KAVARMAT®
the Cleansulation company
#calciumfree
heat-retaining insulation pillows

Whitepaper 2022/10

#stopCr6
#calciumfree

the substitution of calcium-containing insulation systems to avoid the formation of the hexavalent chromium-compound calcium chromate (CaCrO4) on turbines and engines and other hot parts

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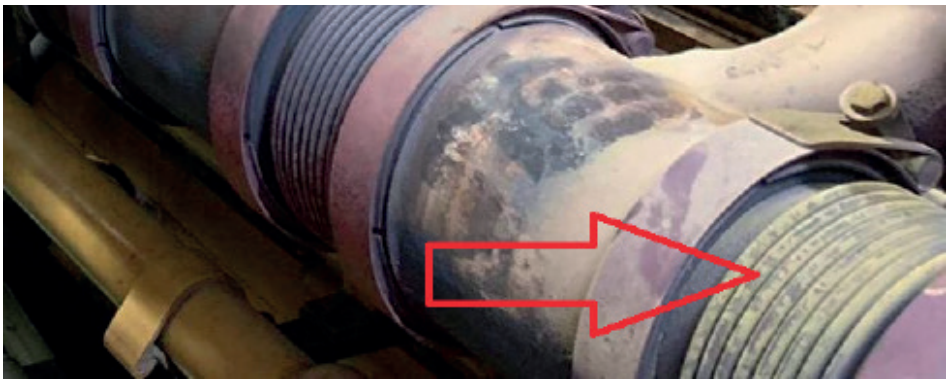
Whitepaper

01. Preamble
#TheChromateDisaster



01

Calcium chromate particles are detected on more and more turbines and engines during service work after the insulation systems that have been in use have been uninstalled. The deposits are not only found on the previously insulated objects, but also on the inside of the insulation material.

Hexavalent chromium compounds

All hexavalent chromium compounds are toxic as well as carcinogenic (IARC Group 1), especially if airborne and inhaled where they cause lung cancer. Also positive associations have been observed between exposure to chromium (VI) compounds and cancer of the nose and nasal sinuses.

Workers in many occupations are exposed to hexavalent chromium. Problematic exposure is known to occur among workers who handle chromate-containing products and those who grind and/ or weld stainless steel. Workers who are exposed to hexavalent chromium are at increased risk of developing lung cancer, asthma, or damage to the nasal epithelia and skin.

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have determined that chromium(VI) compounds are known human carcinogens. In workers, inhalation of chromium(VI) has been shown to cause lung cancer. Chromium(VI) also causes lung cancer in animals.

Framework
the formation of hexavalent chromium-compounds

???

how can something arise, which actually does not exist?

For a long time it was unclear how the deposits on the housing or the inside of the insulation actually arise. In the (cold) delivery state, neither the object to be insulated nor the insulation to be used contain active chromium 6 compounds.

As a result, only a chemical reaction can be responsible for the development process, so it is important to deal with the individual chemical components of all elements in question and, above all, the external circumstances must be also taken into account.

The system to be thermally insulated and the insulation material used therefore had to be analyzed individually, but also thermally connected. If you examine the individual building blocks, you can see that stainless steels contain chromium, but no hexavalent chromium compounds.

Insulating materials do not contain chromium, but contain other chemical elements such as calcium, sodium, potassium, magnesium etc.

In order to make the surface of stainless steel more resistant, it is passivated and thus oxidized. This passive layer therefore consists, among other things, of oxidized chromium, for example chromium (III).

Under certain conditions, chromium (III), which is classified as harmless, can oxidize into a problematic element, chromate, which is harmful to health and the environment.

In order to promote this development process, another chemical element and a certain temperature level are required. If you look at science, it is considered to be proven that calcium, for example, supports this process if the temperature is sufficient.

The temperature range determined for this is exactly in the range of the operating temperature of a running turbine or an industrial engine, namely between 300 °C and 800 °C.

In summary, it can be stated that three aspects must be assumed for the formation of calciumchromates:

Aspect 1

A stainless steel body with a chromium-containing passive layer such as:

steam or gas turbines
diesel- or gas-engines
exhaust pipes
industrial pipes and steam boilers

Aspect 2

an insulation material containing calcium, natrium or potassium

eg. in the form of

- insulating blankets
- insulating shells
- fiber mats

Aspect 3

a hot ambient temperature in the range of

- 300°C up to 800°C

there is unfortunately no way back

The resulting, carcinogenic and mutagenic chromates can regress at temperatures from 800 ° C, preferably at 1,000 ° C, but this temperature range does not exist in most industrial applications.

What has arisen once, and this development process takes place relatively quickly, remains as hazardous dust on the system or on the contact surfaces of the insulating elements!

the often invisible enemy of the worker and of the environment

Hexavalent chromium compounds (the chromates) are not always visible to the naked eye due to discoloration.
A so called "chromium (VI)-test is often required in order to even detect the health hazard!

02. Protection
Safety For Workers And Environment

Banned!

The applicable regulations for carcinogenic substances of category 1A and mutagenic substances of category 1B prohibit their use or placing on the market.

2.1 The fallacy

As long as the ambient air values are within the tolerance range and the workers wear protective equipment, everything is fine, many companies think!

But: Thought wrong!

As soon as the service provider knows that substances harmful to health and the environment can be released, special regulations apply that make a risk analysis unavoidable. All those involved who could come into contact with the substances must be informed, trained and the work area must be clearly cordoned off..

The safety regulations to be carried out correspond roughly to those that are also to be used when working with other harmful fibers!

2.2 Disposal

Before we deal with the substitution requirement in the next chapter, an important note on the disposal of contaminated insulating elements:

Chromium (VI)-compounds like the named chromates are particularly harmful to the environment and water poisoning. For these reasons, contaminated elements must be specially marked and disposed of. Furthermore, care must be taken that the contaminated waste is stored in a self-contained manner and is not accessible to everyone before it is properly disposed of.

The containers in which the contaminated material is stored should preferably be labeled with the pictograms shown above.

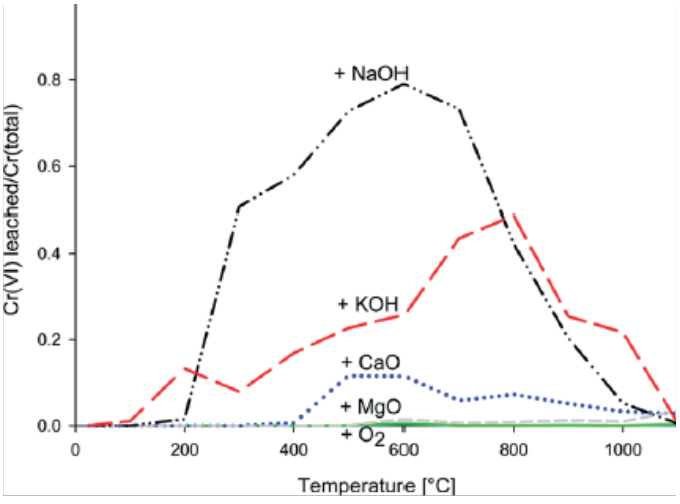
Substitution
The challenge

The spatial and technical conditions are given, we cannot reinvent stainless steel, we have to take Aspect 1 above for granted.

We cannot start with Aspect 3 - operating temperature - either.

So the insulator is required, we need a calcium-free, magnesium-free sodium-free material or, at best, an insulating material that is free of alkaline and alkaline earth elements!

The graphic below shows why this is so, it shows the different reactions and oxidations of chromium (III) in the presence of different chemical elements; the only changeable Aspect 2 according to the current state of the art of the interlinking of thermal-chemical unfortunate circumstances mentioned at the beginning:



Substitution
The key

Which material? The proverbial search for a needle in a haystack. The good news: there are such materials available! Let us take a look at the applicable regulations or technical rules for hazardous substances >TRGS< (Germany/EU):

4.1 Scope of apllication

Within the framework of the information gathering and risk assessment
according to § 6 of the Ordinance on Hazardous Substances, the employer must also assess the hazards identified
as relevant from the point of view of the possibilities of substitution. The employer has the obligation to determine and assess the substitution possibilities, to carry out assessments of substitution and to document them.

This TRGS is intended to support the employer in this,

1. to avoid activities involving hazardous substances,
2. to replace hazardous substances by substances, mixtures or processes which, under the conditions of use in question, present no risk or a lesser risk to workers, or
3. to replace dangerous procedures with less dangerous procedures.

The aim of substitution is to eliminate or reduce to a minimum the hazards associated with all activities involving hazardous substances, including maintenance, operating and monitoring activities. As a priority measure for the protection of employees working with hazardous substances, the employer must examine the possibilities of substitution within the framework of information gathering and risk assessment in accordance with the Ordinance on Hazardous Substances (§ 6 GefStoffV, see also TRGS 400) and implement them in accordance with the requirements described in more detail in this TRGS.

Substitution
break new ground

Substitution within the meaning of these TRGS refers to the replacement of a hazardous substance or a process by a substance, a mixture, a product or a process that leads to an overall lower risk for employees (substitution solution).

4.2 Definition of terms

Substitution solutions in the sense of these TRGS designate substances or mixtures or products or processes that reduce the overall hazards of hazardous substances in the workplace.
At the same time, they should not increase the risk to other protected goods (environmental protection, consumer protection).

The assessment of substitution in accordance with the requirements must also be applied if the use of new substances and processes is planned for economic or technological reasons.

4.3 Decision on the implementation of substitution

(1)

If a hazard exists in activities involving hazardous substances, the employer shall – based on the assessmant as described - give priority to substitution. This applies in particular to activities involving carcinogenic, germ cell mutagenic and reprotoxic substances and mixtures of categories 1A or 1B and acutely toxic substances and mixtures of category 1, if alternatives are technically possible and lead to an overall lower risk for the employees.

(2)

It can be assumed that substitution options from TRGS on substitutes (TRGS 600 ff.) and sector- or activity-specific guidance containing statements on substitution are basically suitable for application. Therefore, the employer must generally implement them.

(3)

The employer can make the integrated decision taking into account the economic evaluation criteria (see also Annex 1 "Flow chart"). Guidance on which aspects the employer should take into account in the weighing process is given in Annex 3 "Criteria for the realisation of substitution".

(4)

The substitution solution must be used if the operational factors examined in accordance with Annex 3 are essentially positively influenced.

Higher costs of a substitution solution do not automatically exclude substitution.

We have the solution!
It's name is Kavarmat© pure

The real test is not whether you avoid this failure, because you won't. It's whether you let it harden or shame you into inaction, or whether you learn from it; whether you choose to persevere.

Cleansulation
#stopCr6

02

Cleansulation for engines, machines and turbines with Kavarmat©pure

the future of insulation is clean

and of course calcium-free so under normal and general conditions and on the basis of all chemical and thermal knowledge, it can actually be ruled out that there is a possibility of calcium chromate particles forming when using the Kavarmat insulation systems because there is a simple formula:

No calcium - no calcium chromate
No sodium - no sodium chromate
No potassium - no potassium chromate

#calciumfree
Kavarmat© high-teperature and heat-retaining insulation pillows

Why Kavarmat©? Because it is the first calcium-free insulation system, especially developed to avoid the formation of chromates on turbines, engines and machines

5.1 first sign

calcium-free instead of low calcium.

If calcium is the reason for the formation of calcium chromate, this chemical element must be completely banned from the machine!

- When using pillows and blankets, the cover must be made of a calcium-free material, at least where it could come into contact with a stainless steel body.
- If the cover should be damaged, the insulation material must not contain any calcium.

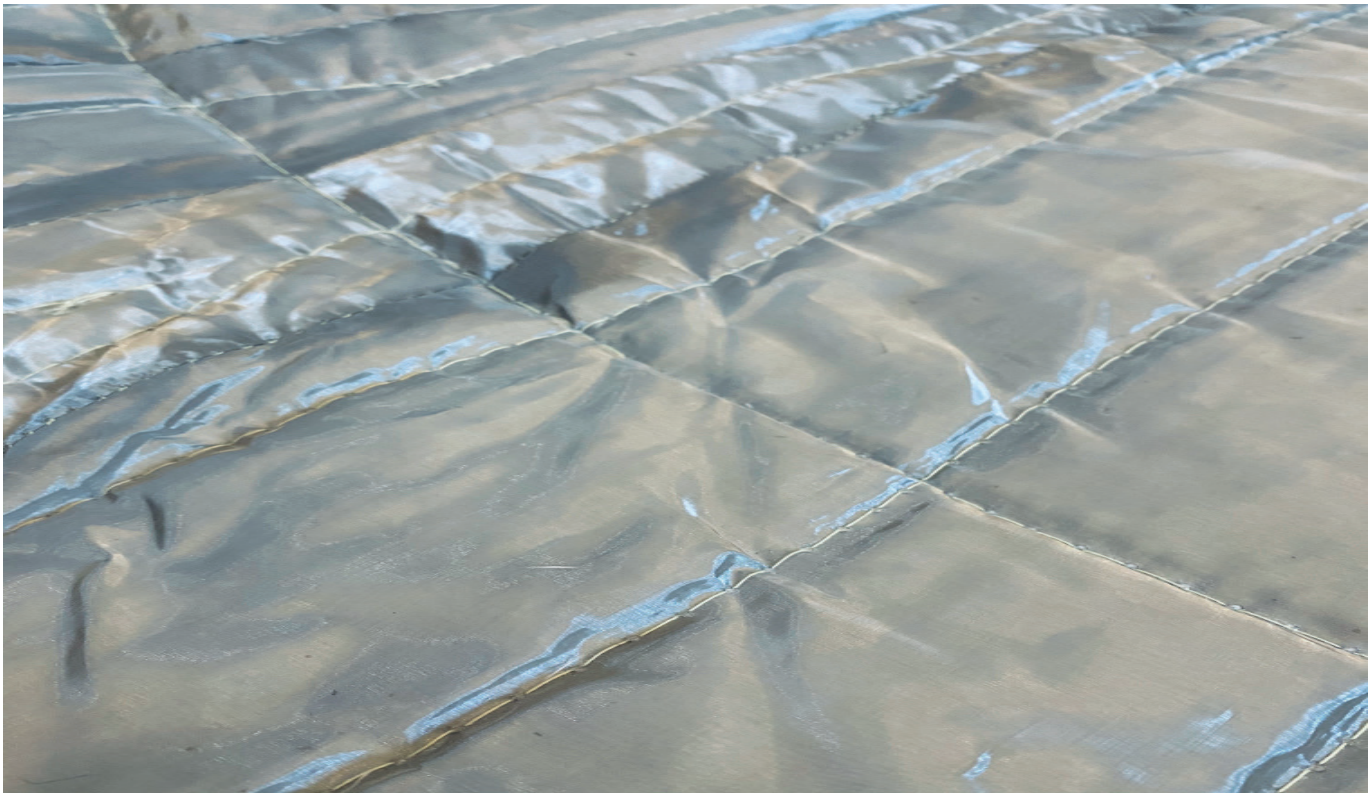
5.2 connecting benefits

Kavarmat© insulation systems consist exclusively of calcium-free components!

Dr. rer. pol. Gerhard Kocher

Research & development is dangerous:

you could discover something new.



6. steel becomes fabric

6.1 equals among equals

a chemical element can react with another element.
Probably not two of the same elements!

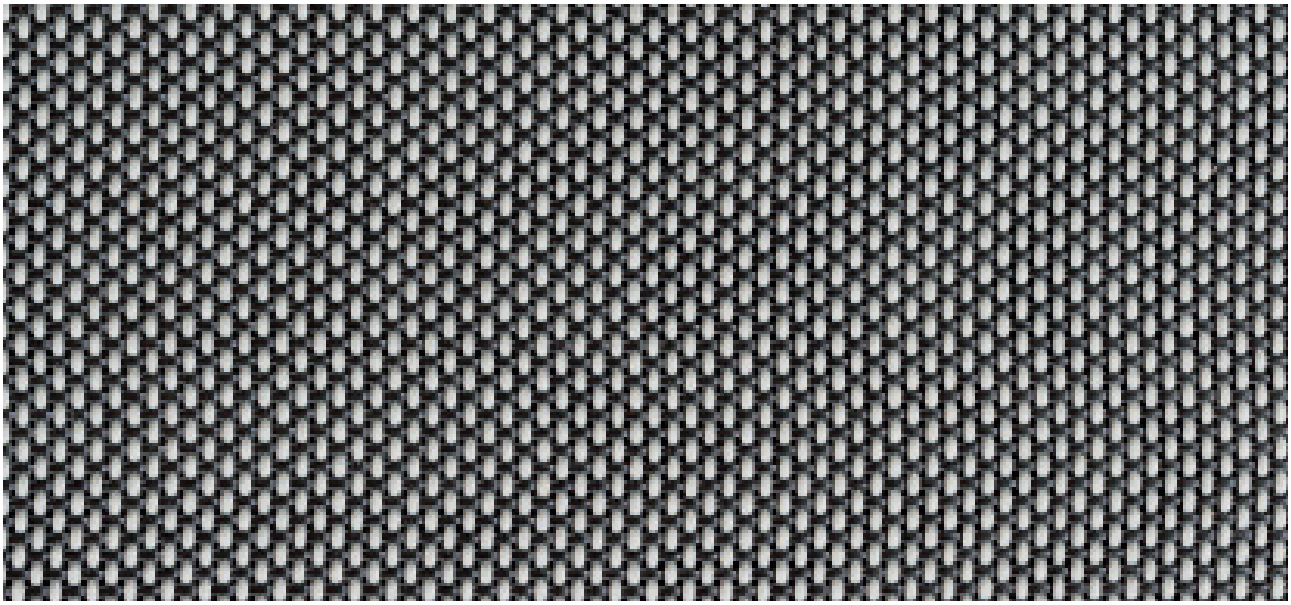
- Kavarsteel is woven stainless steel.
- Countless stainless steel threads are woven into a fabric and form the protective layer of the cover.

Kavarsteel
stitching metal

Not possible? Never say never. When there's a will there's a way! Kavarsteel is the way to make stitching metal possible.

6.2 making metal flexible

With the smallest mesh size of the warp and weft threads, Kavarsteel becomes a textile, cuttable and ready-to-use fabric. Through the use of pure stainless steel threads, the heat from the object to be insulated is directed into the insulating element and thus directly onto the insulating material.



#Bergkristall
the masterpiece of thermal insulation high-temperature quartz fibermats

mineral in its almost purest form

made of high-quartz rock crystal

SiO_2

See the difference!

Due to its excellent insulating properties, silica fibers are often used for thermal insulation. Often, however, these are combined with calcium mixtures and used as so-called "*calcium silicate products*". These products also consist of 30% calcium compounds. , sometimes even more than 30%.

Unfortunately, the term "silicate mats" has established itself on the insulation market, even if these only partly consist of silicates!

#Bergkristall high-temperature quartz fibermats and tissues consist of approx. 95% pure silicate fibers and contain NO calcium compounds and thus offer the certainty *that the oxidation process of chromium (III) compounds to* harmful calcium chromates is prevented!

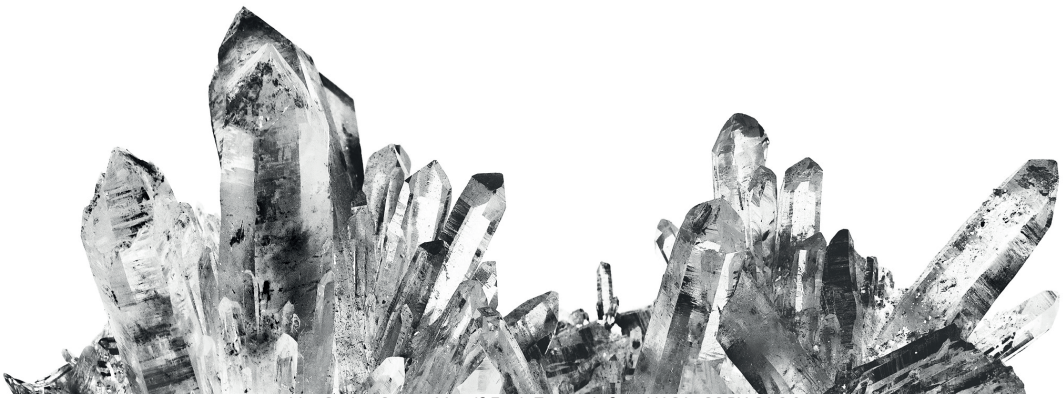
Scientific studies even show that SiO_2 compounds can lead to hexavalent chromium (VI) being "oxidized down" to **harmless chromium (III) compounds.**

rock crystal

The mineral of the earth's crust

Sometimes, however, "the devil is in the detail" and we have to pay close attention to the definition, also exactly distinguish which material e.g. is used for the manufacture of #Bergkristall

Pure quartz is completely transparent and colorless and, when it develops well-formed crystals, is called rock crystal (Latin formerly Cristallus). Quartz crystals are usually milky cloudy due to microscopic inclusions of liquids and gases (milky quartz) and appear gray when grown into the rock. Under the name Rheinkiesel transparent to milky cloudy rolled pieces of rock crystal are also known, which originate mainly from the Alpine region and are found in the Rheinkies.



source: Von SoylentGreen - Myself, Earth-Texture is from NASA., CC BY-SA 3.0

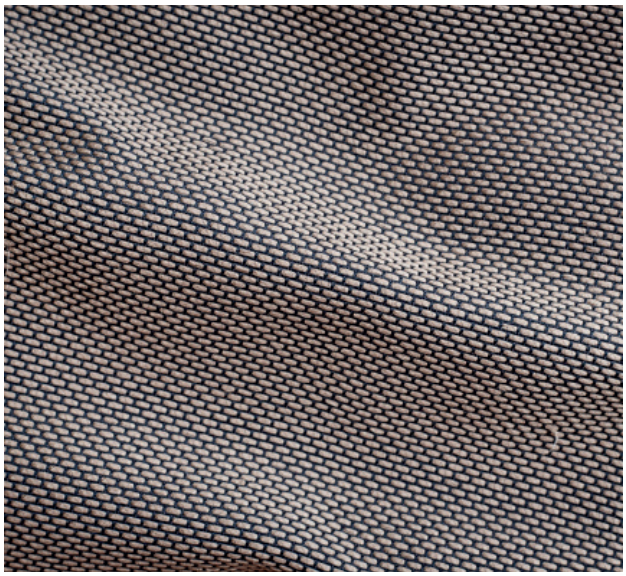
Kavarsil
Fabrics made of #Bergkristall

Finest cloth using natural raw materials. Committed to our calcium-free obligation.

> With Kavarsil, a tissue was specially developed for use as a covering for calcium-free insulation materials, which takes account of the challenges that are placed on such a material.

All Kavartex fabrics consist of a multitude of interwoven threads made of high quartz rock crystals and are additionally reinforced with stainless steel threads to improve the tensile strength in the warp and weft.

Kavarsil tissues are heat-resistant up to 800°C and are characterized by its good skin tolerance.



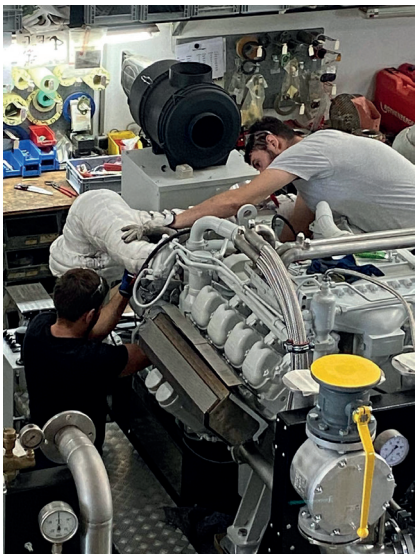
it doesn't itch
Become a #happyfitter

Put an end to dust and itching!

If you want to usher in a paradigm shift and develop innovations, you should put everything to the test and turn off and revise the things that have made work difficult up to now.

With Kavarmat pure, we have developed not only a calcium-free, but also itch-free and low-dust high-temperature insulation system. So you can apply our insulation systems without hand protection and without face and mouth protection, provided local regulations allow it, and you can do so in ordinary work clothes.

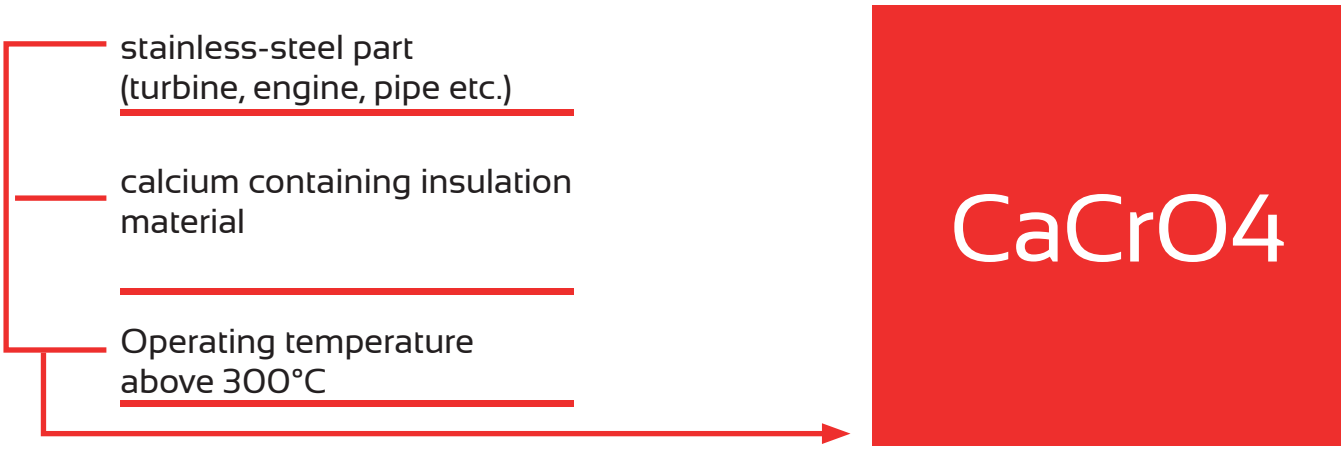
If new development, then right and so installing Kavarmat©pure insulation pillows becomes a pure pleasure!



As far as we know today, all Kavarmat© products can be disposed of as normal building rubble after use without having to comply with special disposal regulations. Nevertheless, it is necessary to check country-specific whether special regulations have to be observed.

Summary
In nuce

When insulating materials containing calcium are used, an unwanted thermal reaction between the calcium contained in the insulation system and a stainless-steel part to be insulated can cause formation of calcium chromates (CaCrO4). These compounds are **carcinogenic** and **mutagenic heavy metal compounds**. Contact with chromates must be prevented; there is a risk to health and the environment. There is a legal obligation of the **substitution** of the polluter.



The formation and local limitation when the harmful heavy metal compounds occur cannot be foreseen. It can be assumed that both the component and the insulation system are contaminated over a large area.

Extensive safety measures must therefore be taken during dismantling.

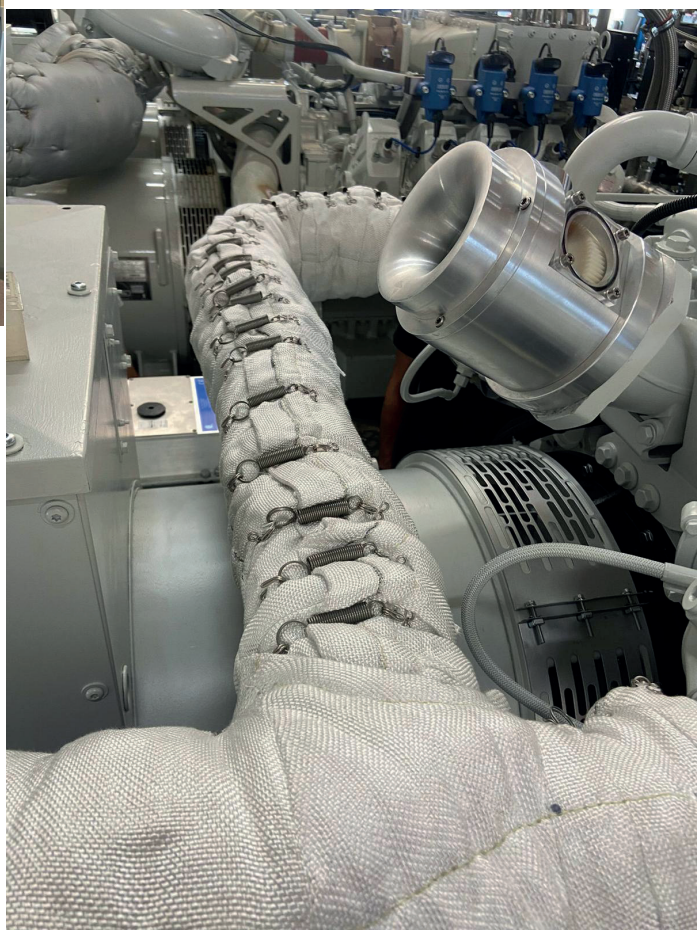
The work area must be cordoned off over a large area and only trained personnel may carry out this work.

The work area must be vacuumed and the removed insulating parts must be marked as hazardous to health and the environment and disposed of in closed containers.

The dismantled insulation material must never be reused. It is to be replaced by the substitute material.

Exchange
the future of thermal insulation
is #calciumfree

basics
Kavartech



cover

Kavarsil by #Bergkristall

Composition :	88,5 % high-quartz rock crystal (SiO_2) 11,5 % Stainless Steel 1.4401
Weight :	760 g/m² ± 8 %
Width :	1000 mm ± 20 mm
Thickness :	1,0 mm ± 0,2 mm
Construction Weave :	plain weave
Warp yarn :	540 tex + V4A ± 40 tex
Weft yarn :	540 tex + V4A ± 40 tex
Number of ends (warp) :	6,0 ends/cm ± 2 Fd
Number of picks (weft) :	5,0 picks/cm ± 2 Fd
Tensile strength:	
Warp :	>400 N/cm
Weft :	>300 N/cm

Inlet
Kavartemp by #Bergkristall

Composition:	95,0 % high-quartz rock crystal	(SiO_2)	+/- 1,0%
	3,5 % corundum	(Al_2O_3)	+/- 0,5%
	interlocked/needled without binding agents		

manufactured in several thicknesses (12/25 mm)

Thermal conductivity:

°C	100	200	300	400	500	600	700	800	900
W/m K	0,042	0,052	0,065	0,082	0,098	0,119	0,148	0,175	0,190

All raw materials used for the manufacture of Kavarmat© products are **asbestos-free** and free from substances that are subject to labeling.

According to the current state of the art and taking into account all chemical and scientific principles, the use of our products does NOT lead to the formation of hexavalent chromium-compounds (calcium chromate)!

The data of these sheets can only be taken as a non-binding guide due to the variety of installation and service conditions.

The bucket list
it doesn't itch

KAVARMAT®
the Cleansulation company
#calciumfree
heat-retaining insulation pillows

Disclaimer:

This white paper reflects our state of knowledge, which we have summarized based on available scientific data and our own findings.

All conclusions result from the intensive analysis of competent sources, which we are happy to name or provide in fair copy.

When we use the term "chromium (VI)", we usually mean a "chromium (VI) compound" or a hexavalent chromate, mainly the calcium chromate $CaCrO_4$. The pure so-called "chromium (VI)" with the chemical formula CrO_3 is NOT part of this white paper or other papers, published in the name of Kavarmat© s.c..

Far be it from us to defame the suppliers of calcium-containing insulation materials in any way or to deny their products.

The only core message of this whitepaper is the technical understanding that calcium-containing insulation materials should not have direct contact with chromium-containing bodies when operated hotter than 300°C, if it is desired to prevent the possibility of calcium chromate formation.

Kavarmat s.c. -
The Cleansulation company

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