Pioneering Processes for Decorative Applications

The **COVENTYA** Group culture motivates our efforts to always look *beyond the surface* for providing our market and customers state-of-the-art technologies.

With such a target in mind, the COVENTYA R&D team focuses on anticipating market requirements and providing customers with solutions that promptly respond to current – especially the ever changing environmental – challenges! The world seeks eco-friendly processes considering the impact on users and the environment which fits our goals

So how to combine environmental needs with higher performance? **COVENTYA** has the answer.

COVENTYA has ~~a~~ successful, extensive experience today and historically for protective applications that provide cutting-edge technologies. Taking a step back, we can see the **COVENTYA Group** as a pioneer in supplying specialty products for the electroplating industry., This includes, for example, a cyanide-free alkaline zinc deposition process (**OKLANE**) with unique performance characteristics including the perfect distribution of zinc thicknesses.
Our 3S membrane technology can be mentioned, as it allows the same goal to be achieved; removing cyanide formation in PERFORMA Zn-Ni alloy processes. Such an innovation solved the problem of a highly dangerous substance, while also improving process stability in terms of deposition and more consistent alloy percentage, while retaining high process cathode and working efficiency.

Even in protecting components and parts with zinc and zinc-alloy deposits, **COVENTYA** was an early leader in replacing hexavalent chromates with LANTHANE trivalent passivate technology. These were developed for retaining high performance in terms of the corrosion resistance of zinc and its alloy deposits. The **COVENTYA** R&D team developed a full range of passivate technology based on trivalent chromium. Today these dominate the **COVENTYA** portfolio, with specific processes complying, and exceeding the requirements for the market, our customers and specified by many OEM's to protect all types of parts and components.

Replacing a dangerous, toxic and carcinogenic raw material (such as hexavalent chromium) with **COVENTYA** trivalent technology did not decrease passivate performance – in fact anti-corrosion performance improved! By adding our **FINIGARD / FINICOAT** sealer and/or topcoat technologies, **COVENTYA** today can offer very high, full-protection systems that combine specific friction properties appreciated by everyone along the plated part supply chain.

In fact, especially over the last 20 years, the primary environmental challenges faced by the **COVENTYA** Group have focused on removing or replacing chemicals such as cyanides and Chrome (VI) (ahead of legal regulations) and encouraging users to adapt to these changes.

COVENTYA's spirit of innovation began with metal protection as well as decorative applications and their technologies. The company's R&D activities have been targeted at creating and developing processes dedicated to the decorative field – including Plating on Plastics (POP) – for the past two decades.

The COVENTYA Group has developed **SILKEN BOND**: a competitive chrome-free etch technology created especially for POP applications that exceeds the regulatory requirements for hexavalent chromium removal.

COVENTYA launched this project several years ago when institutions began focusing on the issue of environmental changes. For the past 7 years, **COVENTYA** has been performing Beta Site Tests at major POP applicators across Europe to optimize and validate the reliability and stability of the Chrome free etch process. Now, the process is industrialized on production plant level validating and proving its value and output capacity.

This innovative chrome-free etch technology is based on acidic permanganate etching. The content of permanganate is very low at under 1 g/L. In addition to removing the hexavalent chromium, **COVENTYA** went beyond removing hexavalent chromium by also eliminating the need for perfluorinated or polyfluorinated substances (known as **PFOS/PFAS**) from the process sequence. Today these chemicals are typically used as surfactants in chrome (VI) containing plating solutions as mist suppressants to contain chrome (VI) emissions. Such substances have a release limit of just a few ng/L in effluents. This kind of requirement, a real challenge, is increasingly pressing, not only in Europe but also globally. Several US states have recently issued new legislation, practically banning the use of these substances in the manufacture of additives or their use in production. These regulations will change the way our plating and surface finishing industry looks at coatings, but **COVENTYA** is already ahead of these concerns.

The metallization and adhesion results obtained with the **SILKEN BOND** process in the early Beta Site Tests were very satisfactory on ABS and ABS/PC parts.
Today, parts treated with the **SILKEN BOND** process have been submitted for multiple automotive OEM thermal shock-, thermal cycle and peel tests. Results obtained have matched OEM-specified requirements and performance parts treated with a chromic acid based etching process. This success has allowed **COVENTYA** to approve this new process at one of Europe's leading car manufacturers.

There have been two common issues with the introduction of hexavalent chrome-free etch technologies. **COVENTYA** evaluated them during its Beta Site Tests in Europe:

- *Stability* (long life etch process)
- *Selectivity* (rack metallization and metallization of bi-component parts)

In combination with a special additive, we utilize a re-oxidation cell to keep the etching bath performances steady. This re-oxidation cell has the same configuration as a traditional etching bath to re-oxidize trivalent chromium. It includes a membrane system that divides cathodic/anodic areas, with re-oxidation in the anodic area. With this integrated oxidation cell, the **SILKEN BOND** process enables extended solution life while keeping the attack of the plastic surface steady with resulting steady production quality.

Chrome-free etch technology's second weakness has been the selectivity of rack metallization versus the parts, if required - such as required for the bi-component plastic parts market.

Avoiding rack metallization is a crucial point to obtain a proper industrial process working in production. So far, such metallization has been the main obstacle to new Chrome-free etching technology. In the conventional pre-plate process, hexavalent chrome deriving from the etch serves to poison the PVC rack coating and prevent palladium absorption. As with chrome-free etch technology this poisoning is not possible, we need alternative methods to avoid potential rack plating. With the **SILKEN BOND** process, **COVENTYA** has developed a technique to balance the system and avoid this situation. COVENTYA's R&D has developed a new special additive (**SILKEN BOND PROTECT**) that prevents all rack type plating without any additional steps or pre-

treatment prior mounting the parts for production. This additive therefore reduces chrome-free etch technology insertion costs by using the existing treatment line rack.

With regards to bi-component parts, European designers have increased the use of plated bi-injected plastic parts for interior applications (especially on the automotive market) to improve aesthetics and consumer appeal. Compared to chrome containing etch cycles, the use of chrome-free etch technologies has created selectivity difficulties for this kind of special parts. By changing working parameters in the **SILKEN BOND** process, especially in the **SILKEN BOND ETCH** and **SILKEN METAL** Electroless Nickel, we achieved good results for selectivity plating on bi-injected parts.

In addition to developing chrome-free etching, **COVENTYA** also researched and created ammonia-free Electroless Nickel processes. This provided a better process for those handling the products, including better wastewater disposal and plating selectivity.
New **SILKEN METAL 703** assures third generation Electroless Nickel that is industrially proven for conventional and new applications, and with less environmental impact. Its special formulation offers a highly stable process and highly conductive deposit.

Continuing with the focused evolution of the POP line process sequence, COVENTYA has developed EMERALD. This nickel electroplating, boric acid-free process, has been extensively proven to provide excellent performance and resulting nickel deposits perfect for POP applications.

The last step of the plastic metallization process cycle is the decorative chrome plated deposit to provide durability and added performance to retard corrosion. Traditionally based on Chrome (VI), today we have evolved the much safer trivalent chrome technology to replace the hazardous hexavalent systems. All decorative plating applications can benefit from the ammonium free, Trivalent systems that offer many advantages over Chrome (VI).

Our chloride-based **TRISTAR 300** trivalent chromium process has been industrialized and approved for many years in the automotive sector, where calcium chloride resistance (Russian mud) is considered a crucial parameter for some automotive specifications.
The newest, third-generation sulphate-based **TRISTAR 330 AF** trivalent chromium-plating complies with stringent automotive specifications, such as the Volkswagen TL528.

Traditionally, one limitation to adapt the trivalent chromium technologies has been aspect or colour differences to Chrome (VI) deposits.

Our **TRISTAR 330 AF** process enables the market and applicators to provide a deposit that is nearly indistinguishable from a hexavalent produced deposit. Measured in terms of the colorimetric scale *L,*a &*b, the “L” value range of 83-85 is the same as that produced from a traditional decorative hexavalent deposit. The “b” value is less than zero on the scale. The **TRISTAR 330 AF** performance eliminates the dark and yellowish deposit aspect that has handicapped older generation trivalent processes now becomes history. The resulting colour is very uniform across all part current densities, which results in excellent colour uniformity coming from production which is appreciated on assembled parts and components.

Additionally, industrialized sulphate-based trivalent plating tanks were known for cathode inefficiency: compared to chloride-based systems, they needed longer deposition time (above 6 min per 0.2 microns). So their use in the automotive sector necessitated a greater number of working plating tanks to maintain regular productivity.

The new **TRISTAR 330 AF** can obtain a 0.3-0.4 microns of chrome deposit in less than 4 minutes, which reduces production time and achieves automotive thickness specifications. In addition to these decorative features, the new trivalent deposit combined with **TRISTAR SHIELD** a newly developed Chrome (VI)-free post-treatment, allows much improved corrosion resistance performance.

As highlighted by several studies, chrome deposits obtained from Chrome (III) do not have any oxide nanometre layer on their surface, unlike hexavalent processes. This oxide improves corrosion-resistance performances of traditional Chrome (VI) processes. The **TRISTAR SHIELD** Chrome (VI)-free post treatment enables the creation of a thick, solid and uniform oxide on the trivalent deposit surface, without affecting the final aspect of the plated item. The combination of processes such as **CUBRAC, CRITERION SB 100, CRYSTAL 301, CRITERION MP 250, TRISTAR 330 AF** and **TRISTAR SHIELD** allows plastic items to exceed 90h of Copper-accelerated Acetic acid Salt Spray Test (CASS TEST) & 1000h of Neutral Salt Spray Test (NSST) performance. In addition to these conventional tests, **TRISTAR 330 AF** exceeds the PV1073 test in Volkswagen specification TL 528, which indicates very good resistance to calcium chloride.

A key galvanic trend is linked to the process capability of being hypoallergenic and passing the most stringent Ni release tests. **TRISTAR 330 AF** combined with **TRISTAR SHIELD** provides very good resistance in the UNI ISO 1811 test, with nickel release lower than standard. Post-treatment such as **TRISTAR SHIELD**, after a **TRISTAR** trivalent deposit, is clearly crucial to achieve the highest automotive sector requirements, as well as meeting many other demands for many other industrial applications

In summary, **COVENTYA** offers a wide range of products that incorporate state-of-the-art technology, and our company targets removing products considered or known to be toxic/dangerous to health and the environment. Yet only replacing current processes with less impacting ones is not enough. **COVENTYA** is continuously seeking to improve such processes to provide more efficient technical features and higher performance standards. Our consolidated industrial experience, gained in developing new processes, allows offering to customers' processes that are effective and sustainable from an industrial point of view.

The dawn of hexavalent chrome in Electroplating has started now on a global scale. Despite some desperate trials to extend its life expectancy the innovation train has started to roll and gains traction at an ever-increasing speed. Now it's unstoppable!

Nevertheless, it is not possible to achieve and strengthen these goals of our company without partners who are innovation-oriented and focused on the future! Are you ready to become part of the *Technological Revolution with COVENTYA*?