Department for Environment Food & Rural Affairs

Authorisation Decision

by Marc Casale

Deputy Director, Chemicals, Pesticides and Hazardous Waste (DEFRA)

On behalf of the Secretary of State for Environment, Food and Rural Affairs

Decision date: 29 July 2025

Application Ref: AFA056-01

Authorised use

Industrial spraying of chromium trioxide mixtures for the coating of metallic articles subject to harsh environment, to ensure a high temperature corrosion and oxidation resistance, as well as anti-fouling properties or lubricity at high temperature, for automotive, aviation, power generation machinery, oil and gas and marine applications of chromium trioxide.

UK REACH authorisation number:

Authorisation number	Authorisation holder
UKREACH/25/17/00	Linde AMT UK Ltd

Preliminary Matters

- Chromium trioxide is listed in Annex XIV to assimilated Regulation (EC) No 1907/2006 concerning the registration, evaluation, authorisation and restriction of chemicals (UK REACH).[1] As such, chromium trioxide is subject to the authorisation requirement referred to in Article 56(1) of UK REACH.

[1] References to Regulation (EC) No 1907/2006, referred to in this decision as UK REACH, are to the assimilated law available online at https://www.legislation.gov.uk/eur/2006/1907/contents

- Chromium trioxide was included in Annex XIV due to its intrinsic carcinogenic and mutagenic properties (Article 57(a) and Article 57(b) of UK REACH).
- Hexavalent chromium (Cr(VI)) is the form of chromium in chromium trioxide to which the hazardous properties are attributed.
- The application is made by Linde AMT UK Ltd (the 'Applicant'), with company number 02416734, whose registered office is at Drakes Way, Swindon, Wiltshire, SN3 3HX, United Kingdom.
- As a result of the conditions of Article 127H of UK REACH having been met, the authorisation of the use of chromium trioxide under EU REACH[2] continued until it expired on 21 September 2024.
- On 13 November 2023, the Applicant submitted an application for authorisation (the 'Application') to the Health and Safety Executive (the 'Agency'), for the use of chromium trioxide mixtures via industrial spraying for the coating of metallic articles subject to harsh environment for the automotive, aviation, power generation machinery, oil & gas and marine industries and their supply chains. The industrial spraying process ensures high temperature corrosion and oxidation resistance as well as anti-fouling properties or lubricity at high temperature.
- On 13 February 2025, the Agency sent its opinion (the 'Opinion') to the Secretary of State for Environment, Food and Rural Affairs, and Scottish and Welsh Ministers.

Decision

1. This decision is addressed to the Applicant.
2. In accordance with Article 60(4) of UK REACH, authorisation is granted to the Applicant as set out under the authorisation number **UKREACH/25/17/00** for the following use:
    a. **UKREACH/25/17/00:** For industrial spraying of chromium trioxide mixtures for the coating of metallic articles subject to harsh environment, to ensure a high temperature corrosion and oxidation resistance, as well as anti-fouling properties or lubricity at high temperature, for automotive, aviation, power generation machinery, oil and gas and marine applications of chromium trioxide.
3. The review period referred to in Article 60(9)(e) of UK REACH is set at 3 years. The authorisation will cease to be valid on 29 July 2028 unless a review report is submitted in accordance with Article 61(1) of UK REACH by 29 January 2027.
4. The authorisation is subject to the following condition (as well as the requirement in Article 60(10) of UK REACH to ensure exposure is reduced to as low a level as is technically and practically possible):

[2] EU REACH refers to Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

a. The authorisation holder and its downstream users must adhere to the operational conditions (OCs) and risk management measures (RMMs) described in the chemical safety report referred to in Article 62(4)(d) of UK REACH,[3] subject to the monitoring arrangements specified in paragraph 5-6 below.

5. The authorisation is subject to the following monitoring arrangements for exposure of workers to Cr(VI):

    a. The authorisation holder shall implement monitoring for provision of at least 10 personal inhalation exposure measurements for each similar exposure group covering all of the relevant Worker Contributing Scenarios (WCSs) within the exposure scenario where Cr(VI) processes are undertaken. Workplace air sampling surveys should be undertaken at least once per year.

        In every case, these exposure measurements should:

            i) be based on the methodology specified in BS ISO 16740:2005[4];

            ii) be taken within the 30 cm breathing zone of the wearer, with samplers positioned on the outside of any Respiratory Protective Equipment (RPE) that may be worn.

    b. In the case of non-spraying operations, the information gathered shall be used to regularly review the effectiveness of the OCs and RMMs and if personal exposures are close to or above the Agency benchmark of 5 µg/m^3 as an 8-hour time-weighted average (TWA) action should be taken as appropriate to further reduce workers' exposure to Cr(VI).

    c. In the case of spraying operations, the Agency has indicated that effective control would amount to exposure values below the internal benchmark of 5 µg/m^3 as an 8 hr TWA (accounting for the use of RPE). If this exposure benchmark is breached, the following actions would be required:

            i) a thorough review on the working process shall be undertaken;

            ii) the information gathered should be used to regularly review the effectiveness of the OCs and RMMs, and if personal exposures are close to or above the Agency's benchmark

[3] This is a reference to the chemical safety report submitted by the Applicant on 13 November 2023 as part of the Application. The risk management measures and operational conditions are described in section 1 (summary of risk management measures).

[4] BS ISO 16740:2005 specifies a method for the determination of the time-weighted average mass concentration of hexavalent chromium in workplace air. This international standard is applicable to the personal sampling of the inhalable fraction of airborne particles, as defined in ISO 7708, and to static (area) sampling. The analytical method is applicable to the determination of masses of 0.01 micrograms to 10 micrograms of hexavalent chromium per sample, without dilution.

action shall be taken as appropriate to further reduce workers' exposure to Cr(VI);

iii) If the improvement of other non-RPE RMMs is insufficient to demonstrate the control of airborne Cr(VI) below the internal benchmark of 5 µg/m^3 8-hour TWA then consideration should be given to upgrading the RPE used from 40 to 2000 Assigned Protection Factor (APF).

d. If there is a case where the RMMs have been modified to reduce exposures, the authorisation holder should undertake a personal monitoring survey at least 4 times per year until they have obtained a minimum of 10 personal exposure data points, from which the new 90th percentile of the worker's personal exposure to Cr(VI) after the change in the RMMs shall be determined.

e. The results of these measurements should be made available to the Agency if requested.

6. The authorisation is subject to the following monitoring arrangements for exposure of humans to Cr(VI) via the environment.

a. The authorisation holder must:

i) undertake measurements of the concentrations of total chromium and Cr(VI) released to air and wastewater (as appropriate) for the site covered by the authorisation;

ii) use the monitoring data to improve or maintain the effectiveness of their OCs and RMMs in limiting releases to the environment;

iii) make the monitoring data available to the regulatory authority upon request.

b. The samples should be taken in accordance with good practice, from the stack and the final discharge point to the foul sewer. Laboratory analysis of total chromium and Cr(VI) should be undertaken by an accredited laboratory (e.g. MCERTS) using an appropriate level of detection and recognised method (e.g. those available for air[5] and water[6] at GOV.UK).

c. The measurements should be checked against the emission limit values and most up-to-date Best Available Technique (BAT)

[5] https://www.gov.uk/government/publications/monitoring-stack-emissions-techniques-and-standards-for-periodic-monitoring/monitoring-stack-emissions-techniques-and-standards-for-periodic-monitoring#chromium-vi

[6] https://www.gov.uk/government/publications/monitoring-discharges-to-water-cen-and-iso-monitoring-methods/monitoring-discharges-to-water-cen-and-iso-monitoring-methods

standards,[7] which will help inform the assessment of the appropriateness and effectiveness of the authorisation holder's OCs and RMMs, and risks to human health via the environment.

7. The Agency has set out recommendations for the Applicant in section 10 of its Opinion, should a review report be submitted in accordance with Article 61(1) of UK REACH. These recommendations are not conditions of authorisation or conditions for any review report.

Background

8. This decision is made under Article 60(4) of UK REACH and having obtained the consent of Scottish and Welsh Ministers.

9. In making this decision I have taken into account:

    a. the Application submitted to the Agency;

    b. the provisions of Article 60 of UK REACH, including the elements referred to in Article 60(4) and the requirements of Article 60(5);

    c. the Agency's Opinion.

Reasons

10. In its Opinion, the Agency concluded that it is not possible to determine a derived no-effect level for the carcinogenic and mutagenic properties of chromium trioxide. Therefore, for chromium trioxide, it is not possible to determine a threshold in accordance with section 6.4 of Annex I of UK REACH.

11. Therefore, and in accordance with Article 60(3)(a) of UK REACH, this means that Article 60(2) of UK REACH does not apply to the Application and authorisation may only be granted on the basis of Article 60(4) of UK REACH.

12. Authorisation may only be granted under Article 60(4) of UK REACH if it is shown that the socio-economic benefits outweigh the risk to human health or the environment arising from the use of chromium trioxide and if there are no suitable alternative substances or technologies.

Risk to human health

13. Chromium trioxide presents a risk to human health due to its carcinogenic and mutagenic properties.

Workers

14. The Agency noted limitations in the data supplied by the Applicant regarding the potential risk to workers. A reliance on modelled exposures for some of the WCSs created some uncertainties in the effectiveness of the RMMs. Therefore, in its Opinion the Agency concluded that this uncertainty should be

[7] The BAT standard for emissions to wastewater are 0.1 mg/L for Cr(VI) and 1.0 mg/L for total chromium. It is not possible to determine the concentration of Cr(VI) using the concentration of total chromium.

addressed by the implementation of the monitoring arrangement specified in paragraph 5.

15. The Agency also noted that, while the use of RPE by the Applicant with an APF of 40 could be appropriate and effective at limiting the exposure risk to spraying operatives in WCS 2, this could potentially be upgraded to RPE with an APF of 2000 by using positive pressure airline full face respirators with a demand valve. The Agency notes that the monitoring arrangement, specified in paragraph 5, will provide ongoing assurance that the current RPE used in the spray rooms remains appropriate and effective at reducing the amount of airborne Cr(VI) spraying operatives are exposed to, and has suggested that the Applicant give consideration to upgrading RPE if the Agency's internal benchmark of 5 $\mu g/m^3$ as an 8-hour Time Weighted Average is exceeded.

16. In its Opinion, the Agency concluded that the risk associated with worker exposure to chromium trioxide has been minimised to an appropriate and effective level, provided that the OCs and RMMs described in the Application are adhered to correctly and are appropriately maintained.

17. In its Opinion, the Agency considered that the biomonitoring results provide good evidence that the OCs and RMMs are appropriate and effective at controlling exposures from all routes. The Agency therefore concluded that the described OCs and RMMs are both appropriate and effective for worker exposures.

18. The Agency assessed the monetised human health impacts to workers to be up to £211,000 over the 3-year review period using the willingness to pay methodology.[8] This accounts for 29 directly exposed workers at one site in GB.

19. Having evaluated the Agency's assessment, I agree with its conclusion that the OCs and RMMs described in the Application are appropriate and effective in limiting risk to workers provided they are adhered to. I also agree that the implementation of routine monitoring will address the uncertainty created by the use of modelled data and provide assurance that the RMMs will continue to remain effective at minimising the exposures of workers to Cr(VI).

Humans via the environment

20. In its Opinion, the Agency noted three potential routes of exposure by which chromium trioxide could be released to the atmosphere – air, water and waste. The Agency considered the described RMMs in relation to the release of air and waste to be appropriate and effective based on the Applicant's compliance with the BAT standards for air and compliance with GB waste management legislation. However, due to concerns noted by the Agency in the data for emissions to air and water, exposure data has been modelled using the European Union System for the Evaluation of Substances (EUSES). The Agency was subsequently satisfied that these uncertainties were addressed by this modelling and used the resultant figures in its exposure

[8] Monetised statistical cancer cases were calculated using the formula - Discount factor x (fatality probability x value of a statistical life + value of cancer morbidity). Figures from an ECHA 2012 willingness to pay study are used for the value of a statistical life (€3.5 million to €5 million) and value of cancer morbidity (€0.41 million).

assessment. Nonetheless, the Agency proposed monitoring arrangements to prevent any future uncertainties regarding the monitoring data for exposure to humans via the environment.

21. The Agency also noted specific concerns in relation to releases to water, namely that the monitoring data taken by the Applicant indicates that the BAT standard of 0.1 mg/L of Cr(VI) has been exceeded on several occasions. These exceedances indicated that, although appropriate, the current OCs and RMMs were not always effective.

22. Due to the exceedances of the BAT standard for water by the Applicant and the variability and uncertainty in the data used to calculate emissions of Cr(VI) to air, the Agency proposed monitoring arrangements outlined in paragraph 6., The Agency expect this monitoring arrangement to provide feedback to the Applicant for when and where they should take appropriate action to improve OCs and RMMs when the BAT standard is exceeded, thereby offering assurance to the Applicant that their RMMs are, and continue to remain, appropriate and effective. We agree with this position.

23. In its Opinion, the Agency concluded that the OCs and RMMs in place to limit the risk of human exposure to Cr(VI) via the environment were not appropriate and effective because the number of exceedances of the BAT standard for water indicated that, although appropriate, they were not always effective. The Agency judged that the proposed monitoring arrangements should offer assurance to the Applicant regarding the effectiveness of the OCs and RMMs in place to reduce human exposure to Cr(VI) via the environment. We agree with this position.

24. The Agency assessed the monetised human health impacts to humans via the environment to be up to £212,000 over the 3-year review period using the willingness to pay methodology. This accounts for an estimated general population of 10,000 people at one site in GB.

25. Having evaluated the Agency's assessment, I agree with the Agency that the OCs and RMMs described in the Application are appropriate but not effective in limiting human exposure to Cr(VI) via the environment, and that the described monitoring arrangements will address concerns relating to the exposures of humans to Cr(VI) via the environment where these concerns are present.

Socio-economic analysis

26. In its Opinion, the Agency assessed the socio-economic benefits arising from the applied for use and the socio-economic implications of a refusal to authorise. The socio-economic benefits of authorisation consist of avoided producer surplus loss and avoided social cost of unemployment, and the Agency estimated this to be at least £4.3 million over 3 years.

27. There are additional qualitative benefits suggested by the Applicant, but these are not discussed in detail by the Agency. These include avoided losses to customers and avoiding customers potentially relocating outside of GB.

28. Having evaluated the Agency's assessment, I agree with its conclusions on the quantitative and qualitative benefits.

Conclusion on whether the benefits outweigh the risk

29. In its Opinion, the Agency concluded that the Applicant have demonstrated that the monetised socio-economic benefits of granting authorisation (at least £4.3 million over 3 years) are greater than the monetised risks to human health (up to £423,000 over 3 years).

30. I consider that the Applicant has shown that the socio-economic benefits outweigh the risk because of:

    a. the likely quantitative benefits in respect of the avoided producer surplus loss and avoided social cost of unemployment to the Applicant;

    b. the likely qualitative benefits in respect of avoided losses to customers and avoided costs of customer relocation outside of GB;

    c. the assessed risks from the use of chromium trioxide.

Alternatives

31. In its Opinion, the Agency concluded that there were no available alternative substances or technologies with the same function and a similar level of performance that were technically and economically feasible for the Applicant by the expiry date of their current authorisation (21 September 2024). However, the Agency noted that there is information available in the Application indicating that there are technically and economically feasible alternatives that will become available to the Applicant in the next 2-3 years. The Applicant noted in the Application that further testing is required to demonstrate this and as such have included these alternatives in their recent analysis of alternatives and substitution plan.

32. The Applicant noted that the purpose of the Application was to achieve the substitution of the remaining 15% of coatings that could not be achieved in the time frame of their initial Application. The Applicant established six requirements that would need to be met for an alternative to chromium trioxide to be considered feasible: to be sprayable, processability, convertibility to insoluble form, mechanical properties, chemical resistance and thermal resistance. Based on these requirements, the Applicant established five possible alternatives (four overlay coating systems and one coating for diffusion) to chromium trioxide.

33. The Applicant submitted a substitution plan as part of the Application. The substitution plan outlined three key steps that must be taken by their customers before they are able to implement an alternative. These were: qualification (including substance testing and component testing), certification and industrialisation. In their Application, the Applicant stated that qualification can take up to several years, with testing taking a further year and the estimated period of industrialisation varying depending on the process.

34. The three suitable alternatives identified by the Applicant in their previous Application have been internally tested and have demonstrated excellent performance. As part of their new Application, the Applicant has shortlisted five potential Cr(VI)-free alternative solutions based on results obtained from early research, development campaigns and consultations. These five

alternatives have been split into two categories based on the nature of the key alternative ingredient. Of these two - SermeTel and Sermaloy J – Sermaloy J is the furthest progressed, with two major customers having completed all tests on the material. This alternative is now in the process of being industrialised. Based on this information, the Agency concluded that the substitution plan is consistent with the information provided in the analysis of alternatives and judged that the Applicant has demonstrated convincingly that they are making good progress towards substitution and are moving forward in accordance with their substitution plan.

35. Having evaluated the Agency's assessment, I agree with the conclusion that there were no available alternatives by the expiry date of the authorised use and consider that the Applicant has discharged its burden of proof in demonstrating the absence of suitable current alternatives. In reaching this conclusion, I have considered the Agency's assessment of the technical and economic feasibility of alternatives and the consistency with the analysis of alternatives provided. I have also considered that the Applicant's initial trials with the favoured alternative suggest that it will be a successful substitution candidate.

Review period

36. In its Opinion, the Agency recommended the review period referred to in Article 60(9)(e) of UK REACH should be set at 3 years.

37. The Agency considers the Application to be a 'bridging' Application in order to allow the Applicant to transition to the alternatives identified. The Agency considered this in their recommendation of a 3-year review period. I agree with this position.

38. The Applicant initially requested a review period of 2 years. However, this was revised to 3 years when the Agency noted that no contingency time had been built into the substitution plan to allow for any issues with substitution to be overcome, for example with the pace of customer acceptance. The Applicant went on to state that they expect full substitution to be technically and economically feasible within 3 years, but they still endeavour to have substitution complete within 2 years.

39. Having evaluated the Agency's assessment, I agree with the Agency's conclusions on these points and its proposal for a 3-year review period.

Conclusion

40. For the reasons set out above I conclude that the socio-economic benefits outweigh the risk to human health for the use of chromium trioxide referred to in paragraph 2 and that there are no suitable alternative substances or technologies.

41. The Scottish Ministers and the Welsh Ministers have given their consent to this decision in accordance with the requirements of UK REACH.

Marc Casale

Deputy Director, Chemicals, Pesticides and Hazardous Waste

On behalf of the Secretary of State *for Environment, Food and Rural Affairs*