THE „SHUTTER EFFECT“

COLOUR STABILITY OF FACADE COATINGS


REMA

COLOURS
IN COLOURFUL

Colours change: Wood becomes grey, white coatings turn yellowish and facades fade. How obvious colours can change show individual areas of a facade that were in the shade like for example behind shutters. The problem of exposed and unexposed surfaces lying next to each other and showing changed and unchanged colour shades, can be solved. With paints from KEIM!

COLOUR STABILITY – A NEGLECTED QUALITY FEATURE

PAINT IS A DESIGN ELEMENT

Paint is multi-functional: It protects the structure on one hand, and serves as important design medium in architecture and urban planning on the other hand. Investment in the proper paint material and colour design will pay off, because paint is the most inexpensive and most effective design element for a building. One-family house or residential complex, administration or public building, individual building or entire streets, well thought out colour concepts enhance perceptibly the living quality und well-being of the users. They provide orientation and identity, increase values and express oftentimes an attitude to life.

SHUTTER EFFECT

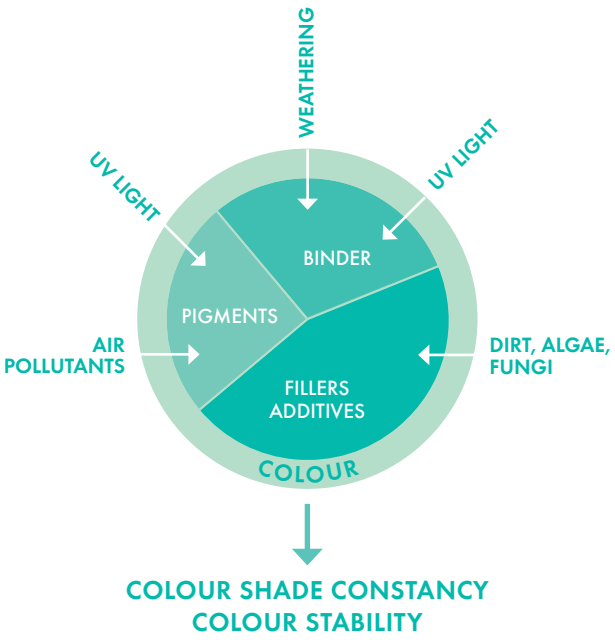
As we all know, nothing lasts forever. Colours change also, sometimes faster sometimes slower, by soiling, pollutants and of course the UV component in the sunlight. Colour shade changes of exterior paint coatings are a visual shortcoming and visible to everyone.
A typical picture is the so-called "shutter effect": The facade has faded but only behind the shutters, where the wall is protected from sunlight and weather, you can find the original colour still largely unaltered. This and many other phenomena disrupt the overall impression of a facade severely. Not only are they unattractive, but also ruin any colour design.

PAINT QUALITY IS DECISIVE

Incomprehensible that colour fastness of paint products as a quality concern does not call for more attention. There is certainly no such thing as a hundred percent colour shade stability, but the differences in quality and behaviour of paint materials are tremendous. There are indeed coatings whose colour shade remain over decades unchanged for the human eye! It is, of course, quite true that there is barely a commercial coating product which is not promoted as being "UV resistant", "lightfast" or "colour stable". But, not all paints are equal. What are the differences?

INFLUENCE FACTORS ON COLOUR CONSTANCY

Colour stability and a constant visual impression over the long term are determined by a series of different factors. While the soiling tendency or the self-cleaning effect of coatings depend on the binding agent, result other impacts in changes of the "inner values" of a coating. For example, when the binder disintegrates occur microcracks that impair the light refraction and the colour shade of the coating appears grey and milky. Also the pigments themselves become stressed when exposed to UV light: They change their chemical structure and thus their colour.



MINERAL PIGMENTS: RESISTANT AGAINST UV LIGHT AND AIR POLLUTANTS

KEIM mineral paints are formulated with solely highly light-resistant, inorganic pigments providing a colourfulness that is stable over decades.

THERE ARE TWO TYPES OF PIGMENT

Colouring pigments may be divided into organic and inorganic (mineral) pigments. The differences in the materials on which they are based result in differences in resistance between the two categories of pigments.

UV radiation can cause colour changes in pigments. This phenomenon is familiar from textiles: items of clothing which have been hung on outdoor display racks exposed to sunlight often have faded areas. Exterior wall coatings can suffer a similar fate if UV resistant pigments have not been added to the paint or have not been added in sufficient quantity. In the same way that citric acid removes organic dyes in fruit stains, cause aggressive atmospheric pollutants ("acid rain") colour changes in organic pigments.

Mineral pigments, however, are acid-resistant and excel by an outstanding high colour fidelity and lightfastness because the chemical structure of their powder form is stable against external influences. Thus, mineral paints remain almost unchanged over decades and plus, they sparsely attract dirt particles.

In brief:
Mineral pigments convince with highest light and UV resistance and keep their colourfulness over decades.

MINERAL BINDERS: RESISTANT TO UV LIGHT AND WEATHERING

Top: Already after 2 years of weathering, this organically bound coating shows microcracks and spalling in the initially intact coating layer.

Left: The binder is the most important, quality-determining component of a paint. It ensures the bond of the different ingredients and, above all, the adhesion of the paint to the substrate.

NOT ALL PAINTS ARE EQUAL

Good paint material depends on the binding agent. It holds the coating together, is decisive for the coating properties and renovation cycles of a facade. UV resistance and weather fastness of the binder also play an important part in the colour stability of the finished coating. Like pigments, paint binders can also be divided into two fundamental directions: The mineral or the petrochemical technology.

- Organic binders, such as synthetic resin dispersions including silicone resin emulsions or dispersions and,
- Inorganic (mineral) binders, such as water glass (potassium silicate) or sol-silicate (silica-sol water glass mixture)

Organic binders are manufactured on the basis of polymers, meaning synthetics which are produced from crude oil in energy-intensive synthesis processes. The binding agent particles are the core of dispersion or silicone resin paints and form a more or less porous paint film on the surface after drying.

UV light and weather loads such as extreme changes in temperature (hot/cold) or moisture fluctuations can result in microcracks and later in binder disintegration because of the insufficient durability of organic binders in an initially smooth and intact paint film. The colour shade of the coating appears greyer, milkier, and not so pure anymore.

In a nutshell:
Mineral binding agents are UV stable, weather-resistant, structurally optimal facade coatings.

KEIM'S SILICATE PRINCIPLE: UNEQUALLED DURABILITY

District recruiting office in Potsdam (left), painted in 1992 with KEIM silicate paint (colour shade 9071). Right: This part was coated with an organically pigmented paint from a competitor in the same colour shade, but clearly shows a colour change!

DURABILITY AS A MATTER OF PRINCIPLE

A facade coating should last for at least 20 years – in visual and in functional terms. This won't be a big challenge for mineral paints as they easily last twice that long thanks to their silicate structure.

Silicate technology is the silicification of the binder with the mineral substrate. The liquid binder (potassium water glass) in the paint forms an insoluble, crystalline bond with the substrate (render, natural stone, concrete, etc.) due to a chemical reaction.

This type of bonding is the crucial factor for the unequalled longevity of KEIM's silicate paints.

The binding agent potassium water glass silicifies with the substrate.

Lightfast! 21-year-old coating.

COOPERATIVE BUILDING,
AFFOLTERN, SWITZERLAND,
PURLY MINERAL STRUCTURE WITH
KEIM'S SILICATE TECHNOLOGY,
KEIM PURKRISTALAT COATING,
21-YEAR-OLD

KEIM'S SILICATE PAINTS – FOR CLEAN FACADES

Brilliant white and long-time clean: Facade coating with silicate paints from KEIM.

STATIC CHARGE, THERMOPLASTICITY AND DEW

Soiling, too, alters the colour and the visual appearance of facade coatings. The soiling tendency of facade coatings is mainly influenced by three factors:

- Static charge
- Thermoplasticity, the so-called "tackiness" of the binder
- Dew on the surface

THE BINDER'S INFLUENCE ON THERMO-PLASTICITY AND STATIC CHARGE

Organic synthetic resin or silicone resin binders become statically charged in the wind due to friction and so actually attract dirt particles from the air. Plus, at high temperatures these binders show thermoplastic behaviour which means they become tacky. Dirt particles in the wind and attracted by the static charge find "ideal conditions to stick" to the surface. Silicate binders do not show this phenomenon at all.

AVOID SOILING

DISPERSIONS ARE MADE OF SYNTHETICS AND PROPERLY ATTRACT DIRT PARTICLES

The paint is charged electrostatically and dust is attracted.

Synthetics become soft and tacky when it is warm.

Water vapour condenses on the wall, the facade becomes wet and water runs down.

KEIM SILICATE PAINTS DO NOT PROVIDE ANY CONTACT SURFACE FOR DIRT.

KEIM silicate paints do not charge.

KEIM silicate paints do not become tacky.

KEIM silicate paints prevent the formation of condensation water.

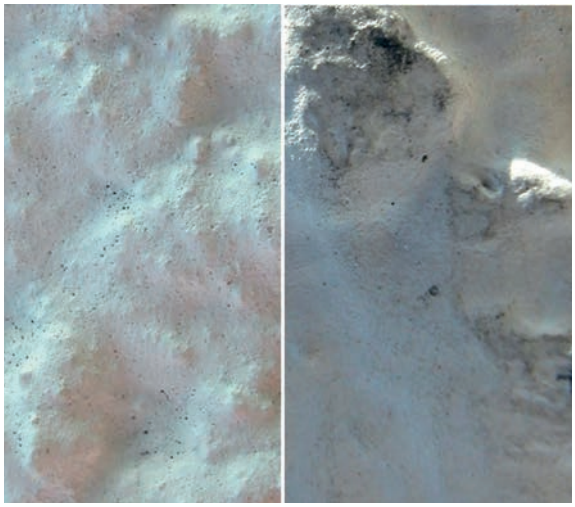
HYDROPHOBIC VERSUS HYDROPHILIC

Particularly the extreme water repellency ("hydrophobicity"), the so-called "lotus effect" in context with a "clean facade" is a controversially discussed public issue. The degree of water repellency of paints is definitively controlled by adding appropriate additives, such as silicone oils. Paradoxically, however, silicone oils result in greater adhesion of dirt particles. In practice the praised "lotus effect" has not turned out at all to be advantageous. Many facades coated with this extremely "hydrophobic" paint material suffer from severe soiling. Water drops carrying dirt particles roll down the wall, come to a standstill on a render particle and get stuck there.

Also in cool weather silicone resin paints are at a disadvantage to silicate paints because, more dew water condenses on silicone resin paints. This applies particularly for paints with lotus effect, entailing that the surfaces are longer moist and dirt particles can easily adhere.

By the way, silicone resin paints have a clearly higher risk for algae growth due to the unfavourable dew water behaviour (unless toxic biocides are added that become washed out over time).

Mineral coatings age gracefully and keep their character.



Facade coatings after 2 years of natural weathering.
Silicate paint (left) and silicone paint with lotus effect (right).

STUDIES CONFIRM THE ADVANTAGES OF SILICATE PAINTS

Study results confirm, what has already been evident for years and decades from coated structures, namely that silicate paints show the best properties in terms of cleanness and soiling resistance.

This is primarily due to the above-described features of silicate paints: antistatic, non-thermoplastic, low levels of condensation, favourable wetting characteristics – and largely defined by the silicate binder water glass.

The phenomenon of microchalking assists additionally by providing controlled, nanometer-scale "sanding" of the coating, caused by weathering, which proceeds uniformly over decades. In this way, any deposits of dirt are constantly removed.

In brief:
Dispersion binders become tacky due to heat and embed dirt particles. Silicate paints are anti-static, non-thermoplastic and the surface remains dry longer. This keeps the facades longer clean and attractive even after decades.

COLOUR RESISTANCE – WHAT DO PAINTS ACTUALLY DO?

Facade with clearly visible colour changes in the areas of dismantled shutters.

FIRST SYSTEMATIC INVESTIGATIONS INTO COLOUR CHANGE

There is no such thing as perfect colour stability, but there are still huge differences in the behaviour of coating products, something which practical experience teaches us time and again. If realistic statements are to be made, the only solution is outdoor testing in a true to life situation.

The „iLF Forschungs- und Entwicklungsgesellschaft Lacke und Farben mbH" (= Institute iLF for R&D of varnishes and paints) has carried out comparative outdoor weathering tests over eight years on five different exterior paints with different types of binder and assessed them in relation to colour change.
The parameter investigated was the colour difference of the individual coatings after completion of eight years' weathering in comparison with an unweathered reference sample which had been stored in the laboratory protected from light and moisture.
The assessment or measurement of colour difference also included an evaluation of pigment changes, binder changes, soiling and plant growth.

Test products specified were a pure, two-component silicate paint, a silicate emulsion paint, a (silica-)sol/silicate paint, a lotus effect silicone paint and a pure acrylate exterior paint. The particular products tested were deliberately selected to be of the highest quality in their particular category.

The colour shade selected was an intense blue (NCS S 2050-R80) because blue shades are particularly sensitive to weathering, and the human eye is particularly good at and sensitive in discriminating colour differences in the blue/grey range.
Parallel outdoor weathering tests were carried out to DIN EN ISO 2810 in two different climates, one the industrial climate of Magdeburg and the other the rural climate of southern Bavaria. In this way, climatic conditions could also be taken into account, so additionally ensuring the general validity and practical relevance of the results. Both visual and instrumental methods were used for testing. All test methods were based on generally recognised standards.

Left: 8 years of outdoor weathering test (2001-2009), "iLF Forschungs- und Entwicklungsgesellschaft Lacke und Farben mbH" in Magdeburg

OUTDOOR WEATHERING TESTS OF FIVE EXTERIOR PAINTS

RESULTS OF PRACTICAL STUDY

After eight years of outdoor weathering in two different climatic zones, no adhesion problems in form of cracks or blisters occurred in any of the exposed samples.
In terms of decorative properties, the investigated silicate products all exhibited distinctly less change than the silicone paint and the acrylic paint.
This is impressively clear from the instrumentally measured delta E-value and blue value. The silicate product accordingly exhibit the best colour stability.
The photo documentation below shows the superiority of high-quality silicate paints manifested in terms of colour stability.

In a nutshell:
The superiority of high-quality silicate paints over polymer and silicone resin bound exterior paints when it comes to colour stability has been impressively substantiated by comprehensive tests carried out.

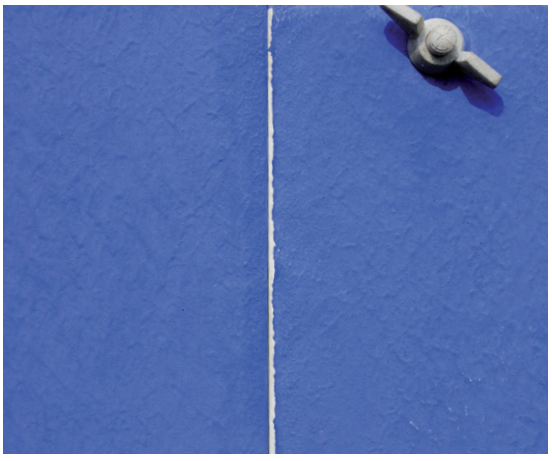
PROBLEMS OF COLORIMETRY

An appropriate colorimeter is used for instrumentally verifying colour shades and colour differences by determining the specific "colour location" of the colour shade within the three-dimensional "colour space". Colour shades are defined by three parameters: firstly on a light-dark axis, secondly on a red-green axis and thirdly on a yellow-blue axis. If all three axes are visualised, a three-dimensional space is created. This colour space comprises an infinite variety of subtly different colour shades. Each possible combination of the three values on the three stated axes represents a point within this colour space and thus a colour shade.

Conversely, the exact position within the colour space can be determined for each colour shade as the combination of the three coordinates. This combination unambiguously defines the colour shade. If the colour shade undergoes change, this can be unambiguously demonstrated instrumentally, the change being manifested as a change in one or more of these values on the axes. The sum of these changes is known as the "delta E value" which describes the "total colour difference" as the sum of the three colour differences on the axes.

The problem is that the delta E value is perceived differently by the eye depending on how delta E is made up and the particular colour shade in question: delta E is the sum of three individual values.

COLOUR CHANGE (LEFT UNWEATHERED, RIGHT AFTER 8 YEARS OF OUTDOOR WEATHERING)



KEIM PURKRISTALAT

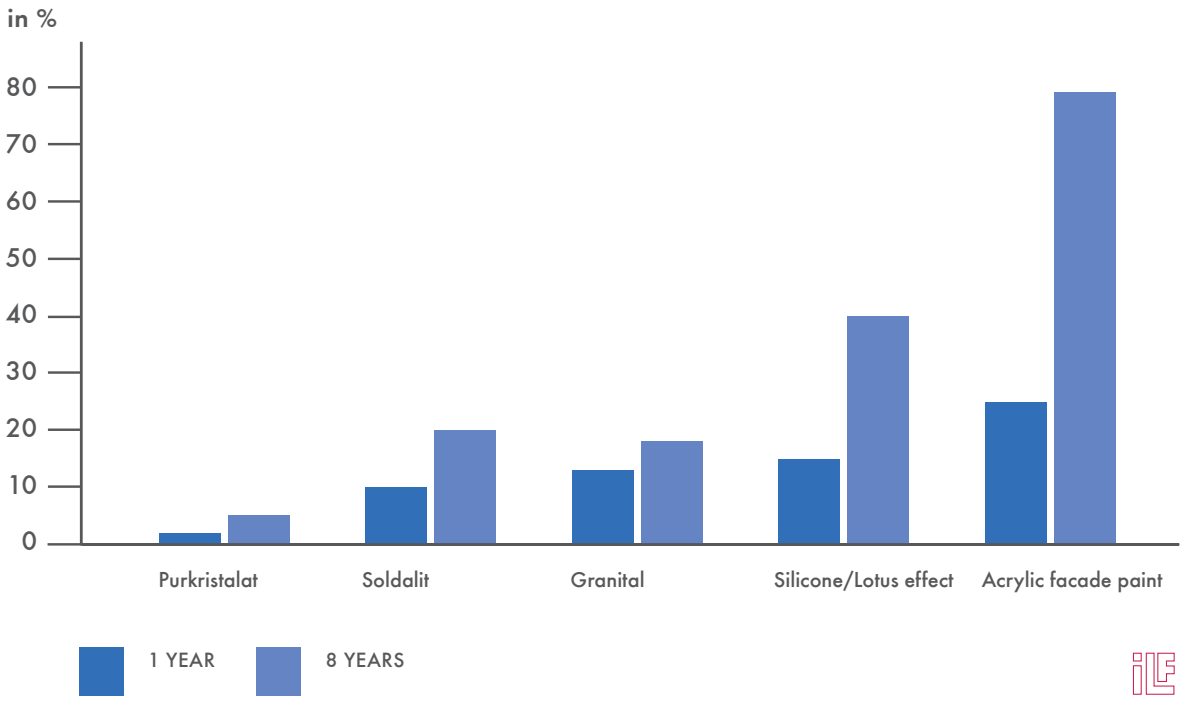
KEIM SOLDALIT

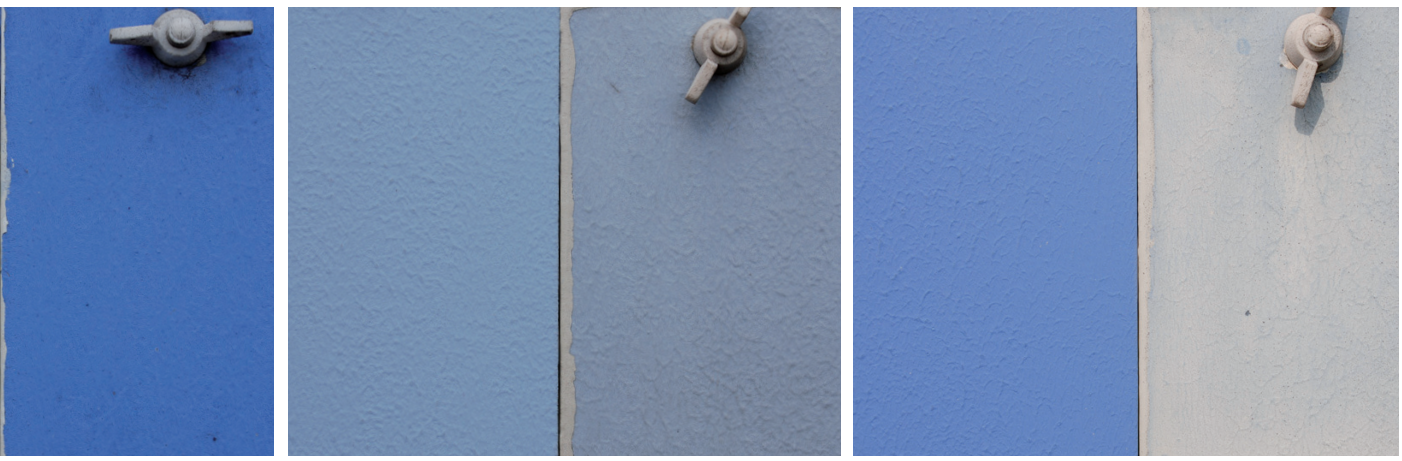
KEIM GRANITAL

Accordingly, many different individual values can be added together to give the same result and thus the same delta E value. This is simple arithmetic: 1+2+3 = 6 is just as correct as 3+0+3 = 6, but while the result may be the same, a visual assessment may prove to be entirely different. The explanation for this is that human perception also differs in sensitivity depending on colour shade. In the case of blue or grey shades, our eye is highly sensitive and recognises even very small delta E values as a colour difference. In the case of yellow-orange shades, on the other hand, our eye is fairly insensitive. In this case, small delta E values are not even perceived.

In brief:
Instrumental delta E-values do not always correlate with what we humans see, especially when it is a question of the extent and intensity of a colour difference.

CHANGE IN BLUE VALUE B





SILICONE FACADE PAINT/LOTUS EFFECT

ACRYLIC FACADE PAINT

HALF-TIMBERED HOUSES
SCHWÄBISCH HALL (DE)
KEIM GRANITAL COATING

A BRIEF ASIDE ON COLOUR BRIGHTNESS

GLOWING COLOURS

When discussing the colour stability of exterior wall coatings, the brightness of the colour shades should not pass entirely unmentioned because there are also visible differences between coating materials in terms of colour brightness. We usually take "brightness" to be an attribute like "silk-gloss" or "high-gloss" – characteristics with which different grades of coating are distinguished and which describe the degree of surface gloss.
However, "brightness" does not necessarily mean gloss, but instead characterises another dimension of our perception: the luminance of paints and is not related to the degree of gloss.

The luminance of paints is primarily caused by light impinging on the pigment and being reflected back. The less obstruction there is to light impinging on the pigment and being reflected by the pigment, the greater the luminance and "brightness" of the colour shade.

- Organic binders, as used in dispersion or silicone resin paints, form a film around the pigment and so modify refraction. The original luminance of the pigment is thus lost and the paint has dull and diffuse appearance.

- Mineral binders, as used in silicate paints, are transparent. They allow light to pass through unhindered and impinge on the pigment. Reflection is not distorted, the paint glows and looks bright.

In a nutshell:
Only mineral binders allow a straight reflection of light from pigments, which so retain their original luminance and brightness.

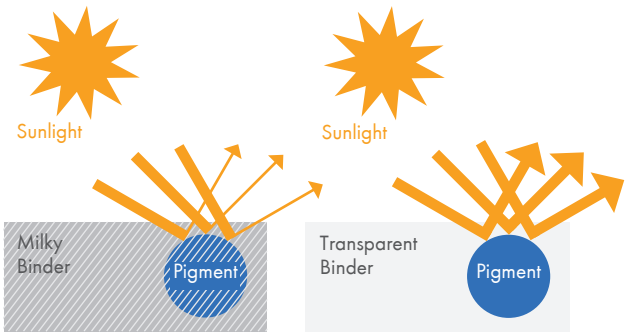
Seminary in Meersburg coated with KEIM Soldalit. An impressive demonstration of the brilliance of a matt silicate coating even after many years.

COMMON DISPERSION PAINT

THE PIGMENT IS COATED BY THE MILKY BINDER. LIGHT REFLECTION IS DULL AND FLAT.

KEIM SILICATE PAINTS

THE PIGMENT IS EMBEDDED IN TRANSPARENT WATER GLASS, CREATING DIRECT AND BRILLANT LIGHT REFLECTION THAT UNDERLINES THE STRUCTURE.



Truly sustainable: Mural painting on the "Bürgerasyl" (former hospital and poorhouse) in Stein am Rhein (CH), original from 1900 with KEIM's silicate technology.

MINERAL QUALITY FOR SUSTAINABLE PAINTING CRAFT

Nowadays the term "sustainability" suffers from over-use and presents above all one thing – marketing. Sustainability in the original sense means constancy, incessancy, efficiency and insistence. A sustainable product is the exact opposite of our "throwaway culture". This means for the building trade: Quality of building materials that can also be renovated as well as their renovation intervals are valuable parameters for the assessment of true sustainability.
Theo Schaub, owner of Schaub Maler AG with its main office in Zurich and branch offices in Oerlikon and Wetzikon, Switzerland, stands for a culture of true sustainability in his business.

MR. SCHAUB, WHAT MEANS SUSTAINABILITY FOR YOU?
TS: Sustainability for me is to provide quality and to preserve or create values. That could be a good craftwork, a renovation or the management of a company and practised values.

WHAT STANDS SCHAUB MALER AG FOR?
TS: I manage this company founded in 1900 in fourth generation as master painter. As my predecessors I set my standards high and give every day my full commitment to belong to the best.

WHAT IS YOUR ENTREPRENEURIAL APPROACH IN TERMS OF SUSTAINABILITY?
TS: When selecting the material we choose the highest quality on the market. Our top priority is the long-term use for our customers and thus the durability of the coating system. And we always consider the first renovation cycle. For this reason, we rely on KEIM mineral paints.

"I wish that the long-term aspect of a painter's work will receive more attention."

Theo Schaub, Owner of Schaub Maler AG

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Value 03/2019