

Superwool[®]
insulating fibre solutions

What is Superwool® fibre?

Superwool insulating fibre is a low bio-persistent product offering a versatile alternative to traditional insulation solutions for industrial and commercial applications.

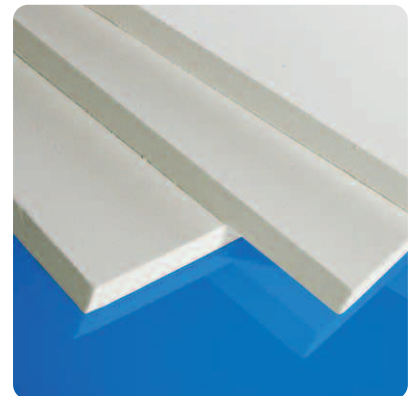
Morgan's development in low bio-persistence fibres have led the revolution in their use for high temperature insulation applications over the last 20 years.

Our patented Superwool products, manufactured using ISO 9002 certified processes, are manufactured from Alkaline Earth Silicate (AES) composition fibres, uniquely engineered to offer advantages in high temperature insulation applications:

Key benefits include:

- low bio-persistence
- low thermal conductivity
- minimal linear shrinkage up to their classification temperature

Read our Environment, Health & Safety Overview on page 10 to learn more about low bio-persistent fibres.





Why Superwool® fibre

Low bio-persistence:

- Helps you be proactive in meeting your environmental and Health & Safety obligations
- An environmental solution, potential savings on waste disposal, may be disposed in a non-hazardous waste landfill giving

Higher energy savings compared to RCF and other commercial AES:

- Up to 20% lower thermal conductivity than other tested AES blanket materials

Improved handling

- Soft and smooth material improving operator comfort
- Less irritation to the skin, throat, nose and eyes

Longer life time

- 30% more fibres result in improved, stronger fibre matrix and thus longer life time under vibration conditions
- Lowest shrinkage of any comparable insulation up to its classification temperature

Features & benefits

- Lower thermal conductivity, improves insulation by 20% compared to other tested AES fibres
- Up to 30% more fibres due to high fibre index, efficient prevention of heat transfer and greater strength
- Improved handling, operator satisfaction

Two fibre grades are available:

- Superwool Plus (classification temperature: 1200°C)
- Superwool HT (classification temperature: 1300°C)



Blankets

Superwool® blankets offer a high temperature thermal insulation material, efficient at restricting heat flow, while maintaining other key material properties such as low shrinkage and good mechanical durability.

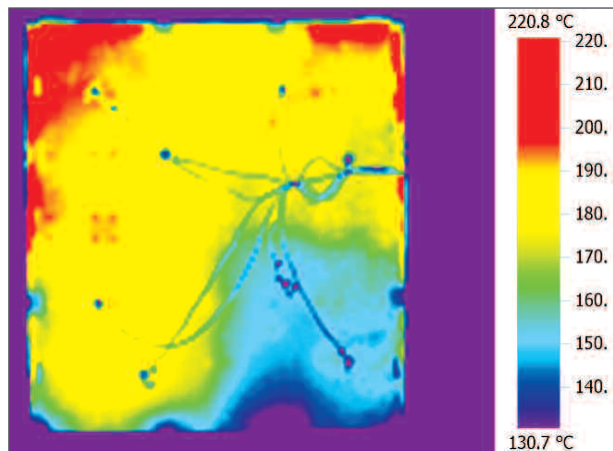
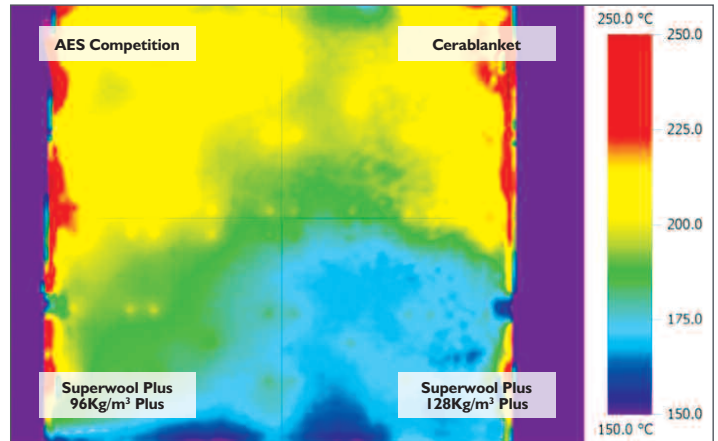
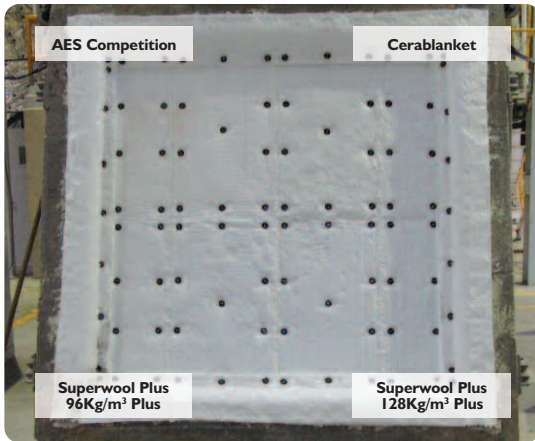
- Reduces energy losses
- With greater fibre surface area is more efficient at blocking thermal radiation
- Provides more material for the energy to pass through, resulting in better insulation

Lower thermal conductivity...improved insulation by 20% compared to other tested AES blanket materials

- Energy savings. Material weight savings up to 25%
- 20% lower thermal conductivity than other tested AES blanket materials
- Lower thermal conductivity with lower density comparisons
- Lowest thermal conductivity compared to all other AES and RCF fibres



The results outline the thermal insulation superiority of Superwool® Plus fibre with energy savings up to 25%



The panel was heated up to a temperature of 1000°C for 2 hours until steady state was achieved. Thermocouples were placed on the cold face (casing) of the 4 zones to follow the temperature evolution in real time.

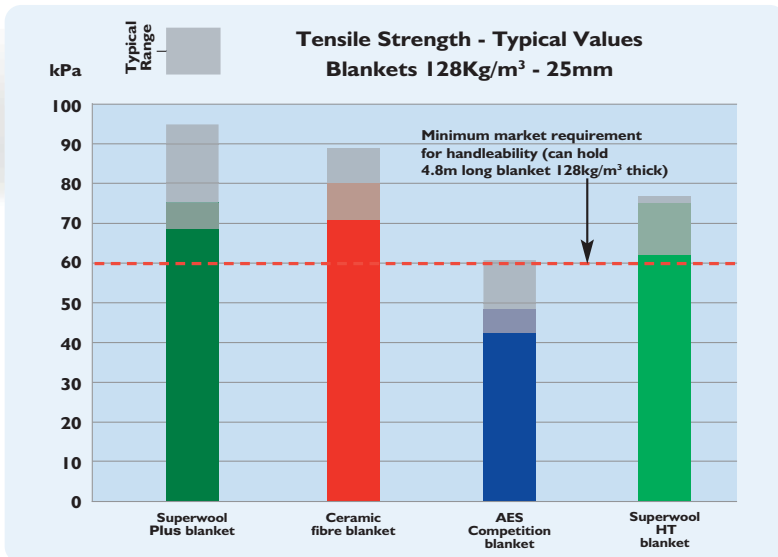
On the same panel, 1m² blanket was installed with 4 different insulation layers:

| | | |
|--------|----------------------|-------------------------|
| 2x25mm | 128kg/m ³ | Competitor AES blanket |
| 2x25mm | 128kg/m ³ | Cerablanket RCF |
| 2x25mm | 96kg/m ³ | Superwool® Plus blanket |
| 2x25mm | 128kg/m ³ | Superwool® Plus blanket |

- Superwool® Plus 128 blanket provides a significantly lower cold face temperature than a competitor AES 128Kg/m³ blanket and Cerablanket RCF 128Kg/m³
- Superwool® Plus 96 blanket provides a lower cold face temperature compared to a competitor AES blanket 128Kg/m³ and Cerablanket RCF 128Kg/m³

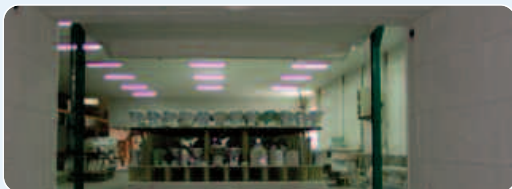
Tensile strength

- Up to 30% more fibres give a higher potential for good tensile strength
- Maximum in-service performance and low installation costs
- Good handleability with minimal tearing
- Stronger than any other tested AES blanket and equal to RCF blanket



Blankets must be strong enough to support entire roll under own weight

Application solutions



Ceramics and Glass industries

- Float glass pre-heating and start-up covers
- Glass casting molds
- Tunnel kiln expansion joints
- Shuttle kiln for sanitary ware - roof and walls insulation
- Roller hearth kiln - back-up behind brick, roller fillings and expansion joints
- Automotive glass plant applications



Metals industry

- Annealing furnace doors
- Ladle side gate insulation
- General heat containment
- Coke oven repairs
- Reheating furnace lining
- Melt / hold furnace door lining
- Tundish cover and slide gate
- Shrouding tube gasket



Consumer goods industries

- Chimney insulation for gas fireplaces
- Oven wrap insulation
- Insulation for boilers and water heaters



Tensile strength test 1

A full roll of a Superwool Plus blanket was suspended 8m from the ground at full length of 7.5m. After more than 3 minutes, Superwool Plus blanket did not break.

Tensile strength test 2

A full roll of competitor AES blanket was suspended 8m from the ground at full length. The blanket failed in under a minute.



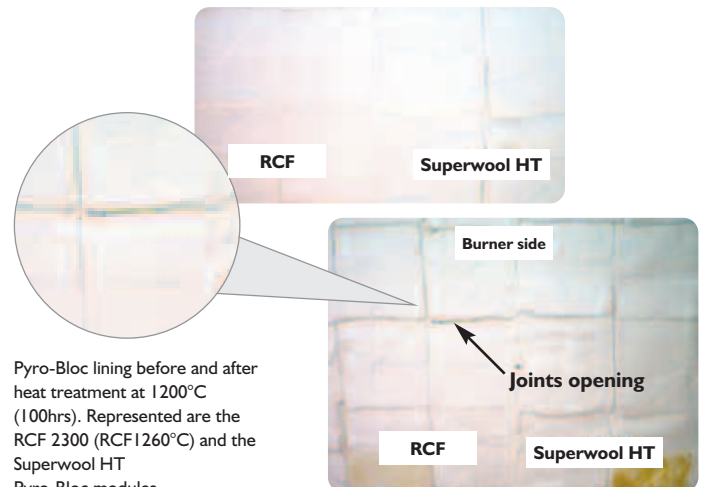
Modules

Pyro-Bloc® products from Morgan Advanced Materials have set the standard for superior performance and versatility in furnace and boiler lining systems; they excel in cyclic environments.

Pyro-Bloc® modules comprise two sections of Superwool® fibre slabs in edge-grain orientation. These are held in position with two stainless steel tubes mounted transversely through the modules and remote from the hot face and they are anchored to the furnace casing with the patented Pyro-Bloc® fixing. Pyro-Bloc fibre contains an agent which automatically hardens the surface upon initial heat up.



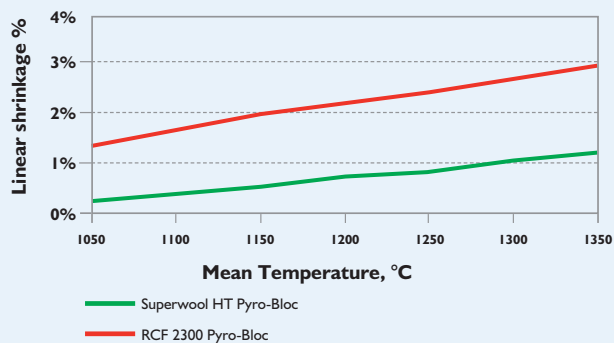
- Unlike folded or stack modules, Morgan's Thermal Ceramics exclusive Pyro-Bloc modules can be compressed in two directions, across and along the module. this reduces the need for additional batten strips and increase natural resistance to natural shrinkage, enhanced by Superwool Pyro.
- Better resistance than folded systems to high velocity gas erosion thanks to the monolithic edge grain surface. Pyro-Bloc is rated to 30.5m/sec (100 ft/sec) untreated. Treatments can improve this rating up to 35%.
- Ease of installation: the patented support yoke system allows the module cold face to conform to any discontinuity of the furnace shell allowing easy installation and high on-the-wall densities.
- 20% better thermal efficiency than like density RCF products resulting in energy savings and safer work environment.
- High longevity due to improved linear shrinkage vs. RCF Pyro-Bloc up to classification temperature and multi-directional compression.

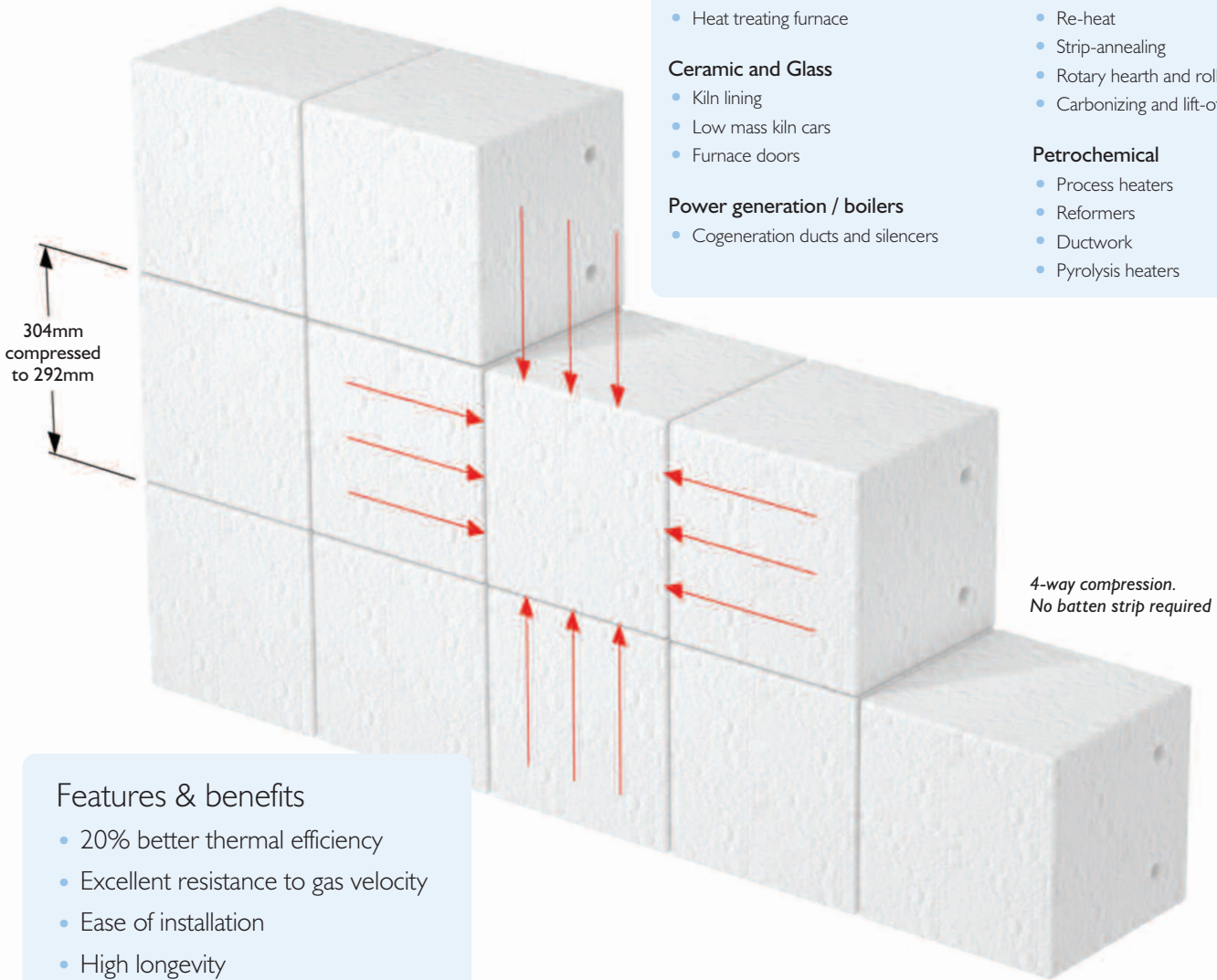


Pyro-Bloc lining before and after heat treatment at 1200°C (100hrs). Represented are the RCF 2300 (RCF | 260°C) and the Superwool HT Pyro-Bloc modules.

The excellent stability of Superwool HT Pyro-Bloc modules compared to RCF 2300 is shown in the photo above. The RCF 2300 modules exhibit opening of joints at 1150 - 1200°C while the joints between the Superwool HT modules remain intact.

Linear shrinkage





Application solutions

Non Ferrous

- Annealing furnace
- Heat treating furnace

Ceramic and Glass

- Kiln lining
- Low mass kiln cars
- Furnace doors

Power generation / boilers

- Cogeneration ducts and silencers

Iron & Steel

- Walking beam furnace skid rail insulation
- Re-heat
- Strip-annealing
- Rotary hearth and roller hearth furnaces
- Carbonizing and lift-off furnaces

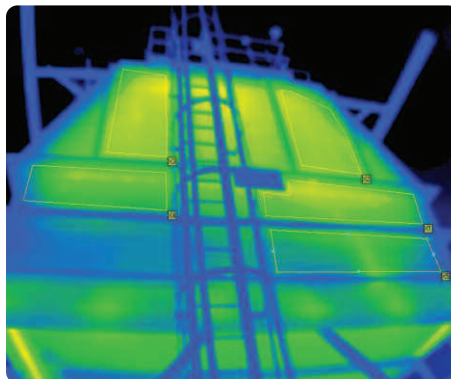
Petrochemical

- Process heaters
- Reformers
- Ductwork
- Pyrolysis heaters

Features & benefits

- 20% better thermal efficiency
- Excellent resistance to gas velocity
- Ease of installation
- High longevity

Superwool HT Pyro-Bloc lined RTO, one year on



Thermal performance

- Superwool Pyro-Bloc modules were installed late 2011. The IR scans were completed after 1 year of continuous operation
- Superwool HT Pyro-Bloc modules were installed in the combustion chamber
- Superwool Plus Pyro-Bloc modules were installed below the media bed

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Insulating fibre

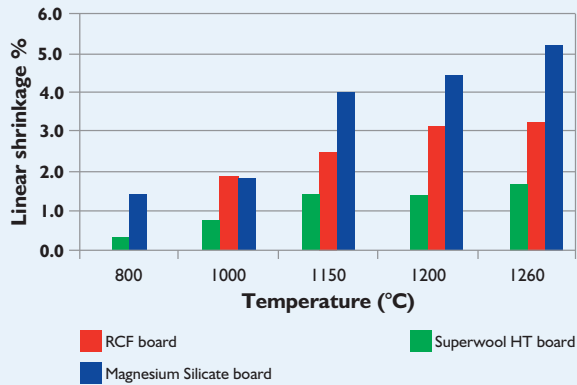
Boards and shapes

Our range of vacuum formed boards and shapes cover an entire temperature and mechanical strength range. They feature excellent insulating performance, good high temperature strength and can be custom designed for a broad range of uses.

- Excellent thermal shock resistance
- Superior insulating performance, excellent molten metal resistance
- Low heat storage
- Dimensional stability up to 1300°C
- Linear shrinkage below 2% at recommended continuous use limits



Linear shrinkage



Custom shape technology allows for male, female and combination molds that are constructed from plastics, stainless steel, wood and fasteners.

Application solutions

Metals industry



Benefits using Superwool for hot pour ladles:

- Reduced thermal conductivity
- Embedded handle to reduce iron contamination of aluminum melt
- Environmentally better working environment for the workforce



Solutions for a range of industries

- Board over blanket hot face lining
- Higher density fibre product for velocity resistance
- Electrical element supports
- Expansion joints
- Back-up insulation for dense firebrick or castables
- Heat shields for employee protection around high temperature process equipment



Papers, felt, textile and mastics

Morgan's high performance paper and felt products are the preferred choice over traditional fibreglass, textile, or metal products for thermal, acoustical or filtration management.

Our QS 9000/ISO 9002 certified quality, lightweight papers and felts feature equal or superior performance with reduced costs, low thermal conductivity, durability, compressibility and flexibility.

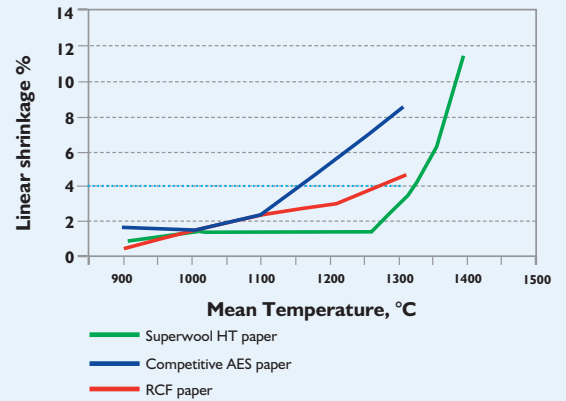
Superwool® papers

- Intumescent, expandable paper (up to 400%) with a continuous use limit of 704°C
- Non-wetting to molten aluminum
- Flexible utility paper with a continuous use limit of 1000°C
- Flexible tear resistant paper with a use limit of 1150°C

Superwool® HT felt

- Superwool HT Felt is an insulating felt, obtained by pressing Superwool HT fibres and binders under high temperature and pressure

Linear shrinkage



Superwool® mortar, cement and mastics

- Mortar, cement and mastic products offer an extensive range which includes pumpables, mouldables, cements and coatings.

Superwool® textiles

- Superwool textile products, suitable for temperatures covering up to 1370°C, are available in a range of forms with either glass or steel reinforcements.



Application solutions

Non Ferrous

- Aluminum casting tip fabrication
- Backup for aluminum troughs
- Metal transfer parts
- High temperature seals and gaskets

Ceramic and Glass

- Glass tank refractory backup
- Glassware separator/parting agent
- Glass sagger mold linings

Appliance

- Appliance/radiant heater insulation
- Fireplace
- Gasketing

Metal Working

- Investment casting mold wrap
- Ladle refractory backup
- Parting agent in brazing, heat treating and metal forming processes
- High-temperature expansion joint packing, filtration, gaskets and seals

Automotive and Aerospace

- Heat shields
- Battery separators
- Muffler insulation
- Airbag filtration
- Catalytic converter

Environment, Health & Safety overview

Our Superwool brand is globally recognised as the leading brand in high temperature low bio-persistent fibre insulation, noted for its reliability and environmental benefits.

Our commitment to research and development ensures we continue to deliver Superwool fibre products enabling you to be proactive in meeting your environmental and health and safety obligations and ensuring the Superwool brand continues to succeed for you.

A key component in achieving effective health & safety and environmental performance is to meet governmental, regional and worldwide legislation. At Morgan Advanced Materials we are dedicated to ensuring the requirements of REACH legislation (Registration, Evaluation, Authorisation and Restriction of Chemicals) are met and are currently working towards achieving ISO 14001 accreditation for the environment management systems in our worldwide locations.

Our policy is to:

- Comply with environmental, health and safety legislation, regulations and other applicable requirements.
- Minimize the environmental impact of historic, current and likely future operation.
- Conduct operations in such a manner as to avoid unacceptable risk to human health and safety.
- Supply products that reduce risk to human health & safety when used in compliance with product safety communications and common practices.
- Establish measurement tools for and continuously monitor environmental, health and safety.
- Maintain open communication on environmental, health & safety performance with all stakeholders of Morgan Advanced Materials.
- Set objectives for the continuous improvement of environmental, health & safety performance.



Superwool fibre products enabling you to be proactive in meeting your environmental and health and safety obligations.

Superwool regulation by region

| | Europe Union (EU) | United States and Canada | Asia (including Australia) |
|---|--|--|---|
| Classification of Superwool family | <ul style="list-style-type: none"> • Alkaline Earth Silicate (AES) • Not RCF | <ul style="list-style-type: none"> • Alkaline Earth Silicate (AES) • Not RCF | <ul style="list-style-type: none"> • Alkaline Earth Silicate (AES) • Not RCF |
| Superwool status | <ul style="list-style-type: none"> • Fully exonerated from any carcinogen classification in the European Union under the Provisions of Directive 97/69/EC | <ul style="list-style-type: none"> • Viewed as a nuisance dust • May cause temporary, mild mechanical irritation to the eyes, skin, nose and / or throat | <ul style="list-style-type: none"> • Not classified as hazardous • Viewed as a nuisance dust or in same category as rock wool and glass wool (general MMVF) |
| PEL / Regulatory Control | <ul style="list-style-type: none"> • No PEL • Not regulated | <ul style="list-style-type: none"> • No PEL • Not regulated | <ul style="list-style-type: none"> • Not regulated • Some countries (China, Australia) have OEL's in place |

PEL : permissible exposure limit

OEL : occupational exposure limit

Key health properties

Do low bio-persistent fibres pose risks?

Key health properties

The key health property of all Superwool® products, including the latest member of the family, is that any fibres that might be breathed in and reach the lungs are rapidly removed. This characteristic is referred to as low bio-persistence. As a consequence fibres do not accumulate in the lung, preventing the occurrence of any significant inflammatory effect that might affect the lungs. Low bio-persistence is achieved by producing the fibres that are a glassy material, which partially corrodes and then fragments when it comes into contact with the fluids found in the lungs.

However, does this ensure that these fibres are really as safe as they can be?

Can we be sure that the fibre fragments and leached materials do not pose any danger?

Superwool fibres are made only using chemical elements that are themselves generally regarded as safe. Non-fibrous materials with the same chemical composition as Superwool are permitted ingredients in foods, medicines and cosmetics as well as having many uses in industry. In none of these applications has this group of compounds been found to be dangerous. Even fibrous calcium silicate is not regarded as carcinogenic by the World Health Organisation and is exonerated under the extremely rigorous German regulations and in the entire EU.

We are all exposed to considerable amounts of dust from environmental as well as industrial sources. A lot of this dust resembles Superwool fibres in that, among other components, it contains a great deal of silicates and calcium. If fine enough to reach the lungs, this dust is removed by cells known as macrophages - the "dust carts" of the lungs. These cells with their dust content are eliminated through the lymphatic system or swept up the airways, swallowed and the dust voided via the gut. Superwool fibres, which are initially too long to be carried away by the macrophages, are partially corroded and break into short pieces which are then cleared in a similar manner to dust particles. Chalk and cement are good examples of dusts, which contain the same elements as Superwool fibres that are found naturally in the body. These also partially corrode and their components are eliminated via the natural lung clearance system. These calcareous dusts do not cause disease unless they are contaminated by other materials.

Of course the body also needs a regular input, usually from food, of all the major elements making up Superwool. A simple calculation taking into account Superwool fibre workplace levels of fibrous dusts, the amount of air breathed and fibre deposition in the lungs, shows that fibre concentrations in the air would have to be hundreds of times greater than they are to provide inputs which even approach those from food. It is true that the concentrations and distribution of these elements in the blood, tissue and other "compartments" is very carefully controlled by a number of more or less complicated mechanisms.

Maintaining this control is essential for good health.

Could inhaled Superwool fibres affect these control mechanisms?

This is unlikely as the body can easily handle dusts with similar components. The dissolved elements coming from such dusts are the same as those which dissolve out of Superwool fibres, and no effect of even large exposure to these materials has been detected.

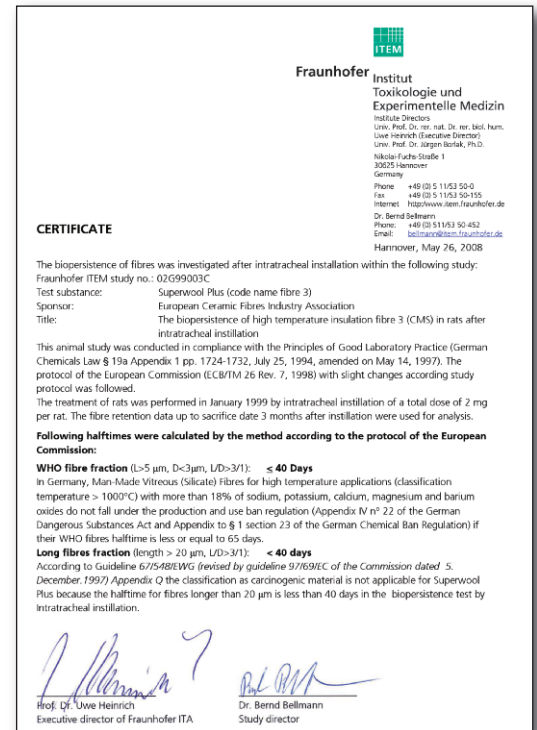
Conclusion

Although AES fibres, such as Superwool, are designed to corrode and fragment after being inhaled, the chemical elements released into the body are the same as those commonly found in nuisance dusts or in food. The quantity released is very small in comparison to these other sources and so the body's normal systems of regulation are easily able to cope.

These considerations have been central in the development of all Superwool products.

Prof. R.C.Brown
Toxicology Services, Stretton, Rutland

To view our Fraunhofer Exoneration Certificates visit our website: www.morganthermalceramics.com



ABOUT MORGAN ADVANCED MATERIALS



Morgan Advanced Materials is a global engineering company offering world-leading competencies in materials science, specialist manufacturing and applications engineering.

We focus our resources on the delivery of products that help our customers to solve technically challenging problems, enabling them to address global trends such as energy demand, advances in healthcare and environmental sustainability.

What differentiates us?

Advanced material science and processing capabilities. Extensive applications engineering experience.

A strong history of innovation and reinvention. Consistent and reliable performance.

A truly global footprint. We find and invest in the best people.

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