-based test two samples of Krion® K-Life 1100 are tested and their results compared with a highly self-cleaning material and another corresponding to a flat, non-photocatalytic glass.

Results

The results of the test carried out with Krion® K-Life 1100 shows a reduction in said angle, as we can see in the graph.



	INITIAL ANGLE	FINAL ANGLE	REDUCTION
PLAIN GLASS	79.07°	76.00°	3%
KRION® K-LIFE 1100	47.16°	24.35°	49%
SELF-CLEANING	52.52°	4.26°	92%



Conclusions

After the test and with the data obtained, it was possible to verify the photocatalytic activity of the material, concluding that the material with Krion® K-Life 1100 is **ACTIVE** on facilitating the cleaning of its surfaces by following standard **ISO 27448:2009**.

Degradation of substances of everyday use

For this study, the photocatalytic degradation will be determined for products considered to be in contact with a solid surface in their day-to-day use.

This study has been carried out by the Institute of Chemical Technology of Valencia



Firstly, we have a series of compounds representing common colorants.

Substance



Alizarin is a compound widely used as a reddish colorant, especially common in hair dyes.



Chlorophyll is a compound that is present in plants and/or vegetables and is widely known for its essential role in photosynthesis.



Nicotine, widely known for its presence in cigarettes.



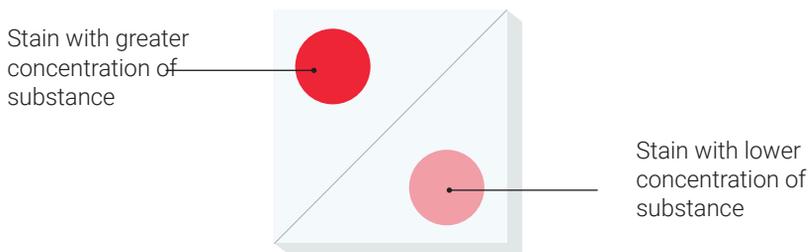
Blood. Hematoporphyrin is a molecule found in the blood with a typically brown color.



Tomato, one of the main stains present in our kitchens.

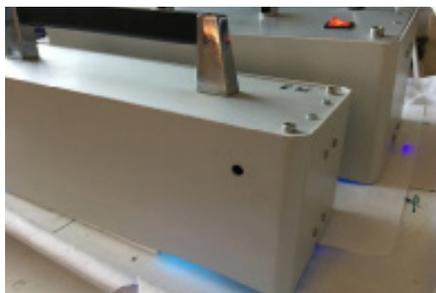
For this study the staining on Krion® K:Life 1100 was carried out in parallel with photocatalytic technology and also on a conventional solid surface to see the difference between the degradation on these two surfaces.

Each stain was applied to each sample in two different concentrations to have control of the whole range of speeds of degradation.



The various organic products were introduced in dissolution, depositing one drop on the surface and waiting for it to dry. Once dry, the stains were subjected to photocatalytic testing under radiation. The radiation selected was monochromatic ultraviolet at 380 nm with a radiation of 24 W/cm². The atmosphere during the experiment was ambient for similar standard conditions of use.

The test was carried out over 21 days, taking regular images to see the evolution in each case.



Results

Shown below are the results following 21 days of irradiation on the conventional solid surface (table 1) and on Krion® K·Life 1100 (table 2) for each one of the organic products at 2 different concentrations. The top of the sample has the greatest stain concentration and the bottom part has the stain with the lowest concentration.

Conventional solid surface sample

The results of the conventional solid surface samples. The reason for this non photocatalytic test is to assess the degradation of the stains as a result of the photolysis. This degradation is due to the exposure of the stain itself to ultraviolet radiation. The activity of an active sample such as Krion® K·Life 1100 should be assessed by comparing it with an inactive sample, and see the difference in effect.

As we can see in table 1, most of the stains remain at two concentrations after 21 days of exposure. Just for the case of the chlorophyll, we can see a considerable degradation before reaching the end of the test. The degradation observed is the effect of the photochemical oxidation reaction in the presence of ambient oxygen.

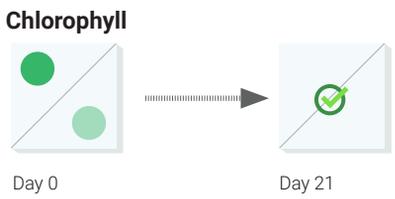


Table 1. Result with conventional solid surface.

	Alizarin	Chlorophyll	Nicotine	Blood	Tomato
Day 0					
Day 1					
Day 2					
Day 7					
Day 14					
Day 21					

Sample Krion® K-LIFE 1100

Observing the evolution of each type of organic product, we can make several groups of results.

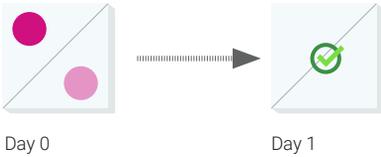
In the first place we would have the stains of alizarin and chlorophyll.

These stains as seen at 21 days have completely disappeared after the 21 days, even the most concentrated ones.

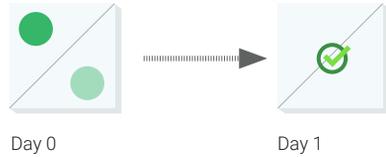
Comparing the speed of degradation for each stain, we can see that the alizarin and chlorophyll stains are the first ones to be degraded in scarcely 24 hours.



Alizarin

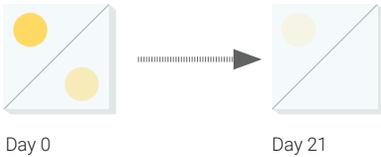


Chlorophyll

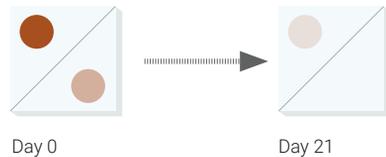


Later, we find a group of stains consisting of nicotine, blood and tomato and that after 21 days the stain of lower concentration has disappeared and the one with greater concentration is still present, but at much lower intensity.

Nicotine



Blood



Tomato

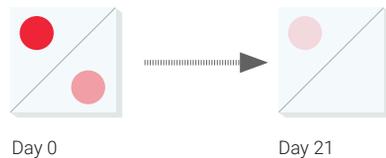


Table 2. Result with Krion® K-LIFE 1100

	Alizarin	Chlorophyll	Nicotine	Blood	Tomato
Day 0					
Day 1					
Day 2					
Day 7					
Day 14					
Day 21					

Table 3. Results with conventional solid surface.

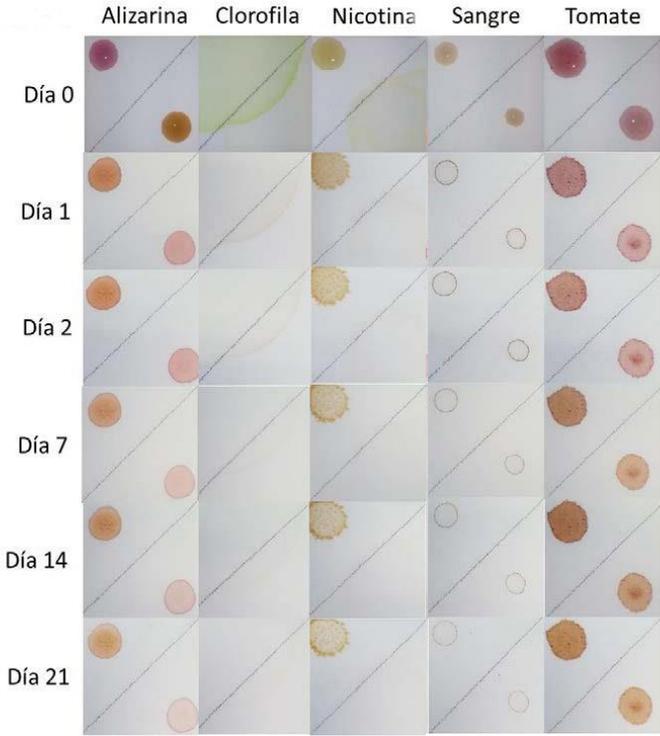
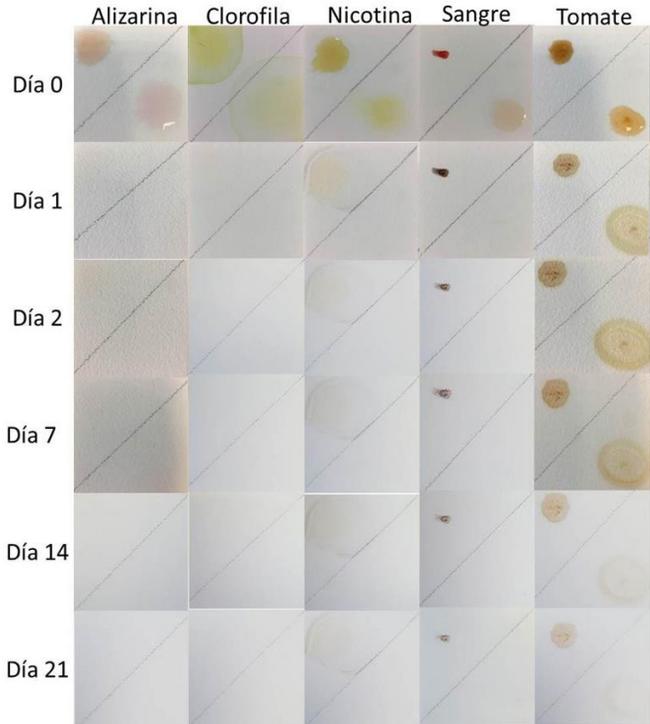


Table 4. Results with Krion® K-LIFE 1100 



Conclusions

The objective of this project is to record the photocatalytic activity of samples of Krion® K-Life 1100 provided by KRION in comparison with a conventional solid surface, through the acquisition of graphic documents that prove the efficacy of these elements.

As we have seen, the use of those of Krion® with KEAST technology accelerate considerably the degradation by degradation caused by irradiation of colorant light and common stains.

The graphic evidences show that the action of this technology can degrade some of these substances within 24 hours, while other more persistent ones need several weeks.





It is still Krion®

Whenever a change is made to a product a testing exercise is required in which an assessment is made as to whether these changes will have a beneficial impact on the clients and if these changes involve changes in earlier work done. **With Krion® K-life 1100 special care has been taken to preserve all the properties already held by the Snow White 1100 model** and 4 more properties were added, provided they respect the previous ones. That is why we affirm that Krion® K-Life 1100 continues to be Krion® but with the uniqueness of adding 4 differentiating, exclusive properties:



Air purification



Bactericide



Disposal of
chemical products



Easy
cleaning

Mechanical Properties

From the extensive list describing the mechanical properties of Krion® K-Life 1100, it is worth insisting on the bending strength and the impact of the material, achieved thanks to the unique formulation and production process.

The bending strength of Krion® K-Life 1100, defined as **73 Mpa**, allows the material to have various applications over and above coatings and decorative elements. To that effect, it is advisable to carry out a preliminary study to validate and check any proposals for specific mechanical demand.

It is possible to bend sheets of Krion® K-Life 1100 in cold. This option may be considered for radii of 1800 mm in 12 mm thick plates and reduced to 900 mm in 6 mm thick plates.

The high impact resistance of Krion® K-Life 1100 allows the material to absorb the energy produced by possible shocks or impacts without any breakage. Krion® K-Life 1100 12 mm can satisfactorily pass a test that consists of repeating 10 impacts at a height of 1900 mm.

73 Mpa

Tensile strength is the property most relevant for determining the performance of the designs created with solid surfaces.



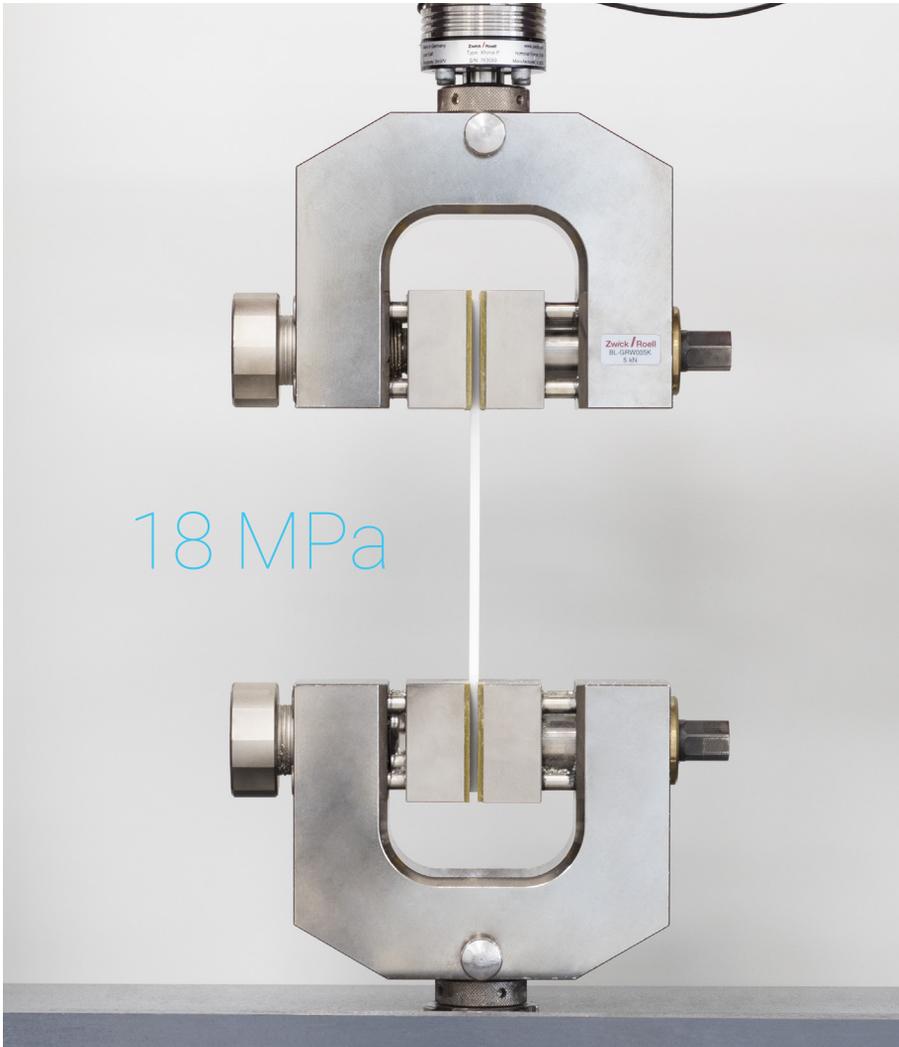


High tensile strength in the joint

Using Krion® adhesive, the tensile strength in the joint between Krion® sheets is almost double that shown by conventional solid surfaces.

The test, carried out in the laboratories approved by the **CSTB: Centre Scientifique et Technique du Bâtiment** shows that the tensile strength of Krion® remains stable after subjecting the material to moisture and UV aging tests.

Material	Thickness (mm)	Initial tensile strength (MPa)	Tensile strength following aging (MPa)
Conventional Solid Surface	12	10	9
Krion®	12	18	18





Fire performance

Excellent fire performance, material of limited contribution to fire and self-extinguishing.

The composition with high concentration in natural minerals of high quality make Krion® a perfect ally as far as safety is concerned.

KRION, has carried out relevant tests, at international institutions of recognized prestige for providing data relating to said fire performance parameters.

STANDARD	PROPERTIES	Krion®
EUROCLASS UNE 13501	Fire performance	B s1 d0
NFPA 101		Class A
DIN 4102-1		B1 Unrestricted
NFPA 259/ ISO 1716	Calorific potential	9.3 MJ/Kg
ASTM D1929	Flash point	440 °C
ASTM E84	Flame propagation/smoke generation	0/5

B-s1,d0

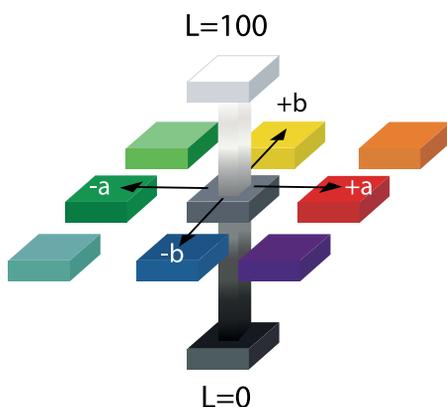
Ensures we have a high level of quality, given that the material in the event of fire does not emit toxic or dense smoke (s1) which make evacuation difficult.



PROPERTY	STANDARD	RESULT
Specific heat	UNE-EN 23721	1.361 J/g · K
Thermal resistance	UNE-EN 12667	0.064 m ² · K/W
Naval	IMO Certificate	Mod.B & Mod. D
Naval. Toxicity of the smoke	IMO FPTC Part 2	Pass
Ventilated facade	UNE-EN 13501-1	B-s1,d0
Fire performance	UNE-EN 13501-1	B-s1,d0 (without support)
Flammability	UL94HB	Pass
	UL94V	V0
Burnt surface	ASTM E84 (NFPA 255)	Flame propagation 0
		Smoke developed 5
Surface of floor burned	CAN/ULC-S102.2	Flame propagation 0
		Smoke developed 0
Fire classification	DIN 4102-1	B1 Unrestricted
Calorific potential	ISO 1716 / NFPA 259	9.3 MJ/kg
Ignition	NFPA 268	Pass
Flammability. Surface combustion feature of construction materials	NFPA 101	Class A
Flame ignition temperature	ASTM D1929	440 °C
Self-ignition temperature	ASTM D1929	490°C
Single test of item in combustion for building materials and products	GB/T20284-2006	Pass
Gosudarstvennyy Standard	GOST	Pass

Color stability

Color stability is one of the main assumptions that characterize Krion®. KRION pays particular attention to this characteristic and sets stringent controls based on continuous measurements of L, a, b and ΔE while establishing some comprehensive limits so that changes in tone, if any, will be as imperceptible as possible. The human eye is capable of sensing millions of colors, but every individual perceives them in different ways, and these different perceptions are problematic for manufacturers. Thus, color spaces appear. L, a, b is a color space defined by the CIE (Commission Internationale de l'Éclairage), an organization considered to be the authority on the science of light and color. Numbering is used to express the color of an object and in this way it can be expressed and communicated objectively. (L) indicates luminosity, (a) is the coordinate that crosses from red to green and (b) the coordinate that crosses from red to blue:



The numerical comparison of one sample with the standard is the difference in color. To determine the difference in color between the 3 coordinates L, a, b, a formula is applied that gives us the result ΔE , which will be the one we use to tell us the total magnitude of the color change. KRION, with its comprehensive controls in the production process ensures that your sheets of Krion® can have the maximum of variations in tone never exceeding an ΔE of 1 in sheets of the same production batch and a $\Delta E < 2$ for sheets of the same color but from a different batch. Standard ISO 12647-2 is for regulating the color standards and, among many other definitions, addresses the tolerance thresholds for the ΔE :

ΔE of 1

Krion® shows a variation of tone in sheets of the same production batch.

$\Delta E < 2$

Krion® shows a variation of tone in sheets of the same color but different batch.

ΔE	QUALITY	ΔE	QUALITY
<1	Excellent	4-5	Sufficient
1-2	Good	>5	Poor (other color)
2-4	Normal		

 Ultra-white

Krion® K-Life 1100 enjoys some levels of whiteness that are unusual in other materials cataloged as solid surfaces. These levels are considered very close to what is understood as the theoretical perfect white.

	L	a	b
Perfect white	100	0	0
Krion® K-LIFE 1100	95.37	-1.01	0.86

NOTE: These values are endorsed in the KRION laboratories in accordance with the international standards and using calibrated measurement equipment (Spectrophotometer BYK model Sphere Gloss & X-Rite Ci6x UV).

95.37

The luminosity (L) is the degree of light that any color is capable of reflecting. With 0 a perfect black and 100 perfect theoretical white.

100



Reflectance Value

The light reflectance value LRV of Krypton® K-Life 1100 the light reflectance value LRV of Krypton® 88.00, according to standard ASTM C609, *Standard Test Method for Measurement of Light Reflectance Value and Small Color Differences between Pieces of Ceramic Tile*.

The reflectance indicates the total amount of light reflected by a surface, when it is illuminated by a light source, with 0% being the value that would correspond to absolute black and 100 % to absolute white (within the 0-100% scale that represents the reflectance).

NOTE: These values can be used to determine the visual contrast between the different materials, where it is important for an object to be visually distinguishable. In addition to these values, they are used to calculate the lighting requirements of a room. High reflectance values in the materials used in ceilings, floors and walls reduce the lighting requirements, as these materials help to reflect the existing light, both from lamps and from natural daylight.

LRV 88

White-colored materials contribute to better absorption of heat due to the high light reflection index, therefore it is very useful as a solution for improving the thermal enclosure of the buildings.





UV resistance

Krion® K-Life 1100 guarantees a very high color stability faced with prolonged exposure to weathering. This has an ΔE value at 10 years lower than 1.5.

This value was obtained based on a series of laboratory tests that simulated the outdoor installation of the material, and tests of exposure to the actual weather were also carried out at installations of recognized international prestige located at parts of the planet with extreme and particular climates;

- 1. Accelerated artificial aging test using QSUN chamber according to standard ISO 4892-2.** Methods of exposure to laboratory light sources, Part 2: Xenon arc sources.
- 2. Accelerated artificial aging test using QUV chamber according to standard ISO 4892-3.** Methods of exposure to laboratory light sources, Part 3: Fluorescent UV lamps.
- 3. Natural aging test by exposure to direct sunlight.** Radiation between 150-200 W/m² in the experiment area.
- 4. Aging test of materials:** Q-LAB Florida & Q-LAB ARIZONA. Approved according to standard ISO 17025.

$$\Delta E \leq 1.5$$

The degradation of color shall not exceed a color gradient (AE) of 1.5 in the first 10 years, a value barely perceptible to the human eye.

Acoustic Insulation

Krion® K-Life 1100 has a few intrinsic physical features that make it into a product with a high **Acoustic Reduction Index** rising to 33.5dB, according to accredited laboratory tests and in accordance with **ISO 717-1:2013**. The properties that contribute to this result are the high density (1750 kg/m³) and elasticity of the material, successfully managing to behave as a membrane for acoustic energy dissipation. Other factors that also favor its acoustic behavior are its zero-porosity and the type of joints.

Acoustic improvement on conventional partitions

The acoustic tests performed in the external laboratory accredited by ENAC and following **UNE EN ISO 10140-1:2011** Annex G, certify that the application of 12mm thick Krion® as cladding over standard vertical enclosures results in an acoustic reduction between rooms (Δ R/A DB-HR) of between **8-10 dBA**.

Following the LAW OF MASS ACTION theory (6 dBA reduction each time the thickness of a partition is doubled), and thanks to the use of Krion® as a vertical enclosure, an improvement in the acoustic performance of the integral system has been achieved. In comparative terms, with regard to acoustic performance, the adhesion of Krion® to a standard enclosure of between 8-10 cm would have an insulation equivalent to that of a standard 25 cm enclosure.

33.5 dBA





Thermoforming possibilities

Krion® K-Life 1100 has a very high thermobending capacity, managing to achieve minimum internal radii of 13 mm and shapes in 3 maximum dimensions.

NOTE: In the Transformer Manual there is a series of guidelines and fundamental procedures recommended for carrying out the the thermobending process correctly.

The heating time and temperature depend on the thickness of sheet to be thermoformed and the complexity of the design. In a simple design with very large radii, it will be possible to thermobend it by applying just 130 °C. For smaller and more pronounced radii, temperatures close to 160 °C will be required.



R13 mm





Bacteriostatic

Krion® can be classified as an aseptic material due to its zero-porosity and easy cleaning, and the fact that sepsis or contamination from bacteria and other germs cannot proliferate on its surface. Several types of tests were carried out to certify these qualities of Krion®.

1.- Zero-porosity

To demonstrate zero-porosity throughout its mass, water absorption methods or tests are used such as ASTM D570 where a specimen is introduced into the water for a minimum of 24 hours and weighed before and after to find out the amount of water absorbed where the result is 0.07%.

A similar test is also carried out but instead of water at ambient temperature, it is carried out with boiling water to accelerate the absorption process and make the material dilate, with possible cracks opening up or other anomalies. The part in question is introduced into the boiling water for 2 hours with the result lower than 0.07%.

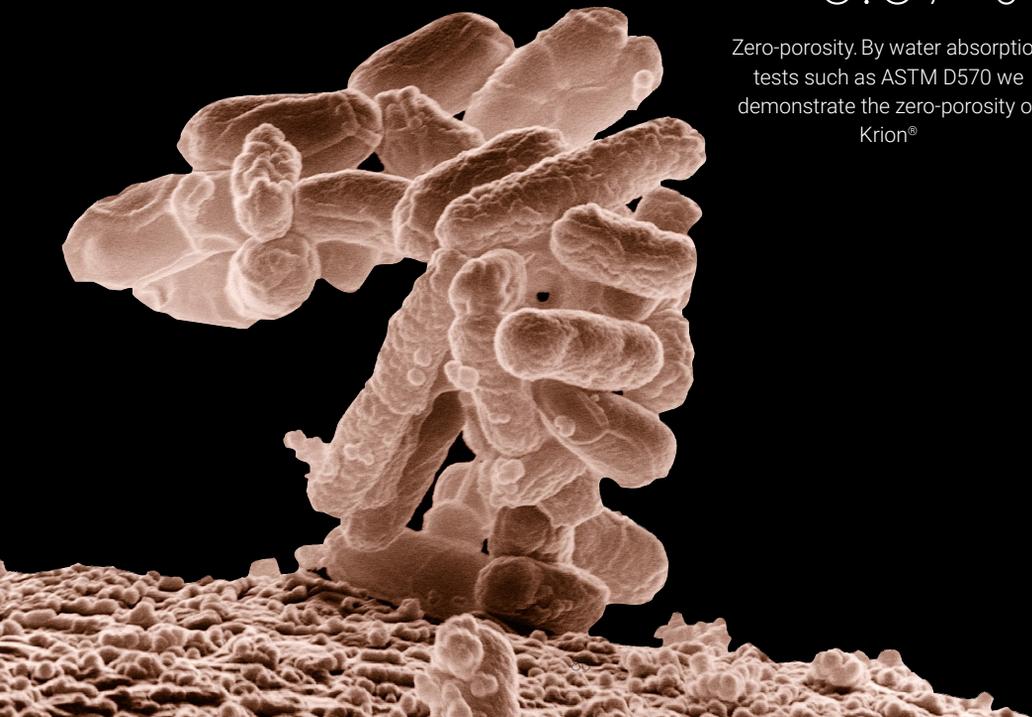
2 - Easy cleaning

The easy cleaning and non absorption of liquids in Krion® is also proved by several tests such as:

- Wear & Cleanability CSA & IAMPO.
- Resistance to the staining/cleanability NEMA LD3.
- Resistance to chemical agents ISO 19712.
- Resistance to staining in bathroom products UNE 56867.

< 0.07%

Zero-porosity. By water absorption tests such as ASTM D570 we demonstrate the zero-porosity of Krion®



3.- Non-proliferation of organisms.

Through standard ASTM G-22 the resistance of bacteria has been determined of Krion[®], testing for the bacteria *Pseudomonas Aeruginosa* which is a Gram-negative bacterial species, with unipolar motility. It is a pathogenic opportunist in humans and also in plants. The result of the test after 21 days is that there is no visible growth on the surface of the agar underneath the samples. With standard ASTM G-21 the resistance of the fungi of Krion[®] is tested, with several of them such as:

- *Penicillium pinophilum* is another species of fungus discovered in New Guinea.

- *Aspergillus Niger* is a fungus that produces a black mold on vegetables - very common in lettuce, the tomato or the chard and lemon-. One of the most current species of the genus *Aspergillus*, it is a ubiquitous black fungus similar to yeast that can be found in various environments such as soil, water, air and limestone. It is used in the biological control of disease in plants, especially disease during storage.

- *Gliocladium virens* is a genus of asexual fungi. The majority of the pathogenic and disease-causing fungi in humans are mitosporic, such as *Gliocladium*. *Gliocladium* is filamentous, grows in a tubular, elongated and string-like manner. It can be considered a pollutant.

- *Chaetomium globosum* is a well-known member of the Chaetomiaceae family of molds. It is a saprophyte fungus that mainly resides in plants, soil, straw and manure. There are human allergens and opportunist agents of nail mycosis and neurological infections.

The test consists of keeping the samples for 30 days at 30°C and at 90% moisture and check that, following 30 days of testing, none of the samples with each one of the fungi and the pattern do not show fungal growth on the surface.

Construction materials exposed to environmental conditions and/or with a poor maintenance can lead to the microbial growth. A test protocol was established to determine how susceptible or resistant a product can be to microbial growth, based on ASTM Standard D6329. Microbial growth is measured with time, and the results indicate whether a product is likely to support microbial growth under these pre-defined environmental conditions. This tests consist of inoculating on the surface of the material *Penicillium Brevi-Compactum* and keep it for 3 weeks at 25°C and at 95% humidity. Resulting in the fact that Krion[®] is a material resistant to microbial growth.





Translucency Level

Krion® K-Life 1100 has different values of translucency (ability to allow the light to pass through a material) that may vary between 78-1200 Luxes depending on the thickness of the material considered. The level of translucency increases exponentially with the reduction in thickness. The following table shows the passage of light in luxes depending on thickness.

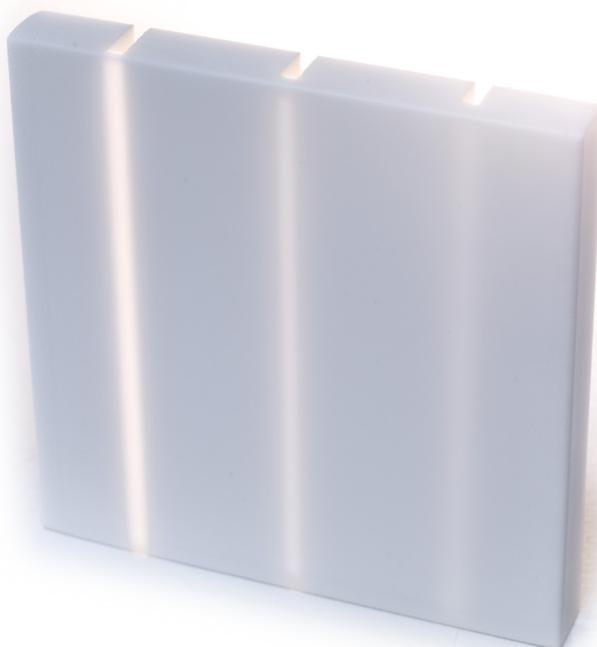
TRANSLUCENCY ACCORDING TO THICKNESS

4 mm	6 mm	8 mm	10 mm	12 mm
1145 Lx	611 Lx	265 Lx	115 Lx	78 Lx

NOTE: Results checked with Luxometer Hanna model HI 97500.

The effect of backlighting required depends both on the thickness of the material and the lighting system used (type of source, light power, recommended distances..). Therefore it is very important to determine the type of lighting to use before carrying out the project and checking that the desired effect is obtained. Review the "Transformer Manual" in the translucency section.

Thanks to the many possibilities afforded by Krion® at the time of interacting with the lighting, it is converted into an ideal material for use in environments in which a greater role is given to the play between lights and shadows.





Thermal conductivity

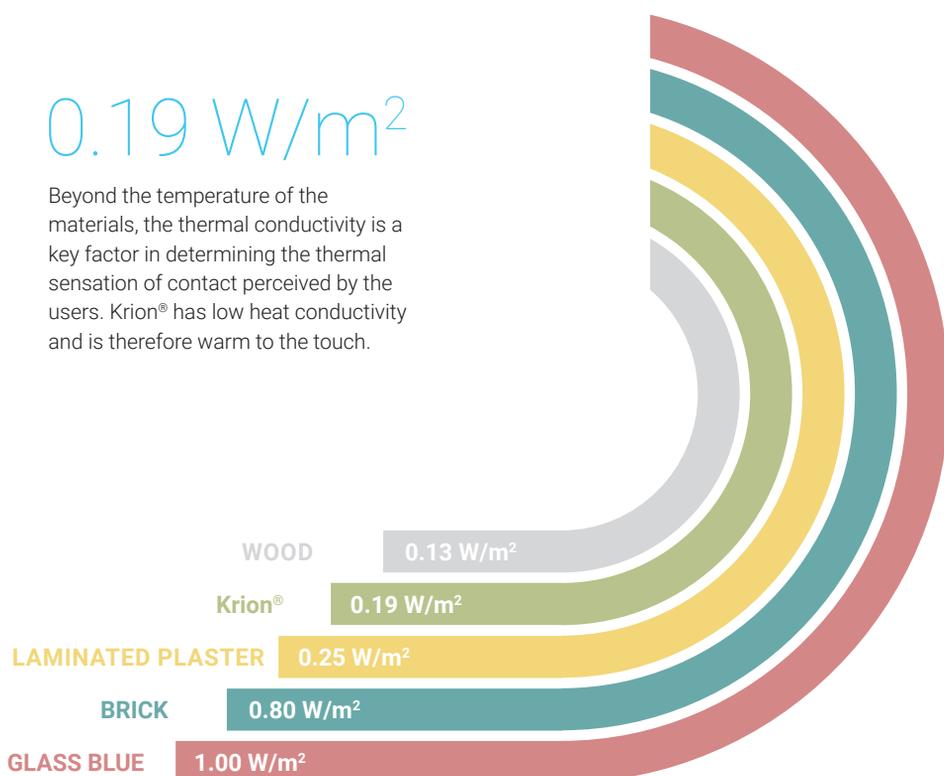
The thermal conductivity value (λ) of Krion® K-Life 1100 stands at 0.19 W/m².

Krion® provides low thermal conductivity λ for improved efficiency, as the lower the thermal conductivity level of a product or material, the more insulating it is. That is, the better is its property to disrupt the flow of heat and the more efficient it is in preventing heat loss (or heat gain in the case of cooling systems).

NOTE: Both the conductivity and the resistivity depend on the temperature of the material, its density, the humidity of the environment, its internal structure and the air convection.

0.19 W/m²

Beyond the temperature of the materials, the thermal conductivity is a key factor in determining the thermal sensation of contact perceived by the users. Krion® has low heat conductivity and is therefore warm to the touch.





Resistant to extreme conditions

In cold climates, the damage to building materials attributable to the action of ice (freeze/thaw cycles) is one of the most important problems; resulting in significant costs both in repairs and replacements.

In salty or humid areas where adhesion of salt crystals to materials causes damage due to saline weathering, electrochemical attacks and corrosion.

Dry and desert conditions where high temperatures in combination with high ultraviolet radiation causes great damage to many types of materials.

Extreme situations such as the seismic movements caused by earthquakes, the material responds satisfactorily as we can see in the CSTB tests.

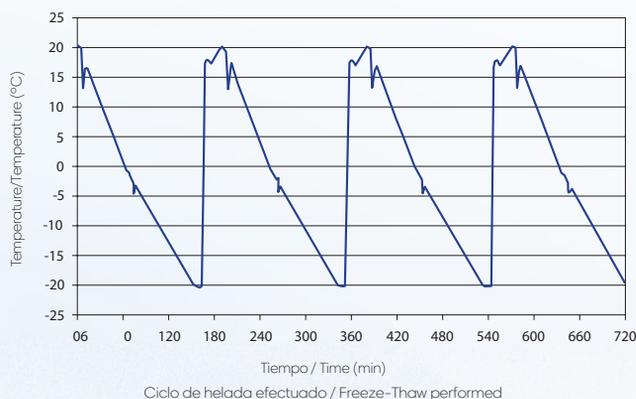
One of the reasons for which we claim that Krion® is a durable material is due to its resistance to extreme conditions. Due to its physical-chemical properties derived from a perfect combination of the natural mineral and the high resistance resin, the result is a lack of porosity, a good expansion coefficient, a correct density and a consistent homogeneity. These properties are certified by:

3200 hours

Test of salt spray. Continuous cycles of spraying and stopping up to 3200 hours resulting in a material with the same conditions that were introduced before the test.



• **Frost resistance test under standard ISO 10545-12** where an extra extreme condition was applied. The standard marks cycles of -5 °C to +5 °C. Krion® was tested at different temperatures of 40°C, that is -20°C to +20°C and up to about 100 cycles in accordance with the standard. The result was that there was no detachment, flaking, cracking or exfoliation, maintaining the material in perfect conditions as at the start of the test.



• **Test of salt spray.** In this test, it was attempted to simulate the effects of saline environments that cause corrosion, flaking and saline weathering caused by the peeling of the material when increasing the volume owing to the crystallization of dissolved salt.

The test is performed by spraying saline water inside the chamber at a given temperature and concentration of salt set out in standard ISO-9227. Continuous cycles of spraying and stopping were performed for up to 3200 hours, resulting in a material with the same conditions that were introduced before the test.

• **Crack-resistant according to EN438:** The material is subjected for a long time to temperatures of 80°C and once the test is completed and the surface analyzed with a 6x magnifying glass it was determined that the material does not show any visible cracking on the surface.

• **Seismic resistance according to CSTB MRF 17 26061183:** One of the tests for gaining the CSTB certification is the seismic resistance performed by the mechanical division and fire resistance by the same organization CSTB. In this test several panels are assembled, then stuck and joined together in various shapes for subsequent testing. This consists of vibrating and moving this structure by the simulation of a seismic movement from phase 1 a, an acceleration of 3.5m/s² to phase 8 of 16.5 m/s². At the end of the test the result is that no element detaches from the panel and there is no significant degradation.

Benefits

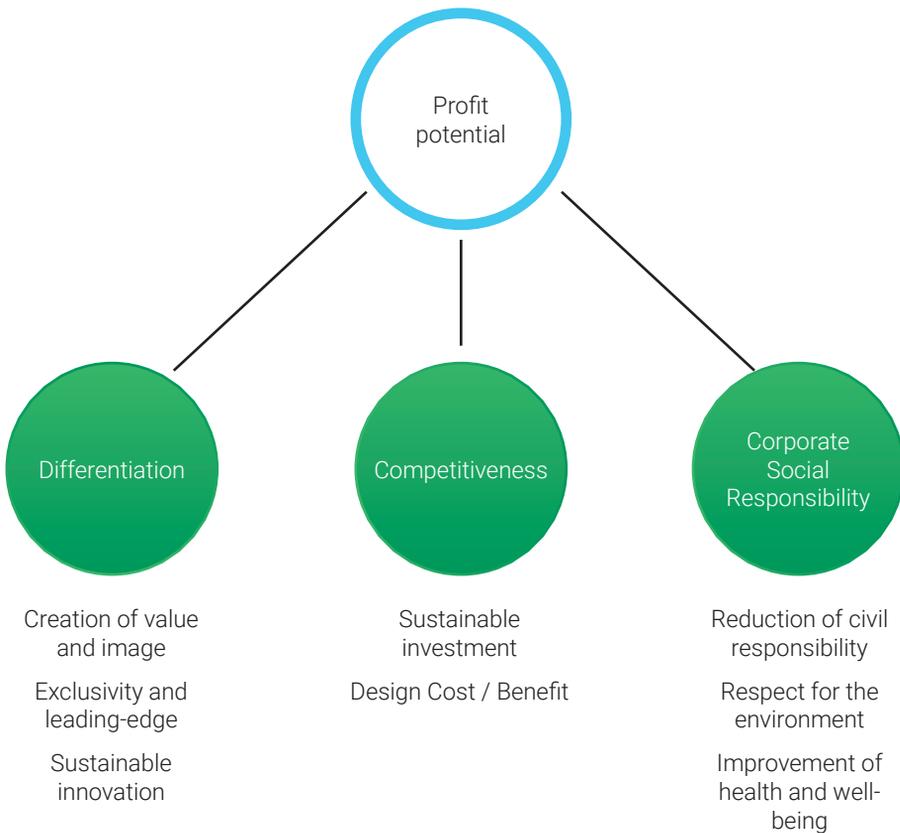
A photograph of two men in business suits on a high-rise balcony. One man is sitting on a wooden ledge, looking at a smartphone. The other man is standing with his back to the camera, looking out at a panoramic view of a city with many skyscrapers under a clear blue sky. A large white circle is overlaid on the image, containing text.

We have explored and incorporated new technologies and practices to provide better products and experiences to our clients and better value to our investors.

Benefits

Thanks to KEAST technology there is a real development in the production of solid surface. Our contribution may seem limited, but therein lies something very big such as being able to contribute towards improving the quality of life of our clients and users of the creations into which Krion® K-life 1100 has been transformed.

We firmly believe that Krion® is the best option for carrying out any project of whatever magnitude, but Krion® Klife 1100 is a unique and exclusive option that brings the experience of the material to another level where there is direct benefit to the user. But this is not the only benefit that Krion® K-life 1100 can offer. There are advantages at different levels both for the person and for the organization considering using Krion® K-life 1100 in its facilities. We have differentiated them into three parts: **differentiation**, **competitiveness** and **corporate social responsibility**.



Differentiation

Innovation is the engine of development and the push towards competitiveness and excellence in all productive sectors, in the global and very competitive market. Products, materials and technologies of the latest generation are innovative tools that enable business differentiation between competitors.

Creation of value and image

1 A brand can only be significant to the public if it brings **real and tangible value** to people while generating value for its shareholders. One example that is focused on consumers is **the direct improvement to quality of life** provided by our products or services, including emotional, natural and social well-being... or in other words: what the brand does for me.

Krion® has a very positive influence on the consumer or operator experience as it can at times feel as though there is a predisposition towards respecting the environment and towards feeling safer in these spaces, generating a more positive vision of the brand. For this reason, Krion® K-Life 1100 is becoming a symbol that is recognized by the public and which promotes some values that connect with many of our clients. This identity is aligned with the image strategy of companies opting for strategies of commitment to the environment.

Exclusivity and leading-edge

2 Krion® K-Life 1100 offers an additional feature to the generic benefit of conventional solid surface materials, making it unique on the market. It is an intelligent investment that enables it to stand out as a material of contemporary use and to construct projects of a distinctive unique character and individual personality.

This innovation enables the construction of objects and buildings with very low maintenance costs, greater profitability and productivity as well as the creation of a healthier and happier environment for people to live and work in.

Sustainable innovation

3 There is a **target market** within the property sector dedicated to healthier and more sustainable living, making their sale and promotion remarkably easier. In this regard, there are many tools for assessing the environmental performance and safety of buildings, which enable the recognition and differentiation of a product on the market. LEED, BREEAM, VERDE and DGNB are some of the certifications that accredit the high levels of sustainability achieved in the buildings. Other programs such as WELL, FITWELL and RESET measure and certify the spaces constructed as healthy and comfortable for the users.



Krion® K·Life 1100 is an innovative tool that enables differentiation of products and services even in the most competitive markets

An aerial, high-angle photograph of a busy city intersection. The central focus is a large, multi-way crosswalk with wide, white diagonal stripes on a dark asphalt surface. Numerous pedestrians are seen walking across the crosswalk in various directions. Long, dark shadows are cast by the people and the surrounding buildings, indicating a low sun position. The overall scene conveys a sense of movement and urban activity.

We are facing a new
paradigm that requires social
change, and a change in
vision of the products

Competitiveness

Sustainable investment

4 Investments in strategies and sustainability factors enable companies to generate value in the short term and long term. As the factors of sustainability tend to have long-term implications for the company's performance, their inclusion in the communications of the leading investors help change the time horizons of companies and investments. In other words, they facilitate and accelerate the **recovery of the investment**.

The international exchanges are demanding the inclusion of sustainability factors in the corporate reports of the companies listed on the stock exchange. In this way, together with the financial performance, aspects of environmental and social performance are being incorporated.

Dow Jones or FTSE4 Good are some of the sustainable benchmark stock market indexes that incorporate and assess "**sustainable investments**" made by the main global companies.

Design Cost / Benefit

5 The **eco design** is a practice that consists of incorporating the environmental factors in decision-making during the development of products, as an additional factor to those which were contemplated, such as the costs or quality.

Krion® K-Life 1100 arises from this **holistic view of the life cycle** of the materials and knowing the need to create buildings and installations that, in addition to allowing the maintenance costs during their lifespan, turn out to be positive and beneficial for the environment and for human beings. Ultimately, to design bearing in mind the whole life cycle of the construction or product, permits evaluation of the options that reduce the resources necessary in the medium and long term.

A sustainable installation of high profitability is an efficient construction. Some of the factors and measurements that enable these savings and benefits are; high durability, reduction in the need for maintenance and use of water, chemical products and energy, high rate of solar reflectance for less heating of the enclosure and better thermal performance, constructive flexibility to allow an easy spatial transformation of the interiors in the light of a possible change of use, etc.

Corporate Social Responsibility

Currently, this is in fact a high level commitment by citizens to their environment. A fact that is extrapolating the business sector. Increasingly, a greater number of companies carry out non profit making practices and actions for the benefit of the company. In such a globalized world, these practices generate new challenges for the private sector regarding its obligation and responsibility to society in general.

Reduction of Civil Responsibility

6 Clean and healthy buildings can also reduce the legal demands and civil responsibility of the owner. Claims for fungi-legionella infections and other infections in sanitary spaces or other resources are becoming more commonplace, stemming from what is known as "sick building syndrome". For this reason, the insurance companies introduce safer and more efficient premiums and contributions.

Respect for the environment

7 Within the comprehensive concept of sustainability, the main environmental challenges facing humanity are undoubtedly included, as is climate change, desertification, resource depletion, loss of biodiversity and social challenges such as poverty, inequality, migratory movements and human rights, among others.

KRION demonstrates its concern by incorporating measures that eventually result in benefits for the environment and community. Studies of the life cycle analysis of our products allows us to analyze their impact on the natural environment and to understand the need to focus our efforts and investments into enabling the creation of environmental benefits in other phases of the life cycle of the building. In this way, the idea and the preliminary studies arise from what will end up being the patented technological development KEAST® that allows the photocatalytic activity of our material and the creation of a positive environmental impact on the environment.

Improvement of health and well-being

8 The sustainable constructions provide a healthier and more satisfactory work environment for the users, creating beneficial atmospheres for all parties. The companies are beginning to use the healthy and comfortable work spaces as a powerful tool for recruiting and maintaining the best employees, while at the same time significantly reducing absenteeism.

In this point, numerous studies report that improvements to the air quality and the prevention of mold in work places could lower costs in terms of health and job losses due to respiratory illnesses, allergies and asthma and other effects on health and comfort.

Krion® provides healthy and safe work spaces due to the low emissions of VOCs and the absence of dangerous products in their composition.



Krion® K·Life 1100 intends to give a response to this paradigm by offering a product that, as well as increasing the comfort and well-being of users, is long lasting and maintains high performances

A product or project carried out with Krion® K·life 1100 is sustainable as it reduces the environmental impact through an increase in environmental efficiency in its life cycle



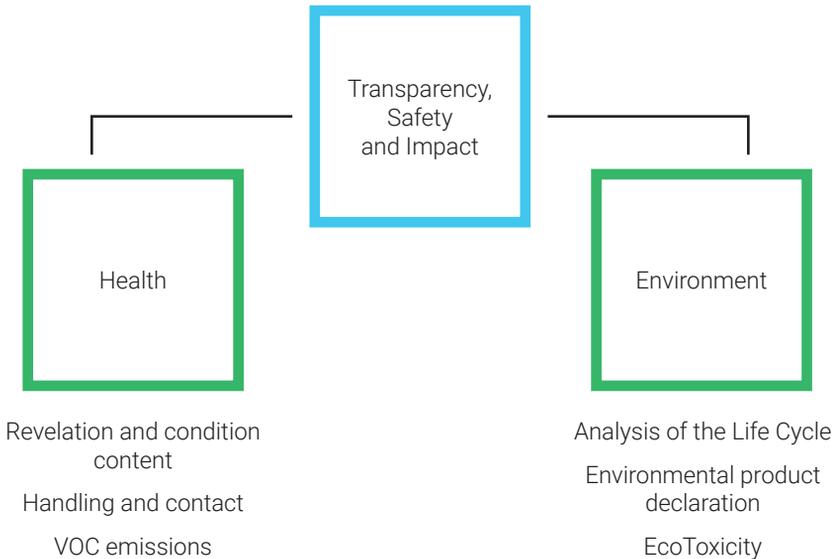
Transparency, Safety and Impact

KRION Porcelanosa Group incorporates the ethics and sustainability of essential conditions to ensure long term results. **Transparency, safety, confidence and innovation** are four of the values of our corporate reputation.

Currently the R+D+i equipment of KRION is working around the world with professionals specialized in various fields, academics, governments, other companies and non-governmental organizations to promote scientific innovations that enable the development of innovative solutions of long duration, that are sustainable and viable according to our value chains. That's why we are currently assessing all our suppliers to identify the critical points in the supply chain.

Each year KRION strives to incorporate new sustainable aspects in all the phases that make up the life cycle of our materials. Our commitment is firm, with continuing innovation and challenges to the establishment to contribute to a **safer, healthier and more sustainable world**.

Detailed below is the evidence that accredits the transparency, safety and impact of our material on the health of people and the environment.



Health

Revelation and condition content

HPD



The **health product declaration**, (HPD) is a tool that allows compounds of Krion® K-Life 1100 to be presented transparently and in a standardized and normalized format. The HPD of KRION shows that it does not present dangerous components and is verified by SCS Global Services, independent third party.

DECLARE



Declare is a **label of transparency and disclosure of content** and health of construction products, following the requirements of the Living Building Challenge. In this “nutrition label”, accessible to the public, KRION clearly provides the most relevant information with regard to composition and possible risks of the same, providing effective communication between the manufacturers, consultants and consumers of construction products and materials.

FRIENDLYMATERIALS



FriendlyMaterials is a virtual library of sustainable materials created and managed by PMMT Forward Thinking Healthcare Architecture. This is a tool that assesses analytically the construction products based on the **factors that influence people's health**. Within this ranking, Krion® K-Life 1100 obtains **91 points above a maximum of 94 points**, achieving a **gold medal** and standing out as one of the healthiest coating materials on the market.

REACH



The REACH standard regulates chemical products that are being manufactured or included as substances in mixtures and in finished products on the EU market. Its main purpose is to guarantee a high level of protection to human health and the environment. KRION accredits REACH regulatory compliance through certification issued by external laboratory.

Handling and contact

PARTICLES

Regarding the transformation of the Krion® dust particles do not present toxicity according to **ISO 11348** and the material may be considered as free of crystalline silica endorsed by the INS (National Institute of Silicosis).

Thus, the Krion dust generated during the cutting and sanding operations must be treated as any other non-toxic dust, taking into account the use of suitable PPEs (personal protective equipment) according to the Safety Sheet and follow the recommendations of the transformer manual.

KRION regularly analyses its transformation processes along with the technological institutes certified to know and recommend good practices in its transformation.



NSF



The NSF (National Science Foundation) certification, recognized organization of the United States which issues health, hygiene and environmental certificates, considers Krimon® to be a safe material for direct contact with a wide variety of foods, without posing any risk to health.

VOC emissions

GREENGUARD



This certificate granted by the Greenguard Environmental Institute, guarantees that Krimon® meets the standards of air quality with regard to Volatile Organic Compounds (VOCs) with respect to the sheets and also the adhesives. The labels awarded are the "Indoor Air Quality Certification" and the "Greenguard Children Schools Certified".

A+



In line with the Greenguard Institute, the French Government has created the need to analyse the construction and furniture materials to determine the degree of generation of VOCs (volatile organic compounds) inside the buildings. In this way, some rigorous tests have been set up to classify the different materials according to their emissions. Krimon® K-Life 1100 has obtained the highest classification, holding the label A+ that certifies it.



The life cycle analysis
allows us to assess
the environmental
performance of our
materials and improve the
performance of our new
developments

Environment

Life Cycle Analysis

The life cycle analysis enables analysis and management from an environmental point of view, in an objective and systematic manner, of the environmental impacts associated with a product, process or activity from its manufacture to its disappearance as such. Identifies, classifies and quantifies each one of the impacts from the material resources and the energy involved in the complete cycle.



KRION has incorporated this tool as essential criterion for the Eco-design and its products, and to determine the environmental impacts associated to Krion® K-Life 1100 in all the phases of its life cycle. Following the reference framework of normative reference UNE EN ISO 14040:2006 and UNE EN ISO 14044:2006, the inputs, outputs and potential environmental impacts of the range of unitary processes connecting materials and energy are collected and assessed during the useful life of the product with a “cradle to the grave” approach, that is, from whenever the raw material is obtained until its disposal as a product.

Likewise, the ACV, in addition to being a very useful tool in public policies such as the circular economy, it is compatible with employment in other environmental footprints such as carbon or water footprint.



Environmental product declaration



® An **environmental product declaration (EPD)** is a document that contains objective and transparent information verified by a third party about a product with regard to its **environmental performance throughout its life cycle**.



The content of the Krypton® K-Life 1100 EPD is developed following a standardized science-based methodology at international level, for which purpose they are used by the **Product Category Rules (PCR)** establishing the methodology for calculating and communicating the information contained, to be subsequently based on the data obtained from the **Life Cycle Analysis (LCA)** in which the different environmental indicators are shown for the different categories of impact (climate change, ozone layer depletion, eutrophication, etc).

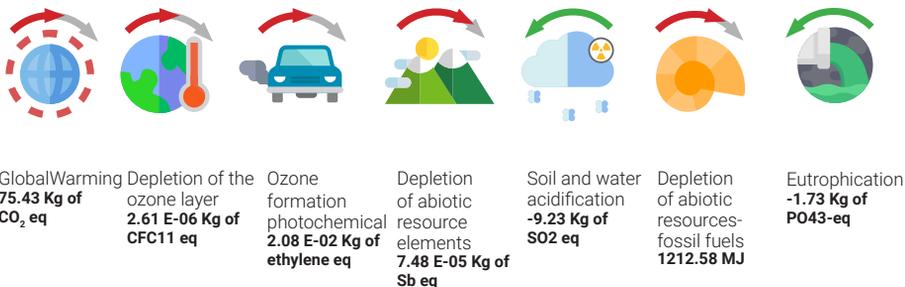


In order to carry out this study **3 use cases** were considered on the basis of the most common applications: **Exterior cladding, interior coating and furniture/ fittings.**

This environmental declaration is considered an ecolabel type III because the information it contains is verified by an independent organization (3rd Party). The transparency and objectivity of these declarations, along with the possibility of comparison with similar products, makes these a very well-known tool and which serves to help the technical experts and prescribers of materials in the process of designing and developing projects that take the environmental impact into consideration for their buildings.

With the EPD Krypton® K-Life 1100 **demonstrates the reduction of the impacts** on the environment in a quantitative manner. The photovoltaic activity of the material is what causes, in the **use and maintenance phases** the creation of **benefits to the user and environment**, including the disposal of dangerous compounds from the air and a reduction in maintenance intervals, resulting in lower consumption of water, chemical products and energy.

Environmental impact indicators Krypton® K-Life 1100



EcoToxicity

The environmental toxicology is the branch of toxicology that studies the possible damage that chemical substances or products may cause to living organisms.

KRION Porcelanosa Group has carried out some external tests at the renowned Valencian Institute of Microbiology (IVAMI) to ensure that Krion® K-Life 1100 and by-products derived from it being worked, are inert to the environment, and do not cause any possible accidental release to the natural environment, also in response to growing demands from society.

A series of tests guarantee the safety of the material to living organisms, with tests on organisms present in terrestrial and aquatic ecosystems of particular significance.





Sustainable and healthy construction

Sustainable building standards

KRION is an associate member of the "Spain Green Building Council " (GBCe), a non-profit organization affiliated to the International Association "World Green Building Council" (WGBC). These associations bring together representatives of leading companies in the building industry, who work together to promote cities and buildings that are environmentally responsible, cost-effective and healthy for the people who live or work in them.

The WGBC is in charge of providing the methodologies sector with up-to-date and internationally approved tools that enable the objective assessment and certification of the sustainability of the buildings, adapted to the needs of Spanish consumers in general and to the distinct geographical areas in particular. Among them are the sustainable construction standards LEED®, BREEAM®, VERDE®, HQE® and DGNB®.



BREEAM®



DGNB
Deutsche Gesellschaft für Nachhaltiges Bauen
German Sustainable Building Council

HQE®

Krion® K-Life 1100, contributes to all these building standards thanks to the intrinsic properties prizes. All the environmental, social and economic benefits derived from the application of the material have been analyzed, quantified and developed in the **KRION'S SUSTAINABLE CONSTRUCTION DATA SHEETS**. These dossiers demonstrate all the impact categories where KRION® contributes towards the obtainment of points, both at LEED®, and in BREEAM®, and in VERDE.

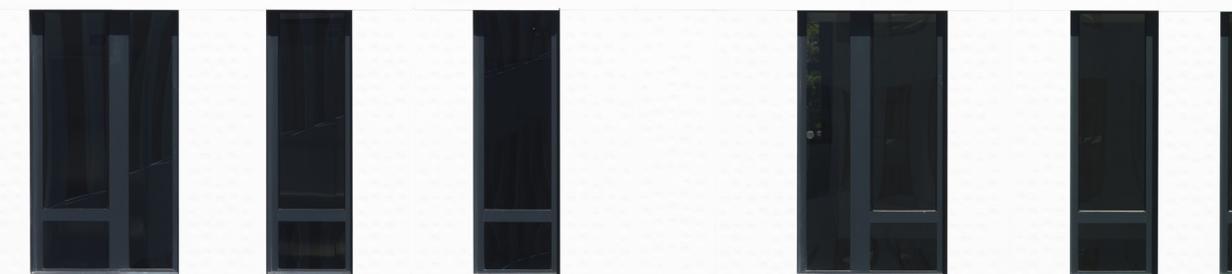
All the product certificates of Krion® K-Life 1100 contribute directly to those impact categories of all standards related to it;

- **The indoor air quality (GREENGUARD GOLD, A+)**
Low emission of VOCs.
- **Reflection index of the material (IRS ISO 9050 CERTIFICATE ASTM E1980)**
Minimum coefficient that allows the reduction of the heat islands.
- **The analysis of the life cycle (EPD - Environmental Product Declaration-)**
Study of the analysis of the life cycle of Krion®, including its useful phase.
- **Certificates revealing content (HPD, DECLARE)**
Revelation of the material composition.
- **Acoustic efficiency (UNE EN-ISO 10140)**
Global acoustic insulation.

Added to these, KRION® is likely to contribute to many other points awarded with respect to the project that it wants to carry out, given that the versatility of the material allows it to form part of a multitude of applications relating to the design for **flexibility, pre-fabrication and recycling**.

Similarly, there are other impact categories where KRION® Porcelanosa Group can contribute thanks to the internal management, following the most innovating standards on RSC.

The construction of sustainable and healthy buildings benefits our clients, employees, collaborators and for the community



The environmental qualification systems are increasingly becoming more important in the construction industry, as it is the method used to quantify the sustainability of the buildings. The creation of these standards has helped professionals from different countries to improve the quality of the buildings and their impact on the environment.

The sustainable construction sector is growing exponentially, and, increasingly, professionals in construction, operators and owners are seeing the benefits of ecological construction and the green classification systems.

Ultimately, the environmental benefits provided by **Krion® K-Life 1100 help the buildings to achieve a better general ecological certification**. Krion® has a set of invaluable environmental performances and the leading certifications most recognized that can contribute towards the attainment of different LEED®, BREEAM®, VERDE®, DGNB® and HQE.

Building standards for safe and healthy spaces



The current style of life of the human being has evolved and transformed, which means we spend 90% of our time in indoor spaces. This is why it has become a priority to centralize the human being as a pivot around which the construction moves.

In the search for this new constructive methodology, **the new standards of certification aimed at improving the health and well-being of the users of the building** have become essential.

Its function is to provide health and comfort for its occupants, analyzing the relationship between people and spaces through the **implementation of strategies, programs, building and design technologies** that improve nutrition, the physical fitness, mood, sleep patterns etc. of their occupants.

One of the most relevant construction standards relating to well-being is the **WELL BUILDING STANDARD**, administered by the International WELL Building Institute™ (IWBI™) certified by third parties through collaboration with Green Business Certification.

Krion® has a technical specification based on the WELL standard, indicating the impact categories to which the material contributes thanks to all the product certificates it has.

Our photovoltaic material has a series of certificates such as the GREENGUARD GOLD, A+, REACH STANDARDS, NSF51 (food contact), REIRS, ACOUSTIC STANDARDS, HEALTH PRODUCT DECLARATION, that directly supports the attainment of points for the property certificate in question.

In this way, Krion® K-Life 1100 also contributes actively to many other standards focused on the well-being of people, such as **FITWELL, RESET**, etc., as all of them are based on similar parameters to classify the healthiness of the rooms.

Annex

Technical utility sheet

	PROPERTY	TEST METHOD	RESULT
PHYSICAL PROPERTIES	Density	ISO 1183 / ASTM D792	1.73 - 1.76 g/cm ³
	Approximate weight per m ² - 6 mm		11 kg
	Approximate weight per m ² - 12 mm		21 kg
	Thermal expansion	ISO 11359-2 (EN 14581) / ASTM D696	3.5 ± 0.3 · 10 ⁻⁵ °C ⁻¹
	Rockwell Hardness	ISO 19712 (UNE-EN 2039-2) / ASTM D785	> 90
	Barcol Hardness	ISO 19712 / ASTM D2583	65 - 70
	Hardness to the ball	ISO 19712 (UNE-EN 2039-1)	250 - 290 N/mm ²
	Thermal conductivity	EN 12667 / ASTM C518	0.18 - 0.40 W/m· K
MECHANICAL PROPERTIES	Modulus of elasticity		9300 - 12000 MPa
		ISO 178 / ASTM D790	
	Bending strength		68 - 78 MPa
	Tensile strength		40 - 50 MPa
		ISO 527 / ASTM D638	
Elongation at breaking point		0.6% - 0.7%	
Compressive strength	ISO 604 / ASTM C365	98 - 115 MPa	
SUITABILITY FOR USE	Light stability (Arc Xenon)	UNE-EN 438 / ISO 19712	Satisfactory
	Color stability	NEMA LD3	Satisfactory
	Resistance to impact by large diameter ball	ISO 19712-2 (324 g) / NEMA LD3 (224 g)	> 200 cm
	Resistance to chemical agents	ISO 19712 (Method A)	Satisfactory
	Cigarette burn resistance		
	Resistance to dry heat		
	Resistance to damp heat	ISO 19712	Satisfactory
	Resistance to thermal shock		
	Load test		
	Dimensional stability	ISO 4586-2 / NEMA LD3	Exceeded
	Resistance to wear of the surface	ISO 4586	0.028% / 25 rev
	Resistance to bacteria and fungi	ASTM G22 / ISO 846 / ASTM G21 / UL2824	Does not support growth
	Resistance to boiling water	ISO 4586 / NEMA LD3	Satisfactory
Resistance to cracking	UNE 438-2	Satisfactory	
Frost resistance	ISO 10545-12	Exceeded	

For more information consult the file, bulletins and technical notes.

Sizes available

Thickness 3mm

2500x760x3mm
2500x930x3mm

Thickness 6mm

2500x760x6mm
2500x930x6mm
2500x1350x6mm
3680x760x6mm
3680x930x6mm
3680x1350x6mm

Thickness 9mm

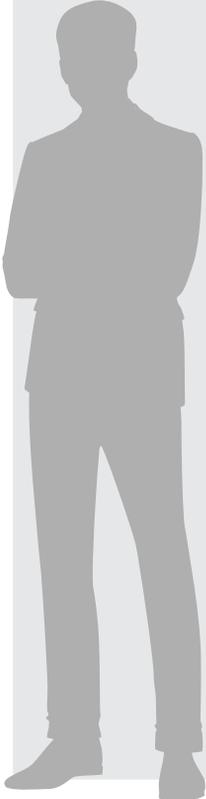
3680x760x9mm

Thickness 12mm

3680x760x12mm
3680x930x12mm
3680x1350x12mm
3680x1520x12mm

Thickness 19mm

3680x760x19mm



3680 x 760 mm · 145" x 30"	3680 x 930 mm · 145" x 36 5/8"	3680 x 1350 mm · 145" x 53 3/16"	3680 x 1520 mm · 145" x 60"
2500 x 760 mm · 98 7/16" x 30"	2500 x 930 mm · 98 7/16" x 36"	2500 x 1350 mm · 98 7/16" x 53 3/16"	

