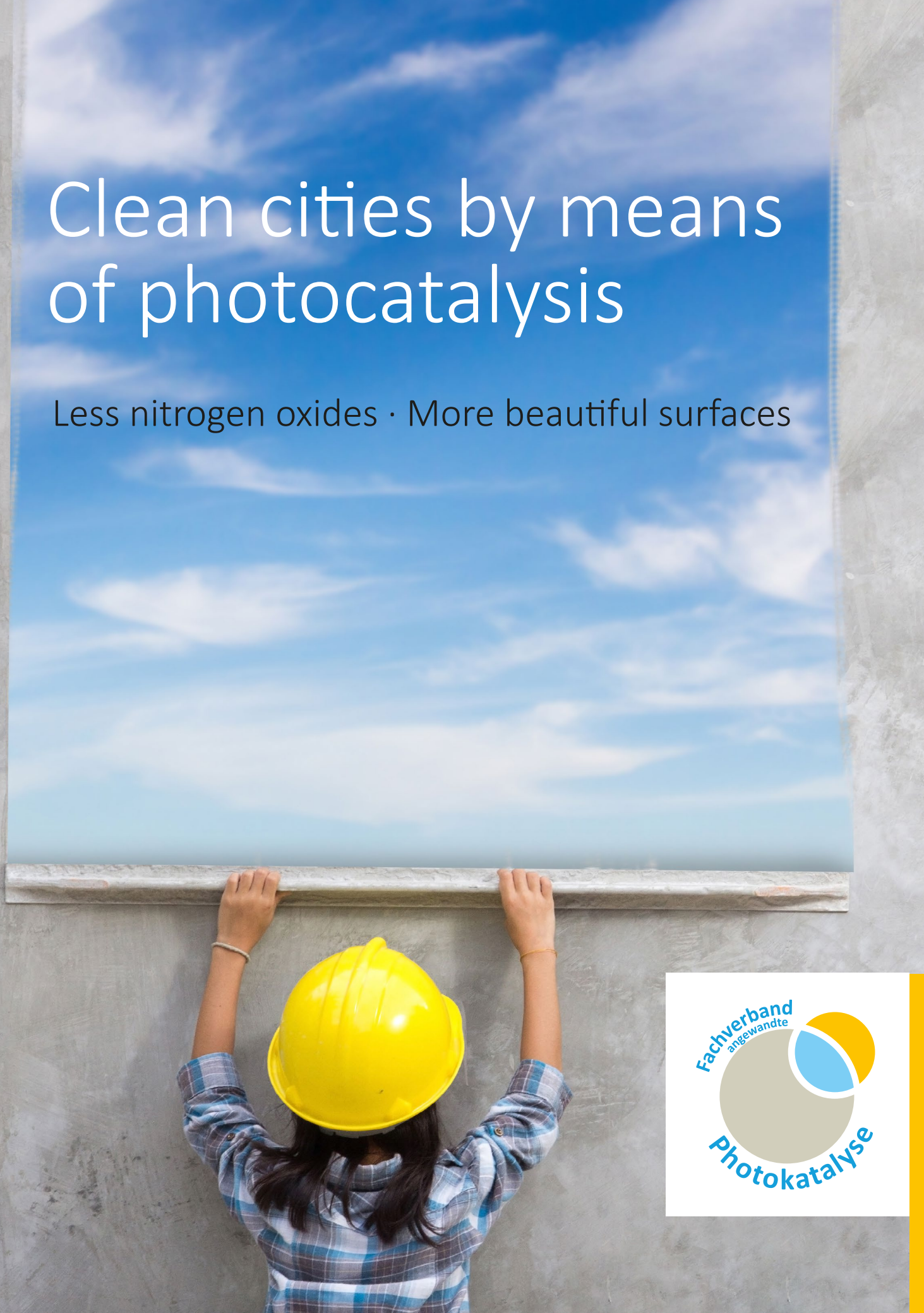
Clean cities by means of photocatalysis

Less nitrogen oxides · More beautiful surfaces



Fachverband angewandte Photokatalyse

Pooling our strengths for you.

Dear reader,

façades, roofs and walls removing pollutants from the air almost automatically; surfaces cleaning themselves from dirt particles. All of that by means of the natural power of light, air and moisture; this may still sound like a dream of the future to many. And yet: products harnessing the advantages offered by photocatalysis have long since become a reality.

Dr. Frank Menzel

Chairman of the
German Federation for
Applied Photocatalysis

On behalf of its members, the German Federation for Applied Photocatalysis – Fachverband angewandte Photokatalyse; short: FAP – would like to provide private consumers as well as public bodies and local authorities with information on the efficiency and mode of action of photocatalysis. In addition, we would like to provide information and advice on the scenarios and fields of application in which photocatalytically active products are able to draw on their strengths.

Photocatalytic products do not offer a universal remedy. We are nevertheless convinced that photocatalytically active products can take the role of an important and sustainable building block in the context of a holistic approach. It is a building block associated with only little effort and low cost. A building block that places a burden neither on people nor on the environment.

In this brochure, we will introduce you to the subject of photocatalysis, the German Federation for Applied Photocatalysis (FAP) and the potential applications of photocatalytically active products. We hope to be able to answer your most important questions in this way and wish you a revealing and inspiring read!

Yours sincerely,

On the ease of cleaning the air

High levels of air pollution caused by nitrogen oxides represent a major challenge for cities and municipalities. It is not only the EU that is pushing for compliance with the limit values laid down in the Ambient Air Quality Directive 2008/50/EC. Citizens are also increasingly calling for a reduction of the pollutant levels especially in densely populated urban areas. But how can effective measures be designed both on a long-term basis and on a large scale?

Photocatalytically active products clean with the power of light

A contribution to solving this widespread problem: photocatalytically active construction materials and coatings. They make a lasting contribution to purifying the air at comparatively low investment costs. How do these products work? Through the power of light alone – without the use of additional energy, without additional chemicals or filter media.

Photocatalytically active products such as pavers, roof tiles, paints and plasters can be used to quite easily transform surfaces – which are abundant especially in densely populated urban areas – into effective air filters: pedestrian paths, roofs and façades.

Photocatalytically active products are suitable also for indoor use to purify the air of gaseous pollutants and odors. In addition, the photocatalytic effect inhibits soiling of the active surfaces both indoors and outdoors, and the surfaces are easier to clean and dry faster after cleaning.

In real life, photocatalytically active products have already demonstrated their positive properties in numerous fields of application. The general rule of thumb here is: the more, the better. For the larger the photocatalytically active surface, the more pollutants can be eliminated.

One reaction – numerous positive effects

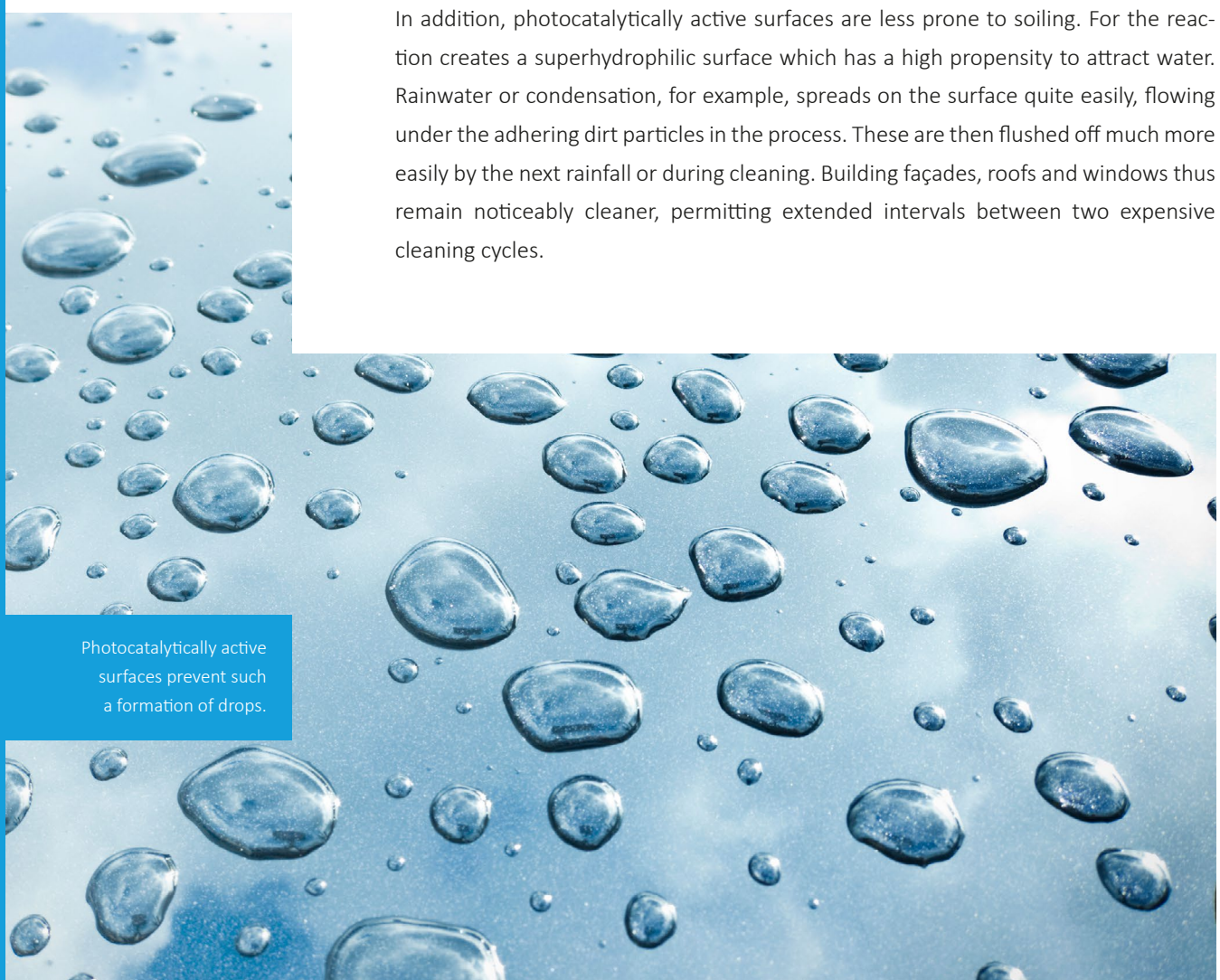
Photocatalysis can make our lives a little easier in numerous different ways: in the public sphere, on the inside and outside of buildings, and anywhere else where clean surfaces are of particular importance. All that is required in addition to the catalyst: light, air and moisture.

The air is cleaned

Hazardous gaseous substances such as the nitrogen oxides contained in exhaust emissions or the formaldehydes frequently emitted by new pieces of furniture are degraded by the photocatalytic reaction. Even odor nuisances such as cigarette smoke or cooking odors can be reduced by means of photocatalysis.

Surfaces remain clean

In addition, photocatalytically active surfaces are less prone to soiling. For the reaction creates a superhydrophilic surface which has a high propensity to attract water. Rainwater or condensation, for example, spreads on the surface quite easily, flowing under the adhering dirt particles in the process. These are then flushed off much more easily by the next rainfall or during cleaning. Building façades, roofs and windows thus remain noticeably cleaner, permitting extended intervals between two expensive cleaning cycles.



Photocatalytically active surfaces prevent such a formation of drops.

Titanium dioxide – well-known but used in new ways

Three basic things are required for the photocatalytic activity of the upgraded products: light, air, moisture and the catalyst which initiates the reaction. Titanium dioxide is the most common and most widely used photocatalyst.

The substance is not new – it has been used for many decades as a white color pigment, for example, in wall paints and varnishes, cosmetics and foodstuffs. Its use is safe for both human health and the environment.

For photocatalytically active products, the manufacturers use titanium dioxide with an exceptionally high level of photocatalytic activity produced specifically for this application. When exposed to light, the substance initiates a reaction which degrades pollutants in the immediate vicinity of the active surface. The reaction produces substances such as nitrate and carbon dioxide in non-hazardous quantities. The nitrate settles on the surface and is flushed off the next time it comes into contact with water.

The catalyst is not degraded

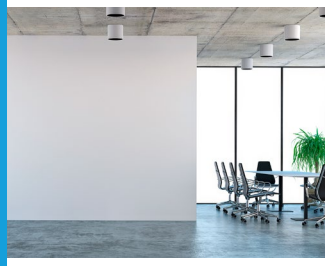
Titanium dioxide normally requires ultraviolet light to be photocatalytically active. When used outdoors, this is provided by the ultraviolet fraction of the solar spectrum. In order to be able to use the positive effects also in indoor application, special catalysts were developed which are also effective when exposed to visible light. The photocatalytic process is then initiated by an artificial light source.

Important to note
Titanium dioxide is, indeed, involved in the reaction exclusively as a catalyst and not as an active ingredient. This is important because active ingredients are used up over time, whereas the amount of titanium dioxide in the photocatalytically active product remains unchanged. And it does so over the entire service life of the product.

Wide variety of products – broad performance spectrum

The German market offers customers a large choice of photocatalytically active products that score points with positive properties. Among other things, photocatalytically active surfaces remove pollutants from the air, are easier to clean and counteract unpleasant odors.

Wide range of practical applications

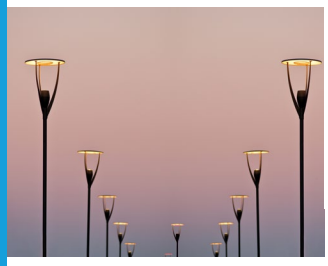


In building maintenance, products with photocatalytically active coatings not only reduce noxious gases but also counteract unpleasant odors.

There are numerous specific fields of application for photocatalytically active products. In an urban environment, for example, they form part of the measures taken by several cities and municipalities to control air pollution: photocatalytically active road pavements reduce nitrogen oxides in areas exposed to high traffic loads. In building construction, façades, roofs and windows are created that have air-cleaning properties and are additionally less prone to soiling – valuable advantages also in terms of sustainable construction.

But photocatalytically active products are demonstrating their strengths also in fields outside the construction industry. Self-cleaning lights, for example, have an improved long-term luminous efficacy. In areas where hygiene is important, for example, in the bathroom or in public spaces, photocatalytically active coatings contribute to the prevention of dirt and the spread of germs.

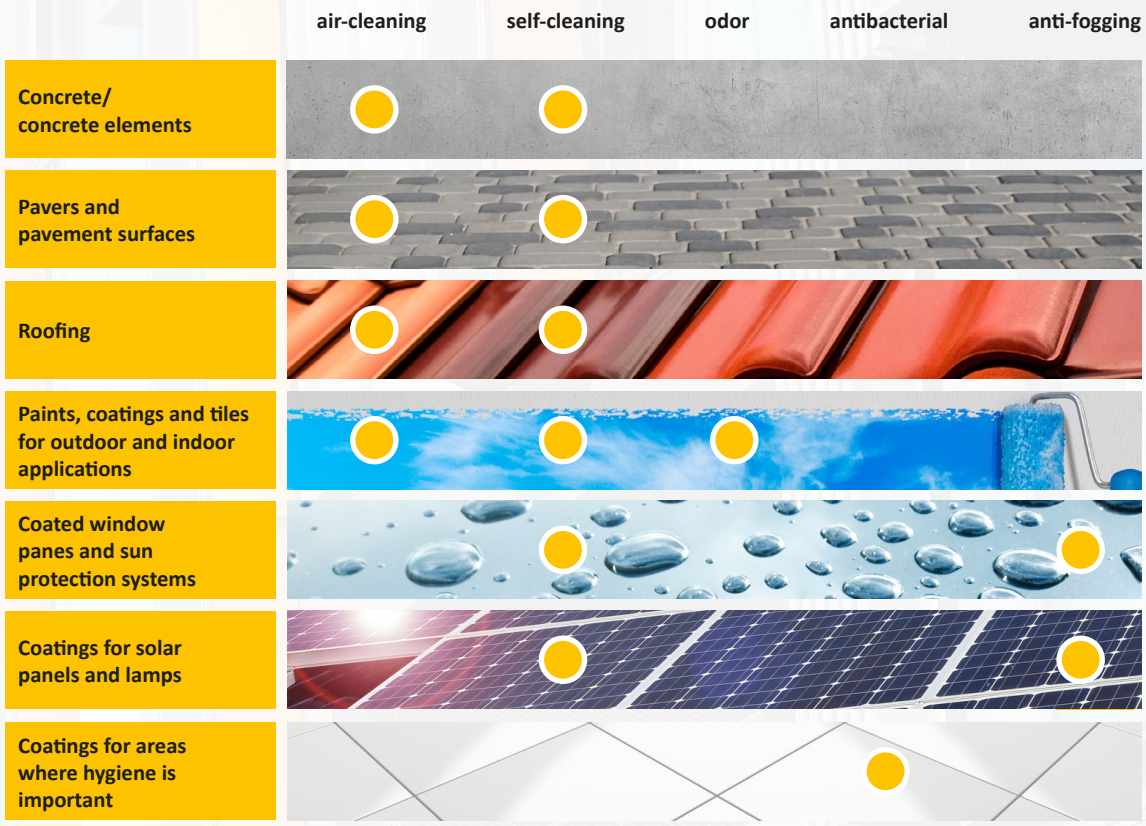
In short: photocatalytically active products are used in numerous fields of application even today. And more will follow, as the members of the German Federation for Applied Photocatalysis – FAP – are continuously enhancing the applications and products in an ongoing active exchange with science.



Self-cleaning lights have an improved long-term luminous efficacy as less dirt accumulates on the covers.

At a glance: the range of photocatalytically active products

Numerous well-established products on the market, from pavers via wall paints all the way to coatings, make use of the positive effects of photocatalysis – the following diagram will give you a brief overview.



Network for the photocatalysis pros

The German Federation for Applied Photocatalysis (FAP) closely links companies in the pigment, coating and building materials industry. It was established in 2011, and with its members represents both the manufacturers of photocatalysts and users from the industry, serving as a platform for a differentiated debate on the subject of photocatalysis.

In addition, the federation provides the media, private end users and public decision-makers with information on the mode of action and possible fields of application of photocatalytically active products. To this end, the FAP publishes press releases and information brochures as well as video animations which are tailored to the appropriate target audience and highlight the advantages of photocatalysis and its broad range of applications.

Supporting basic research and communicating research findings

However, the mission of the federation extends far beyond the exchange of information with the public: the federation's research committee promotes an ongoing dialogue with researchers and scientists. Research and development are thus strengthened and contribute to optimizing existing products and identifying new applications of photocatalysis.

The federation also supports its members in verifying the effectiveness of their products and assuring their quality by means of test series and laboratory testing. The members of the federation have already compiled clear evidence of the effectiveness of photocatalysis – both under controlled laboratory conditions and in field use. In addition, the FAP brings its expertise to support and promote the standardization work on photocatalysis at the German Institute for Standardization (DIN).

Participation in research projects

The member companies are actively involved in broad-based research projects designed to advance the development of the technology. To give an example: in the PureBau® project funded by the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung) within the context of HighTechMatBau®, highly efficient photocatalytically active construction materials for floors, façades and roofs were developed over a period of three years. In addition, an easy-to-use mobile measurement procedure has been developed to determine the activity of photocatalytic products right on site.

Setting standards for greater transparency – with the FAP commitment

It is not discernible to the naked eye whether a product is photocatalytically active. That is why the FAP has collaborated with independent institutes to develop a voluntary commitment. It sets a minimum standard for the photocatalytic activity of a product which can be tested based on standardized and recognized rules.

The participating companies commit to verifying the photocatalytic efficiency of their products in accordance with a specified procedure. The photocatalytic efficiency of a product is then retested by an independent institute at regular intervals.

These tests make sure that a product will meet the requirements of the FAP commitment also in the long term. This brings clarity, security and transparency for the users – everyone can find out quite easily which of the products offered on the market have proven to be photocatalytically effective.

Answers to the most important questions about photocatalysis in practical application

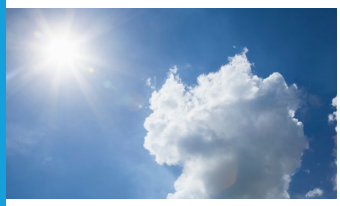
Does photocatalysis always work?

Photocatalysis is initiated as soon as light is present in combination with air and moisture. For maximum effectiveness, the photocatalytically active surface should be as large as possible.

Are photocatalytically active surfaces safe for human health and nature?

Yes. The catalyst is safe and permanently bound in the upgraded surface. The substances generated during photocatalysis are produced in small quantities only and are harmful neither for humans nor for the environment.

Does photocatalytic nitrogen oxide degradation contribute to increased nitrate levels in the groundwater?



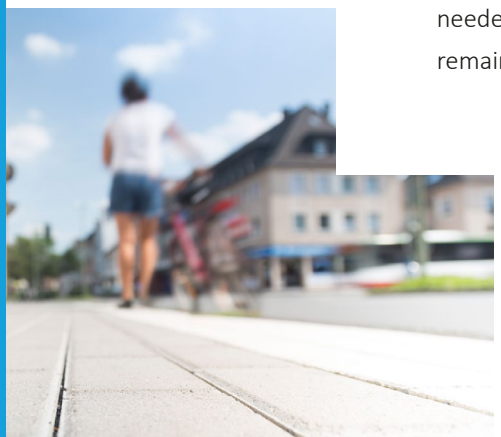
No. The amounts of nitrate produced by the degradation of nitrogen oxide are negligible compared to those getting into the groundwater, for example, from the use of agricultural fertilizers. The nitrogen oxide present in the atmosphere is also converted into nitrate in a natural process. This involves several intermediate steps, however, and takes much longer than the photocatalytic process.

How does photocatalysis facilitate the cleaning of surfaces?

Photocatalytically active surfaces are highly hydrophilic, meaning that water spreads on these surfaces quite easily. The water flows under the dirt particles which can then be flushed off more easily when exposed to water during the next rainfall or during cleaning.

How long can the photocatalytic activity be maintained?

Since titanium dioxide is merely the catalyst which initiates the reaction but is not needed as an active ingredient, it is not used up over time. As a result, the surface remains active until it is removed or repainted.



How much titanium dioxide is needed to reduce nitrogen oxides?

The larger the photocatalytically active surface, the more pollutants are eliminated. Smaller surfaces do contribute to the degradation of nitrogen oxides. If you wish to reduce local nitrogen oxide concentrations, for example, at inner-city traffic junctions exposed to exceptionally high traffic loads, however, the size of the surface should be in a significant proportion to the heavily trafficked road. In addition, the light intensities and wind directions always need to be considered as influencing factors in the design stage.

How to contact us

Your personal contacts at the FAP will be pleased to answer any questions you may have and to provide expert advice on the subject of photocatalysis.

Further information is also provided on our website:
www.applied-photocatalysis.com

You can reach our office:

- by calling 0049 (0)69/25 56 1351
- by sending an e-mail to info@angewandte-photokatalyse.de

Our members will also be pleased to answer your questions on everything to do with photocatalysis. Please do not hesitate to contact the FAP companies for any questions you have about specific products or applications.

A regularly updated directory of the members of the federation can be found on our website www.applied-photocatalysis.com – or simply scan the QR code which will take you directly to the members list.

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