BEYOND CHEMISTRY

SIKA SEALING & BONDING SOLUTIONS FOR SUSTAINABLE CONSTRUCTION

BUILDING TRUST

Sika Solutions Contribute to a Sustainable Future

“Sika is committed to putting high-performance solutions into practice – to the benefit of our customers and for a sustainable development.”

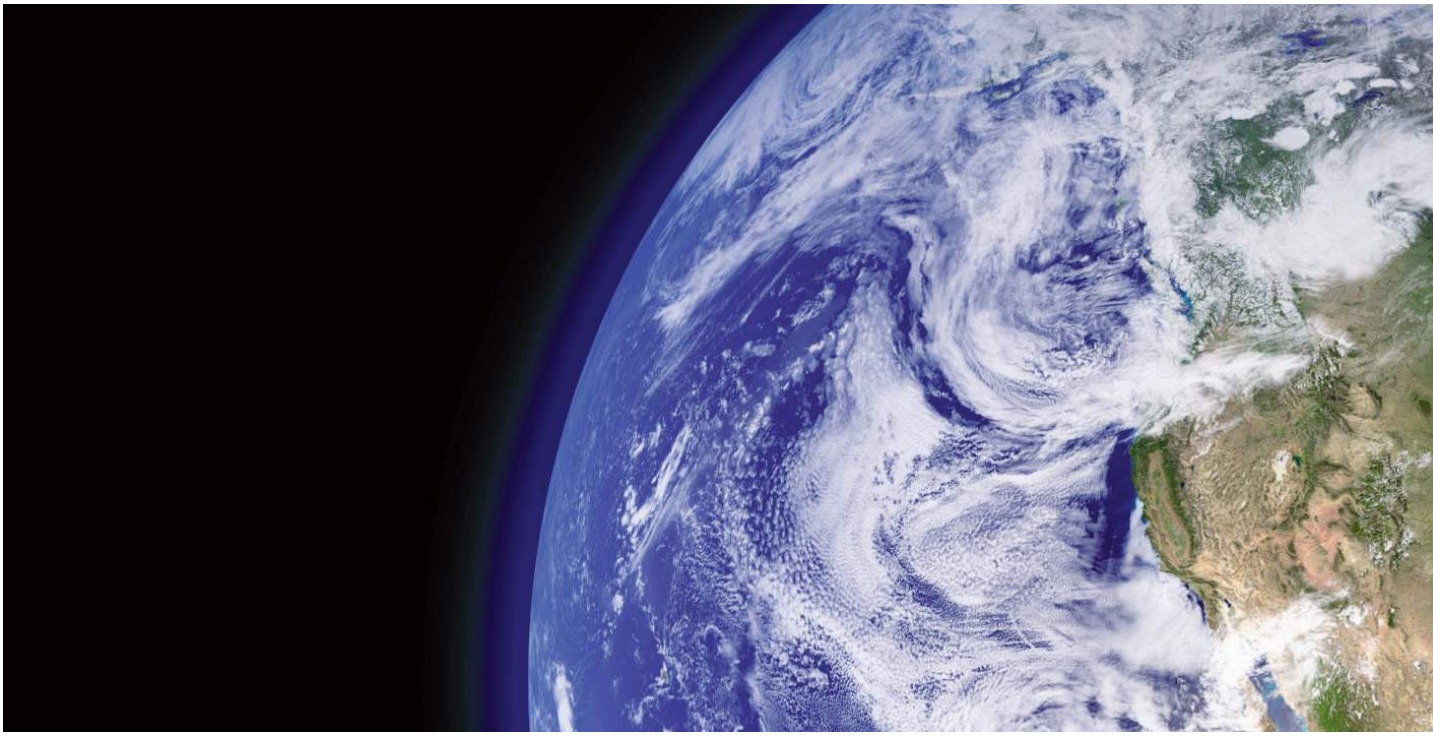
In a marketplace that faces challenges such as higher costs for raw materials and energy, faster growth in emerging economies, and growing global competition, it is vital to be able to innovate. Since its foundation in 1910, Sika has shown this ability repeatedly and will accelerate in doing so. It is in this interest that we invest in research.

In the future, this approach will remain crucial to our success, and we will anticipate and respond strongly to major challenges ahead such as energy and resource efficiency, climate change, water scarcity, efficient infrastructure, and air quality. These challenges demand new solutions which are directly linked with our company’s growth. Consequently, we need to ensure that sustainability is integrated effectively into our management and business methods, our research and development strategy, marketing and sales activities, production processes, and into our collaboration across company lines.

As a company with a strong innovative tradition, Sika not only develops creative solutions, we also engage in sharing this tradition across company lines with our partners in trade and industry. It is in this respect that we engage in the following programs:

Content

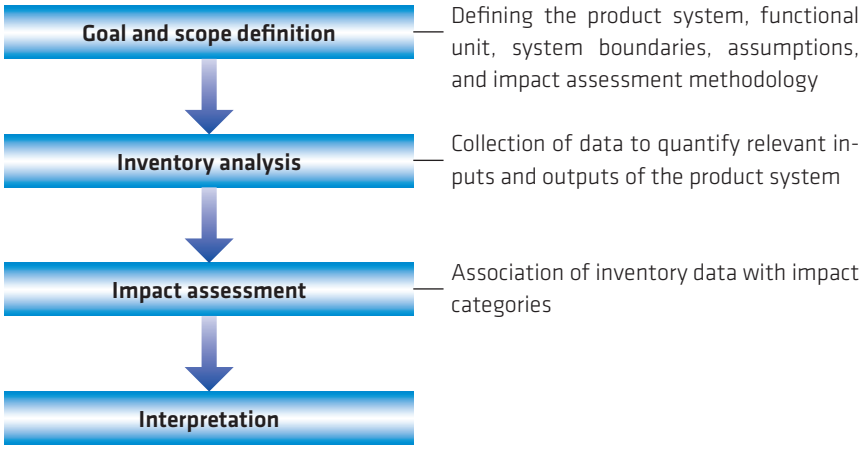
What Is Life Cycle Assessment and How Can I Measure It?



What is Life Cycle Assessment (LCA) and why is it relevant?

Life Cycle Assessment (LCA) is a standardized method to assess and compare the inputs, outputs, and potential environmental impacts of products and services over their life cycle. LCA's are increasingly recognized as the tool to evaluate the sustainability of products and systems.

What are the steps to prepare an LCA?



What impact categories and resource indicators are included in an LCA?

There are several different impact categories and resource indicators which can be assessed with different methods. The impact categories and resource indicators to be presented according to the standard EN 15804 Sustainability of construction works – Environmental product declarations – "Core rules for the product category of construction products", include the following:

Cumulative Energy Demand (CED)
Cumulative Energy Demand (CED) accounts for the consumption of energy resources, namely the total amount of primary energy from renewable and non-renewable resources.

Global Warming Potential (GWP)
Global Warming Potential (GWP) measures the potential contribution to climate change, focusing on emissions of greenhouse gases, such as carbon dioxide (CO_2), which enhance the heat radiation absorption of the atmosphere, causing the temperature at the earth's surface to rise.

What impact categories and resource indicators are included in an LCA? (continued)

Photochemical Ozone Creation Potential (POCP)
Photochemical Ozone Creation Potential (POCP), or summer smog, is the formation of reactive chemical compounds, e.g., ozone, by the action of sunlight on volatile organic compounds (VOC) and nitrous oxides (NO_x). It is common in large cities, where high amounts of VOC and NO_x are released (e.g., industrial and automobile emissions), especially during summer when there is more sunlight. Summer Smog may be harmful to human health and ecosystems.

Use of Net Fresh Water
The use of net fresh water accounts for the consumption of fresh water (e.g., feed water, ground water, lake water, river water, surface water, water with river silt).

Eutrophication Potential (EP)
Eutrophication is the excessive enrichment of aquatic or terrestrial ecosystems with nutrients, nitrogen and phosphorus being the most important, which may cause an adverse shift in species composition and biomass production.

Acidification Potential (AP)
The acidification potential describes the conversion of air pollutants, such as sulphur dioxide (SO_2), into acids, which have a wide variety of impacts (e.g., in form of acid rain) on soil, water, organisms and materials.

Ozone Depletion Potential (ODP)
Ozone depletion refers to the degradation of the ozone layer due to anthropogenic emissions, such as chlorofluorocarbons (CFCs). This allows a greater fraction of UV-B radiation to reach the earth's surface, with potentially harmful impacts on human health, organisms and materials.

Abiotic Depletion Potential (ADP elementary and ADP fossil)
Abiotic resources are natural resources such as minerals, iron ore, crude oil and wind energy. The ADP elementary impact category includes all non renewable, material resources, while the ADP fossil category includes all fossil resources, including feedstock.

Are "Carbon Footprint" and Global Warming Potential (GWP) the same?

Yes, the Carbon Footprint is the sum of the total greenhouse gases emitted (directly and indirectly) expressed in lb CO_2-equivalents. GWP is the corresponding impact category of an LCA.

The Sika Life Cycle Approach

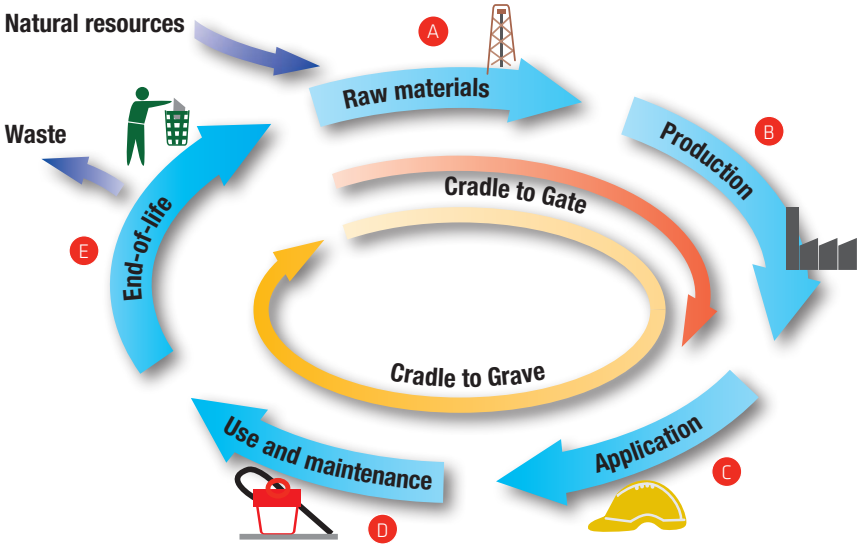
On what standards are Sika LCA's based?

Sika carries out LCA's according to the ISO 14040 series and the standard EN 15804. The impact assessment methodology used is CML 2001.

Where does the Sika LCA data come from?

The data for the Sika LCA is based on public databases, such as those from ecoinvent, the European Reference Life Cycle Database (ELCD) and PE-GaBi, plus the specific data from Sika production plants and products.

Which life cycle phases are included in these Sika LCA's?



What does Cradle to Grave mean?

In a "Cradle to Grave" approach, the LCA investigates the potential environmental impact of a product from raw material extraction, production, application and use to final disposal at the end of life.

The Sika Contribution to Sustainable Construction

How can the Sika LCA data be used / interpreted?

The LCA can greatly assist our customers in evaluating Sika's products and systems namely by providing quantitative data on their environmental profile. This enables the differentiation of products that may have similar performance, but greater differences concerning their environmental impact – where obviously the lower, the better.

How can Sika contribute to sustainable construction?

Sika evaluates its products systematically with regard to all of the major challenges and based on regular and fully comprehensive Life Cycle Assessments.

Energy efficiency solutions
Sika products and systems which contribute to reducing the energy demand over the entire value chain.

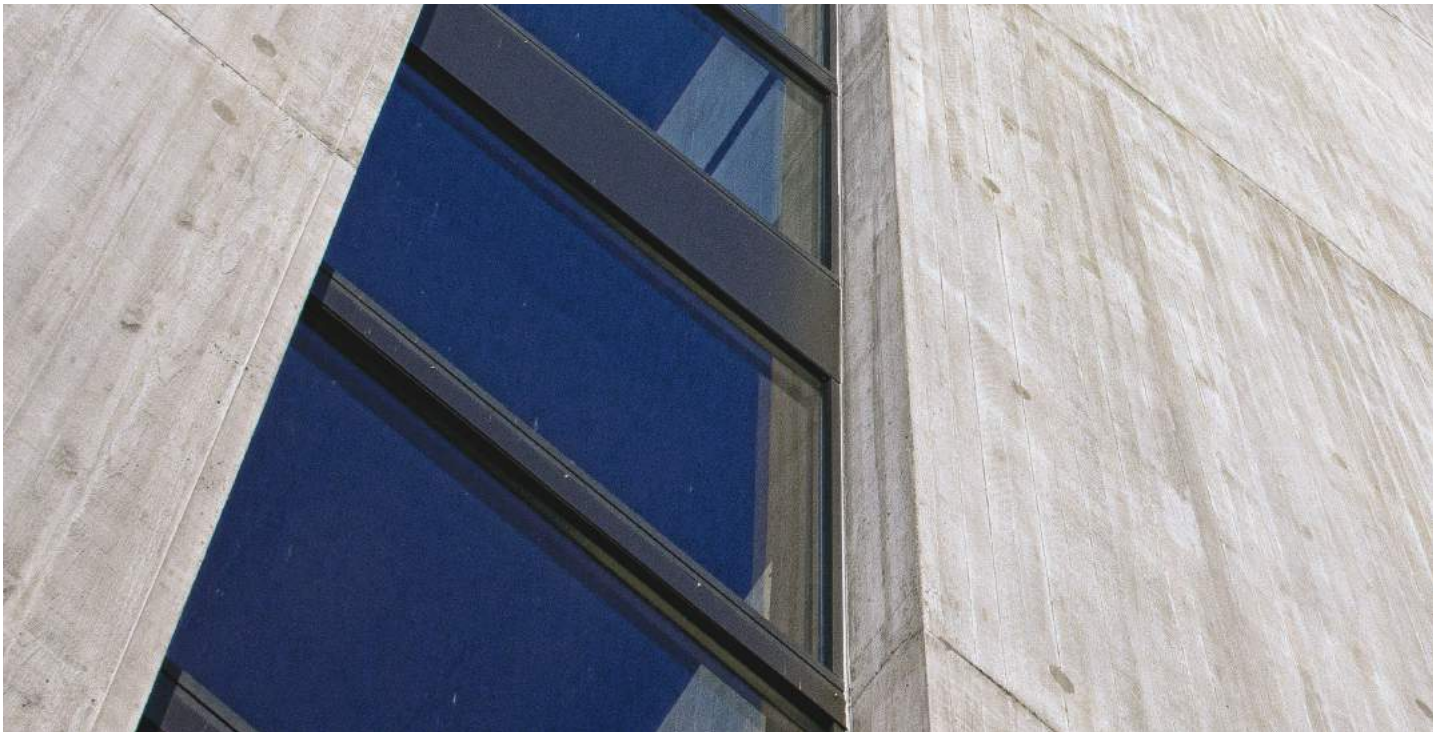
Resource efficiency solutions
Sika products and systems which contribute to reducing the resource demand over the entire value chain.

Climate protection solutions
Sika products and systems which contribute to reducing the carbon emissions over the entire value chain.

Water efficiency solutions
Sika products and systems which contribute to reducing the water demand over the entire value chain.

Air quality solutions
Sika products and systems which contribute to reducing summer smog and the emission of air pollutants and hence improve the well-being of people and ecosystems over the entire value chain.

The Sika Life Cycle Approach to Construction Joint Sealing



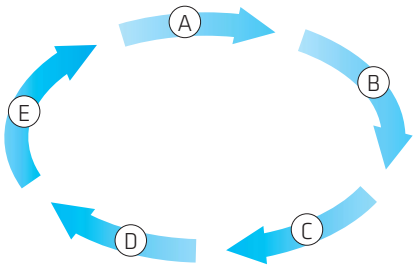
The Sika Sealing Life Cycle Approach

Which impact categories and resource indicators are most relevant for Joint Sealing?

As a standard approach, Sika evaluates all impact categories and resource indicators deemed as important according to the relevant standards. For Joint Sealing Cumulative Energy Demand (CED) and Global Warming Potential (GWP) are considered to be most relevant. Others, such as Use of Net Fresh Water are less significant for Sealants and hence not included in this publication.

Which life cycle phases are most relevant for Joint Sealing?

From a **Cradle to Gate** perspective, the majority of the potential impacts are connected to the raw materials (A) that are used to produce (B) sealants. From a **Cradle to Grave** perspective, the use phase (D) has the most significant influence on the overall sustainability performance of construction joint sealants due to their contributions in saving energy and avoiding carbon emissions. The leverage of all of these potential benefits is longevity and durability.



What is included in Sika's Sealant LCA's?

The LCA data in this brochure refer to 1 lb of sealants and are based on a Cradle to Gate approach[1].

Who performed Sika's Sealant LCA's?
The Sealant LCA's have been performed

Sika Corporate Product Sustainability Group, using the state of the art GaBi software from PE International.

[1] In the LCA's, neither the additional products (backer rods, primers, etc.), nor capital goods (e.g. application equipment) were considered.

How Can Sika Sealants Contribute to Sustainable Construction?

(A)(B) Raw material and production

Generally, the environmental impact of a sealant's raw materials are negligible compared to the total consumption of construction materials for an entire building. Nevertheless, sustainability is one of the main drivers of all R&D efforts within Sika to reduce the environmental footprint of raw materials. Sika's most modern production facilities have been built to fulfill the highest environmental standards and to use as little energy and to produce as little waste as possible.

(C) Application

Air quality and low waste solutions: Sika provides Volatile Organic Compound free (VOC-free) sealants with very low emissions (e.g. EC1 PLUS certified), which ensure a safe working environment for the applicators and avoid any air pollution. Intelligent packaging with foil packs reduces waste. Secondly, Sika focuses strongly on 1-component sealants even for applications where traditionally 2-part products have been used. These 1-component products do not need mixing, thus avoid the use of solvents for cleaning mixing equipment and tools which would be necessary in the case of 2-component products.

(D) Use and maintenance

Saving energy: Sika's long lasting sealing systems save energy by using tight joints in the building envelope, reducing hot or cold air loss through air permeable connections between different building parts, and protecting the construction from water ingress.
Innovative bonding solutions for window installation increase the size of glass open to sunlight and reduce the dimensions of sash frames. This results in a higher intake of solar grains, which ultimately leads to energy savings. Additionally, larger glass surfaces allow more daylight to enter the building; thus, reducing the need for artificial lighting.

(E) End-of-life

Disposal: Sika sealants do not contain any hazardous substances and can be disposed with usual waste without any danger of environmental contamination.

Description of Sealant Technologies Covered in the LCA's

Polyurethanes:

Use

For sealing of floor and facade joints especially on porous substrates such as concrete, masonry etc.

Key advantage

- High mechanical and chemical resistance
- Excellent adhesion to porous substrates
- Paintable

Silicones:

Use

For sealing of joints in glass, metal or insulated facades, on roofs and for interior joints in restrooms.

Key advantage

- Low modulus
- Excellent UV resistance
- Excellent adhesion to non porous substrates

Silane-Terminated Polymers (STP):

Use

For sealing of joints in facades on porous and non porous substrates and for connection joints around windows.

Key advantage

- Low modulus
- Good adhesion to porous and non porous substrates
- Paintable

Waterbased Acrylics:

Use

For sealing of interior joints in dry areas with low joint movements.

Key advantage

- Very easy to apply
- Cost efficient solution for low-movement joints
- Paintable

LCA comparison

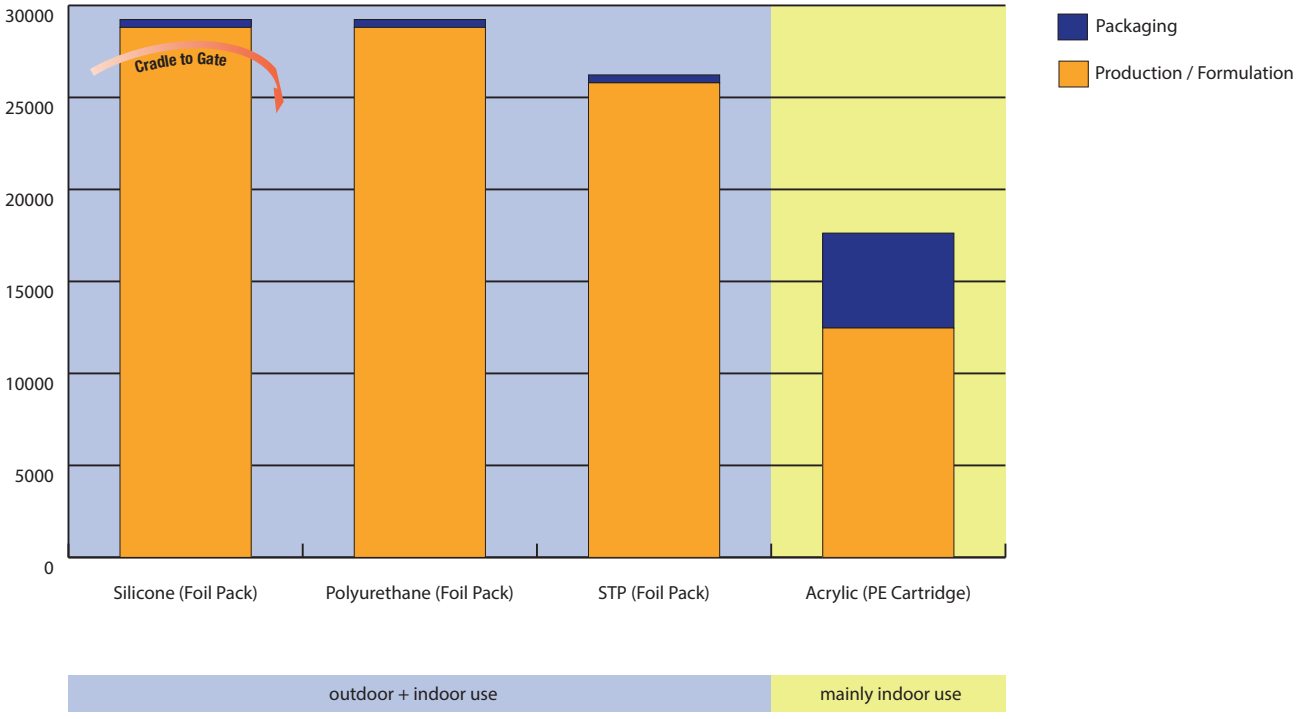
The products and technologies differ not only in their main application fields, but also in their properties. Both technology and application have an impact on the sustainability performance of the products. Hence, the LCA results will help to determine which technologies perform better. Correctly applying the proper joint sealant type is also important for a durable and sustainable construction.

LCA Results for Cumulative Energy Demand (CED)

Challenge:
The demand for limited resources is increasing.
Worldwide, the demand for resources including oil, coal, natural gas, iron ore, and copper is increasing, driven by a growing population and higher spending and purchasing power. These resources, however, are limited, and their extraction is becoming increasingly expensive. Efficient and intelligent use of limited resources is one of the main challenges for future growth.

LCA Results for the Four Main Sealant Technologies

Cummulative Energy Demand (CED) for 1 lb Sealant [BTU/lb]



Interpretation of results

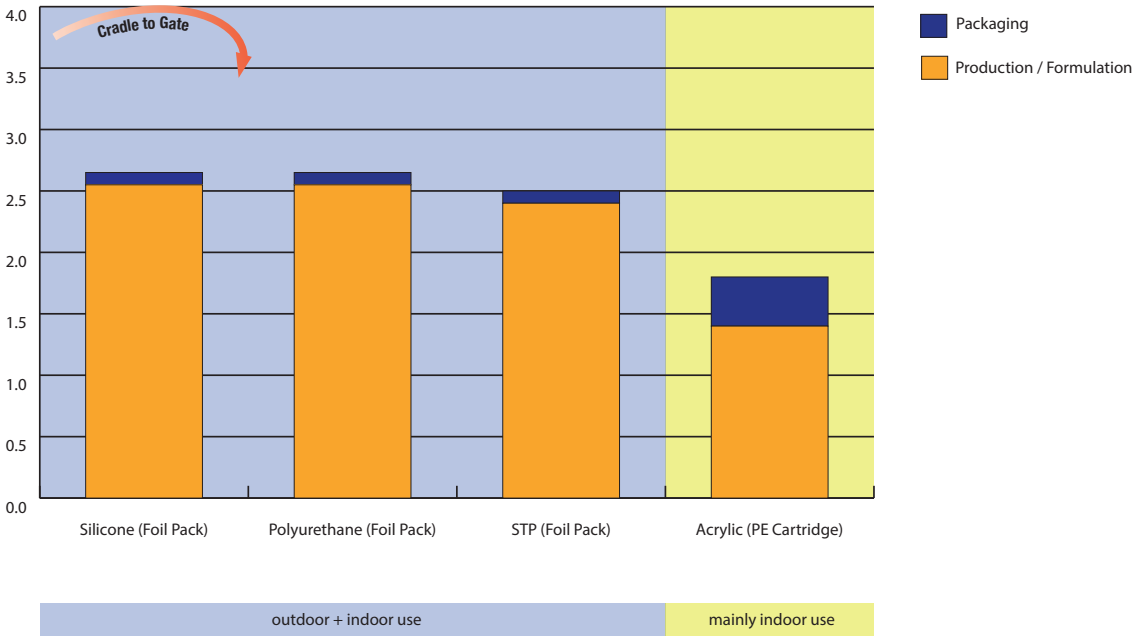
- Raw materials have the main impact in terms of Cumulative Energy Demand.
- The influence of production is almost negligible and therefore is not reported seperately. Nevertheless Sika is striving for ongoing improvement of the production process and the reduction of its energy demand.
- PE cartridges have the largest energy demand of all packaging types. In contrast, the energy demand of aluminium foil packs is low.

LCA Results for and Global Warming Potential (GWP)

Challenge:
The climate is changing faster than ever before.
The earth's climate is changing faster than ever before. The consequences are manifold and affect us all. Climate protection is one of the most important tasks for the future. By 2050 the world will have to reduce its greenhouse gas emmissions by 80%. To act now is crucial because a complete overhaul of currently used energy systems needs to be financed and realized within less than two generations. Decisive action is needed urgently.

LCA Results for the Four Main Sealant Technologies

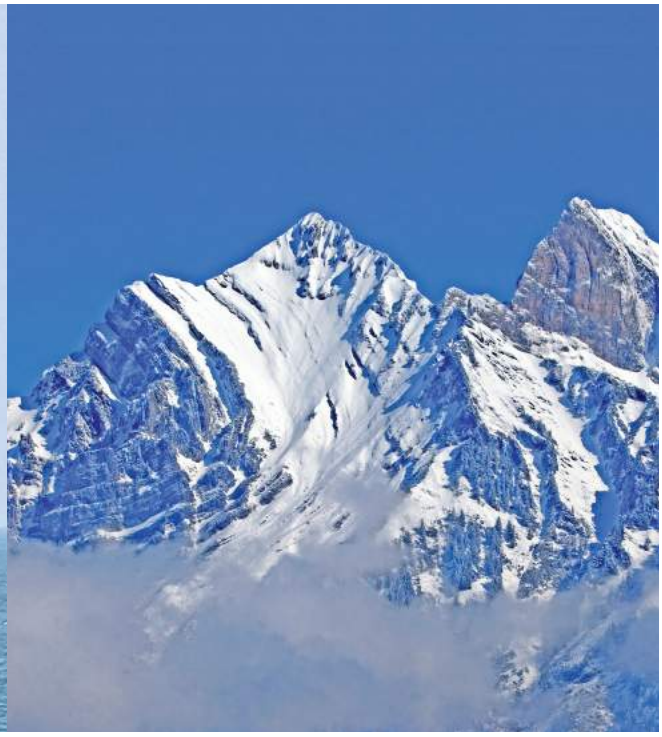
Global Warming Potential (GWP) for 1 lb Sealant [lb CO_2-eq./lb]



Interpretation of results

- Raw materials have the main impact in terms of Global Warming Potential.
- The influence of production is almost negligible and therefore is not reported separately. Nevertheless, Sika is striving for ongoing improvement of the production process and the reduction of its Carbon Footprint.
- PE cartridges show the largest global warming potential of all packaging types. In contrast, the GWP of aluminium foil packs is low.

Conclusion of the LCA Results



Conclusion of the LCA Results for the Four Main Sealant Technologies

Polyurethane, Silicone and STP sealants for outdoor and indoor use

All three sealant technologies show similar results per lb:

- No technology can be determined as most sustainable
- All three technologies can have – depending on the specific application, the environmental conditions and the quality of the product – quite similar life expectancies and impacts.

Water based acrylic sealants, mainly used for indoor applications

Acrylic sealants have the lowest Cumulative Energy Demand and the lowest Global Warming Potential per lb from a "Cradle to Gate" perspective but cannot be compared 1:1 with the other technologies:

- Due to the shorter life expectancy of acrylics, their environmental performance over a lifetime is similar to that of other technologies.
- Additionally, acrylic sealants usually have a lower movement capability and are less weather resistant than sealants based on any of the three other technologies. Also, they provide less security against flaws within the joint; and thus, they likely have a higher risk of leaking during their expected lifetime.

Interpretation of results and further studies
The importance of sealants in tightening building envelopes and other constructions is proven and their impacts on sustainability during Application Phase (C) and Use Phase (D) are crucial. To illustrate and to prove this the following three case studies were made:

1. **Safe and environmentally friendly application** with 1-component sealants with intelligent packaging.
2. **Tight building envelope:** Influence of sealants on the energy consumption of buildings.
3. **Tight civil engineering constructions:** Durable sealants help to protect potable water from aggressive liquids and waste water even under severe conditions.

Environmentally Friendly Application of 1-Component Sealants

1-Component Sealants for Safe & Environmentally Friendly Application

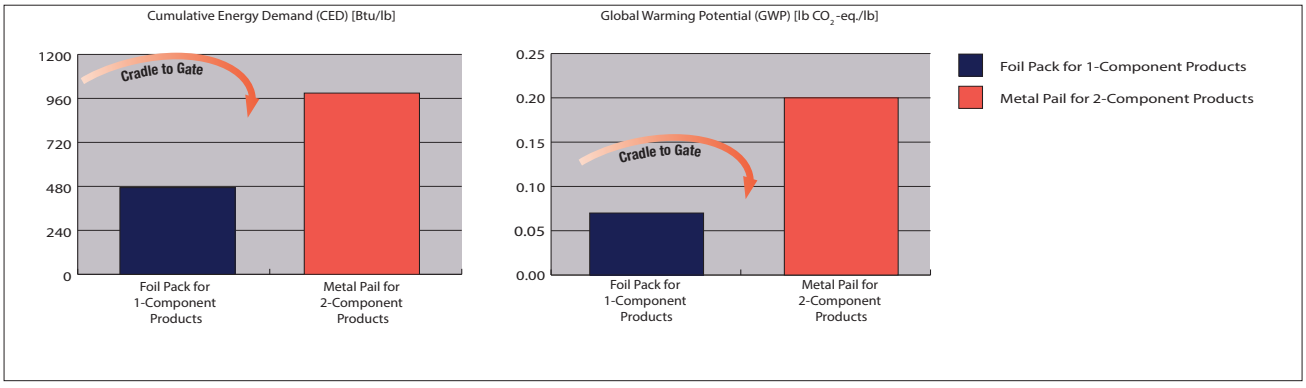
Sika focuses strongly on 1-component sealants even for applications where traditionally 2-part products have been used. These 1-component products are ready to be used without prior mixing, thus avoiding the use of solvents for cleaning mixing equipment and tools which would be necessary in the case of 2-component products. Additionally, mixed residues can be avoided and the risk of installing defective sealants through mixing failures can be eliminated.

Waste Reduction through Intelligent Packaging Solutions

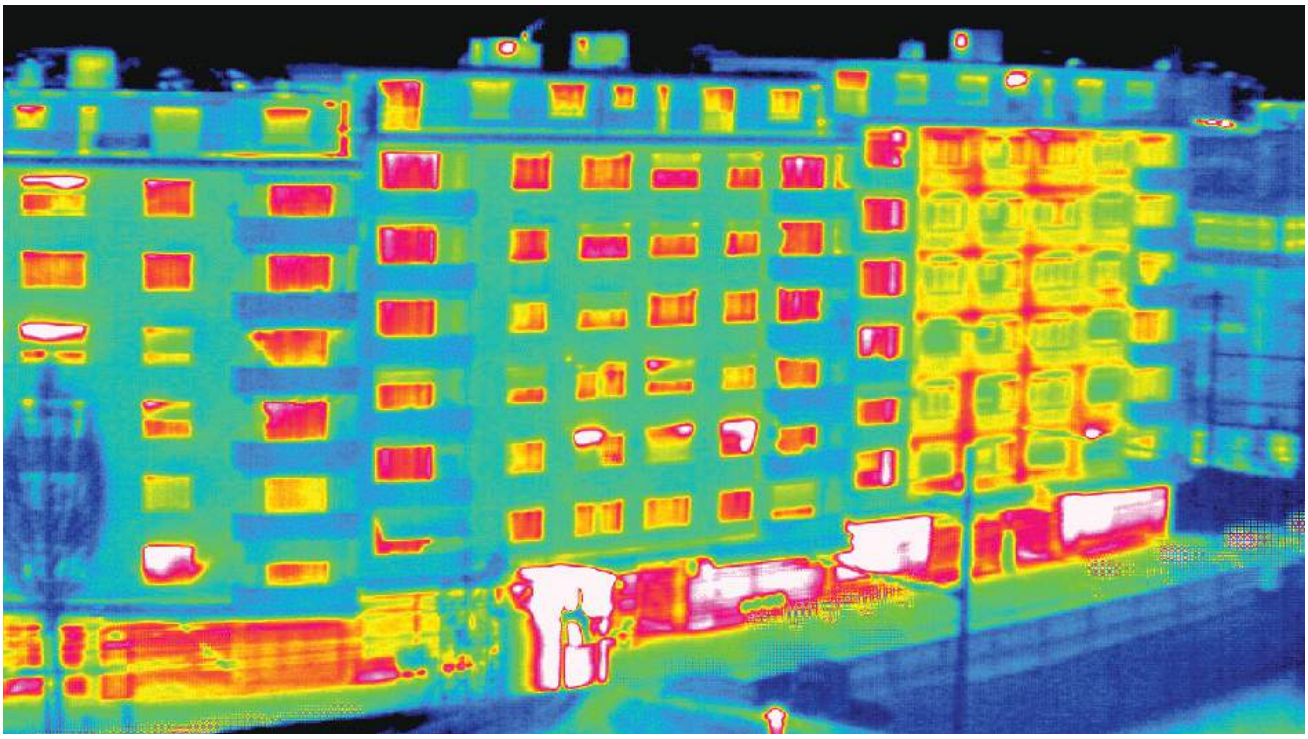
Packaging causes the most waste during the application of sealants. For this reason, Sika was the first sealant producer worldwide that introduced 20 oz. foil packs for 1-component products to minimize waste from packaging as much as possible.

The Cumulative Energy Demand and the Global Warming Potential of foil packs is less than half when compared with that of metail pails, which are commonly used for 2-component sealants. With an intelligent packaging like foil packs, 0.15 lb CO_2 and 645 Btu of energy could be saved for each applied pound of sealant.

LCA Results per Packaging Type for 1 lb Sealant



Importance of a Tight Building Envelope

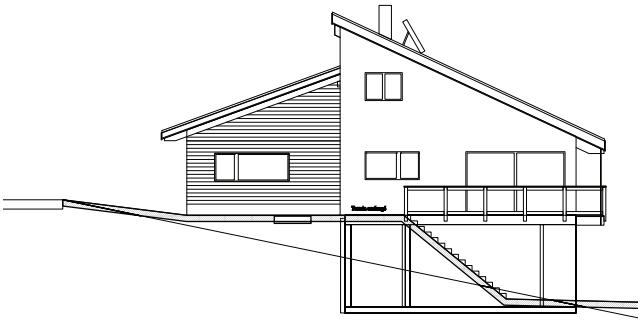


Influence of Weather Sealants on Energy Consumption of Buildings During Use Phase

Sealants contribute little to the environmental impact caused by the construction of a building, but their proper use, performance, quality, and longevity are of great importance to the total energy consumption of a building during its whole lifetime. Sealants help to tighten building envelopes and thus save heating or cooling energy by reducing air exchange between the inside and the outside. Additionally, they protect the insulation from wetness.

Case Study

Three calculations were conducted by the University of Applied Science for Architecture, Wood, and Construction in Biel, Switzerland (Berner Fachhochschule)* to determine the contribution of Sika's sealant and adhesive technologies to the energy saving potential of buildings. The case study is based on a house located near Biel, Switzerland, 3,350 feet above sea level.
The basement is made of concrete and the floors above are a wood frame construction. The entire building envelope is insulated with exterior isolation and the window area is 345 ft^2.



The following three aspects have been examined:

1. Due to new bonding technologies for window manufacturing, larger windows (more glass = more day light) with smaller frames and better insulation properties are possible (see page 16).
2. Sealants ensure a tight building envelope and prevent energy loss through air exchange (see page 17).
3. Sealants ensure a tight building envelope and prevent energy loss through wet insulation (see page 17).

* The university has a great deal of experience in assessing facade systems and is one of the inventors and promoters of the sustainability standard Minergie in Switzerland, which rates the improvement in insulation of buildings as well as the reduction of the demand for heating and cooling energy through energy saving building services.

Sika Solutions for Energy Saving Windows

Sika Combines Bonding Technology with Window Fabrication

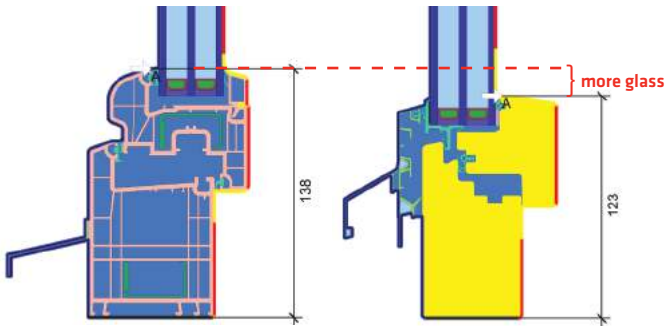
Structural bonding of glass to the sash frame stiffens the window. As a result, the glass supports the frame instead of the usual situation where the frame supports the glass. Reduced requirements of the structural strength of the sash frame allows for minimized frame dimensions; thus, increasing the glass-to-frame ratio, which leads to more solar grains.
Even small reductions of the frame size have an obvious impact on the glass area as shown below.

Energy balance of two different windows
1) Type "mechanically fixed glass"
2) Type "bonded glass" with more glass area

The solar gains ($Q_S{}^*h_g$) per ft² of window are: ■
- For mechanically fixed glass: 66,040 Btu/ft²
- For bonded windows / glass: 72,645 Btu/ft²

That results in a difference of 6,605 Btu/ft²

For the entire building, with a total window area of 345 ft², **2,275,000 Btu of energy is saved per year.**

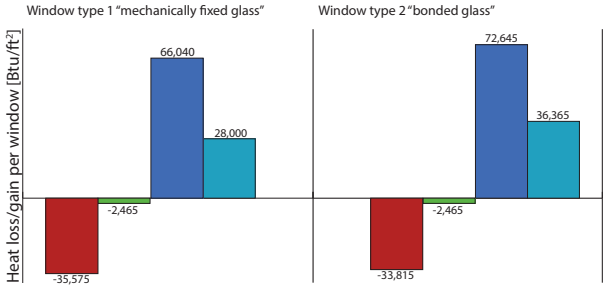


Window type 1 "mechanically fixed glass"

Window type 2 "bonded glass"

Energy balance of the two different window systems

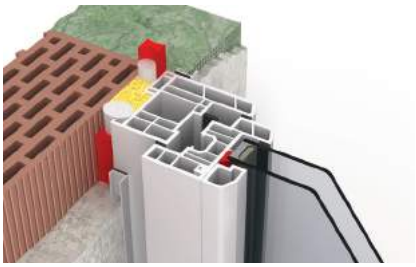
[Air Permeability Class 4, ΔP = 0.0006 psi]



- $Q_{T,\,Window}$ = Transmission loss through glass
- Q_V = Loss of energy through air exchange
- $Q_S \cdot h_g$ = Solar gains through window (glass)
- $Q_{Result} = Q_S \cdot h_g + Q_T + Q_V$

Sika Solutions for Tight Connections Save Energy

Sika Solutions Ensure Tight Window Connections



Better thermal building insulation as well as substantial improvements in window design reduce energy consumption and energy costs to a great extent. Poorly installed windows, however, can eliminate all these benefits.
Therefore it is crucial to install windows properly and connect them airtight to the adjacent building parts. Vapor diffusion and functionality of the waterproofing system must be taken into account as well, especially in wooden constructions to prevent any water infiltration.

Energy balance of window connections
Definition: Energy balance comparing the energy savings with and without a proper seal and the energy savings with wet versus dry insullation.

Loss through air leaking connection
Energy losses (Q_V) through air exchange are:
- For unsealed constructions**: 9,510 Btu/ft²
- For sealed constructions (p.16)***: 2,465 Btu/ft²

That results in a difference of 7,045 Btu/ft²

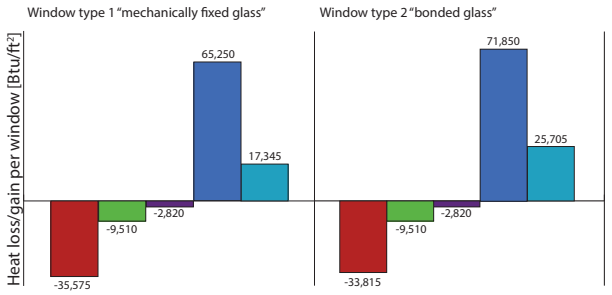
For the entire building, with a total window area of 345 ft², **2,426,000 Btu of energy is saved per year.**

Loss because of wet insulation
Energy losses ($Q_{T,\ Wet\ Insulation}$) through wet insulation are:
- For wet insulation: 2,820 Btu/ft²
- For dry insulation: no additional losses

That results in a difference of 2,820 Btu/ft²

For the entire building, with a total window area of 345 ft², **970,500 Btu of energy is saved per year.**

Energy balance of the two different window systems
[Air Permeability Class 4, ΔP = 0.0006 psi]



- $Q_{T,\ Window}$ = Transmission loss through glass
- Q_V = Loss of energy through air exchange*
- $Q_{T,\ Wet\ Insulation}$ = Transmission loss through wet insulation*
- $Q_S \cdot h_g$ = Solar gains through window (glass)*
- $Q_{Result} = Q_S \cdot h_g + Q_{T,\ Wet\ Insulation} + Q_V + Q_{T,\ Window}$

* Not related to the window system
** No sealants or membranes to seal the connection between window and adjacent building construction are used
***Properly sealed window installation with sealants or membranes

Energy Savings and CO_2 Reduction due to Sika Solutions

Evaluation and Summary of Results of Case Studies

The energy saving potential through Sika solutions per year for this building is as follows:

- Larger windows through bonded frames: 2,275,000 Btu/year
- Air tight connection (reduced air exchange): 2,426,000 Btu/year
- Water tight connection (protected insulation): 970,500 Btu/year

5,671,500 Btu/year = 1662 kWh/year

Energy Saving Potential vs. Electricity Consumption

Based on a life expectancy of 20 years for the window and the installation materials, there is a savings potential of **113.43 MMBtu** (= 20×5,671,500 Btu) [33 MWh]. An American household with four family members consumes **36.9 MMBtu (10.8 MWh)** electric energy per year. Over 20 years this results in a total consumption of **738 MMBtu (216 MWh).**

Properly installed windows and bonded frames reduce the total electricity consumption for the entire building and household by 15% during their lifetime. These savings correspond to the total electrical energy demand of 3 years.

Energy Saving and CO_2 Reduction Potential vs. Heating Energy Consumption

The yearly heating energy consumption of the house in this case study is about 32 MMBtu (which is already very low because of the high insulating standard). With a properly installed window, the consumption could be reduced to 26.5 MMBtu. With a life expectancy of 20 years for the window system and a savings of 5,671,500 Btu per year, a reduction in oil consumption and CO_2 emissions by 870 gallons and 19,300 lb, respectively, per year is achieved.

Properly installed windows and bonded frames reduce the total consumption of heating energy for the entire building by nearly 20% during their lifetime. This means a savings of about 870 gallons of heating oil and nearly 9 tons CO_2.

Positive Environmental Impact of Sika Solutions

Energy and CO_2 Costs

Total amount of products which were used:

- For connection joints: Two 2.6 ft joints with the dimensions of 0.6 in. (depth) × 0.4 in. (width) joints: ➔ Total material requirement for 6.3 gallons = 68.3 lb of sealant
- For window manufacturing: 4.9 ft frame with the dimensions of 0.4 in. (depth) × 0.07 in. (width) frames: ➔ Total material requirement for 0.8 gallons = 8.8 lb of sealant

Cumulative Energy Demand (Total 77.1 lb):
CED in average = 27,945 Btu/lb** ➔ Results in a total CED of **2.16 MMBtu = 0.6 MWh**

Global Warming Potential (Total 77.1 lb):
GWP in average = 2.6 lb CO_2-eq./lb** ➔ Results in a total **GWP of 200 lb CO_2**

Energy and CO_2 Savings

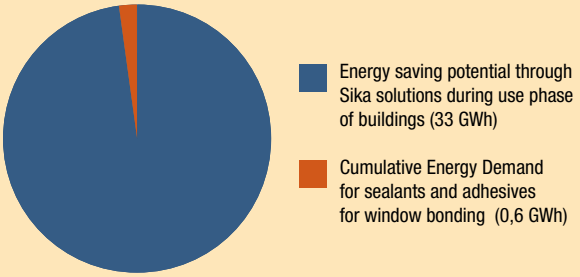
With a life expectancy of 20 years for both the windows and the installation materials, the following savings can be seen*:

Energy savings (over 20 years) ➔ **113.43 MMBtu** (20 × 5,671,500 Btu) = 33 MWh

CO_2 savings (over 20 years) ➔ **9 tons**

Conclusions of all calculations:
The energy cost of cradle to gate production of Sika products in terns of CED and GWP is negligible in comparison to the lifetime energy savings potential. A proper installation of windows and other parts of the building envelope is crucial in preventing air and water infiltration over the building's lifetime. Poorly sealed connection joints can eliminate all the benefits of well insulated construction parts.

Energy costs vs. energy savings



*see page 18 ** LCA values are based on the average of three technologies for indoor and outdoor use.

Durable Sealants Help to Protect Water

Demanding Applications

Sika as inventor of 1-component polyurethane sealants provides specialized and highly resistant joint sealing solutions for demanding applications such as:

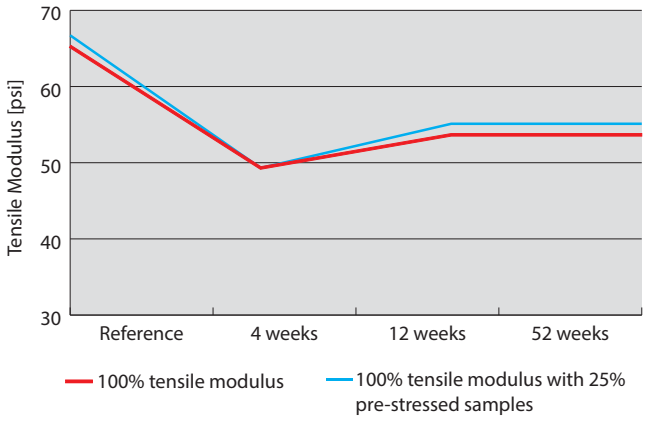
- Sewage treatment tubes and plants
- Biogas digesters and liquid manure and silage tanks
- Containment bunds and pavements of gas stations

All of these structures need to be designed to protect the environment from polluting liquids. Therefore, the tight and long lasting connection between different building parts is crucial. Specialized Sika sealants are able to fulfil the demanding requirements of chemical and microbiological resistance.
Long-term studies demonstrated the outstanding performance of Sika 1-component polyurethane sealants compared to other technologies and proved their exceptional durability even under severe conditions.

Chemical and Microbiological Resistance for Use in Sewage Treatment Plants:

After 4 weeks of immersion in sewage waste water, the tensile modulus decreased by approximately 20% due to water absorption. From 4 weeks to one year, the modulus remained relatively constant. The samples neither exhibited a visual change such as discoloration, nor a loss of adhesion. There was no significant difference in the change of modulus depending on the pre-stress. This clearly shows that even with elongation, the chemical and microbiological resistance of this specialty high-performance 1-component polyurethane sealant is excellent and thus keeps the construction tightly sealed, even with multiple demands.

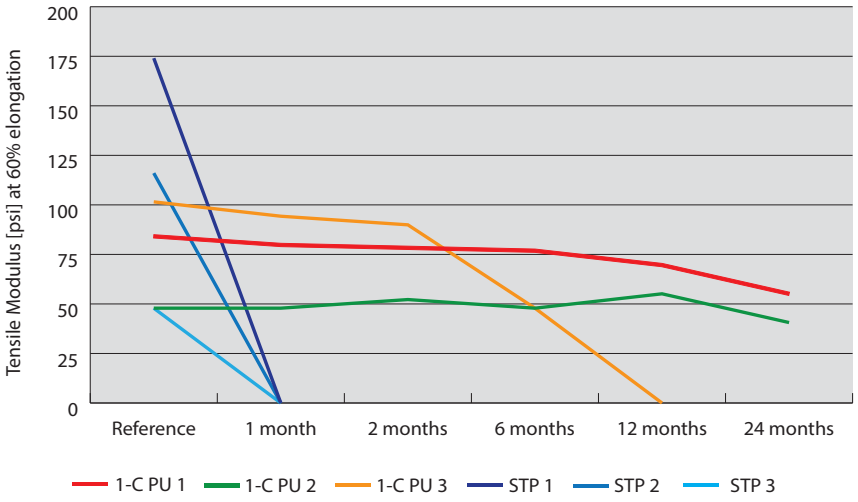
Change of tensile modulus after 1 year immersion in waste water



Resistance Against Organic Acids, Liquid Manure, and Silage in Silos and Tanks

All tested silane-terminated polymer based sealants (STP 1 – 3) show adhesion loss and a significant depolymerisation after 1 month of exposure. The polyurethane PU 3 also shows a significant decrease in modulus after 6 months and after one year of exposure a strong depolymerisation. On the other hand, PU 1 and PU 2 only show a decrease in modulus between 5 and 25%, even after two years of exposure. These tests clearly show that only special **Sikaflex**® sealants (PU 1, PU 2) designed for such applications can resist such harsh conditions including the attack of organic acids and gas and show an outstanding durability.

Variation of the tensile modulus over 24 months



Sikaflex® polyurethane sealants help to protect the environment and ensure durable tight constructions

As shown, it is possible to develop 1-component polyurethane based sealants that possess excellent mechanical properties such as high movement capability. Additionally, such sealants have the ability to keep their tightness even under harsh conditions found in waste water treatment plants and biogas digesters. Therefore, they help to protect the environment from polluting liquids even in the case of accidents. Further, Sika sealants also keep their properties under continuous and prolonged exposure and ensure durable and tight constructions.

Sika's Responsibility for Health & Environment

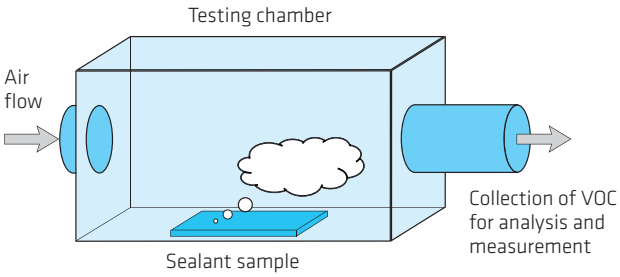
Volatile Organic Compounds in Sealing

What are VOC's?
VOC is the standard abbreviation for 'Volatile Organic Compound', chemicals with a significant vapor pressure. VOC's often have a potential long term health impact and may also have an adverse effect on the environment. Sika assumes responsibility in minimizing VOC content in joint sealing compounds and systems. VOC's are defined based on local regulations. For instance, Europe and the USA have quite different definitions of what constitutes a VOC.

VOC content
Mentioned below are the legal regulations used when setting threshold values of VOC content in a product. Their aim is to reduce total emissions during the life-cycle of a product and to minimize any contribution of VOC's to generation of ground level ozone. Legal limit values apply mostly to paints, coatings, adhesives and sealants.

- European Decopaint Directive (2004/42/EC)
- Several US Specifications such as SCAQMD

VOC Measurements
Definitions and legal limits of VOC's vary from region to region, as do the test methods used to determine VOC's.
Europe, for example, conducts emission measurements in a chamber. VOC's are collected in a specific tube and are analyzed. Through assessment of the results, the products are classified accordingly; for example, as a product with "very low emissions".



In the USA, a different test method is used. Most common is the classification of VOC content of construction materials with method 24. Instead of an emission measurement in a chamber, it determines the weight loss of the construction material in an oven. But some single state regulations prescribe chamber testing as well, such as California, CA section 01350.

All new Sika sealants are developed in order to comply with their respective limits and typically to fall well below the different local threshold values. Additionally, Sika focuses strongly on 1-component sealants even for applications where traditionally 2-part products have been used. These 1-component products are ready to be used without prior mixing, omitting the need to use solvents for cleaning mixing equipment and tools which would be necessary in the case of 2-component products.

Sika Sealants for Good Indoor Air Quality

Controlling the quality of indoor air is a recent concern as modern efficient buildings are characterized by thermal insulation and reduced ventilation. Both measures result in a decreased air exchange rate. Thus, modern, low-emitting construction materials are required in order to obtain appropriate air quality. Some governments have already introduced measures to reduce emissions from building materials.

Reaching and exceeding the new requirements for low-emission products is a key target for each new construction sealant launched.

For this reason, the majority of Sika products are now based on new **i-Cure**® technology, which can be used within buildings that have to reach the highest "Indoor Air Quality" standards. Additional solvent free products such as water based primers or water based sealants complete the indoor friendly system.

Sika Emission Competence Center
For the development of low and ultra-low VOC solutions Sika invested in an Emission Competence Center within our Analytics Laboratory, equipped to run emission measurements based on various standards.

Sika's Emission Competence Center is familiar with all relevant VOC assessment schemes and is able to adapt or develop emission measurements according to customer needs as well.

Sika® i-Cure® products passed different highly demanding emission tests.

Low Emission Certification (AgBB, EC 1 PLUS etc.)

3 day test representative of building renovation with early reoccupancy
- Prohibits high initial VOC emissions
- Absence of Carcinogens

28 day test representative of long term emissions
- Total volatile and semi volatile organic compounds (TVOC, SVOC) at 28 days
- Absence of carcinogens

Sika® i-Cure® technology is approved

Most people spend more than 80% of their time in indoors. Therefore, Indoor Air Quality in buildings is crucial for the health and well-being of all of us.
Solvent free sealants from Sika comply with the most stringent initiatives in terms of Indoor Air Quality today and enable emission free construction without any limitations regarding quality.

Sika's Responsibility for Health & Environment

Sika's Responsibility as a Chemical Company

Sika is aware of its responsibility as a producer of chemical products and therefore selects raw materials for adhesives and sealants very carefully, both for their technical performance and to prevent any impact on the environment and user health and safety.

This is why Sika disapproves of using substances of very high concern (SVHC), e.g. carcinogenic, mutagenic or reprotoxic substances and persistent bio accumulative or toxic substances, identified in the European chemicals legislation.

Sika has been a member of Responsible Care since 1992:
Responsible Care is the chemical industry's unique global initiative that drives continuous improvement in health, safety, and environmental performance together with open and transparent communication with stakeholders. Responsible Care embraces the development and application of sustainable chemistry, helping the industry to contribute to sustainable development while allowing to meet the world's growing need for essential chemicals and the products those chemicals make possible.

Sika is a member of the Sustainable Buildings and Climate Initiative (SBCI):
As a company with a strong innovative tradition, Sika not only constantly develops creative solutions used in the construction and maintenance of infrastructure, we also engage in sharing this tradition across company lines with our partners in trade and industry and other stakeholders. It is in this respect that we engage in the Sustainable Buildings and Climate Initiative (SBCI) of the United Nations Environment Program (UNEP).
The initiative brings together stakeholders from all phases of buildings' lifespans. Through SBCI, members take an active role in shaping the market of sustainable buildings and construction.

Sika is also a member or partner of the following international initatives, councils and programs:
- The World Business Council for Sustainable Development (WBCSD)
- U.S. Green Building Council (USGBC)
- Global Nature Fund (GNF)
- United Nations Global Compact

Low Emission Solutions for Clean Rooms

Cleanroom Suitable Materials Protecting Your Critical Environment

Manufacturing under cleanroom conditions is becoming increasingly more widespread and demanding. VOC emissions, AMC (Airborne Molecular Contaminants) emissions, particle emissions, and biological contamination must all be controlled. The number of products which have to be produced and processed under cleanroom conditions vary from electronics and automotives, to food, pharmaceuticals, and cosmetics. In many of these industries, cleanroom manufacturing, plus a high degree of component cleanliness, are now essential to achieve the desired product quality.

Therefore Sika has developed a new generation of advanced flooring, wall coatings, and joint sealant solutions for cleanroom environments in recent years.

Many **Sikafloor**®, **Sikagard**® and **Sikaflex**® systems are 'State of the Art' for cleanroom suitable product solutions, specifically developed and certified for cleanroom environments ranging from Electronics to Life Science Industries. Sika can help customers select the correct solutions for their individual process with the unique CSM product qualification guide.

The last edited list of Cleanroom Suitable systems and products is available online http://tested-device.com/.

Comprehensive Cleanroom Suitable systems of Sika include flooring systems such as **Sikafloor**®**-269 CR**, wall coating solutions such as **Sikagard**® **Wallcoat N** and joint sealants such as **Sikaflex**® **PRO-3** (i-Cure technology) which are essential parts for a clean and emission free environment.

Sika Sealing Solutions Contribute to a Sustainable Future

Sika Sustainable Sealing & Bonding Solutions

The energy and resource efficient solutions from Sika for sealing and bonding help to save energy during the lifetime of a building. They fulfill high standards for low emissions and contribute to sustainable constructions in manifold ways:

Sika sealants tighten the building envelope

- Sealants and sealing materials have a very low impact on the whole Cumulative Energy Demand of a building but their application is of great importance for sustainable building constructions.
- Sealants ensure a tight connection between window frames and the adjacent wall construction and reduce heat transfer through air exchange between different climates.
- Tight connection through sealants and other sealing solutions protect the building insulation from water immersion and guarantee the thermal insulation value of the wall construction.

Sika adhesives to bond window panes and frames

- Adhesives require a minimal amount of material for a tight connection; thus, there is a low Cumulative Energy Demand and Global Warming Potential in the entire construction.
- Bonding technology stiffens the window construction and therefore enables a reduction in the width of the frame. The surface of the glass becomes larger, the solar gains are improved and the energy for heating is reduced.

Sika sealants help to protect water

- Drinking water is one of the most important resources that must be preserved. Sika offers different tailor-made sealants with a long service life even under permanent water immersion. They resist aggressive liquids used in water treatment plants, ensuring a long life expectancy of such facilities.
- Sika also provides sealants with an outstanding chemical resistance for sealing of containment bunds. The resistance of these sealants ensure the integrity of a containment bund for a longer time than usual sealants would in case of an accident. Hence, emergency services gain time to pump the aggressive chemicals into secure containers and the risk of contaminating ground or drinking water is significantly reduced.

Sika sealants for good indoor air quality

- Solvent free sealants from Sika comply with the most stringent initiatives in terms of Indoor Air Quality today and enable emission free construction without any limitations regarding quality.

Selecting Sika Products that have a Positive Impact on the Sustainability of Construction

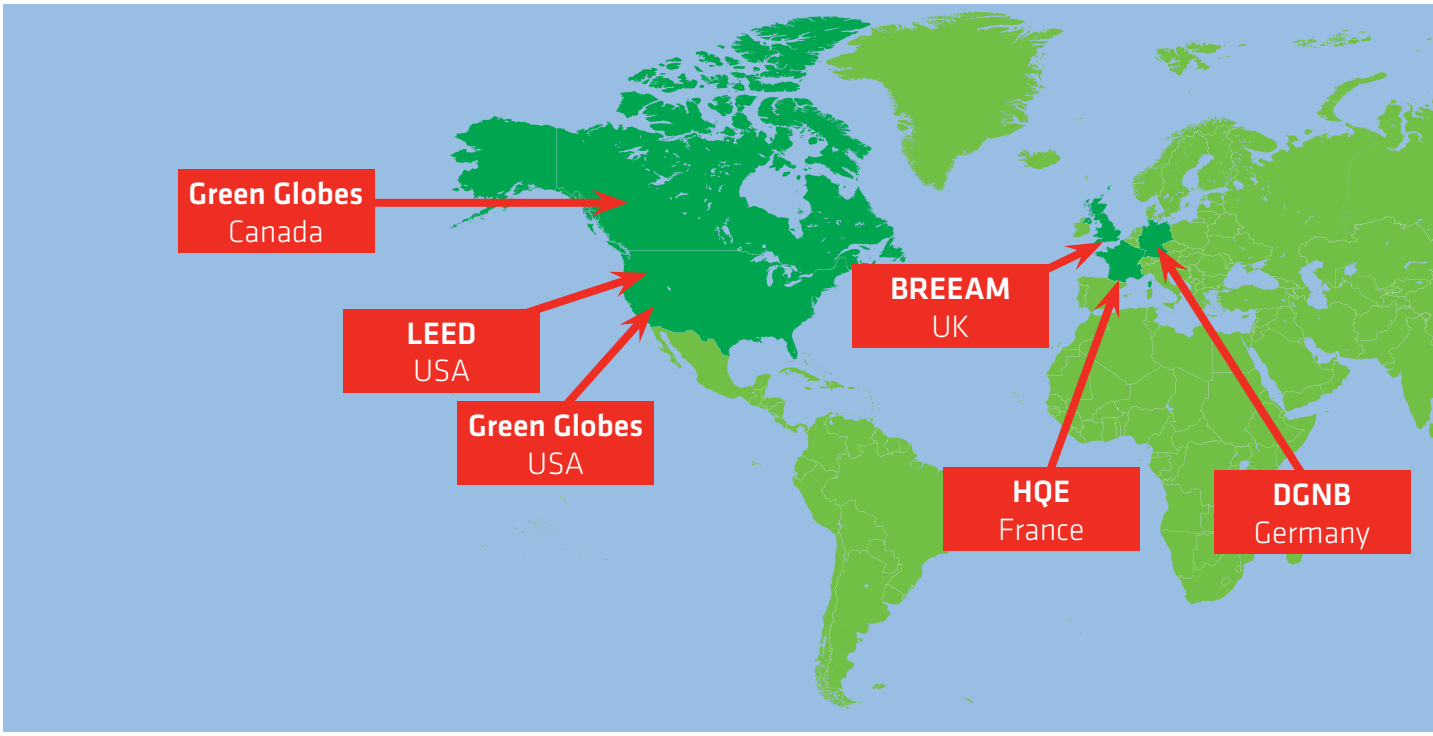
Sealing of building envelopes
Sikaflex® and **SikaHyflex**® sealants are low modulus sealants with high movement capability and excellent weathering based on Sika's latest technologies. These products are specially designed for the building envelope and ensure durable, long lasting, and tight joints within facades and roofs.

Tight connections between windows and the adjacent construction
Sika provides a full range of elastic and air tight membranes and tapes under the brand **SikaMembran**®, which ensure a tight connection between different parts of the building envelope and different facade types such as curtain walls, glass-metal facades, windows, and doors.

Sealing of joints in containment bunds and sewage treatment plants
Tailor made **Sikaflex**® sealants are very resistant and durable and maintain their properties even under chemical and mechanical influences. Their high movement capability and water resistance ensure a tight construction and protect therefore water from aggressive liquids despite movements within the construction and despite permanent water ingress.

Sika adhesives to bond window panes and frames
Sikasil® **WS** adhesives with their high flexibility and outstanding UV resistance are ideal for connecting different materials such as glass and window frames.
The bonding technology enables a reduction in the width of frames and thus enlargeds the fenestration area, which is crucial for the solar gains.

Overview of Green Building Certification Programs



Over recent years, several countries and organizations have developed environmental certification programs for buildings. Practical experiences as well as new findings have been leading to adaptations and extensions of the programs.

The criteria of the programs are similar, but the evaluation process differs substantially. Most Green Building Certification Programs focus on assessing whole buildings rather than building products. Requirements for individual product categories, however, are also included in several programs (e.g. VOC content, chemical content). LCA allows for an accurate characterization of products and systems in terms of sustainability performance. For specific information regarding the various Certification Programs, please contact your local Sika organization.

LEED (Leadership in Energy and Environmental Design)

www.usgbc.org/LEED

LEED is the world's best known green building certification system. It was developed in 2000 by the USGBC (US Green Building Council) and is most relevant for North America, but is also used in many other regions around the world, such as South America, Europe and Asia. It is based on a set of rating systems where specific topics are assessed, such as transportation, recycling content, etc. The current LEED program is not LCA based.

Sika sealing systems can contribute to multiple points in LEED:

- IEQ Credit 4.1: Low –Emitting Materials – Adhesives and Sealants (1 point)
  Sika Sealants have very low VOC content and comply with South Coast Air Quality Management District (SCAQMD) Rule #1168
- IEQ Credit 8.1: Daylight and Views – Daylight (1 point)
  Sika bonding technologies stiffen window constructions and therefore enable a reduction in the width of the frame. The glass area becomes larger
  and the daylighting is improved.
- EA Credit 3 (LEED Homes): Air infiltration (max. 3 points)
  Sika sealants and membranes ensure a tight building envelope and reduce air infiltration significantly.

For further details, please contact Sika US or visit
www.usa.sika.com

BREEAM (BRE Environmental Assessment Method)

www.breeam.org

BREEAM is an environmental assessment method and rating system for buildings launched in 1990 by the British organization BRE (Building Research Establishment). It is also used in other countries such as the Netherlands and Spain. BREEAM assesses the overall performance of buildings using factors such as energy and water use, the internal environment (health and well-being), pollution, transport, materials etc., awarding credits in each area according to performance. The environmental impact is determined by using LCA.

Sika sealing systems can contribute to multiple points in BREEAM:

- Ene 01: Reduction of CO_2 emissions
  Sika sealants and membranes ensure a tight building envelope and reduce air leakage significantly. Thus the energy demand for cooling and/or heating and CO_2 emissions can be minimized.
- Hea 02: Indoor Air Quality
  Sika sealants have very low emissions and fulfill the most stringent requirements and help therefore to improve the indoor air quality.

For further information, please contact Sika UK or visit
www.sika.co.uk

HQE (Haute Qualité Environnementale)

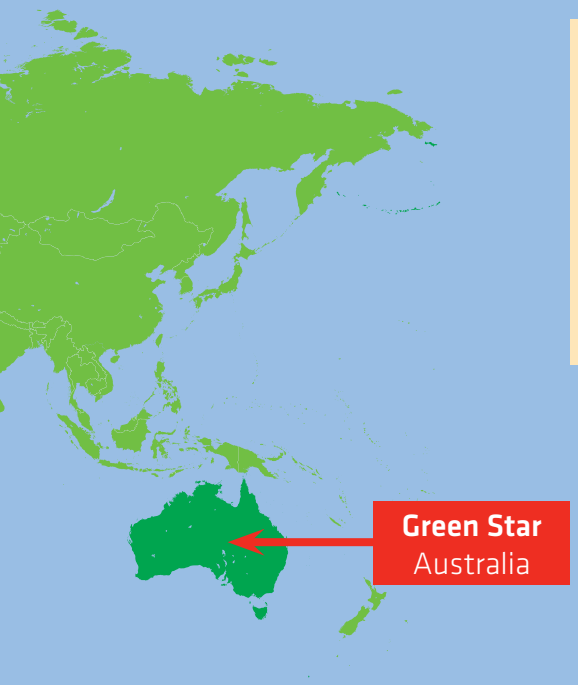
www.assohqe.org

HQE is the French environmental quality management approach for construction developed in 1994 and controlled by the Association for High Environmental Quality (ASSOHQE). The HQE certification is based on 14 target areas grouped in 4 themes: environmental construction, environmental management, comfort and health. The choice of construction products and materials is based on Environmental Product Declaration (EPD's) that include LCA data.

For further details, please contact Sika France or visit
www.sika.fr

DGNB (Deutsches Gütesiegel für Nachhaltiges Bauen)

www.dgnb.de



How can Sika Sealing Solutions contribute towards your Green Building Certification rating?

Sika sealing products contribute to multiple points in most Green Building Certification programs. This is done by:

- Using Sika sealants with very low VOC content
- Tightening the building envelope with durable Sika sealants
- Installing window systems with Sika membranes that are not air permeable
- Using Sika sealants with very low emissions for good indoor air quality

The DGNB Certification System was developed by the German Sustainable Building Council (DGNB) and the German Government in 2009 and several country adaptations are under preparation. It is based on several criteria within 6 topics, among which are Ecological Quality, Economical Quality and Technical Quality. For the Ecological Quality topic, LCA data is required. As a basis for data communication, Environmental Product Declarations (EPD's) are used.

Sika sealing systems can contribute to multiple criteria of DGNB rating system:

- Criterion 20: Indoor Air Quality
  Sika sealants have very low emissions and fulfill the most stringent requirements (e.g. EMICODE EC 1^{Plus}) and help therefore to improve the indoor air quality.
- Criterion 22: Visual Comfort
  Sika bonding technologies stiffen window constructions and therefore enable a reduction in the width of the frame. The glass area becomes larger and the amount of daylight is improved.
- Criterion 35: Technical quality of thermal and moisture protection of the building envelope
  Sika sealants and membranes ensure a tight building envelope and reduce air infiltration (e.g. air permeability of joints) significantly. Vapor tight joints prevent damages through condensation within the construction.

For further information, please contact Sika Germany or visit
www.sika.de

Green Globes

www.greenglobes.com

The Green Globes system is based on BREEAM and was created in 1996. It is used in Canada, operated by the Building Owners and Managers Association of Canada (BOMA) and Energy and Environment Canada Ltd. (ECD), and in the USA, where it is operated by the Green Building Initiative (GBI). In the Green Globes system for the Design of New Buildings, points are given in the resource section for conducting a LCA of building assemblies and materials.

Sika sealing systems can contribute to multiple points in Green Globes categories:

- Building Envelope
  Sika sealants and membranes ensure a tight building envelope and reduce air leakage significantly. Thus the energy demand for cooling and/or heating and CO_2 emissions can be minimized.
- Fenestration System / Integration of Daylight
  Sika bonding technologies stiffen window constructions and therefore enable a reduction in the width of the frame. The glass area becomes larger and the solar gains are increased.
- Source Control of Indoor Pollutants – Indoor Air Quality
  Sika sealants have very low VOC content and comply with South Coast Air Quality Management District (SCAQMD) Rule #1168 and fulfill the most stringent requirements such as EMICODE EC 1^{Plus}.

For further details, please contact Sika US or visit
www.usa.sika.com

Green Star

www.gbca.org.au/green-star

The Green Star environmental rating system of buildings was developed in 2003 by the Green Building Council of Australia (GBCA), based on LEED and BREEAM. It is the leading system in Australia, South Africa and New Zealand. Green Star assesses a project's environmental performance against nine environmental impact categories. It encourages the use of materials that fulfil its environmental best practice, but does not have a real inclusion of LCA.

Sika sealing systems can contribute to multiple points in Green Star's categories:

- Ene 01 (Office): Green Gas Emissions
  Sika sealants and membranes ensure a tight building envelope and reduce air leakage significantly. Thus the energy demand for cooling and/or heating and CO_2 emissions can be minimized.
- IEQ 13 (Office): Volatile Organic Compounds (VOC)
  Sika sealants have very low VOC content and comply with the most stringent requirements and help, therefore, to improve the indoor air quality.

For further details, please contact Sika Australia or visit
www.sika.com.au

Sustainable Sika Sealing Solutions at Work

Sika Solutions Enable Sustainable Buildings

Sealants and many other solutions of Sika help to reach the high standards of many «Green Building Rating Systems»* such as LEED, DGNB, Minergie-P Eco – Switzerland, Green Star, BREEAM and many others. Below is a list of selected Sika references:

* For more information about the main « Green Building Rating Systems » (see pages 28 and 29).

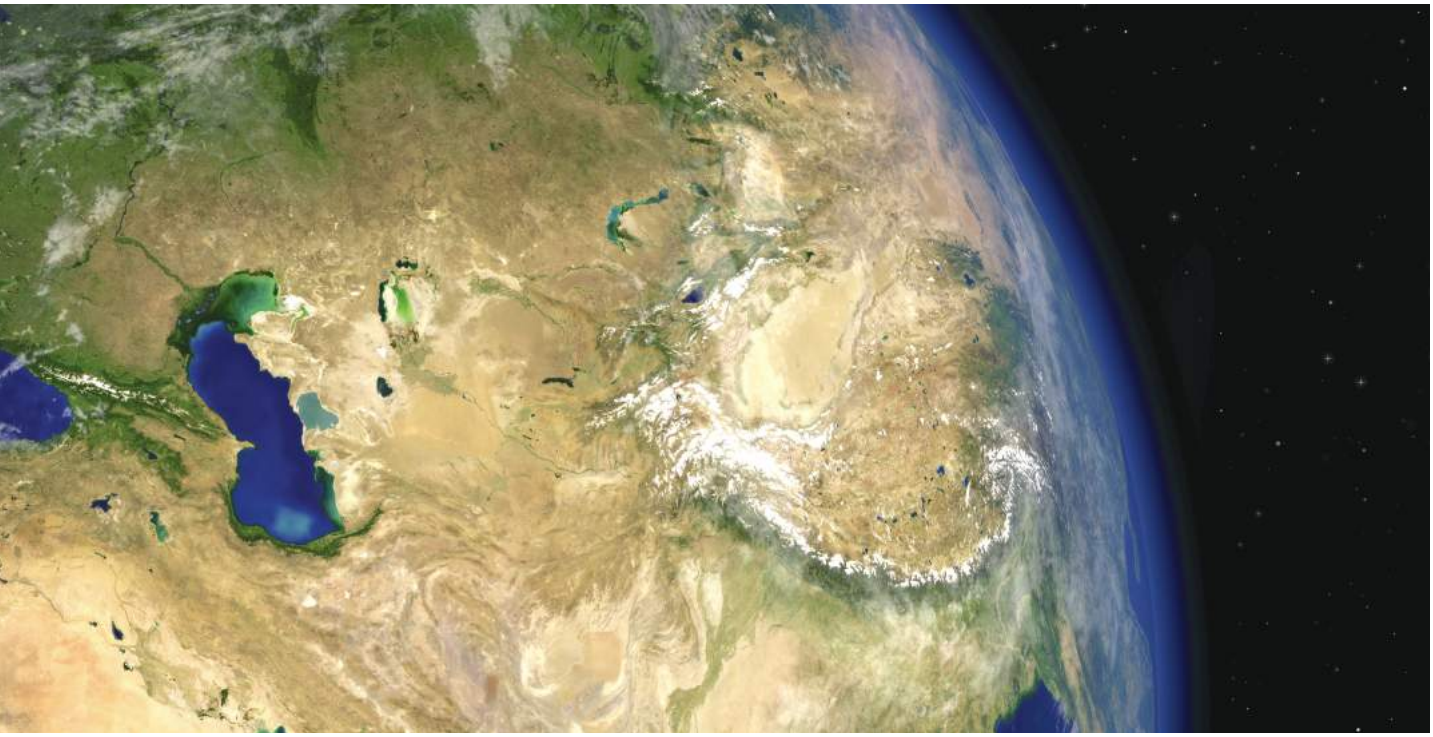
LEED (Canada)
This new project for the Fort Saskatchewan Hospital achieved a LEED Silver Certification.

All floor joints such as saw cut, perimeter, and other construction joints within and around the building were sealed with the durable and elastic sealant **Sikaflex®-2 C**, which fulfilled the demanding requirements of the user and the standards of LEED.

DGNB (Germany)
Ericus-Contor is an office and administration building in Hamburg that complies with the requirements of DGNB.

This glass facade with an outstanding view over the harbor of Hamburg is sealed with **SikaMembran®**, a tape used to seal connecting joints between different construction elements, and **Sikasil® WS-605 S**, a long-lasting silicone sealant. Both products ensure a tight building envelope to reduce the amount of energy used for heating and cooling the building.


RS Photography



BREEAM (UK)
Cabot Circus in Bristol is a multi-functional building with a shopping mall and offices that met the requirements of BREEAM standard after renovation.

The connection joints between different precast cladding panels, consisting of a mix of natural stone and brick faced precast concrete, were sealed with **Sikaflex® PRO-2 HP**, a durable and flexible polyurethane sealant. This Sika sealant ensures a top class weatherproof and airtight construction and fulfils all requirements of the BREEAM standard.

Green Star (New Zealand)
The Laminex Group's new building is a New Zealand Green Star rated office and warehouse facility.

A range of joint sealing solutions were required for various situations and substrates – from joints in pre-cast concrete to high performance joints between aluminium façade panels. With **Sikaflex® AT-Façade, Sikaflex®-11 FC and Sikaflex® Construction,** Sika was able to provide long lasting and sustainable sealing solutions to fulfil the high standards of New Zealand's Green Star.

Minergie-P Eco (Switzerland)
Uetlihof, of the Swiss bank Credit Suisse in Zurich, is an office and administration building that meets the requirements of Minergie-P Ecobau standard.

The connection joints of the glass facade elements and the joints between different panes are sealed with **Sikasil® WS-605 S,** a long-lasting silicone sealant. The sealant ensured a tight building envelope that reduced the amount of energy used for heating and cooling the building and therefore helped to meet the high standard of Minergie P and the ecological requirements of the Ecobau standard.

How Can I Contribute to Sustainable Construction?

Sika provides a full range of solutions for tight building envelopes from basement to roof. Please request further information from your local Sika organization.

You Can Contribute to Sustainable Construction by:

- Choosing the correct sealant technology that fulfils the requirements of a specific application area,
- planning the technical details of material connections properly and hence ensuring a tight building envelope,
- using the know how of Sika, employing over 50 years experience in sealing and bonding.

Further Information on Sustainability

The link opens the Sika Corporate Sustainability webpage. It provides you access to information on Sika sustainability partnerships and initiatives, environment & safety, and much more.

www.sika.com/sustainability

Our most current General Sales Conditions shall apply.
Please consult the Product Data Sheet prior to any use and processing.

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