ANALYSIS OF ALTERNATIVES

and

SOCIO-ECONOMIC ANALYSIS

PROVIDED AS COMMENT TO THE PUBLIC CONSULTATION ON THE REACH RESTRICTION PROPOSAL ON PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Public

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CONTENTS

No copying / Use allowed – Property of Maschinenfabrik Kaspar Walter GmbH & Co. KG

No copying / Use allowed – Property of Maschinenfabrik Kaspar Walter GmbH & Co. KG

No copying / Use allowed – Property of Maschinenfabrik Kaspar Walter GmbH & Co. KG

LIST OF TABLES

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LIST OF FIGURES

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LIST OF ABBREVIATIONS

[redacted]	[redacted]
AfA	Application for Authorisation
CAGR	Compound Annual Growth Rate
CLP	Classification, Labelling and Packaging
CSR	Chemical Safety Report
DU	Downstream User
EBIT	Earnings Before Interest and Taxes
ECHA	European Chemicals Agency
EiF	Entry into Force
EEA	European Economic Area
EU	European Union
EUR	Euro
FTE	Full-Time working Equivalent
[redacted]	[redacted]
LCI	Labour Cost Index
NPV	Net Present Value
NUS	Non-Use Scenario
OEM	Original Equipment Manufacturer
PFAS	Per- and polyfluoroalkyl substances
PFOS	Perfluorooctane sulfonic acid
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
SDS	Sodium dodecyl sulphate
t	Tonnes

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1. SUMMARY

Maschinenfabrik Kaspar Walter GmbH & Co. KG, further on referred to as K. Walter, is a manufacturer of plating equipment for gravure and embossing cylinders and supplies customer-specific equipment for different segments: printing of packaging, decorative printing, printing of publication and embossing. The Device for the application of a Cr(VI)-based functional chrome plating of printing cylinders presents the core part of such plating systems and it is highly important that such coating provides multiple beneficial properties such as high wear resistance and longevity combined with the high-quality printing for long printing runs. During the Cr(VI)-based electroplating process at K. Walter's downstream users (DUs), a toxic Cr(VI)-containing aerosol is formed exposing the workers in the surrounding area. Therefore, K. Walter supplies its DUs with a mixture of [redacted] and [redacted] to be used as a mist suppressant / wetting agent in the Cr(VI)-based electrolyte and reduce the formation of Cr(VI)-containing mist and subsequent exposure of workers to this hazard (Note: when referring to [redacted] both substances, i.e. [redacted] and [redacted] are meant. The concentration of [redacted] in the mixture is almost two orders of magnitude lower).

In February 2021, K. Walter applied for the authorisation to continue the use of chromium trioxide in the formulation of chromium trioxide-based electrolytes for electroplating processes (Use 1) and the chrome plating of printing cylinders used for rotogravure printing and embossing (Use 2).

According to the substitution plan described in the AfA, the phase out of Cr(VI) and [redacted] at K. Walter's DUs is expected to be completed end of 2032. For K. Walter's [redacted] use, this translates to a required derogation timeline of 7.5 years (calculated from the expected EiF in mid-2025). However, since ECHA's restriction proposal only foresees 5(+1.5) year and 12(+1.5) year derogation options, K. Walter needs to request the 12-year derogation to cover the required time for substitution.

Please note that the 12-year derogation request is also in better alignment with recent R&D findings where K. Walter discovered that for special applications such as the plating of highly structured components (e.g. embossing with deep texture), there is still no chromium trioxide-free alternative process available at the current stage of development. Therefore, for highly demanding coatings, the continued use of chromium trioxide is expected after 2032. Consequently, the use of PFAS as wetting agents is also required.

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2. AIMS AND SCOPE

2.1. AIMS

The following substances are subject to this AoA and SEA:

TABLE 1: INFORMATION ON [redacted].

Substance	Intrinsic property(ies)[1]
[redacted]	[redacted]
[redacted]	[redacted]

Downstream users (DUs) of Maschinenfabrik Kaspar Walter GmbH & Co. KG (K. Walter) currently use wetting agents containing the PFAS substance [redacted] as surfactants during the electroplating of gravure or embossing cylinders with chromium trioxide. However, K. Walter is concerned with the non-availability of equivalent PFAS-free wetting agents.

As of now, there is no harmonised classification in Annex VI to Classification, Labelling and Packaging (CLP) Regulation, only self-classification. Determined health hazards are given in the table above (see Table 1). Evaluation and more details on the adverse effects of the substance can be found in the chemical safety report (CSR).

Currently, there are no restrictions in place regarding the [redacted] substance. However, the national authorities of Germany, the Netherlands, Norway, Sweden, and Denmark have submitted a joint REACH restriction proposal to limit the risks to the environment and human health from the manufacture and use of a whole group of PFAS, including also 6:2-FTS. The proposal was published by ECHA on 22 March 2023. Possible date of entry into force of this restriction is expected in 2025 with two restriction options considered:

- A full ban with no derogation and a transition period of 18 months
- A full ban with the use of specific time-limited derogations (18 months transition period plus either a 5-year or a 12-year derogation period).

In February 2021, K. Walter applied for the authorisation to continue with the use of chromium trioxide in the formulation of chromium trioxide-based electrolytes for electroplating processes (Use 1) and the chrome plating of printing cylinders used for rotogravure printing and embossing (Use 2). During the chromium (VI)-based functional chrome plating (Use 2) formation of Cr(VI)-containing mist occurs (due to the electrolysis) which poses a significant risk to workers on site. Therefore, K. Walter uses [redacted] as an adequate wetting agent and supplies their DUs to suppress Cr(VI)-containing mist and thus reduce the exposure of workers to this cancerogenic hazard.

[1] Self-classification

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In ECHA's final opinion, the committees proposed a review period of 12 years (until the end of 2032) for the continued use of chromium(VI)-based functional chrome plating in the manufacture of printing and embossing cylinders. After this period, K. Walter plans to implement either HelioChrome® NEO or/ and Helio® Pearl. It is important to note that none of these two alternatives require the use of PFAS-based wetting agents. Therefore, K. Walter would continue with the use of [redacted] only until chromium (VI)-based functional chrome plating is fully replaced.

The aim of this document is:

a) from the Analysis of Alternatives (AoA) side, to demonstrate that no technically and economically feasible alternatives to [redacted] are available at the moment or anticipated until the end of 2032;

b) from the SEA side, to demonstrate that the socio-economic benefits associated with the continued use of [redacted] by K. Walter's downstream users outweigh the remaining risks to human health associated with prevalent use conditions.

2.2. SCOPE

K. Walter is a manufacturer of plating equipment for gravure and embossing cylinders and supplies customer-specific equipment for different segments: printing of packaging, decorative printing, printing of publication and embossing. Device for the application of a chromium (VI)-based functional chrome plating of printing cylinders presents the core part of such plating systems and it is highly important that such coating provides multiple beneficial properties such as high wear resistance and longevity combined with the high-quality printing for long printing runs.

In the hard chrome plating baths of K. Walter's downstream users (DUs), a toxic Cr(VI)-containing aerosol is formed during the process, thus exposing the workers in the surrounding area. Therefore, to reduce the formation of Cr(VI)-containing mist and subsequent exposure of workers to this hazard, K. Walter supplies their DUs with [redacted] to be used as a mist suppressant / wetting agent in the Cr(VI)-based electrolyte. Addition of [redacted] to the Cr(VI)-based electrolyte results in significant reduction of surface tension of Cr(VI)-based electrolyte in which the components to be coated are immersed. This addition ultimately leads to highly effective suppression of formed Cr(VI)-containing aerosols.

High aqueous solubility and a high resistance to electrochemical degradation makes [redacted] ideal for a wide use in hard chrome plating processes, especially after the ban of PFOS, which was previously used to a large extent.

Over the last years, K. Walter has worked on a strategy to substitute chromium trioxide in the manufacture of gravure and embossing cylinders. This strategy features the development and implementation of the alternative manufacturing techniques Helio® Pearl and HelioChrome® NEO, focusing on Cr(III)-based plating. The use of PFAS-containing wetting agents is coupled to the use of Cr(VI).

According to the substitution plan described in the AfA, the phase out of Cr(VI) and [redacted] at K. Walter's DUs is expected to be completed end of 2032. For K. Walter's [redacted] use, this translates to a required derogation timeline of 7.5 years (calculated from the

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expected EiF in mid-2025). However, since ECHA's restriction proposal only foresees 5(+1.5) year and 12(+1.5) year derogation options, K. Walter needs to request the 12-year derogation to cover the required time for substitution.

Please note that the 12-year derogation request is also in better alignment with recent R&D findings where K. Walter discovered that for special applications such as the plating of highly structured components (e.g. embossing with deep texture), there is still no chromium trioxide-free alternative process available at the current stage of development. Therefore, for highly demanding coatings, the continued use of chromium trioxide is expected after 2032. Consequently, the use of PFAS as wetting agents is also required.

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3. ANALYSIS OF ALTERNATIVES

3.1. Use applied for

Fluorine-based surfactants are special type of surfactants where the hydrophobic tail is totally or partially (as in the case of [redacted]) replaced with fluorine molecules. Due to strong C-F bonds, these surfactants exhibit excellent physicochemical properties such as high thermal and chemical stability.

K. Walter provides [redacted] as a wetting agent for chrome plating of printing and embossing cylinders to reduce the airborne loss of chromium(VI) from the bath and thus decrease exposure of workers to this carcinogenic substance. The resulting effect provides following advantages:

- Reduction of exposure of workers to Cr(VI)-containing mist → due to the formation of oxygen and hydrogen bubbles on the electrodes which entrap chromic acid from Cr(VI)-based electrolytes (thus forming Cr(VI)-containing mist) and can burst once they reach the surface, there is a high exposure of workers to this hazardous substance. Addition of [redacted] to Cr(VI)-based electrolytes leads to the reduction of Cr(VI)-containing mist and employee's exposure is significantly lowered.
- Reduction of surface tension without formation of foam during electrolysis → the low surface tension alone ensures extremely small bubble size of the resulting gases so that almost no fog is formed from chromic acid electrolyte. For the purpose of low emission, electrolytes are encapsulated (closed cycle concept) and require a non-foaming electrolyte system or wetting agent such as [redacted] because of the strong internal hydrodynamics. Foaming would lead to contamination of the machine and inevitably to increased emission of chromium trioxide. Improved wetting properties → [redacted] enhances the wetting properties of the surfaces through the reduction of surface tension which allows it to spread more easily and evenly over a surface.
- Reduced carry-over of the process solution to the following sinks → the rinsing of the rollers after coating is carried out more effectively and the carry over into the downstream processes and ultimately into the wastewater is minimised.
- High chemical stability → [redacted] is highly resistant in the chemically aggressive medium of chromosulphuric acid in the chromium (VI)-based functional chrome plating. This also ensures low consumption of the substance since less addition of substance is required. Additionally, no degradation products are formed during the process which could influence the quality of chrome-plated components.

These properties are highly important in ensuring reduced exposure of workers to Cr(VI)-containing mist formed during the chromium (VI)-based functional chrome plating.

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3.2. Baseline scenario

3.2.1. The value chain of [redacted] in rotogravure printing

The end products from rotogravure printing are used in one of three market segments in the printing industry, namely packaging, publication and decorative gravure or for embossing applications.

3.2.1.1. Packaging gravure

For long printing runs and to achieve fine and clear images of high quality, rotogravure printing is the most preferred technique for packaging applications (Maschinenfabrik Kaspar Walter GmbH & Co. KG, 2015). Since multiple materials are used as print substrates, such as paper, plastic or aluminium foil, this segment is particularly sensitive to the use of chromium trioxide on the gravure cylinder's surface and thus also the use of [redacted] as a surfactant.

Around [redacted] % of all packaging for different kinds of products in supermarkets, discounters and drugstores are manufactured with rotogravure printing. This includes food products, cosmetics, tobacco or bottle labels. Out of total print sales in the EEA, the packaging segment contributes to [redacted] % of the market. Out of this share, [redacted] % can be attributed to K. Walter.

Within Europe, almost 350 packaging rotogravure plants with more than 800 packaging rotogravure presses can be found (European Rotogravure Association, 2021).

3.2.1.2. Publication gravure

Publication material, like magazines, catalogues, advertising inserts and flyers are also primarily printed with rotogravure. These constitute [redacted] % of total EEA sales in the printing industry, of which [redacted] % are related to K. Walter's products and services.

In Europe, around 93 publication rotogravure presses with a capacity of more than 2,500 tonnes of paper per year are in operation (European Rotogravure Association, 2021).

3.2.1.3. Decorative gravure and embossing

Decorative gravure is used to produce base paper for laminate flooring, PVC flooring, furniture, kitchen units and wallpapers. As high print quality is decisive in this segment, gravure printing is amongst the preferred choices.

The market for decorative applications constitutes [redacted] % of total EEA sales in the printing market of which K. Walter has a market share of [redacted] %. Around 80 decorative rotogravure plants with 300 decorative rotogravure printing presses are based in Europe (European Rotogravure Association, 2021).

3.2.1.4. Embossing

Embossing is used to apply a 3D-texture to a surface for either decorative or functional purposes. Decorative applications include, for instance, embossing wooden looks on furniture or flooring or the embossing of flexible/ plastic films. A functional application would be embossing a specific surface pattern in a way that it will provide anti-slip properties to the surface. For embossing, a multitude of materials is used, such as paper, aluminium foils, ceramic glass, leather or PVC floor coverings. Since achieving the desired

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embossing pattern is a long and expensive process, embossing cylinders are used for a long period of time. Thus, the functional chrome layer allows for resistance against wear and corrosion throughout their service life.

3.2.2. Key stakeholders involved in the supply chain

The vertical supply chain described in the following relates to the use of [redacted] in the chromium trioxide-based electroplating process of rotogravure cylinders and the dossier submitter’s role as a supplier of associated formulations and machinery. It covers suppliers (upstream supply chain) as well as customers (downstream supply chain) that are relevant to the scope of this derogation request. In all cases, there is close cooperation between K. Walter and the related actors, marking the importance of K. Walter as an important stakeholder in this segment.

Founded in 1906, K. Walter, is a German company in the rotogravure sector. K. Walter designs electroplating units for gravure form production used for rotogravure printing, as well as embossing applications (Maschinenfabrik Kaspar Walter GmbH & Co. KG, 2023).

In 2009, the Heliograph Holding was established around K. Walter. It comprises seven manufacturing companies and is the umbrella organization for the manufacture and handling of gravure and embossing cylinders and other technologies. It must be acknowledged that there is presence of other stakeholders in the upstream supply chain in the EEA. However, due to data constraints, the supply chain is explained from the perspective of K. Walter which can be seen as representative for the sector with K. Walter having the largest market share in the EEA in this segment.

Downstream of the supply chain, K. Walter provides its customers with wetting agents and electrolyte concentrates containing [redacted] along with chromium trioxide formulations and the self-manufactured plating machinery that are used in the chromium trioxide-based electroplating process of rotogravure cylinders. These Dus can be categorised into three different groups, namely intermediate service providers, printing companies with rotogravure cylinder manufacturing for self-use and a combination of the former two. The European rotogravure and embossing cylinder manufacturing market consists of a total of 102 Dus spread across multiple European countries. K. Walter alone has a market share of [redacted] % for the sale of plating units and consumables to these Dus in the EEA. Therefore, this derogation request can be seen as representative for the whole rotogravure printing and embossing market in the EEA.

Further down the supply chain are printing shops using the chromium trioxide coated rotogravure cylinders to manufacture end products in the packaging, publication, or decorative market along with embossing (see section 3.2.1.1, 3.2.1.2, 3.2.1.3 and 3.2.1.4) to be used by original equipment manufacturers (OEMs) in a consumer product. In addition to K. Walter’s products, the Heliograph Holding as an umbrella organization, and its subsidiaries provide further equipment and services, such as engraving or logistics along the supply chain.

3.2.3. Market and financial considerations

Over the last few years, the demand in gravure printing has increased in Europe with a share of 50 % in total printing processes and is the highest in Asia, with a share of 80 % (Chidambar, 2019). In Europe, around 1,200 gravure printing machines are in operation

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(Siever, 2020) and the market is expected to grow at a compound annual growth rate (CAGR) of 2.5 % (Market Research, n.d.).

Globally, the market for gravure printing is anticipated to reach a value of EUR 3.6 billion in 2023 and grow up to EUR 6.7[2] billion at a CAGR of 6.5 % (Future Market Inisghts, n.d.).

3.2.4. Description of the functions of the substance and performance requirements of associated products

[redacted] used as a wetting agent, primarily at K. Walter's Dus facilities, belongs to a large group of per- and polyfluoroalkyl substances (PFAS), synthetic chemicals widely used due to their desirable properties. [redacted] belongs also to a group of amphipathic molecules, meaning they consist of both polar hydrophilic head and non-polar highly hydrophobic fluorocarbon tail.

During the electrochemical process in Cr(VI)-based functional chrome plating, hydrogen is formed on the cathode and oxygen on the anode. Due to low efficiency of the Cr(VI)-based functional chrome plating, a significant amount of gas is formed which entraps the chromic acid, thus forming a Cr(VI)-containing mist and posing a significant health risk to workers on the site. As described in the application for authorisation the machines marketed by K. Walter have a sophisticated "closed loop" design minimizing the emission of chromium trioxide in general. Nevertheless, to reduce the formation of Cr(VI)-containing mist and subsequent exposure of workers to this hazard, K. Walter uses [redacted] as a wetting agent. By addition of [redacted] to the Cr(VI)-based electrolytes, surface tension of the aqueous solution is significantly reduced which impacts the size of the formed gas bubbles (i.e., leading to a smaller size of the bubbles). Subsequently, due to the smaller size, formed bubbles rise more slowly compared to large bubbles and instead of being emitted in the air the chances are higher they will fall back onto the surface of Cr(VI)-based electrolytes.

Another benefit achieved by adding [redacted] into the Cr(VI)-based electrolytes is uniformity and adhesion of the chromium layer on the surface of the component. More particularly, reduced surface tension leads to even spread of the plating solution across the surface of the substrate. This helps in preventing uneven coating thickness or other defects which may occur during the electroplating process.

When compared with other PFAS-free wetting agents, [redacted] exhibits high resistance to degradation during the exposure to extremely aggressive and strong oxidising agents such as chromic and sulphuric acid due to the presence of strong carbon-fluorine bonds.

[2] Note: Exchange rate of USD 1 = EUR 0.904681 as of 02.08.2023.

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3.2.5. Key process functionalities

Key advantages of the PFAS-based wetting agent in use are given in the table below.

TABLE 2: KEY PROCESS FUNCTIONALITIES OF PFAS-BASED WETTING AGENT.

Key process functionality	Technical Minimum Requirement (quantitative/qualitative)
Reduction of surface tension→ easier maintenance and cleaning of the facility	Reduced discharge of chromic acid. Less contaminated coating system.
Reduction of surface tension→ minimization of emissions via exhaust air	Reduced discharge of Cr(VI)-containing mist into the environment.
Reduction of surface tension → minimization of carry over or emission via wastewater	Reduced discharge of chromic acid. The rinsing of the rollers after coating is carried out more effectively and the carry over into the downstream processes and ultimately into the wastewater is minimised.
Reduction of surface tension → minimisation of worker exposure	Reduced discharge of chromic acid. Formation of aerosols is greatly reduced. The employee's residual exposure to chromic acid is lowered.
Degradation of the wetting agent to uncritical products	The chemical degradation of the wetting agent must not produce any substances that have a negative impact on the coating process.
No foam formation → minimised risk of explosion	The tendency of wetting agent to foam can lead to explosive foaming due to the gas evolution of oxygen and hydrogen during the electrolysis. This results in a high risk for the coating system and the operator. Therefore, foaming must be suppressed by a targeted use of a defoamer component. Use of [redacted] as a wetting agent results in no formation of foam thus ensuring reduction explosion risk.
Durability of the properties → improved process safety	Reduced surface tension. High resistance of the wetting agent in the chemically aggressive medium of the chromium-plating process with chromosulphuric acid.

3.2.6. Annual volume of the substance used

The total tonnage of PFAS that is used per year is estimated to 78 kg for the market share of K. Walter and 130 kg for the whole market or rotogravure.

3.3. Efforts made to identify alternatives

K. Walter screened the market for commercial PFAS-free products that theoretically could be used as wetting agent for Cr(VI)-based plating in its machine design for rotogravure cylinders. Available options have been investigated with laboratory scale experiments and tested against the currently used PFAS-based wetting agent.

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3.3.1. Prerequisite and mode of action of the wetting agents

Wetting agents in chrome tanks have two major influences on the coating process. Firstly, they lower the surface tension, which leads to smaller gas bubbles during electrolysis. On the other hand, they can lead to foam formation which covers the electrolyte surface. Both result in a significant reduction of the electrolyte discharge via aerosols.

The chromium plating equipment from K. Walter have a two-tank design. The electrolyte is located in a storage tank below and is conditioned there, i.e. heated, cooled and metered. As soon as a cylinder is brought into the upper coating trough, the machine closes, and the chrome electrolyte is pumped up. This has the advantage that the toxic process chemistry is always encapsulated and by this ensures lowest possible emissions. This system concept requires little to no foaming electrolytes, otherwise uncontrolled foaming will occur due to the strong hydrodynamics and gas formation in the coating system. Also, from an exposure point of view, it does not make sense to constantly control the foam formation and expose the worker to the process chemistry containing chromium trioxide.

In this context, K. Walter came up with the following lab scale test set-up (see Figure 1):

[redacted]

FIGURE 1: SET-UP FOR THE EVALUATION OF EFFECT OF WETTING AGENTS.

A 900 mL of Cr(VI)-based electrolyte used in Cr(VI)-based functional chrome plating process was prepared. To ensure the representative process conditions the beaker with the prepared electrolyte was put on the magnetic heating stirrer. For stirring the stirring power was set on level 1 (out of 5) while the temperature was kept at 60 °C.

The duration of electrolysis was 2 minutes at the current density of 50 A/dm. Round rod situated in the middle of the beaker presents the cathode, while the platinum-plated titanium anode is situated on the edge of the beaker. Both electrodes are connected with

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the external source of electric current (i.e., red cable is attached to anode, while the black cable is attached to cathode). Additionally, part of the set-up was the filter paper on top of the beaker which purpose was to trap the formed Cr(VI)-containing mist which otherwise would end up in the surrounding air. That way the amount of formed Cr(VI)-containing mist could be measured.

In the end, both aerosol formation and surface tension were measured with the additional observation of foam formation. More details on the obtained testing results are provided below.

The laboratory experiments show that it is possible to minimize aerosol formation by simply lowering the surface tension using a wetting agent. The wetting agent used, which contains PFAS, also contains another substance in a very low concentration, [redacted]. This acts as a defoamer and always ensures an undisturbed chrome plating process without foaming in K. Walter's closed loop systems. This PFAS-based wetting agent is referred to *HelioChrome® Wetting Agent FF*.

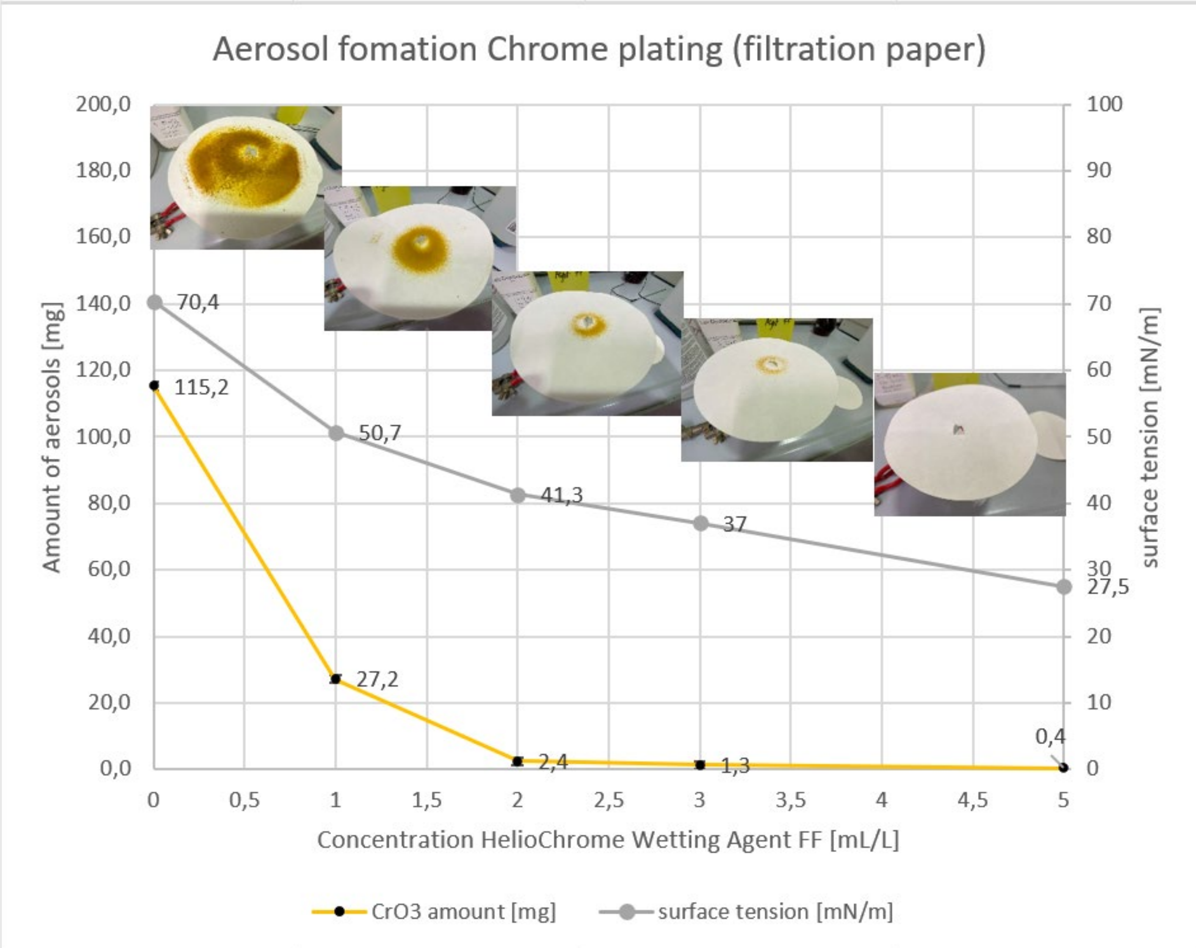

FIGURE 2: LAB-SCALE EXPERIMENTS TO SHOW EFFECTS OF WETTING AGENT.

Starting from high airborne Cr(VI) mist of 115.2 mg from electrolyte without any wetting agent the emission lowers tremendous at smaller surface tension. For initial concentration of 5 mL/L *HelioChrome® Wetting Agent FF* the amount of aerosol generated by electrolysis is zero respectively at the limit of detection. No foam formation was observed. For

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production process the surface tension is regularly controlled to set below 40mN/m ensuring a minimum of airborne emission.

3.3.2. Research and development

The following section details the efforts undertaken by K. Walter to gather insight in potential alternatives for the substitution of [redacted] used to suppress the Cr(VI)-containing mist formation during the chromium (VI)-based functional chrome plating.

Research and development activities included an in-house investigation on a commercially available alternative, [redacted] supplied by [redacted] supplied by [redacted]. Part of this investigation was also testing of a scenario in which no wetting agent is used. However, the investigation took place only on the laboratory scale because K. Walter decided to pursue the implementation of HelioChrome® NEO and/ or Helio® Pearl as Cr(VI) substitute. HelioChrome® NEO is a technology based on deposition of hard chrome layer from a Cr(III)-based electrolytes, while Helio® Pearl results in polymer-composite coating engraved directly on the surface of the component. Regardless of the technology, the use of PFAS-based wetting agent would not be required. After all, development and introduction of such technology represents the most efficient method to avoid both chromium trioxide and PFAS-based wetting agent.

[redacted] *supplied by* [redacted]

The [redacted] chrome wetting agent showed a significant foaming effect already after the addition of 1 mL/L which indicates this product lacks the defoaming component. While the formation of foam on the surface of Cr(VI)-based electrolytes is usually desirable since it reduces the emission of formed Cr(VI)-containing mist, it can also have a negative impact if the layer is too thick. More specifically, thicker layer of foam increases the risk of explosion due to the build-up of gases (formation of hydrogen on the cathode) during the electroplating process. Even though the suppression of Cr(VI)-containing mist this way would be guaranteed, an investigation showed that generated foam was still present even after one hour (see Figure 4), meaning the use of this wetting agent would pose too much of an explosion risk for operators of the plant.

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[redacted]

FIGURE 3: IMPACT OF [redacted] ON THE FORMATION OF AEROSOLS IN LAB SCALE TESTING.

The effect of lowering the electrolyte dust is achieved by foam layer. The surface tension is not as low as on [redacted].

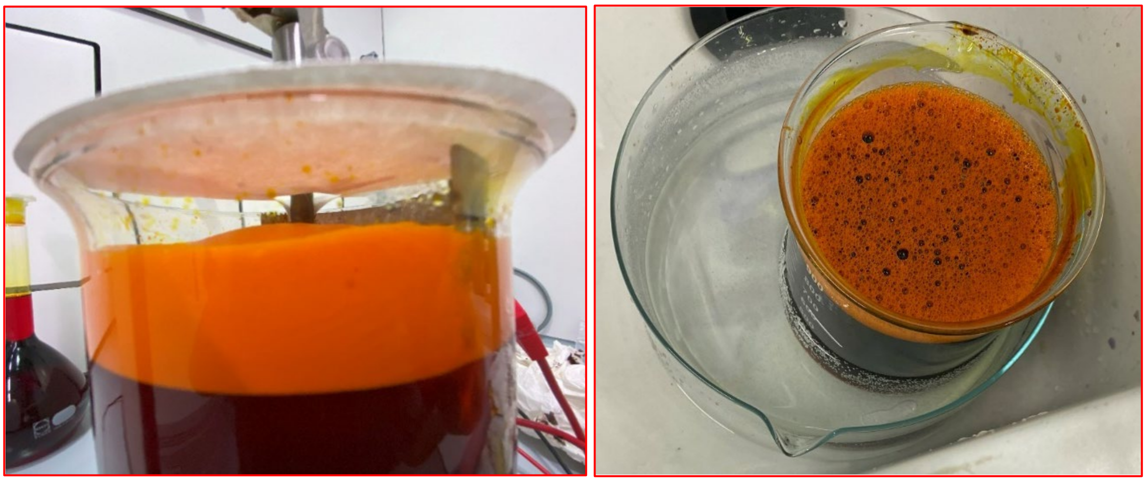

FIGURE 4: FOAM FORMED DUE TO THE ADDITION OF [redacted] WETTING AGENT SUPPLIED BY [redacted].

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[redacted]

The wetting agent of [redacted] show similar effects to chromium electrolyte as the product from [redacted]. There is foam from the lowest concentration, and it is stable over time. The effect of low aerosols is caused by the foam blanked.

[redacted]

FIGURE 5: IMPACT OF [redacted] PFAS-FREE WETTING AGENT ON THE FORMATION OF AEROSOLS IN LAB SCALE TESING.

No wetting agent

In case when no wetting agent is used, a considerable amount of Cr(VI)-containing aerosols is formed. According to the conducted experiment (see Figure 3), 0 mg/L of wetting agent results in Cr(VI)-based aerosol formation of approximately 120 mg. Despite a recirculation via exhaust air scrubbers, an increased emission of chromium trioxide could be expected which doesn't correspond to the values stated in the submitted authorization application. Furthermore, this would have a negative impact on the cleanliness of the plant and increased risk to the plant operator.

It is important to note that these research activities conducted as part of an in-house investigation took place while developing the alternative for Cr(VI)-based functional chrome plating. As the identification of alternatives progressed, an ultimate decision was made to proceed with the research on the two alternatives that do not require the use of PFAS-based wetting agent in their processes. Later, after ECHA's decision in which they

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support the substitution process with a review period, K. Walter decided to focus on the substitution of Cr(VI)-based functional chrome plating rather than on further research and development activities on PFAS-free wetting agent. That strategy ensures replacing both chromium trioxide and [redacted] as a PFAS-based wetting agent.

3.3.3. Consultations with customers and suppliers of alternatives

In addition to multiple efforts gained as part of in-house investigations on PFAS-based wetting agent alternatives, several technical exchanges were held with experts in the field of Cr(VI)-based functional chrome plating including:

- ChemAkademie symposium "PFAS not included quantitatively in the monetised impact assessment – restriction, exceptions, socio-economic analysis" in Bonn
- Technical exchange with R&D department of [redacted]
- Technical exchange with R&D department of [redacted]
- Technical exchange with R&D department of TU Ilmenau
- Exchange on general expertise at the annual events of the industry ("ZVO Annual Conference" and "Ulm Talks")
- Technical exchange with production and management of [redacted]
- Technical exchange with Electroless Nickel & Hard Chrome Department of [redacted]

Participation in numerous consultation and exchange activities shows the willingness of K. Walter to identify potentially implementable alternatives for PFAS-based wetting agents. However, regardless the efforts, no alternative has been identified so far that is able to fulfil all key process functionalities defined in section 3.2.5.

3.3.4. Data searches

In addition to research and development activities performed as part of an in-house investigation (see section 3.3.1), K. Walter also did a research on other commercially available alternatives, one of them being [redacted] supplied by [redacted]

[redacted] is a wetting agent added to electrolytes used in chromium(VI)-based electroplating process. The name of the wetting agent indicates the presence of [redacted], an essential component in the Cr(VI)-based electrolytes. In a specific range of 2.8 to 4.4 g/L, [redacted] has a very favourable effect on electrochemical chromium deposition. Outside that range, especially above 4.4 g/L, the impact the [redacted] has on the electrochemical chromium deposition is strongly negative and can even lead to a complete destruction of the chrome coating.

Presence of simple hydrocarbon chains leads to a low chemical stability of the wetting agent which ultimately leads to gradual degradation in the chrome electrolyte. More specifically, only carbon dioxide, water, and [redacted] remain. This accumulation of [redacted] can lead to problems in the long run. The supplier of this wetting agent suggests dosing rates in the range of 1 – 2 mL/L/day. Taking into account that this wetting agent

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is 1 % [redacted] solution, that means that 3.4 to 6.8 µL/L of [redacted] are introduced into the chromium(VI)-based functional chrome plating every day leading to the accumulation of the substance. Consequently, after approximately one year, the limit would have been brought from the lower to the upper [redacted] limit.

In decorative chrome plating baths, successive electrolyte discharge can be expected to rejuvenate the chromium bath, i.e., counteract [redacted] enrichment. However, in K. Walter's Cr(VI)-based functional chrome plating, such bath rejuvenation does not occur due to high recirculation rates. Therefore, in order to avoid discard of electrolyte at regular intervals and subsequently increase the use of chromic acid, the use of [redacted] as a wetting agent is not feasible.

Based on the findings presented above, K. Walter decided not to proceed with the laboratory testing of [redacted].

Furthermore, an attempt was made to use a wetting agent from the company [redacted] in order to carry out laboratory tests. According to the company's own information, the product [redacted] is the first fluorine-free, non-PFOS, non-PFAS foam suppressant. Unfortunately, this wetting agent was not available on the market. An inquiry to the manufacturer was equally unsuccessful. [redacted] argued that K. Walter was a competitor and therefore the product [redacted] could not be supplied. In discussion with the company [redacted] and from technical data sheet, K. Walter was able to gain more information for the mode of action for [redacted]. The following theoretical considerations are derived from this.

The wetting agent consists of two components [redacted] and [redacted] The former lowers the surface tension and produces a pronounced foam blanket. The latter is added to a much lesser extent and controls the thickness of the foam or acts as a defoamer component. [redacted] must be added as required. The wetting agent is only effective in a certain concentration range, where foam formation is low but not prevented. Without foam, the effect of preventing aerosol formation is not given. The product therefore requires a system concept that is open and visible, which in turn contradicts the "closed cycle" systems of K. Walter.

The dosing rates of the wetting agent components are about a factor of ten higher than known from the PFOS- or [redacted]-based wetting agents used to date. Consequently, the stability in chromic acid-based electrolytes is only low. On the one hand, this makes process control difficult since the components must be constantly controlled and re-dosed. Respectively the risk of higher emissions due to aerosol formation increases or the process could be impaired by excessive foaming. On the other hand, degradation products are produced to a large extent, which can have a negative influence on the electrolysis process (comparable to [redacted]) or lead to reduced quality of the deposited chromium layer.

3.3.5. Identification of alternatives

Table 3 shows the alternatives identified and investigated by K. Walter to substitute the PFAS-based wetting agent currently used in chrome plating of printing cylinders used for rotogravure printing and embossing. Identification of alternatives was based on the consultations held with formulators in the field of electroplating chemistry, conducted

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market research, exchanges with companies in the field of chromium (VI)-based functional chrome plating as well as on the consultations held with scientific institutes.

All alternatives identified as potentially implementable alternatives have been rejected due to significant technical limitations (alternatives no. 1 – 3).

An overview of the limitations leading to the rejection of alternatives is presented in section 3.3.6.

TABLE 3: A LIST OF PFAS-BASED WETTING AGENT ALTERNATIVES.

Category	No.	Alternative	Supplier
Rejected alternatives	1	[redacted]	[redacted]
	2	[redacted]	[redacted]
	3	[redacted]	[redacted]
	4	[redacted]	[redacted]
	5	No wetting agent	-

3.3.6. Assessment of rejected alternatives

An overview of the limitations that led to the exclusion of alternatives no. 1 – 5 is given below in Table 4. Please note that only the criteria leading to the exclusion of each alternative is shown.

TABLE 4: LIMITATIONS OF REJECTED ALTERNATIVES.

Alternative	Limitations met
[redacted]	• Significant foam formation • Increased explosion risk due to foam formation • Contamination of plating machine an higher exposition by foam
[redacted]	• Significant foam formation • Increased explosion risk due to foam formation • Contamination of plating machine an higher exposition by foam
[redacted]	• Low chemical stability of the wetting agent • Gradual degradation of the wetting agent in the Cr(VI)-based electrolyte • Accumulation of [redacted]
[redacted]	• Limited availability • Difficult control, especially in closed systems • Low stability can have negative effects on the coating process and the coating quality
No wetting agent	• Considerable formation of Cr(VI)-containing mist • Increased discharge of Cr(VI) by at least a factor of 200 • Negative impact on the cleanliness of the plant • Increased exposure of workers to Cr(VI)-containing mist • Increased transfer of Cr(VI) into subsequent process

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4. SOCIO-ECONOMIC ANALYSIS

4.1. Continued use scenario

4.1.1. Summary of substitution activities

The overall substitution potential of PFAS-based wetting agent by alternatives that could potentially be implemented was mainly based on K. Walter's in-house investigation (see section 3.3.1) where the investigated alternative was [redacted] and a scenario in which no wetting agent is used.

Another important aspect is the fact that K. Walter already decided to substitute chromium trioxide used in chromium (VI)-based functional chrome plating for which an application for authorisation has been filed in 2021. ECHA's opinion on the AfA suggest a review period until end of 2032. More precisely, K. Walter decided to implement HelioChrome® NEO and/ or Helio® Pearl, alternatives which are based on Cr(III)-based electrolytes and polymer coating, respectively. Large advantage of those alternatives is that none of them requires the use of PFAS-based wetting agent, meaning that the dossier submitter would use the PFAS-based wetting agent only during the transitional period, until the full substitution of chromium trioxide takes place.

At this point, the use of PFAS-based wetting agent is crucial to maintain the exposure and emission values specified in the AfA application. In particular, only with this wetting agent can such low emissions be achieved that protect both people and the environment. The wetting agent containing PFAS ensures that formed chromium(VI) aerosols are not emitted or are emitted to a very low extent. Again, [redacted] used for this purpose by K. Walter would only be used for until the implementation of a new alternative process.

4.1.2. Conclusion on suitability of available alternatives in general

Based on the conducted in-house research on potentially implementable alternatives and exchange with experts in the field of hard chromium electroplating process, K. Walter concluded that none of the PFAS-free alternatives is able to fully meet the key functionalities required (main concerns are related to the exposure of workers to Cr(VI)-containing mist formed during the process). At this point, further R&D on PFAS-free wetting agents could only prolong the substitution of Cr(VI)-based functional chrome plating and increase the financial burden K. Walter is already experiencing due to the ongoing substitution. Hence, K. Walter decided to put all its efforts on the substitution of chromium(VI)-based functional chrome plating with the alternative that does not require the use of PFAS-based wetting agent.

The substitution plan for this scenario is given in section 4.1.3.

4.1.3. Substitution plan

4.1.3.1. Factors affecting substitution

The substitution of PFAS-based wetting agent largely depends on the substitution of chromium(VI)-based functional chrome plating, since none of the planned alternatives require PFAS-based wetting agents.

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However, an aspect that could slow down the substitution process is a complete ban on PFAS, especially fluoropolymers such as Teflon (used in HelioChrome® NEO or Helio® Pearl equipment).

4.1.3.2. Justification for derogation request

In 2021, K. Walter submitted the AfA to continue the use of chromium(VI)-based functional chrome plating and estimated that at least 12 years will be needed for a complete transition to a Cr(VI)-free alternative. The final opinion from ECHA supports a review period of 12 years, meaning the use of chromium trioxide would be allowed until the end of 2032 in case of successful decision by the EU Commission.

As mentioned above, substitution of PFAS-based wetting agent largely depends on the substitution of chromium(VI)-based functional chrome plating. At this point, K. Walter has finalized the technical development phase which comprised of development of stable process parameters to ensure the quality and reproducibility of the new technology. After the completion of this phase, K. Walter started with the next step in the implementation process, the external R&D phase. Therefore, at this point, K. Walter is putting all its efforts to successfully finalize the external R&D phase and move towards the transition period during which K. Walter will continuously substitute the chromium(VI)-based functional chrome plating at Dus with either Cr(III)-based electroplating or polymer coatings.

Transition period will take place approximately two years before the end of the External R&D phase (around 2025). Since none of the alternatives for chromium(VI)-based functional chrome plating require the use of PFAS as a wetting agent, a progressive decrease in the volume of [redacted] is expected, which will occur in parallel with a decrease in the volume of Cr(VI). It is important to note that the length of the transition period largely depends on how fast K. Walter can manufacture the new machines and how fast it can build the know-how required for the service. The transition phase must be done steadily over time. Dus must be convinced to switch as early as possible but it is not possible building more than 200+ machines for more than 100+ Dus in short time. Another limiting factor might be the low availability of qualified personnel on the labor market which could prevent the simultaneous installation and servicing of new plating units at several sites.

It is very important that K. Walter continues with the substitution of chromium(VI)-based functional chrome plating since that would ensure the substitution of both undesirable substances (chromium trioxide and [redacted]). At this point, additional research and implementation of potentially implementable PFAS-free wetting agent could not just prolong the substitution of chromium(VI)-based functional chrome plating but also create unfavorable working conditions.

According to the substitution plan described in the AfA, the phase out of Cr(VI) and [redacted] at K. Walter's Dus is expected to be completed by the end of 2032. For K. Walter's [redacted] use, this translates to a required derogation timeline of 7.5 years (calculated from the expected EiF in mid-2025). However, since ECHA's restriction proposal only foresees 5(+1.5) year and 12(+1.5) year derogation options, K. Walter requests the 12-year derogation to cover the required time for substitution.

Please note that the 12-year derogation request is also in better alignment with recent R&D findings where K. Walter discovered that for special applications such as the plating

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of highly structured components (e.g. embossing with deep texture), there is still no chromium trioxide-free alternative process available at the current stage of development. Therefore, for highly demanding coatings, the continued use of chromium trioxide is expected after 2032. Consequently, the use of PFAS as wetting agents is also required.

4.1.3.3. Monitoring of the implementation of the substitution plan

In order to successfully phase out the use of [redacted], K. Walter will progressively ramp up the potential and implementation of alternative technology. This will contribute to both substitution of Cr(VI)-based electrolyte and at the same time fluorine-based wetting agent. Therefore, to ensure a good implementation of the substitution plan, a monitoring strategy has been developed to ensure the appropriate development of the substitution efforts.

The development of the most promising alternatives, Cr(III)-based electroplating and polymer coatings, is managed through separate project leaders. For both projects, internal timetables as well as milestones with due dates are defined to monitor development/substitution progress. Each project is split into three different teams: mechanical engineering, electrical engineering and software and process engineering. Updates of the team leaders are reported to the project leaders as well as the CEO in an internal weekly meeting. The manager responsible for the preparation of the AfA is a further member of this meeting.

In order preparing transition phase K. Walter qualified HelioChrome Neo process at DU [redacted] in 2023. One plating machine is in beta-site production and one more plating line for Cr(III)-based plating is in budget consideration. This would be then the first company with a Cr(VI)-free production. Currently, K. Walter is in discussion with seven additional companies to prepare for the transition period by implementing HelioChrome Neo. In 2023 the Cr(III)-based process was introduced to the market. It is planned to have the first systems implemented from 2025 onwards.

Polymer coated cylinders are evaluated on the printing press of the Hochschule der Medien, Stuttgart. Reports of the printing quality and surface wear are generated from the operators of the printing machines and sent to the project leaders of K. Walter.

Possible technologies not provided by K. Walter are discussed and monitored through the participation in biannual meetings of the industry associations (ACIMGA, ERA, GAA). Furthermore, national distribution partners, which are not part of Heliograph Holding, provide further insight in national markets and technologies offered to Dus.

4.1.3.4. Conclusions

During the research and development respectively screen phase, K. Walter identified several potentially implementable alternatives. However, an insight into those alternatives showed they are not technically and economically feasible alternatives that could replace the use of [redacted] as a wetting agent in Cr(VI)-based functional chrome plating. Further R&D would be needed to find alternatives that could fulfil all the key process functionalities (main concerns are related to the exposure of workers to Cr(VI)-containing mist formed during the process) currently provided by PFAS-based wetting agent.

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However, as the research progressed, ECHA announced they support a requested review period for a complete transition to Cr(VI)-based electroplating, meaning the use of chromium trioxide can be used until the end of 2032. Therefore, K. Walter decided not to proceed with the further R&D but rather put all its efforts into the substitution of Cr(VI)-based electroplating with an alternative that doesn't require the use of PFAS-based wetting agent.

4.1.3.5. References

1. Federal Environment Agency (UBA), Best available techniques for PFOS substitution in the surface treatment of metals and plastics and analysis of alternative substances to PFOS when used in equipment for chromium plating and plastic etching, 2022

4.2. Emissions as a proxy for risk

As mentioned before, K. Walter has a total of 102 Dus in the EEA, that are supplied with plating machinery and liquid formulations for the electroplating of gravure and embossing cylinders. The [redacted]-containing wetting agents are added at the DUs' sites for the chrome plating of gravure and embossing cylinders in a closed electroplating unit to lower the surface tension of the electrolyte and thus to reduce the formation of explosive or hazardous gases.

K. Walter's chrome plating process is designed in an automated way so that no staff is involved and thus no contact with the wetting agents takes place. After the plating process, the cylinder is automatically rinsed with water, which will remain within the closed loop-system. Consequently, any exposure from [redacted] in the electrolyte solution can be held low.

During the electroplating, exhaust air is passed through wet scrubbers and the captured water is redirected into the process cycle. No air emission measurements for PFAS were available, but an estimation of emissions conducted in the Chemical Safety Report (CSR) assumes releases of 0.108 kg of [redacted] from the plating processes at all sites per year.

The chromium solution, containing [redacted], is exchanged around once every twelve years and is disposed of as hazardous waste via incineration. The maximum PFAS concentration in the electrolyte solution entering the waste stage can be estimated at [redacted] kg once it needs to be exchanged. Extrapolated on the 102 DUs of K. Walter and based on the number of exchanged electrolytes during the last three years, 1.16 kg of PFAS waste accrue per year. As stated in the ECHA restriction proposal (Section 1.1.5.5), the efficiency of incineration depends on numerous conditions and a complete destruction (100%) of PFAS is not expected. However, please note that the values above represent a worst-case scenario. While it is acknowledged that a small proportion of PFAS may be emitted from incineration, it would not be adequate to assume that the total waste fraction is released to the environment.

Thus, a total of 0.108 kg of PFAS emissions are expected to be generated annually. However, it is very likely that these emissions will decline due to a decreasing use of Cr(VI) at K. Walter and across its supply chain.

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4.3. Restriction scenario

This chapter describes the hypothetical scenario resulting from a PFAS restriction which serves as a basis for the following assessment. According to current expectations, a potential PFAS restriction is assumed to enter into force mid-2025, with an 18-months transition period. Depending on whether and which derogations for PFAS uses would be foreseen within the restriction text, there would be different socio-economic costs as well as health and environmental benefits for the EEA society.

If no exemption is granted for rotogravure printing, K. Walter will no longer be able to provide its DUs with plating formulations and machinery for this printing process due to the unavailability of a commercial alternative. As a result, the company may consider relocating its production outside the EEA, potentially to Asia where the majority of rotogravure printing customers are based. In this scenario, the producer surplus associated with rotogravure printing equipment and formulations sales incurred within the EEA would be lost. This would include sales within the EEA and outside. Consequently, the dossier submitter estimates that around [redacted] % of full-time working equivalents (FTEs) in the EEA, which equates to approximately [redacted] FTEs, could face dismissal.

Similarly, as the Heliograph Holding's rotogravure business strongly depends on the sales of plating units used in rotogravure printing, it would also relocate its production activities outside the EEA and its subsidiaries would permanently shut down their business activities. In this scenario, the producer surplus associated with rotogravure printing equipment sales incurred within the EEA would be lost. Consequently, respectively [redacted] FTEs from Heliograph Holding and [redacted] FTEs from its subsidiaries, overall, in the EEA are likely to be dismissed.

To assess the reaction of the DUs due to a restriction, the survey conducted for K. Walter's application for authorisation (AfA) for the use of chromium trioxide in 2021 was used (ECHA, 2021). As part of the survey, DUs chose their most likely non-use scenario (NUS) in case they could no longer perform electroplating for rotogravure printing and embossing (end application where the wetting agent containing PFAS is used). Based on these results, it was derived that the majority of DUs (27 %) would permanently shut down their chromium trioxide-dependent gravure and embossing cylinder production in the EEA and around 13 % would temporarily shut down until an alternative is implemented. Furthermore, 8 % decided that relocating the Cr(VI)-dependent gravure and embossing cylinder production outside the EEA would be their most likely NUS. Another 7 % of the DUs would either switch to another already available printing technology (e.g., digital printing, flexography or polymer cylinders) or outsource the chromium trioxide-dependent processes to service providers outside the EEA. Lastly, 2 % stated that none of the proposed scenarios would be applicable for them.

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5. IMPACT ASSESSMENT

This chapter assesses the impacts of the individual most-likely restriction scenarios in the EEA for each stakeholder. The impact assessment assumes that the restriction enters into force mid-2025. However, for simplicity in the assessment, values were discounted to the beginning of 2025. Based on a transitional period of 18 months, the impact realization period commences in the beginning of 2027. The socio-economic impacts are then discounted to the base year of 2025 using a social discount rate of 3 %.

Based on the restriction scenarios demonstrated in chapter 4.3 for the Heliograph Holding and its subsidiaries, K. Walter and its DUs, the following impacts were considered:

- Foregone profits
- Job dismissals
- Additional investment costs (one-off costs)
- Additional annual operating costs

Additional impacts that were taken into account for K. Walter's DUs, include the following:

- Changes in product quality
- Changes in the market price for end consumers
- Changes in customer retention and market position

5.1. Impact on Heliograph Holding and its subsidiaries

5.1.1. Producer surplus losses

Methodology

To estimate producer surplus losses, SEAC's guidance on evaluating losses in producer surplus, was followed (ECHA, 2021). The approach focuses on the estimation of profit losses from premature retirement of productive capital assets as an indicator of producer surplus losses. To maintain a conservative approach, foregone profits were considered to accrue over a period of 2 years only. As a financial indicator for the profit, the EBIT of Heliograph Holding and its subsidiaries is used for this assessment.

Assumptions

For valuation purposes, the Cr(VI)-dependent EBIT of Heliograph Holding and its subsidiaries for the year 2021 is taken. This is based on the assumption that the use of [redacted] is closely tied to the use of Cr(VI) and similar EBIT levels are anticipated in the future. As previously mentioned, it is assumed that the impact realization begins 18 months after the submission, namely in 2027. Therefore, the EBIT losses are estimated for 2027 and 2028 following the conservative approach. These values are discounted to the base year of 2025 by using a social discount rate of 3 %.

Results

As a result of the restriction, the annual producer surplus losses anticipated by Heliograph Holding and its subsidiaries are estimated at EUR [redacted] million and EUR [redacted] million

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respectively. This translates to a total NPV of EUR [redacted] million in 2025 and an annualised value of EUR [redacted] million per year over the requested derogation period of 12 years.

5.1.2. Societal costs of unemployment

Methodology

Following the methodology presented in a report commissioned by ECHA (Dubourg, 2016), the social costs related to the expected employment loss in the restriction scenario are valued considering multiple components, such as the value of lost output/wages during the period of unemployment, the cost of acquiring a new job or recruitment costs. The NPVs for the social costs of one job position made redundant in the perspective country in 2025 are calculated by using the figures from the paper from Dubourg, which have been updated with data on wages presented by Rogers and Marques (Rogers & Marques, 2021) and data on the duration of unemployment in 2021 as reported by Eurostat (Eurostat, 2022).

First, annual salaries (as of 2021) for the respective country were taken from the paper by Rogers & Marques. These salaries were then adjusted to 2027 values taking an average Labour Cost Index (LCI) of 2.425 % into account, which is based on LCI values registered between 2016 and 2021 and provided by Eurostat (Eurostat, 2022 b). Note that, although data estimations of Rogers & Marques on wages might be already available for 2022, for consistency issues data of 2021 have been used for the estimation of social costs.

Assumptions

As a result of the restriction, [redacted] FTEs from Heliograph Holding and [redacted] FTEs from its subsidiaries respectively, overall, in the EEA are likely to be dismissed. Since they are based in multiple EU countries, the annual salaries for EU-27 were consulted. Based on the aforementioned methodology, the cost of losing one job in EU-27 is valued at EUR 0.098 million in 2027.

Results

The total social costs of unemployment generated due to the restriction at Heliograph Holding and its subsidiaries in the EEA are estimated at EUR [redacted] million for [redacted] FTEs. The NPV in 2025 is estimated at EUR [redacted] million and the annualised value is EUR [redacted] million per year over the derogation period of 12 years.

5.1.3. Additional investment and operating costs

As, in a restriction scenario, the Heliograph Holding would decide to relocate its production sites outside the EEA, it would incur additional one-off investment costs, such as decommissioning costs for the sites within the EEA, investment and planning costs for the establishment of new sites outside the EEA and requalification expenses. Since the subsidiaries of Heliograph Holding would shut down, additional decommissioning costs would be accrued. However, as it is highly uncertain to what extent these costs would occur, these were not further monetised but only qualitatively indicated for the impact assessment.

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5.2. Impact on K. Walter

5.2.1. Producer surplus losses

Methodology

See methodology explained in chapter 5.1.1.

Assumptions

See assumptions presented in chapter 5.1.1.

Results

In 2022, K. Walter generated total annual revenues of EUR [redacted] million and PFAS-dependent revenues of EUR [redacted] million. As a result of the restriction, K. Walter's anticipated annual EBIT loss is estimated at EUR [redacted] million[3]. As profit loss for at least two years is taken into account, this would translate to an NPV of EUR [redacted] million in 2025 and EUR [redacted] million in annualised value per year over a derogation timeline of 12 years when discounted at a social discount rate of 3 %.

5.2.2. Social costs of unemployment

Methodology

See methodology explained in chapter 5.1.2.

Assumptions

Headquartered in Krailling, a district of Starnberg in Bavaria, Germany, the company employs a total of [redacted] people. As a result of the restriction, [redacted] FTEs from K. Walter, overall, in the EEA are likely to be dismissed. Since K. Walter's employees are based in Germany, the annual salaries for Germany were consulted. These values are discounted to the base year of 2025 by using a social discount rate of 3 %. Based on this, the cost of losing one job in Germany is valued at EUR 0.15 million in 2027.

Results

Consequently, the total social costs of unemployment due to the restriction at K. Walter in the EEA are estimated at EUR [redacted] million. The NPV in 2025 for that amount is approximately EUR [redacted] million and the annualised value is EUR [redacted] million per year over a derogation timeline of 12 years.

5.2.3. Additional investment and operating costs

Due to the relocation of its production sites to a non-EEA country, the company would incur additional one-off investment costs, such as decommissioning costs of K. Walter's sites located in the EEA, investment and planning costs for the establishment of the new site(s) and requalification expenses. Due to uncertainties related to the extent of this cost

[3] Since the use of the PFAS substance [redacted] is tied to the use of Cr(VI) and the total revenues associated with it, this socio-economic assessment (chapter 5.4.1.) considers Cr(VI)-dependent revenues for K. Walter.

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impact, these costs are not assessed quantitatively under the scope of this derogation and are only considered in a qualitative manner.

5.3. Impact on DUs

An evaluation of the consequences for downstream users (DUs) was carried out employing a representative DU model, which was developed from input gathered through the survey concerning the AfA application for chromium trioxide. This theoretical DU model enabled the extrapolation of potential ramifications for those DUs who did not participate in the survey. In order to preserve a conservative approach within the socio-economic assessment, the financial estimations – calculated from the predominant DU inputs within the AfA – were utilized to determine the repercussions along the supply chain's downstream stages.

5.3.1. Characteristics of a model DU

TABLE 5: CHARACTERISTICS OF A MODEL DU.

Characteristics of a model DU		
Number of sites per DU	1	
Average total annual revenue	EUR 1 million	EUR 10 million
Representative % revenues	50 %	
Average revenues	EUR 0.5 million	EUR 5 million
Representative average profit margin	1 %	10 %
Average profit	EUR 0.005 million	EUR 0.5 million
Average number of exposed employees	6	

5.3.2. Producer surplus losses

Methodology

See methodology explained in chapter 5.1.1.

Assumptions

To assess producer surplus losses for DUs incurred in the restriction scenario, the lower and upper bound values for average revenues of a model DU were taken and extrapolated to K. Walter's 102 DUs. These average revenues were initially derived by using the mode of total annual revenue stated by 70 % of DUs. To define representative figures for a model DU, further mode values of revenue share (%) and profit margin were used. In this assessment, these values are discounted to the base year of 2025 by using a social discount rate of 3 %.

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Results

Based on the DU survey, a model DU generated an annual EBIT between EUR [redacted] million and EUR [redacted] million (see Table 5) in 2021, which was extrapolated for the EEA 102 DUs. Assuming constant growth, the annual gross profit losses incurred by DUs amount to between EUR [redacted] million and EUR [redacted] million respectively in 2027 and 2028 each. This amounts to an NPV between EUR [redacted] million and EUR [redacted] million in 2025. When discounted at a social discount rate of 3 %, the annualised value lies between EUR [redacted] million and EUR [redacted] million per year over a derogation timeline of 12 years.

5.3.3. Social Costs of unemployment

Methodology

See methodology explained in chapter 5.1.2.

Assumptions

A model DU has on average [redacted] directly exposed workers directly associated with rotogravure plating activities incorporating the wetting agent, that would be likely to be dismissed (see Table 5). This value was derived by taking the total number of exposed workers per total number of DUs addressed in the survey. To include the maximum risk to these workers, this number was calculated based on a conservative approach. Since K. Walter's DUs are located in multiple EU countries, the annual salaries for EU-27 were consulted. These values are discounted to the base year of 2025 by using a social discount rate of 3 %.

Results

Extrapolated on the 102 DUs, a restriction would lead to dismissals of [redacted] FTEs. Consequently, total social costs of unemployment generated due to the restriction will be approximately EUR [redacted] million in 2027. This would amount to EUR [redacted] million as NPV in 2025 and EUR [redacted] million as the annualised value per year over a derogation timeline of 12 years.

5.3.4. Additional investment and operating costs

Assumptions

Average additional investment and operating costs incurred by DUs were assessed by first aggregating additional investment and operating costs incurred by DUs based on their chosen most likely NUS. This value was then divided by the number of DUs that responded to the survey and extrapolated to DUs that did not deliver an answer. Consequently, average additional investment and operating costs incurred per DU were quantified to be between EUR [redacted] million and EUR [redacted] million in 2020. Again, these values are discounted to the base year of 2025 by using a social discount rate of 3 %.

Results

Assuming the same distribution of NUS between these 102 DUs and extrapolating the average additional investment and operating costs to 102 DUs amounts to a total of EUR [redacted] million and EUR [redacted] million in 2027. Discounting these values by using a social discount rate of 3 % results in an NPV between EUR [redacted] million and EUR [redacted] million

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in 2025 and an annualised value between EUR [redacted] million and EUR [redacted] million per year over a derogation timeline of 12 years.

5.3.5. Other impacts

During the COVID-19 pandemic, the need for rotogravure printing of special foils for the packaging of hygiene articles emerged and still persists. Consequently, a non-granted derogation would not only shift the production of these foils outside the EEA, but also potentially cause supply disruptions, as there is less capacity for this special sector outside the EEA.

Other impacts incurred by K. Walter’s DUs were derived from the AfA requesting the continued use of Cr(VI). In the aforementioned survey, DUs were able to provide answers in a qualitative and/ or quantitative manner.

As a result of a restriction, a decline in the quality of their products is anticipated by most DUs, whereas only a few DUs do not expect any changes in the quality of their products. Concerning the market price for end consumers, the DU survey clearly shows that most respondents would expect an increase in the market price, possibly resulting from higher costs of procurement. Consequently, an increasing number of customers would most likely switch to non-EEA suppliers. The second most chosen option is that no changes in the market price would be expected by the DUs. The last impact on DUs assessed in the survey, was whether they would expect a change in customer retention and their market position. Almost 70 % of DUs that answered the survey confirmed that they would expect changes regarding customer retention and their market position.

5.4. Impacts on End users

Considering that many packaging, publication and decorative applications are impacted by the proposed restriction of PFAS and that no alternatives are readily available, a restriction would heavily influence these markets and multiple end users, such as food manufacturers, businesses involved in the publication industry and providers of home décor.

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6. CONCLUSION

[redacted] is used as a wetting agent during the Cr(VI)-based electroplating to ensure the suppression of Cr(VI)-containing mist and subsequent exposure of workers to this hazardous substance.

Section 3.3.1 details the efforts undertaken by K. Walter to identify potentially implementable alternatives to PFAS-based wetting agents. This includes an in-house investigation on commercially available wetting agent and consultations held with the suppliers of alternatives and experts in the field of Cr(VI)-based electroplating. However, conducted experiments were held only on the laboratory scale since in the meantime ECHA announced they support a requested review period of 12 years needed for a complete transition to a Cr(VI)-free alternative, meaning the use of chromium trioxide in Cr(VI)-based electroplating is allowed until the end of 2032. After this period, K. Walter intends to implement HelioChrome® NEO and/ or Helio® Pearl. It is important to note that none of these alternatives requires the use of PFAS-based agents.

Therefore, it is very important that K. Walter continues with the substitution of chromium(VI)-based functional chrome plating since that would ensure the substitution of both undesirable substances (chromium trioxide and [redacted]). At this point, additional research and implementation of potentially implementable PFAS-free wetting agent could not just prolong the substitution of chromium(VI)-based functional chrome plating but also create unfavorable working conditions.

According to the substitution plan described in the AfA, the phase out of Cr(VI) and [redacted] at K. Walter's DUs is expected to be completed by the end of 2032. For K. Walter's [redacted] use, this translates to a required derogation timeline of 7.5 years (calculated from the expected EiF in mid-2025). However, since ECHA's restriction proposal only foresees 5(+1.5) year and 12(+1.5) year derogation options, K. Walter needs to request the 12-year derogation to cover the required time for substitution.

Please note that the 12-year derogation request is also in better alignment with recent R&D findings where K. Walter discovered that for special applications such as the plating of highly structured components (e.g. embossing with deep texture), there is still no chromium trioxide-free alternative process available at the current stage of development. Therefore, for highly demanding coatings, the continued use of chromium trioxide is expected after 2032. Consequently, the use of PFAS as wetting agents is also required.

The proposed restriction would disrupt the supply chain, potentially leading to shortages on the market. A restriction would seriously affect a multitude of markets and businesses and might completely shift the production of gravure printing products out of the EEA. Substantial financial losses, job dismissals, and potential disruptions in critical industries would result from the proposed restriction.

Table 6 shows the total socio-economic impacts of a PFAS restriction for the Heliograph Holding and its subsidiaries, and K. Walter and its DUs in the EEA.

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TABLE 6: SOCIO-ECONOMIC IMPACTS OF A PFAS RESTRICTION FOR THE HELIOGRAPH HOLDING AND ITS SUBSIDIARIES, AND K. WALTER AND ITS DUS IN THE EEA.

Cost Impact Category	NPV 2025 (in EUR million)	Annualised value over 12 years (in EUR million)
Heliograph Holding and its subsidiaries		
Producer surplus losses	[redacted]	[redacted]
Social cost of unemployment (76 job dismissals)	[redacted]	[redacted]
Additional investment and operating costs (e.g. decommissioning costs, investment and planning costs)	[redacted]	
K. Walter		
Producer surplus losses	[redacted]	[redacted]
Social cost of unemployment (26 job dismissals)	[redacted]	[redacted]
Additional investment and operating costs (e.g. decommissioning costs, investment and planning costs)	[redacted]	
DUs		
Producer surplus losses	[redacted]	[redacted]
Social cost of unemployment (612 job dismissals)	[redacted]	[redacted]
Additional investment and operating cost	[redacted]	[redacted]
Total socio-economic costs for the Heliograph Holding and its subsidiaries, and K. Walter and its DUs	[redacted]	[redacted]

Conclusively, the total socio-economic costs for the Heliograph Holding and its subsidiaries, and K. Walter and its DUs due to a restriction of PFAS amount to between EUR [redacted] million and EUR [redacted] million in 2025 or annualised costs between EUR [redacted] million and EUR [redacted] million over the requested derogation period of 12 years. Taking the annualised values of socio-economic benefits from Table 6 and the annual emissions assessed in chapter 4.2, results in a benefit-to-risk ratio between EUR [redacted] million per kg for a granted derogation for this use. It must be noted that the socio-economic impacts monetised here are the minimum amount of impacts anticipated due to a

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restriction. In parallel, this has been compared with the worst-case emissions as a proxy for risk to the society.

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