

Eco-friendly technologies

Chrome(VI)-free solutions for the pretreatment of aluminum for architectural applications and the construction industry

Hexavalent chromium has been the technology of choice for the corrosion protection of aluminium substrates for many years. According to ECHA, many people expect to have abandoned the use of chrome(VI) processes by 2018 when the new regulations will become valid. There is no need to be concerned to move away from chrome(VI) technologies as there are many proven alternatives available. The Frankfurt-based Chemetall GmbH is one of the leading suppliers of surface treatment technologies and offers a variety of highly efficient and Qualicoat-approved technologies.



Frankfurt, Germany, April 2013. In recent years, almost 60 million metric tons of aluminium have been produced annually worldwide. The main users are the construction industry and the automotive market, as well as the machinery and plant engineering sectors. Due to its chemical properties, aluminium substrates, like many other metals, need an optimal protection to be safeguarded from environmental factors. For many decades, hexavalent chrome-based processes have been the standard for aluminium pretreatment. However, more recently, chrome(VI)-based pretreatment processes have been increasingly dropped from many markets due to legal regulations, changed market demands and mounting awareness of rising costs related to health, safety and environmental protection.

“Sunset date” indicates the end of chrome(VI) usage

Chromium, as a hazardous substance, is on the ECHA candidate list and chrome(VI) processes are scheduled to come under very stringent regulation probably in August 2018. With that “sunset date” approaching many companies are now searching for viable alternatives, in order to prepare changes well ahead of the due date. First information with regards to chrome(VI) have been already published some time ago, as in 2000 the use of chrome(VI) in vehicles was prohibited by the EU End-of-Life Vehicle (ELV) Directive and the Waste Electrical and Electronic Equipment (WEEE) Directive prohibited its use in electrical goods as of 2006.

Qualicoat-approved alternatives

There should be no cause for concern as for some years now chrome(VI)-free technologies have successfully been introduced as a reliable alternative metal pretreatment. As a leading global supplier of surface treatment technologies, Chemetall offers chrome(VI)-free Qualicoat-approved processes, such as the new chrome(III)-based Gardobond C 4749 or the complete chromium-free Gardobond X 4707 and Oxsilan AL 0510 technologies.

Chemetall's chrome(VI)-free alternatives are comparable to hexavalent processes in terms of quality performance. Taking a look at the cost-side, these processes are comparable or, considering all process cost elements, even less expensive. The adaption of the production cycle can be done easily and takes place without any major modifications. The processes are stable to run, and the combination with Chemetall's vast experience and knowledge in the application of this technology gained over the past 15 years, is an excellent resource to step into a new area of aluminium pretreatment. Furthermore, quite often the technology switch leads to process simplification and additional process cost savings.

Yellow Chromating chrome(VI)	Green Chromating chrome(VI)	Gardobond® C 4749 chrome(III)	Gardobond® X 4707 chrome-free	Oxsilan® AL 0510 chrome-free
				
				
				
				
				

Classification of the concentrates according to GHS

Easy-to-handle, low-maintenance process - Gardobond C 4749

Chemetall is focused on the development of ecologically compatible technologies. With Gardobond C 4749 the company is introducing a new trivalent chromium process. The technology is ideally suited for the pretreatment of profiles and sheet metals made of aluminium and its alloys prior to powder coating.

The Gardobond C 4749 passivation technology is approved by Qualicoat (No. A-090) and might be the right option for some companies who want to get rid of their chrome(VI) process and rely on a more eco-friendly but stable and high-efficient process. This nontoxic technology provides similar performance results as hexavalent chromium with regard to paint adhesion and corrosion protection as well as bare corrosion on unpainted aluminium surfaces - but with a lower environmental impact.

The main disadvantage of yellow and green chromating lies in the toxicity of the metal salts used. According to the GHS Regulation, the chromium concentrates used are classified as acutely toxic, hazardous for the environment, corrosive, oxidizing and may cause breathing difficulties. Over and above this, chromium-containing baths exhibit an acute aquatic toxicity. This toxicity is mainly related to the highly toxic hexavalent chromium. Trivalent chromium processes, such as Gardobond C 4749, however do not contain any hexavalent chromium. Therefore the subject of hexavalent chromium does not affect the user or end customer.

No changes required for new technology

Chemetall's new chrome(III) technology does not require any major plant or process sequence modifications. Prior to coating with Gardobond C 4749, all metal surfaces must be thoroughly cleaned with an alkaline cleaner and etched, pickled or desmutted. As a full system supplier, Chemetall offers a complete range of cleaning technologies such as Gardoclean and Gardacid for this.

Easy analysis and simplified wastewater treatment

The Gardobond C 4749 bath can be easily controlled by measuring the pH-value with a fluoride resistant pH-electrode and by titration. The technology produces a colorless to iridescent visible layer, which means that a simple visual check can be carried out. Additionally, the pretreatment layer can also be quickly measured using an X-ray fluorescence (XRF) gun.

Gardobond C 4749 allows for a more simplified wastewater treatment compared to hexavalent chromium as the reduction of chrome(VI) to chrome(III) is obsolete. The new technology is also free of cobalt, nickel, organic complexing agents, nitrite and phosphates and meets the requirements of the RoHS Directive (2002/95/EC) and the WEEE Directive (2002/96/EC).

Chrome-free for the better

Besides its new trivalent chromium technology, Chemetall is focused on introducing completely chrome-free technologies to the aluminium construction industry. With Gardobond X 4707 and Oxsilan AL 0510 the company offers established processes that have been in use around the world at customer plants for many years. Gardobond X 4707 is based on zirconium and titanium as coating components and shows excellent results in all common tests (AASS, CASS or Filiform). Even under the harshest outdoor conditions, such as the ten years GSB "Natural Weathering Test" (Hoek van Holland, a coastal area in the Netherlands), the test panels prepared with Gardobond X 4707 could rival chromated equivalents.

A totally new approach was made with Chemetall's Oxsilan technology, which is suitable for use in multi-metal applications. In addition to zirconium, silanes form the basis of this eco-friendly process replacing chromating and zinc-phosphating processes. Oxsilan as well as Gardobond X 4707 hold Qualicoat and GSB approval.

Sustainable success

Economic viability, process stability, good quality, long lifetime and a reliable supply chain are vital criteria in a highly competitive marketplace. As a leading global supplier of surface treatment technologies, Chemetall offers a comprehensive portfolio of state-of-the-art processes including pretreatment and anodizing technologies as well as service products such as wastewater treatment. The focus of the company's product development is always put on sustainable technologies as the way forward. Over the years, the eco-friendly processes have been continually improved and represent nowadays a viable alternative to the chrome(VI) technologies. Gardobond C 4749, Gardobond X 4707 and Oxsilan AL 0510 all offer excellent corrosion protection and paint adhesion and are increasingly used in the aluminium finishing industry today.

Parameter / Process	Yellow Chromating	Green Chromating	Gardobond® C 4749	Gardobond® X 4707	Oxsilan® AL 0510
Bath temperature	20 – 40 °C	20 – 50 °C	20 – 50 °C	20 – 40 °C	20 – 40 °C
Treatment time	60 – 180 sec.	30 – 180 sec.	60 – 120 °C	30 – 120 sec.	30 – 120 sec.
Application	Dip, Spray, Cascade	Dip, Spray, Cascade	Dip, Spray, Cascade	Dip, Spray, Cascade	Dip, Spray, Cascade
Coating weight	600 - 1.200 mg/m ²	600 - 1.500 mg/m ²	5 - 50 mg/m ² Cr 5 - 40 mg/m ² Zr	Rinse: 3 - 20 mg/m ² Ti 3 - 20 mg/m ² Zr No-Rinse: 3 - 20 mg /m ² Ti 3 - 20 mg/m ² Zr	5 - 50 mg/m ² Zr
Substrates	Aluminum, galvanized steel	Aluminum, galvanized steel	Aluminum, galvanized steel	Aluminum, magnesium	Steel, galvanized steel, stainless steel, aluminum, magnesium, cast iron, etc.

Comparison of general process conditions

Interview with Cristiano Laurita, Chemetall Italia S.r.l.



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1. Why is Chemetall now introducing a chrome(III) technology?

Laurita: For us as a leading global supplier it is important to develop sustainable surface treatment technologies. We have excellent and proven eco-friendly processes in our portfolio and our overall goal is the implementation of chrome-free technologies. In some countries however, we realize there is a certain reluctance to change to completely chromium-free technologies. Therefore we have introduced the new trivalent Gardobond C 4749 to respond to customer and market needs.

2. Besides meeting legal requirements, where do you see the big benefit for customers to change to eco-friendly technologies?

Laurita: The hazardousness of hexavalent chromium has a strong impact on the economic viability of the process. Neutralizing, precipitating, separating and disposing of the chromium(VI)-contaminated water accounts for a major part of the overall process costs. Additionally high costs for regular analyses and controls by the environmental protection authorities are strongly affecting overall process costs. Product storage and health protection are additional matters which have to be addressed, with operators needing to take extensive precautions when handling the material. With chromium(VI)-free technologies these measures are redundant. Having considered all the facts and Chemetall's positive experiences, I can only encourage companies to seriously consider eco-friendly alternatives.

3. Is it difficult to implement a chrome(VI)-free technologies?

Laurita: There is little difference between the chromium-containing and chromium-free technologies with regards to the process sequence. The substrates must be pre-cleaned and rinsed before the conversion coating can be applied. Major plant modifications are not needed.

4. ***One argument frequently used against chromium-free processes is the alleged extra work for chemical analyses and greater expenditure for laboratory equipment. Is that true?***

Laurita: When looking at the time required for chemical analyses, it is almost identical for all processes. The same applies for the interval between the measurements. Gardobond C 4749 can be controlled by titration and measuring the pH-value, our chrome-free technologies Gardobond X 4707 and Oxsilan AL 0510 can also be controlled by titration or photometry and with the pH and conductivity values also being measured. A fluoride measurement is only required in exceptional cases.

5. ***How can you control a non-visual pretreatment layer?***

Laurita: You can use a quantitative or qualitative method. In the case of chromium(VI)-free processes, the coating applied is in most cases determined photometrically. Another reliable method is the XRF analyzer. Having a range of chrome-free technologies in our portfolio we can advise our customers on additional and easy methods of control.

6. ***What is Chemetall doing different than the competition?***

Laurita: At Chemetall we understand that true success lies in a close and partnership-based cooperation with our customers. Thus we strive to have a good understanding of our customers' needs and processes. We support our customers in the continuous search for process cost reductions in their entire value chain of application of pretreatment technologies. This approach, combined with our unique technology portfolio, comprehensive technical support and broad expertise in diversified markets, puts ourselves in an optimal position to offer customized system solutions - worldwide.

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About Chemetall

Chemetall, a division of Rockwood Holdings, Inc. (NYSE: ROC), is a leading global supplier of special chemicals with a focus on processes for the surface treatment of metals and plastics. Chemetall is headquartered in Frankfurt am Main, Germany, and comprises about 40 companies and 22 production sites worldwide. With 2,000 employees, the Group achieved sales of about 551 million Euro (2012). More at www.chemetall.com.

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