

Analysis of the chromium(VI) issue in technical applications

A document in question-and-answer format for decision-makers to assess risks, liability issues, and necessary actions

Key messages and facts

To what extent are technical installations affected by the chromium(VI) issue?

A significant number of installations are affected. Any technical installation in which chromium-alloyed, hot components are combined with insulation materials containing basic oxides carries the risk of chromium(VI) compounds forming and being released, even when used as intended.

This includes the following areas of application, among others:

- **Combined heat and power plants** (several tens of thousands of units in Europe)
- **Power and thermal power plants** that use large engines, gas or steam turbines
- **Industrial high-temperature plants**
- **Boiler systems and various aggregates**
- **Power generation units in all types of vehicles**, including passenger cars, trucks, ships, and locomotives
- **Exhaust aftertreatment components**, such as SCR systems
- Any other equipment that has this specific combination of materials and temperatures

The scientific evidence on this is clear. The formation of chromium(VI) compounds under the conditions mentioned is a consequence of basic chemical principles and has been confirmed scientifically by numerous practical studies and warnings from authorities and industry.

The problem is systemic and widespread worldwide.

Is it necessary to classify the areas mentioned as so-called "black areas"?

The necessity of such a classification depends on the specific individual situation. However, the following applies in principle:

Technical equipment containing chromium-alloyed components, operating at temperatures above 300 °C and insulated with materials containing basic oxides (in particular calcium oxide and/or sodium oxide) can form chromates (chromium(VI) compounds). These compounds are classified as carcinogenic, skin resorptive, and chronically harmful to the environment.

Plant operators or service companies that cannot prove that contamination with chromium(VI) compounds is impossible, especially if the presence of sodium chromate cannot be ruled out, are obliged to assume contamination as a precautionary measure in accordance with the "worst-case principle." This requires the introduction of appropriate protective measures, which leads to significantly increased requirements in the areas of occupational safety, monitoring, and documentation.

The majority of plant operators are currently unable to provide this proof. This is not due to malicious intent, but to the fact that this issue has not been the focus of attention for a long time. However, based on current knowledge, there is an irrefutable obligation for operators to take action.

Has the substitution of asbestos in high-temperature insulation technology unintentionally led to a new, equally serious hazard problem?

In the 1990s, the use of asbestos was banned by law. As a result, insulation materials containing basic oxides – such as mineral wool, glass fabric, and glass fiber needle felts and mats – became established as supposedly safe alternatives.

However, no systematic investigation was carried out into which specific basic oxides are contained in these materials and how they react with the alloy components of the components to be insulated under operating conditions.

Nor was the question asked as to what chemical by-products could be produced at high temperatures through the interaction of these materials.

Today, it has been scientifically proven that the known risk (asbestos) has been replaced by a new, long-unrecognized but detectable problem (chromate formation).

This omission cannot be attributed to individual actors, but represents a systemic deficit – a gap in risk assessment that has been ignored for decades.

How should the "neutralization" recommended by some engine and turbine manufacturers and operators using so-called "neutralizing fluids" or "sprays" be assessed from a scientific, occupational safety, and environmental protection perspective?

The term "neutralization" is a misleading and suggestive play on words in this context. The term is factually inaccurate and gives the false impression of a complete and safe elimination of the danger posed by chromium(VI).

Scientific assessment:

From a chemical point of view, this is not neutralization (an acid-base reaction), but reduction. Complete reduction of chromium(VI)-containing dusts by spraying ascorbic acid in open, uncontrolled environments cannot be reliably achieved. Such a reaction would require complete, stoichiometrically exact contact between the reducing agent and each individual dust particle.

In practice, however, complete wetting of the heterogeneously distributed and partially shielded particles is impossible, so that residues of chromium(VI) compounds inevitably remain.

In addition, crucial parameters such as reaction kinetics and dependence on humidity and pH value cannot be reliably controlled during short-term application as an aerosol. Reliable control or analytical verification of complete reduction is also not feasible under these field conditions.

Occupational safety assessment:

The STOP principle enshrined in European hazardous substances regulations establishes a clear hierarchy of protective measures:

Substitution (S) takes precedence over technical (T) and organizational (O) measures without exception. Personal protective equipment (P) is often misinterpreted in practice as a primary measure, but in the hierarchy it is the least important option, which may only be used if the priority measures do not achieve sufficient effect. The use of full protective equipment in a regular workplace must not become standard procedure.

A superficial reduction of chromium(VI) compounds in the workplace is to be classified as a purely organizational measure (O) and does not release the employer from the fundamental obligation to prevent the hazardous substance from being generated at source (S).

Environmental protection assessment:

Chromium(VI) compounds are classified under the CLP Regulation with the hazard statement H410 ("very toxic to aquatic life with long-lasting effects").

Incomplete reduction carries the immediate risk that these environmentally harmful compounds will be released into the environment.

Overall regulatory assessment:

The process of "neutralization" is neither valid from a chemical point of view nor can it be recognized as an adequate protective measure from an occupational safety or environmental protection perspective.

Its use can only be considered risk-reducing in the context of a comprehensive plant remediation aimed at substituting the hazardous substance and concluding with final decontamination. In this specific context, the process reduces the health and environmental risk for remediation personnel and subsequent disposal. However, the remaining residual risks must be addressed by further appropriate measures.

Implications for your company

The chromium(VI) issue requires a differentiated assessment from various business perspectives:

For plant operators:

- **Contamination risk:** There is a possibility that your plant may be contaminated with chromium(VI) compounds.
- **Documentation requirement:** You are legally required to keep an exposure record for a period of 40 years.
- **Duty of care:** You must take preventive protective measures for your employees.
- **Regulatory requirements:** The ECHA restriction must be implemented by 2027/2028.
- **Process unsuitability:** So-called "neutralization" is not a scientifically or legally viable solution strategy.
- **Pressure to act on substitution:** Substitution of the causative materials must be considered as the primary solution strategy.
- **Cost risk:** Inaction can potentially lead to significantly higher costs than proactive action.

For engine manufacturers:

- **Product liability:** You produce engines that contain chromium-alloyed hot parts and are factory-fitted with insulation materials containing basic oxides (in particular calcium and/or sodium oxide). This combination has been proven to lead to the formation of chromium(VI) compounds, even when used as intended.
- **Scientific evidence:** The scientific evidence for this mechanism is clear.
- **Regulatory knowledge:** The relevant regulatory authorities are aware of this situation.
- **Preventive action required:** From a preventive and liability perspective, you are required to either switch to insulation materials without basic oxides or implement alternative, safe solutions.
- **Investment requirements:** The implementation of these measures requires appropriate investment.

For manufacturers of insulation materials containing basic oxides:

- **Product liability:** Your products containing basic oxides have the property of forming chromium(VI) compounds under operating conditions. This constitutes a material defect that may lead to liability claims.
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- **Strategic realignment:** You potentially have the technical capability to manufacture materials without basic oxides. This would require an adjustment to your product strategy, but it also raises the question of why such materials have not been offered to date despite their technical feasibility.
- **Regulatory pressure:** Ongoing regulatory developments will confront you with this issue in the foreseeable future.
- **Strategic decision:** You are faced with the choice of acting proactively now or only being able to react to regulatory pressure at a later date.

What are the consequences in terms of liability law?

This question is of central importance for all parties involved.

Occupational health and safety liability: If employees have been or are exposed to chromium(VI) compounds and the employer is aware of this fact—which must be assumed to be the case given the current state of knowledge—there is an immediate duty of care. The employer is legally obliged to take adequate protective measures. Failure to take these measures may result in civil and criminal liability.

Environmental liability: Chromium(VI) compounds are classified with the hazard statement H410 ("very toxic to aquatic life with long-lasting effects"). If these compounds enter the soil or water and the responsible party was aware of this danger, there is a clear responsibility. Effective measures must be taken to prevent such a release. Otherwise, there is a risk of liability consequences under the Environmental Damage Act.

Product liability: A product that forms chromium(VI) compounds under normal conditions of use is classified as defective under the Product Liability Act. This also applies if the product is free of chromium(VI) when delivered. If the manufacturer has not disclosed the problem of the formation of these hazardous substances in a transparent manner, this may give rise to liability.

Insurance law aspects: Many public liability insurance policies cover damage caused by known hazards. However, the critical question arises as to whether insurance cover continues to apply in full if the insurer has not been proactively informed about the specific chromium(VI) problem and the associated risks, for example in order to keep insurance premiums low. It is therefore essential for every company to check whether its own business and liability insurer is aware of the chromium(VI) risk. Clarifying the question of liability is a key issue whose strategic relevance should not be underestimated.

What is the significance of the chromium(VI) issue for employees?

Protecting employees from exposure to chromium(VI) compounds is a top priority. These compounds are classified as follows in accordance with the CLP Regulation:

- **Carcinogenic (H350)**
- **Mutagenic (H340)**
- **Reproductive toxicity (H360FD)**
- **Chronic environmental hazard with long-term consequences (H410)**

The latency period for cancers associated with exposure to chromium(VI) compounds can be between 20 and 40 years. This means that an employee who is exposed today may only develop a serious illness after a long period of time.

If exposure records have been kept, a potential causal link can be established. The absence of such records not only makes medical diagnosis more difficult, but can also lead to significant legal consequences for the company at a later date.

The protection of employees is a top priority and requires immediate and consistent action.

Who is responsible for solving the problem?

Responsibility is complex and spread across several players along the value chain:

Engine manufacturers: These companies manufacture engines that contain chromium-alloyed hot parts and are factory-coated with insulation materials containing basic oxides. Manufacturers are aware, or should be aware, that this combination of materials leads to the formation of chromium(VI) compounds under operating conditions. They have a duty to communicate this information transparently and to offer safe, alternative solutions.

Power plant operators: Plant operators bear direct and non-transferable responsibility for protecting their employees and complying with environmental regulations. If they are aware of an existing risk, they are obliged to take immediate action.

Manufacturers of insulation materials: This industry must seriously consider developing and offering insulation materials that are free of basic oxides in order to ensure their long-term marketability.

Regulatory authorities: The competent authorities are called upon to define clear and unambiguous regulatory requirements and to consistently enforce compliance with them.

The central objective is not to assign blame, but to ensure that all stakeholders take coordinated and proactive responsibility.

What is the most obvious and, at the same time, mandatory solution?

The only scientifically valid solution that is sustainable in terms of occupational safety and environmental protection law and makes economic sense in the long term is **substitution**. This means the consistent use of insulation materials that are free of basic oxides.

Such a change requires strategic adjustments in several areas:

- **Materials management:** Evaluation and qualification of new, oxide-free materials.
- **Supply chain management:** Establishment and securing of new supply chains.
- **Technical implementation:** Design adjustments or modifications to the plants may be necessary.
- **Investment planning:** The changeover involves initial investments.

Despite these challenges, substitution is the only solution that meets all relevant criteria:

- **Scientific validity:** It eliminates the chemical cause of chromium(VI) formation.
- **Occupational safety compliance:** It implements the STOP principle at the highest level (S).
- **Environmental responsibility:** It prevents the release of the pollutant H410.
- **Long-term economic efficiency:** It minimizes liability risks, avoids follow-up costs for protective measures and remediation, and ensures the future viability of the business.

What options for action are available?

The available options for action depend largely on the specific role of the respective player in the market. Basically, three strategic approaches can be distinguished:

Option 1: Wait-and-see approach

- **Strategy:** Observation of further market developments and regulatory activities.
- **Assumptions:** The hope that the problem will resolve itself, that the regulatory authorities will not impose strict measures, or that the company's own employees will not be affected by health consequences.
- **Assessment:** This option involves significant and incalculable legal, financial, and reputational risks and is therefore expressly not recommended.

Option 2: Implementation of superficial measures

- **Strategy:** Continuing to attempt to manage the problem through the use of reduction agents (so-called "neutralization sprays").
- **Assumptions:** The hope that these measures will be deemed sufficient, accepted by regulatory authorities, and liability can be averted.
- **Assessment:** This approach is scientifically invalid and legally untenable. It does not address the root cause of the problem and does not meet the requirements of the STOP principle.

Option 3: Consistent substitution

- **Strategy:** Recognition of the problem and proactive investment in high-temperature insulation based on materials that are free of basic oxides.
- **Result:** This approach effectively protects your employees, meets current and future regulatory requirements, and minimizes your corporate liability risk.

Above all, you are acting responsibly and with an eye to the future. This is the only sustainable solution that is also consistent with your own company's compliance guidelines.

Detailed analysis and stakeholder perspectives

General section

The following questions are addressed to all stakeholders involved and serve to shed light on the scientific, regulatory, and economic reality of the chromium(VI) issue.

Who confirms the reality and relevance of this problem?

The problem has been confirmed by a number of independent and authoritative bodies:

Authorities:

- The **BG ETEM** (Professional Association for Energy, Textiles, Electrical and Media Products) has officially recognized the chromium(VI) issue as state of the art and, on this basis, is calling for modified risk assessments from companies.
- The **ECHA** (European Chemicals Agency) is planning a general ban on the use of chromium(VI) compounds, which is expected to come into force in 2028.

Science:

- The mechanism of formation has been clearly documented and scientifically proven by peer-reviewed studies, including those by **Sayano et al.**, **Mao et al.**, **Verbinnen et al.**, and **van Leeuwen**.
- It is particularly noteworthy that van Leeuwen's dissertation was funded by the **ECFIA** (European Ceramic Fibre Industry Association) itself. This underlines the validity of the results, as they were supported by the industry, which could potentially have an interest in denying the problem.
- The research results are experimentally clear and have been published in internationally recognized journals.

Engine manufacturers:

Various leading manufacturers have acknowledged the problem in official documents:

- **Proventia Group Oy:** Information Bulletin Hexavalent Chromium
- **Caterpillar Inc.:** Technical Information Bulletin MO116139 – Hexavalent Chromium detected in certain Caterpillar Engines
- **Caterpillar Energy Solutions GmbH:** Technical Circular on Hexavalent Chromium
- **MAN Truck & Bus SE:** Service Notice on Chromium(VI) Compounds

Insulation manufacturers:

Manufacturers of insulation materials are also drawing attention to the problem:

- **Frenzelit GmbH:** TechInfo 28 on chromium(VI) formation (manufacturer of calcium-containing glass fiber fabrics/mats)
- **Rockwool Technical Insulation:** Information on the safe use of Prorox (mineral wool containing sodium and/or calcium oxide)

In summary, it can be said that the chromium(VI) issue is scientifically sound, recognized by the authorities, and confirmed by the manufacturers of the affected components and materials themselves.

So why are the major engine manufacturers and power plant operators not taking proactive action?

This key question reveals a fundamental dilemma and potential conflicts of interest. If the danger posed by chromium(VI) is so widespread and has been confirmed by scientists, authorities, and manufacturers, why are the major market players failing to take proactive measures? The cautious reactions and vague responses indicate deep-seated conflicts:

- **Cost intensity of recall campaigns:** A manufacturer who publicly admits that its insulation products and systems can lead to the formation of chromium(VI) would potentially be faced with the need to inspect and remediate thousands of facilities. The financial cost of this is difficult to estimate reliably.
- **Existential liability risks:** A manufacturer who is aware of the problem but fails to take action is liable for any resulting damage to employees and the environment. This liability goes far beyond purely financial aspects and can jeopardize business models and, in the worst case, the very existence of the company.
- **Structural rigidity:** Established manufacturers have geared their production strategies and supply chains toward insulation systems with basic oxides for decades. Switching to materials that are free of basic oxides would require fundamental and costly restructuring of their entire value chain.

- **Economic rationality of silence:** From a purely economic perspective, ignoring a problem that is not yet widely known to the general public may appear to be the more favorable strategy in the short term. The hope of not being officially held accountable by adopting a non-communication strategy follows a certain economic rationality within the existing incentive structures.

However, this situation also reveals a profound systemic deficit: smaller, specialized companies such as Cleansulation® Technology B.V. are forced to address the issue because the large, established companies would jeopardize their own business models, which have been established for decades, by openly admitting it.

Is the term "chromate disaster" an exaggeration?

An analysis of the available data paints a clear picture that justifies the use of this term:

Affected areas of application:

- Tens of thousands of combined heat and power plants
- Medium-sized power and thermal power plants
- A large number of industrial high-temperature plants
- Gas and steam turbines
- Exhaust gas aftertreatment systems in millions of vehicles
- Energy generators in ships, locomotives, and other means of transport

Affected groups of people:

- Maintenance and service technicians in power plants
- Mechanics in automotive workshops
- Maintenance specialists in various branches of industry
- The number of potentially affected employees amounts to tens of thousands in Germany alone and hundreds of thousands across Europe.

Regulatory escalation:

- **Recognition by BG ETEM (2025):** The professional association has recognized the issue as state of the art.
- **Planned ECHA ban on use (2027/2028):** The European Chemicals Agency is planning a far-reaching ban on the use of chromium(VI) compounds. In future, no new uses outside the specifically defined applications (UC1-UC6) will be approved. The reduction applied in some cases in practice constitutes "treatment" and thus "use" within the meaning of REACH (Article 3, paragraph 24). This implies that existing facilities must be renovated in the course of maintenance work.

Given these facts, describing the situation as a "disaster" is not an exaggeration, but a realistic assessment of its magnitude. The numbers are significant, the consequences are serious, and the regulatory timeframe is tight.

If the problem is so far-reaching, why is it hardly present in the public perception?

This question is of central importance because it goes to the heart of the communication blockage.

The problem is not unknown among experts; it exists in a discourse space between science, regulatory authorities, and industry. However, it has not yet found its way into the broader media, into vocational training, or into everyday technical discussions.

The reasons for this are complex:

- **Inconvenient truth:** Acknowledging the problem would require admitting that potentially tens of thousands of employees are exposed to a health hazard, that entire industries have a systemic safety problem, and that the substitution of asbestos has unintentionally led to a new, serious problem.
- **High complexity:** Understanding the issue requires knowledge of chemistry, high-temperature process technology, regulatory frameworks, and occupational safety. This complexity defies simplistic, simplistic presentation. The Chromatex experts have made it their mission to present this complex issue in an appropriate and understandable manner.
- **Significant costs:** Solving the problem, i.e., substitution, involves considerable investment. There is a widespread tendency to avoid such expenditure as long as there is no immediate regulatory or public pressure to do so.

- **Strategic interests:** The industry concerned has an understandable strategic interest in avoiding a broad public debate. The longer the problem remains below the threshold of public awareness, the longer the status quo can be maintained.

However, this situation is beginning to change. The official recognition of the problem by BG ETEM and the planned ban on use by ECHA signal a turning point. The authorities will take action, and public attention will inevitably follow.

The crucial question is therefore not *whether* the problem will become public knowledge, but *whether* you, as a responsible actor, will act proactively before it becomes known, or whether you will be forced to act reactively when it may be too late.

Stakeholder-specific questions

Vehicle manufacturers: A self-created vicious circle

Why are vehicle manufacturers not proactively addressing the chromium(VI) problem in engine compartments?

The answer lies in a vicious circle that manufacturers have generally created themselves. This cycle has its origins in earlier cost-cutting measures, in particular through the use of inexpensive insulation materials such as calcium oxide-containing E-glass fiber needle felts and subsequent design simplifications.

Over the years, heat shields in the engine compartment, for example, have been simplified for cost reasons. Instead of a gas-tight full enclosure, "oxygen-permeable" heat shields are now often clipped directly onto the hot components to be shielded. While the pursuit of efficiency is fundamentally legitimate, these decisions did not take sufficient account of potential chemical cross-reactions. This has two major consequences:

- **Enabling chromate formation:** The open design allows the atmospheric oxygen necessary for chromate formation to access the hot surfaces, which initiates the formation mechanism.
- **Contamination spread:** Insulation fibers that are already contaminated are distributed throughout the entire engine compartment by thermal convection. At the same time, fibers that are not yet contaminated can be deposited on originally uninsulated, chrome-alloyed hot parts, where they react thermochemically to form chromium(VI) compounds, in particular calcium chromate.

This situation has far-reaching regulatory consequences. According to the applicable substitution principle, every insulated, chrome-alloyed hot part must be remediated. Due to the classification of chromium(VI) as a CMR substance (carcinogenic, mutagenic, toxic to reproduction), the affected areas, especially in workshop service, must be treated as "black areas" that must be separated.

Due to their chronic environmental harmfulness (H410), these areas must also be designed to be drain-free. For automotive workshops, this means that they must work in accordance with the requirements of TRGS 561 ("Working with carcinogenic metals and their compounds").

Among other things, this technical regulation stipulates comprehensive personal protective equipment and environmental protection measures, as there are no health-based limit values for chromium(VI) compounds.

Vehicle manufacturers are thus caught in an economic trap:

- they cannot ignore the problem because the regulatory authorities are aware of it.
- They cannot openly admit the problem without risking massive damage to their reputation, liability claims, and recalls.
- They cannot simply solve the problem, as this would require far-reaching and costly design modifications.

The resulting strategy is one of wait-and-see silence. The vicious circle closes: initial cost savings led to the uncontrolled release of hazardous substances, which in turn requires the establishment of expensive protective areas and remediation measures, the costs of which no one wants to bear.

Engine and turbine manufacturers: The warranty dilemma

Why don't engine and turbine manufacturers equip their new systems with insulation systems that are free of basic oxides as standard?

This question goes to the heart of the problem and explains its persistence. The reality is that engine and turbine manufacturers are global corporations, often with billions in sales, some of which are publicly traded or seeking to go public. Tens of thousands of gas and steam turbines and combined heat and power plants are in operation worldwide, and the order books are full.

Despite intense competition, all manufacturers have one thing in common: decades of using insulation materials that contain basic oxides. The market for these materials is well established, with long-standing supply chains and business relationships. Insulation companies are also an integral part of this well-oiled system. Insulation technology itself has hardly evolved since the substitution of asbestos; in principle, the insulation technology of the 1980s is still in use today. While engine and turbine technology has been continuously optimized, insulation materials and systems have remained largely unchanged.

The formation of chromates from insulation materials containing calcium and/or sodium oxide is not limited to individual series or models. Some materials, especially those for high-temperature applications above 600 °C, contain over 50% calcium oxide. Scientific research and field studies clearly show that calcium chromate forms particularly efficiently at temperatures above 500 °C. The higher the calcium oxide content and the higher the operating temperature, the more intensively chromium(VI) compounds are formed.

Thousands of engines and turbines are in regular operation, backed by manufacturer warranties. If the previous concealment of these systemic deficits becomes public knowledge, costly liability cases are to be expected. Customers could assert warranty claims or pass on liability risks and their costs to manufacturers. This would not only have a significant impact on market reputation, but could also, in the worst case, lead to negative implications for stock market prices—a risk that should not be underestimated. In addition, regulatory authorities would take action, resulting in inspections and fines and damaging the reputation of manufacturers and operators in the public eye. Due to these potentially far-reaching consequences, proactive communication is avoided.

Why is silence the rational strategy for engine and turbine manufacturers?

The logic behind this strategy is simple and follows the incentive structures of the market. As long as the chromate issue is not discussed publicly, there is no immediate obligation to act. As long as the perception prevails that no specific regulation exists and few critical questions are asked, the current business model can continue.

However, this assumption is deceptive. The ECHA ban on use will come into force by 2028 at the latest, and even this ban must first be understood and applied in its full scope. As long as no public scandals arise, the players involved can seemingly continue their business activities undisturbed.

This is not malicious intent, but a form of business logic based on the incentives available. As long as this incentive structure remains in place, both engine and turbine manufacturers will prefer a strategy of "non-communication."

However, the incentives are beginning to change:

- BG ETEM has officially acknowledged the problem.
- The ECHA is planning a far-reaching ban on use.
- The authorities will act on this basis.

Once this point is reached, the strategy of silence will become a costly and untenable position.

Insulation materials containing basic oxides may in future be subject to a so-called 'de facto' ban if their thermochemical properties cause them to form carcinogenic substances under certain, but often occurring, conditions. Their use will soon be prohibited by the highest European authority.

Systemic contradictions in sustainability and compliance assessment

How should the sustainability communications of companies whose systems potentially release chromium(VI) compounds be assessed?

This reveals a significant discrepancy between the public sustainability claims of many companies and their operational reality. Energy producers, especially in the field of decentralized and renewable energies, position themselves in public as environmentally friendly and forward-looking. However, this narrative is fundamentally challenged by the continued use of insulation systems that have been proven to lead to the formation of carcinogenic and environmentally harmful chromium(VI) compounds.

A holistic and credible understanding of sustainability encompasses not only the reduction of CO₂ emissions, but also, and imperatively, the highest standards of occupational safety and environmental protection. The release of CMR substances (carcinogenic, mutagenic, toxic to reproduction) and compounds classified as H410 ("very toxic to aquatic organisms") is in direct contradiction to any serious sustainability concept.

Particularly in the context of biogas plants, which are often connected to agricultural businesses, the risk is exacerbated by the potential contamination of soil and water. Corporate communications that ignore or conceal these significant risks run the risk of being perceived as misleading and untrustworthy.

True sustainability requires the consistent and unconditional implementation of the STOP principle, i.e., the substitution of hazardous substances at the source. Only companies that take this principle seriously and proactively invest in oxidation-free insulation materials can credibly and consistently represent their own sustainability claims.

What responsibility do the parties involved bear?

Responsibility for solving the chromium(VI) problem is systemic and shared by several parties along the entire value chain:

- **Engine and equipment manufacturers** have a primary obligation to design their products to be safe from the outset. This includes the careful selection of insulation materials that do not form hazardous substances under real operating conditions. The continued use of problematic material combinations while concealing the associated risks is incompatible with a manufacturer's duty of care.

- The **insulation industry** has the technical capability to develop and market materials that do not contain basic oxides. The responsibility here lies in proactively providing safe alternatives rather than passively waiting for regulatory pressure.
- **Plant operators** bear direct and non-transferable responsibility for the safety of their employees and strict compliance with environmental protection requirements. They are legally obliged to carry out risk assessments based on the current state of the art and to act immediately and effectively in the event of a known risk.
- **Regulatory and supervisory authorities** (such as BG ETEM in Germany or ECHA at the European level) have recognized the problem. Their task now is to consistently enforce compliance with legal requirements and generate the necessary regulatory pressure to accelerate market-wide substitution.

Inadequate risk assessment based on air measurements alone

Why is assessing the risk of chromium(VI) solely on the basis of air measurements insufficient?

A risk assessment based solely on compliance with air quality limits is a highly simplified and misleading approach. It suggests a level of safety that does not exist in reality and clearly contradicts the applicable legal requirements.

The facts are clear:

- **Skin absorption as a significant exposure route:** Chromium(VI) compounds are classified as skin-absorbable. This means that even dermal contact with contaminated dust poses a significant health risk, regardless of the concentration of the substance in the air. In Germany, for example, TRGS 401 requires the highest protective measures to be taken even if there is only a possibility of skin contact with CMR substances.
- **Legal requirements of the European Union:** Directive 2004/37/EU clearly stipulates that all relevant exposure routes – i.e., inhalation and skin contact – must be assessed individually and independently of each other in the risk assessment. Any operational practice that ignores skin contact as a relevant exposure route has therefore been illegal for over 20 years.

- **Methodological shortcomings in air measurement:** Even the implementation of air measurements is often methodologically inadequate. Measurements that are not carried out under real, representative working conditions (e.g., during dust-intensive maintenance work) or over a sufficient period of time provide distorted and meaningless results. In addition, comparative studies show that common measurement methods (e.g., according to the DGUV standard) can lead to significantly incorrect and too low measurement results due to interference with other substances present in the working environment, such as oils and dusts. These methods are significantly less sensitive (approx. 15%) than newer and more precise measurement methods (e.g., SEEF B.V.), which means that the actual exposure is massively underestimated.

Relying on supposedly harmless air measurement values while ignoring dermal exposure is therefore neither technically nor legally tenable. This is a systematic gap in the practical implementation of the hazardous substance regulations applicable in each country.

What are the consequences of such an inadequate risk assessment?

The consequences of such a truncated risk assessment are serious and manifest themselves on several levels:

- **Inadequate protective measures:** Employees act under the false belief that they are safe and do not use adequate personal protective equipment, which is particularly effective in preventing skin contact. This leads to avoidable and continued exposure to a hazardous substance that is proven to be carcinogenic.
- **Violation of the substitution obligation:** The legal obligation to substitute in accordance with the STOP principle is circumvented by referring to supposedly harmless measurement values. However, the substitution obligation arises mandatorily from the CMR classification and the skin hazard of the substance, regardless of compliance with air limit values.
- **Growing liability risk:** In the event of an employee subsequently developing cancer, employers cannot successfully invoke air measurements that have been carried out if it can be proven that the legally required complete risk assessment, which includes dermal exposure, has not been carried out. In such a case, the burden of proof for proper implementation lies with the employer.
- **Lack of exposure records:** To date, most companies have failed to keep the legally required exposure records for employees who are potentially exposed to chromium(VI) compounds through inhalation and dermal contact on a daily basis. These records must be kept for up to forty years and made available to the employees concerned.

- **Lack of occupational health care:** As a rule, affected employees are not offered occupational health care. However, such care can only take place within the framework of an open and transparent dialogue between employers and employees about the existing risks. If this dialogue does not take place, employees are deprived of the opportunity to take preventive action for their own health.

In summary, it can be said that arguments based solely on air measurements create a false sense of security and systematically obscure the actual health risks and the legal responsibility of companies. A critical, comprehensive, and legally compliant examination of all relevant exposure routes is essential.

The **Chromate Experts**, a network of various companies with experience in high-temperature insulation technology, chromate analysis, decontamination/renovation of chromate dust-contaminated facilities, as well as occupational safety specialists, environmental officers, and specialist lawyers for European occupational safety and environmental protection, as well as experts in asbestos prevention and specialist lawyers for European product liability, appeal to all protagonists mentioned in this document to deal with the chromium(VI) problem ("**the chromate disaster**") in detail; we will help with any questions and uncertainties.

The **Cleansulation® Academy**, a division of **Cleansulation® Technology B.V.** in Almere, NL, offers free training courses for public authorities and paid training courses for commercially oriented companies. It also certifies interested companies and their employees in the areas of **SHEQ** (Safety, Health, Environment, and Quality) and Decontamination/Remediation (**CORE**) in connection with chromium(VI) compounds and the resulting protection and safety measures. Environment, and Quality) and decontamination/remediation (**CORE**) in connection with chromium(VI) compounds and the resulting protection and safety measures.