Green Roof Innovation


# Mineral Wool on Green Roofs – Chance or Challenge?

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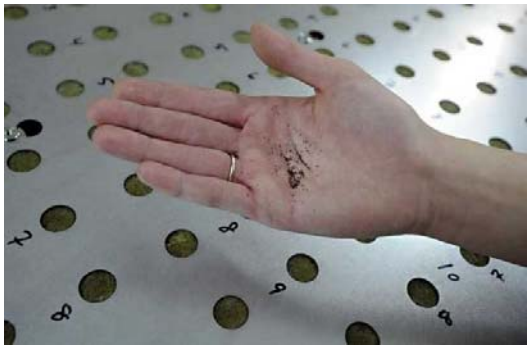
Mineral wool, mineral fibers, or man-made mineral fibers are products made from natural or synthetic minerals. The term "man-made mineral fibers" is generally used to refer solely to synthetic materials including fiberglass, ceramic fibers and stone wool. Since their first commercial production in 1871 (Georgmarienhütte, Osnabrück, Germany), mineral wool found its way in many applications such as thermal insulation (as both structural insulation and pipe insulation), and soundproofing. Patents in this regard date back to the 1930's. The hydrophobic properties of mineral wool makes it ideal for building products.

Much later hydrophilic mineral wool was developed for controlled horticultural purposes like germination of seedlings or simple hydroponic systems for vegetables. Hydrophilic mineral wool has very high water retention so it was no surprise that this specially prepared mineral wool came to the attention of the German Green Roof industry in 1985. International patents from 1986 and later in 1990 by Gruenzweig + Hartman (one of the largest mineral wool manufacturer in the world) document their involvement with the Green Roof industry.

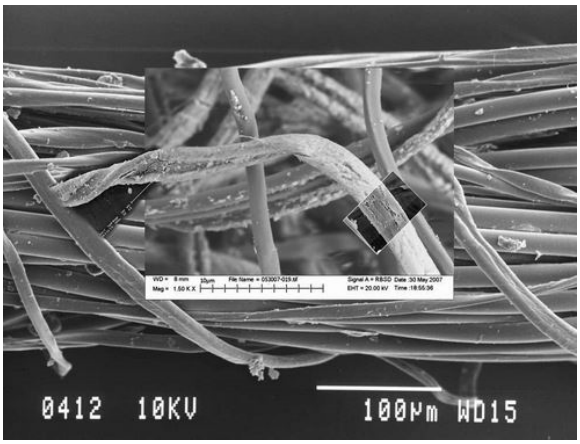


Unlike the US, where new components and materials flood the market with little or no research, G+H made extensive tests over more than 5 years before their scheduled introduction to the Green Roof market. The research and development was led by Prof. Dr.-Ing. Stephan Roth-Kleyer at the University of Geisenheim, Germany. Prof. Dr.-Ing Stephan Roth-Kleyer is one of Germany's leading researchers for modern Green Roof technology having published more than 300 publications, coaching theses and dissertation in the last 30 years.

Research fields in September 2000

The first publications about mineral wool in lightweight Green Roof systems were finally available in May 2001 (Dach + Grün 2/2001). The tests (almost a decade long) revealed results that where shattering the big expectations like a piece of glass that falls on the ground. Without doubt the Mineral Wool has advantages in germinating vegetation but in the medium-run or long-run any traditional Green Roof (according FLL) will outperform a system containing Mineral Wool. The location of Mineral Wool in the green roof buildup doesn't matter. Back then even the world's largest Green Roof component suppliers (like Optima/Optigreen) stepped away from the once so promising Mineral Wool products for Green Roofs.

The discovered issues with Mineral Wool components on Green Roofs cannot guarantee medium-term or long-term success for the vegetation on Green Roofs.




This might be different in North America where most building owners are not spoiled with high quality at decent costs and focusing longevity at the same time. At the same time many Green Roof components suppliers emphasize short-term profits, dependencies with long-term warranties, additional unnecessary components like irrigation or other services that have no impact on healthy driven vegetation.

Green Roof Service LLC /Green Roof Technology cares about the future of modern Green Roof technology as an active and integrated system for environmental protection. Based on our research on existing projects with Mineral Wool and interviews with outstanding Green Roof Experts there are sufficient reasons why GRS/GRT do not design, specify or allow Mineral Wool products on our Green Roof projects are as follows:

1) Dry Mineral Wool is light weight and requires ballast on a roof
2) When saturated it is as heavy as a specifically engineered drainage board that has increased water retention or as heavy as saturated LWA (Lightweight aggregate)
3) The relative air content is very low when saturated comparing to LWA– this saturation can cause problems over the long run, especially with succulents like Sedum (they don't mature, like Peat Moss in pre-vegetated Sedum mats)
4) The ballast (mentioned under 1) can compress Rockwool overtime and this can reduce water retention, but more importantly it can further reduce air content
5) It is proven that the high water content (when saturated) of Mineral Wool is hardly available for the plants.
6) Mineral Wool has very little or no ion exchange capacity (dead material)

7) Mineral Wool can contain a large amount of chemicals that make the material hydrophilic (how long will this last?)
8) The insignificant air content of Mineral Wool – open space – can be compressed or filled with fine particles
9) No equivalent or compressive strength compared to LWA or specifically engineered Green Roof Drainage boards.
10) Drainage capacity of Mineral Wool is poor (below the requirements of FLL)
11) High costs
12) Difficult to recycle once in place over decades
13) High energy consumption in production (over 1600°C/2900°F)
14) Potential health issues of fibers (during install and in runoff water)
15) Attracts birds and rodents for nesting material
16) No sufficient tests in North America (one year or less)
17) Material is not used anymore in the German Green Roof industry by professionals over the last decade – most existing Green Roofs have been replaced by other systems

Jörg Breuning, Green Roof Service LLC September, 16th 2014

*Doing it right in the first place*

Sources:

DACH+GRÜN 2001/2

Interview 2014: Prof. Dr.-Ing Stephan Roth-Kleyer

G+H Webpage

Pictures: DACH+GRÜN, Open Source, Jörg Breuning

## Roof restoration with a sunny side

by Zinco GmbH, Eckert/Koop (Press release, 06 December 2012)

Schiphol Plaza (central terminal) at Schiphol Airport in Amsterdam is the first building in the Netherlands to combine green roofing with a solar energy system.

With anti-slip mat: ZinCo supplied the laminated drainage sheet Fixodrain® XD 20 with an additional rubber protection layer on the underside specially for Schiphol.

Green roofing plays an important role at Schiphol Airport. While the central departure terminal, Schiphol Plaza, has had an extensive green roof since the 1980s it was now in need of restoration. It was decided from the start that this newly-restored roof would also be protected by a green roof. The photovoltaic system integrated into the green roof provides added value. Schiphol Airport is now the first building in the Netherlands to combine solar energy and green roofing.

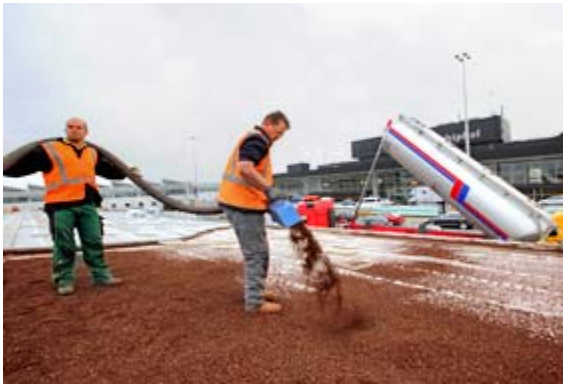
The international commercial airport at Schiphol was the fourth largest in Europe last year with almost 50 million passengers and 1.5 m tonnes of cargo passing through it. In its development plan for the airport, the airport operator the Schiphol Group attached great importance to sustainability and, therefore, to issues of social compatibility, noise control and climate and environmental protection. In order to achieve the targets set in this respect, Schiphol works together with the Universities of Delft and Wageningen, the independent research organisation TNO, experts from industry and other partners. One of the building blocks in the wide-ranging endeavour to achieve sustainability is the green roof, which was enhanced with a photovoltaic unit in an exemplary manner in Schiphol Plaza.

### A challenging assignment

Schiphol Plaza is the main terminal and the focal point of the airport. The roof is approx. 8600 m² in size, has limited load capacity reserves and a roof pitch of between 4° and 10°. It is slightly vaulted and slopes down towards the ground on all sides. Triangular skylights with a counter slope interrupt the roof area and are also greened.

It became necessary to restore the roof as the existing insulating package, waterproof membrane

Roof penetration: Solar Base SB 200 elements are used for the subsequent installation of the solar modules and are held in place by the ballast provided by the roof substrate.



Using silo vehicles, the system substrate "Sedum Carpet" is blown onto the roof where is it immediately distributed.

The roof substrate provides the required ballast for the Solar Base and green roof based on rock wool panels could no longer function in the long term. The material "rock wool" lost a lot of substance over the years and as a result the plants were failing. A permanently reliable solution was now required. A technically secure and appropriate solution for green roofing and solar energy system was quickly found with ZinCo.

However, the greatest challenge with this particular project was the execution of the works. In order to keep the disruption of airport operations to a minimum, the works had to be carried out outside of the busy summer holiday period. The roof contractors Boko Dakbedekker, a cooperating partner of the Dutch organization "Leven op daken", and landscape gardeners Wieringen Prins Hoveniers from Amsterdam were responsible for this. As the roof is not structurally designed to carry construction equipment, the works had to be carried out manually for the most part.

**Minor modification**

Once the old roof build-up was removed, a solid base was created using a root resistant, bituminous roof waterproof membrane. For the required combination of green and solar, ZinCo used the suitable system build-up "SolarVert" with Fixodrain® XD 20. This system build-up is specially designed for large-scale roofs. It is based on the drainage and water retention sheet Fixodrain® XD 20, which has a pre-laminated filter sheet on the upper side and is supplied in rolls. In order to address the issue of roof pitch, a rubber protection layer was laminated onto the underside of the Fixodrain® XD 20 sheet as an anti-slip device. Thanks to factory production, the system manufacturer ZinCo was able to offer this minor modification as a building-specific solution for a large project of this kind. Therefore, the roof area was prepared in one pass for all eventualities.

panels and is carefully levelled to create a good basis for the "Sedum Carpet" plant mats.

The pathways for maintenance personnel run directly above the load-bearing support pillars of the terminal building.

The Solar Base Frames can be set up either before or after the plant layer has been installed. Things were very flexible in this respect at Schiphol Airport.

**Photovoltaic integrated**

The second element in the “SolarVert” system build-up is the Solar Base SB 200. The Solar Base is made of ABS plastic and is approx. 100 x 200 cm in size. It has water retention cells and drainage channels on the underside and is used to secure the Solar Base Frame SGR 35/90 for the subsequent installation of the solar modules.

As per plan, the Solar Bases were distributed across the roof in rows. Due to the limited load capacity reserves of the roof, the solar modules could only be positioned above the supporting pillars of the underlying terminal building.

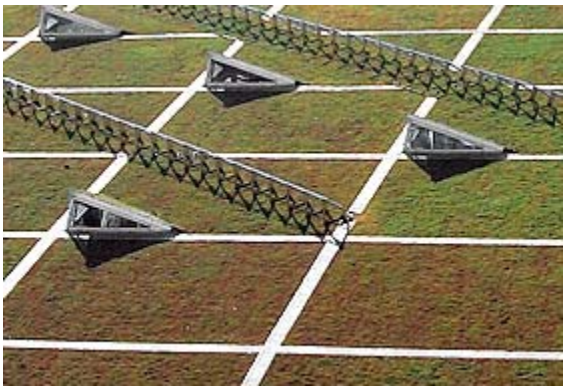
Once the Solar Bases were in place the substrate layer was added. The substrate was blown up onto the roof using a silo vehicle. The pre-calculated ballast provided by the roof substrate secures the mounting frames for the solar modules and holds them in place, even during a storm. This is a well-thought out system that eliminates the need for dangerous roof penetration or separate concrete weights as ballast.
Thanks to the use of the pre-cultivated plant community “Sedum Carpet”, greenery is achieved immediately with this project. The network of paved pathways throughout the green area is intended to guide people who are carrying out maintenance and service work on the roof along “the right path”, that is directly above the load-bearing support pillars.

**Improved efficiency due to greening**

The green roof provides not only the ballast required to anchor the solar system but also improves the efficiency of the unit, because a green roof provides for a lower ambient temperature than a bare or gravelled roof.

It is precisely this effect that ZinCo has proven scientifically in a test facility. The measured values show that the temperature of a solar module

The existing roof pitch was not a problem when installing the rows of solar modules.



The geometric arrangement of the rows of solar modules and the pathways between the skylights resulted from the load-bearing capacity of the roof.

above a green roof is on average 8 Kelvin lower than that of a module installed over a bituminous roof membrane.

Given the fact that the level of performance of most solar modules depends on their operating temperature (rule of thumb: for each degree of heat above 25 °C, performance sinks by up to 0.5 %), this results in an increase in performance of 4 % at a temperature difference of 8 Kelvin.

**Guaranteed reliability for years**

The client, Schiphol Group has a warranty of 10 years on the entire roof including the green roof build-up. In the unlikely event that problems arise during this period, the “Leven op Daken” partner, in this case the company Boko Dakbedekkers will ensure that any issues are addressed. Problems are not envisaged even beyond this period of time, as the green roof will provide excellent protection of the roof membrane from temperature fluctuation and, therefore, premature ageing.

Other benefits of a green roof are rainwater **retention, noise** prevention, improvement of the micro-climate and the provision of a habitat for fauna and flora. Last but not least, the green roof build-up provides an anchor for the solar plant and helps to improve their performance by cooling the environment around them.

The combination of green and solar is already very much in trend in Germany. Schiphol Airport is now the very first building of this type in the Netherlands and is making a significant contribution to sustainability with its exemplary roof restoration project.

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