Sustainable technologies
Our commitment to the future
“Being global means thinking globally. It’s about looking at the bigger picture and pledging a commitment to sustainability. We are all united by our responsibility to our industries, communities and the environment at large. Atotech is committed to making a difference. Are you?”

Reinhard Schneider
President of Atotech
Our commitment to the future

At Atotech, we are committed to being an innovative and environmentally conscious company.

As the leading manufacturer of plating chemicals and equipment for the electronics and surface finishing industries, sustainability is at the very core of our business. Finding the balance between industrial innovation, sustainability and economic viability is what inspires us. It’s what moves us forward.

We have set a clear goal for ourselves: to be the leading supplier of sustainable plating systems. To achieve this we rigorously invest in sharpening our expertise to offer leading-edge and cost-efficient products. At the same time, we strive to stay at the forefront of promoting environmentally sound technologies.

Ultimately we seek to remove all of the following from our products:

- CMR substances (carcinogenic, mutagenic and reproductive toxic)
- Toxic substances (e.g. cyanide, hexavalent chromium, nickel-compounds)
- Heavy metals (e.g. lead, mercury, cadmium)
- Allergenic substances (e.g. nickel)

Our systems are designed to use water, energy and raw materials very efficiently, which means less waste and greater savings for our customers.
In an ever evolving environment we add value for our customers by supplying high-performance, high-quality, and highly reliable production solutions and services.

In recent years, environmental regulations such as REACH, ELV and WEEE/RoHS focused on the chemical industry have gained immense importance. The plating industry is one of many industries to feel its direct impact. As a result, there is a growing need and demand for ecological products, creating a new set of challenges and responsibilities for our industries.

In order to meet our goals of corporate responsibility, we have developed and implemented strategic, sustainable practices across all areas of our businesses and operations. These processes enable us and our partners to remain one step ahead of the competition. Our approach to sustainability is integrated into everything we do.

We have been able to create a strong cooperative environment backed by a growing number of local TechCenters across the world. Through many successful trials and demonstrations at our TechCenters, we have built a high level of trust with our customers and industry partners. Today, we are recognized in our industry for distinct sustainable technologies.

Our chemical processes, plating equipment and auxiliaries are aligned with the latest industry roadmaps. We are constantly working on the development of green and efficient solutions to accommodate future industry requirements.

“We goal is to not only comply with chemical regulations, but to raise the standards even higher.”

Alexander Samai
Manager Sustainable Development
Working together to ensure sustainability

Businesses that focus on short-term gains often fail to see the substantial, long-term merits of sustainability. We have been able to demonstrate measurable cost savings for many of our customers with the help of sophisticated systems such as wastewater treatment technologies, waste reduction, and recycling processes. We also provide a complete factory design concept to our customers, including state-of-the-art sustainable production technology.

Development of sustainable technologies is a lengthy and complex process. Hence, the entire value chain – suppliers, customers, communities, and government bodies alike – needs to work in close collaboration. We have cultivated strong partnerships with the industry in order to keep pace with emerging technology, its cost demands and raising environmental local regulations.

Similarly, close collaboration with our customers helps us expedite the product development process – be it chemistry, plating equipment, or auxiliaries. We also invest heavily in joint projects with the Tier I-IIIs, OEMs, and universities. This gives us a valuable insight into various industrial and theoretical fields – accelerating the development of the next generation products.

39% of our R&D projects were devoted to sustainable goals (2015)

> 90 collaborations with OEMs, Tiers, customers, institutes and universities (2015)
Accomplishments we are proud of

It is our uncompromising commitment to eliminate harmful substances from our products. Always keeping health and safety in mind, we remain critical and hungry for improvement. This is what makes us proud.

3,163 t

reduction in toxic raw materials since 2010

Besides putting people first, our products also contribute to reducing wastewater, energy and chemistry consumptions. This is what makes our products the smart choice for eco-conscious manufacturers.

Environmentally responsible chemical processes for today

- **Cr(VI)-free** processes for zinc post-treatment and chrome plating
- **Cr and Co-free** passivates for zinc plating
- **Cr(VI), Co, Ni, Cd and other heavy metals-free** zinc flake technology
- **CN-free** alkaline zinc, copper, silver processes and zinctes
- **Ni-free** processes as alternative to satin nickel in decorative applications for consumer goods (electronics, cosmetics, etc.)
- **Pb, Cd and toxic heavy metal stabilizer-free** electroless nickel processes for electroless nickel plating and the pretreatment of plastics
- **Boric acid-free** acid zinc and acid zinc nickel processes
- **Pb-free and NPE-free** tin processes for electronic applications
- **Cl-free** palladium nickel process for connector applications
- **Ni and Co-free** hard gold processes for connector applications
- **Non-PFOS, Non-PFC** mist suppressants for decorative and functional Cr(VI) plating applications
- **Liquid chromium replenishment products** for decorative and functional chrome plating with greater user-friendliness
- **Borate, NPE and phosphate-free** cleaners
- **Long-life, low-temperature cleaners** utilizing biotechnology
- **Phosphate and P-free** cleaners, adhesion promoters and zirconium pretreatment coatings for various coating types (powder paint, wet paint, E-coat, enamel)
- **Chlorinated solvent-free**, substrate-preserving paint stripping processes
“Atotech has been pioneering the development of environmentally responsible plating solutions for functional and decorative applications. For years this has been our conviction. And it continues to be the right thing to do.”

Dr. Werner Richtering
R&D Manager General Metal Finishing

We are working to further increase the number of environmentally responsible manufacturing alternatives and to continuously improve our expertise.

Environmentally responsible chemical processes for the future

<table>
<thead>
<tr>
<th>Process Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Cr(VI)-free pretreatment of plastics</td>
<td></td>
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<tr>
<td>Cr(VI)-free functional chrome plating</td>
<td></td>
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<tr>
<td>Ni-free processes in decorative plating and plating on plastics</td>
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<tr>
<td>Ni-free zinc alloy processes</td>
<td></td>
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<tr>
<td>Boric acid-free processes for decorative and functional plating</td>
<td></td>
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<tr>
<td>Boric acid-free nickel phosphorous processes for electronic applications</td>
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<tr>
<td>Low-VOC zinc flake technology</td>
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<tr>
<td>Replacement of all Co-containing passivates for zinc and zinc alloy processes</td>
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<tr>
<td>P-free pretreatment for white goods</td>
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<tr>
<td>P-free soak cleaners</td>
<td></td>
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<tr>
<td>CH₂O-free processes for all decorative and functional surface finishing applications</td>
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<tr>
<td>Metal stabilizer-free electroless nickel for electroless nickel plating</td>
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</table>
Combining cost effectiveness with environmental protection, our equipment ranges from ion exchange systems for Cr(III) passivates, nickel or trivalent chrome plating electrolytes to regeneration systems for zinc nickel electrolytes and an electrodialysis system for electroless nickel plating.

Our automated analysis system controls and optimizes essential process parameters. Designed to enable a more efficient use of raw materials, Atotech’s on-line analytics help to reduce both production costs and environmental impact.

Atotech’s DynaChrome® Plus production system for hard chrome plating combines unique patented plating equipment with high plating rate chemistry to achieve maximum throughput. Reduced risk and exposure to staff, together with minimal chemical and energy consumption and wastewater are major benefits making DynaChrome® Plus the leading environmentally-conscious hard chrome plating system.

Greater efficiency in a sustainable way

Complementing our environmentally responsible chemical products, Atotech offers auxiliary and production equipment to further strengthen sustainable production aims.
## Electroless nickel coatings

<table>
<thead>
<tr>
<th>EDEN® electrodialysis system for electroless nickel</th>
<th>Consistent high quality plating</th>
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<tbody>
<tr>
<td></td>
<td>Significantly increased bath life</td>
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<td></td>
<td>Reduced process costs</td>
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## Corrosion resistant coatings

<table>
<thead>
<tr>
<th>Tricotect® regeneration system for Cr(III) passivates</th>
<th>Fewer dilutions</th>
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<tbody>
<tr>
<td></td>
<td>Fewer additives</td>
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<td></td>
<td>Savings on wastewater treatment chemicals</td>
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<table>
<thead>
<tr>
<th>Membrane anode technology for zinc nickel electrolytes</th>
<th>Cyanide-free</th>
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<tbody>
<tr>
<td></td>
<td>Fewer additives</td>
</tr>
<tr>
<td></td>
<td>Less energy consumption</td>
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<table>
<thead>
<tr>
<th>Recotect® regeneration system for alkaline ZnNi electrolytes</th>
<th>Continuous cyanide removal</th>
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<tbody>
<tr>
<td></td>
<td>Fewer dilutions</td>
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<tr>
<td></td>
<td>Consistently elevated productivity levels</td>
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</tbody>
</table>

## Decorative coatings

<table>
<thead>
<tr>
<th>HELiX® nickel recovery system</th>
<th>Fewer additives</th>
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<tbody>
<tr>
<td></td>
<td>Advanced nickel recovery</td>
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<tr>
<td></td>
<td>Lower process costs</td>
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<table>
<thead>
<tr>
<th>Nikotect® maintenance and recycling system for nickel electrolytes</th>
<th>Fewer additives</th>
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<tbody>
<tr>
<td></td>
<td>Higher yields</td>
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<tr>
<td></td>
<td>Less waste</td>
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<table>
<thead>
<tr>
<th>Satilume® LongLife regeneration system for satin nickel electrolytes</th>
<th>Consistent high quality</th>
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<tbody>
<tr>
<td></td>
<td>Higher yields</td>
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<tr>
<td></td>
<td>Increased electrolyte lifetime</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>TriChrome® regeneration system for TriChrome® electrolytes</th>
<th>Removal of metallic impurities from TriChrome® electrolytes</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Increased electrolyte lifetime</td>
</tr>
<tr>
<td></td>
<td>Fewer rejects</td>
</tr>
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</table>

## On-line Analytics

<table>
<thead>
<tr>
<th>Automated analysis system</th>
<th>Increased bath lifetime</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Higher yields</td>
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<tr>
<td></td>
<td>Fewer additives</td>
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</tbody>
</table>

## Functional chrome coatings

<table>
<thead>
<tr>
<th>DynaChrome® Plus production system for hard chrome plating</th>
<th>Plating to size</th>
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<tbody>
<tr>
<td></td>
<td>No post-grinding</td>
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<tr>
<td></td>
<td>Reduced exposure and risk to staff</td>
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</tbody>
</table>
Atotech’s EDEN® electrodialysis system for electroless nickel plating maintains the plating solution’s component concentration, guaranteeing consistent process conditions over a potentially unlimited bath life.

With more than ten years of production experience as well as having units operating worldwide, EDEN® is a tried and trusted technology for electroless nickel plating.

EDEN® has been awarded the Total Ecosolutions label*. EDEN® provides continuous regeneration of the electroless nickel bath, enabling a potentially unlimited bath life by removing by-products. In addition to constant high-level plating quality, customers benefit from reduced chemical usage and waste.

### EDEN® vs. standard operation for high P EN application

<table>
<thead>
<tr>
<th></th>
<th>Waste volume</th>
<th>Na-hypo-phosphite waste</th>
<th>Ni waste</th>
<th>Chelator waste</th>
<th>Process costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>EDEN®</td>
<td>65%</td>
<td>25%</td>
<td>35%</td>
<td>45%</td>
<td>80%</td>
</tr>
<tr>
<td>EDEN® with Ion Exchanger</td>
<td>65%</td>
<td>25%</td>
<td>4%</td>
<td>45%</td>
<td>80%</td>
</tr>
</tbody>
</table>

*EDEN® electrodialysis system*
Extend the bath life of Cr(III) passivates

Atotech’s production-proven ion exchange system Tricotect® selectively removes contaminating metals from high performance passivates. Tricotect® allows for continuous online purification without interrupting production, providing a potentially unlimited bath life for the passivate. Suitable for rack and barrel lines, Tricotect® can be run with many of Atotech’s trivalent chromium passivates. It allows for lower usage of valuable substances, significant cost savings due to fewer new make-ups and minimized wastewater production.

Tricotect® has received the Total Ecosolutions label*. The continuous purification of trivalent chromium passivates allows for a potentially unlimited solution lifetime, resulting in lower raw material consumption and less wastewater. Tricotect® operates online and eliminates the need for an interruption in the production process.

Comparison of bath aging with/without Tricotect®

- Fewer dilutions
- Fewer additives
- Savings on wastewater treatment chemicals

* Total Ecosolutions is a self-declared environmental claim prepared in accordance with the Total Ecosolutions guidelines, which correspond to the requirements of ISO standards 14020 and 14021 on self-declared environmental claims.

The guidelines can be downloaded at www.total.com.
Increase cyanide-free alkaline zinc nickel plating rate

Atotech’s ZnNi XL processes combine Atotech’s unique alkaline zinc nickel electrolytes with membrane anode technology.

The membrane prevents the decomposition of organic compounds at the anode and inhibits the formation of cyanide. Through this process, the formation of breakdown products can be completely avoided.

Membrane anode technology also allows for reduced consumption of additives and an extended bath life. The deposition rate is 30 - 50% higher than in conventional installations and the quality of the deposits can be maintained at a constant level during production.

### Membrane anode technology for zinc nickel electrolytes
- Cyanide-free
- Fewer additives
- Less energy consumption per square meter
- Higher plating rate

### Reflectalloy® ZNA XL membrane anode system: current efficiency vs. bath age

![Graph showing current efficiency vs. bath age for Reflectalloy® ZNA XL and Conventional ZnNi plating](chart.png)
Enhance zinc nickel plating efficiency

Atotech’s Recotect® is an innovative and flexible regeneration system for alkaline zinc nickel electrolytes. Through the efficient removal of by-products such as cyanide generated by the decomposition of electrolyte components, it enables customers to maintain consistent plating quality, high current efficiency and higher productivity throughout the zinc nickel electrolytes’ entire lifetime.

Recotect® can be easily installed into existing plating lines. The plating parameters of the electrolyte can be adjusted and maintained, enabling a better plating quality.

Recotect® regeneration system for alkaline ZnNi electrolytes

- Continuous cyanide removal
- Fewer dilutions
- Consistently elevated productivity levels due to high current efficiency
- Extends the lifetime of the electrolyte

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Current efficiency of Zinni® AL 450 R zinc nickel electrolyte operating with Recotect®

![Graph showing current efficiency of Zinni® AL 450 R zinc nickel electrolyte operating with Recotect®](image)
Improve nickel plating profitability in a sustainable way

The HELiX® (High Efficient Long ion Exchanger) is Atotech’s next generation ion exchange system designed to recover nickel from the rinse water of Atotech’s semi-bright, bright, satin and microporous nickel processes. It provides an advanced nickel recovery resulting in higher efficiency and higher generated nickel concentrations from the rinses.

Working with a specialized ion exchange resin the HELiX® separates nickel ions from the rinse water. Organic components such as brighteners or wetting agents bypass the resin and go directly to wastewater treatment. After regeneration of the resin an almost organic-free nickel sulfate solution is generated, which is fed back into the nickel electrolyte. The system provides a final nickel sulfate solution with a nickel concentration of approximately 85 g/l.

The HELiX® runs fully automatic and can easily be integrated into existing plating lines. Designed to achieve a more efficient use of raw materials, the HELiX® considerably improves the profitability of nickel plating while minimizing the environmental impact.

**HELiX® nickel recovery from rinsewaters**
- Fewer additives
- Advanced nickel recovery
- Lower process costs

**HELiX® nickel recovery system**
Minimize process maintenance needs for nickel plating

Nikotect® is a patented, advanced maintenance and recycling system for semi-bright, bright and MPS nickel electrolytes.

Maintaining high quality bright nickel plating becomes increasingly difficult as the solution ages. This is due to the accumulation of breakdown products from the brighteners as well as oils and chemicals carried into the bath from earlier processing steps.

The Nikotect® absorber system allows the continuous removal of organic contaminants from nickel electrolytes during production. Typical problems caused by organic contamination are brittleness of the nickel deposit, white washing in chrome due to a passive nickel surface, a change of the deposit structure, an increased consumption of additives or loss of levelling. The system captures organic contaminants on a resin so that they can be easily flushed away with a mild alkaline solution. This replaces treatment with carbon, hydrogen peroxide or potassium permanganate, produces far less waste and prolongs the lifetime of the solution indefinitely. The nickel deposits exhibit optimal properties with reduced process-maintenance needs.

Nikotect® maintenance and recycling system

- Fewer additives
- Higher yields
- Less waste
- No dilutions
- Consistently high quality

**TOC-trendline with Nikotect® adsorber polymers**

![Graph showing TOC concentration in g/l over time]

Typical working window of bright Ni: 5-10 g/l
Satilume® LongLife is a regeneration system that combines Atotech’s well-known Satilume® Plus process with advanced filtration and dosing equipment. Continuous electrolyte filtration and an optimized, fully-automated, additives dosing system help stabilize the process and allow for uninterrupted production, increasing from several hours up to five days with no further maintenance needed.

In addition to ensuring constant, stable satin nickel finishes with improved quality and appearance, Satilume® LongLife also increases the plating capacity of existing production lines, reduces the amount of maintenance required and lowers reject rates.

Satilume® LongLife is a production proven system running for automotive and sanitary applications. It is suitable for high quality production of satin nickel plating.

### Normalized comparison of Satilume® LongLife vs. Satilume**

<table>
<thead>
<tr>
<th></th>
<th>Water consumption</th>
<th>Energy consumption</th>
<th>Waste &amp; wastewater</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>29%</td>
<td>34%</td>
<td>51%</td>
</tr>
</tbody>
</table>

Satilume® LongLife

(*Standard batch regeneration)
The TriChrome® Ion Exchanger is a fully-automated regeneration system for Atotech’s TriChrome® electrolyte range.

The system removes metallic impurities in the electrolyte such as copper, nickel, zinc, lead and iron with an ion exchange resin, which can also be automatically regenerated through an automated control sequence.

As well as being suitable for different solution volumes, the TriChrome® Ion Exchanger system can operate continuously or in multi-loading mode, maximizing the capture efficiency of the resin and drastically reducing the need for new regeneration chemistry. As a result, the working lifetime of the electrolyte is extended considerably.

The TriChrome® Ion Exchanger has been designed for simple adaptation to customer installations with regards to tank size and metallic impurity levels.

### Removal of foreign metals by selective plating vs. TriChrome® Ion Exchanger

<table>
<thead>
<tr>
<th></th>
<th>Cleaning process (selective plating)</th>
<th>TriChrome® Ion Exchanger</th>
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</thead>
<tbody>
<tr>
<td>Chemicals consumption</td>
<td>1,188 (liter)</td>
<td>200 (liter)</td>
</tr>
<tr>
<td>(Rinse) Water consumption</td>
<td>0 (liter)</td>
<td>600 (liter)</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>2,925 (kWh)</td>
<td>25 (kWh)</td>
</tr>
</tbody>
</table>

**TriChrome® Ion Exchanger regeneration system for TriChrome® electrolytes**

- Removal of metallic impurities from TriChrome® electrolytes
- Increased electrolyte lifetime
- Fewer rejects
- Less regeneration chemistry in multi-loading mode
Optimize with an automated analysis system

Atotech’s on-line analytics provide fast, simple and direct control of important parameters that influence the quality of the plating processes.

The automated on-line analysis system is easily implemented in pre-existing production lines and provides consistent monitoring of the baths. It also ensures maximum control over the line by performing a comprehensive range of automated analyses, from titration and spectroscopy to conductivity measurements. If combined with dosing units, the system can also automatically adjust the composition of the baths, extending their lifetime and preserving the high quality of the plated layers.

With prompt analysis results, the entire plating process can effectively be maintained at consistent, optimum conditions, resulting in higher material and production yields.

By drastically reducing laboratory time, automating the analytical control of process baths also allows for lower overall plating costs.

For instance, a corrosion resistant coating rack line for steel parts with zinc nickel and chrome(VI)-free passivates and sealer requires at least four hours of manual work to analyze 17 parameters in 6 different process baths. A decorative, plating on plastics line for automotive parts with 14 process steps and 40 parameters, on the other hand, requires 17 hours of manual work.

Other newly developed methods include an online version of the Simultaneous Thickness and Electrode Potential (S.T.E.P.) tester for automotive plastics applications, as well as a palladium controller allowing control and optimization of the palladium content in activators for plating on plastics.
Reduce hard chrome plating production costs

The DynaChrome® Plus system combines unique, patented plating equipment with specialized chemical processes and can be fully integrated into the production process increasing productivity and reducing manual handling.

In this system, chrome plating is conducted immediately after pre-grinding, eliminating the need for storage. In contrast to conventional systems, DynaChrome® Plus also plates to final specifications. This allows customers to omit the process of grinding to size using mechanical post-processing, reducing chromium consumption by 25% and energy consumption by 42%. Furthermore, an ion exchanger recycles the chrome electrolyte, while the chrome bath is cooled via water evaporation. This allows for the complete recycling of rinse water.

The enclosed nature and safety features of the system help to prevent exposure to hazardous hexavalent chromium.

**DynaChrome® Plus production system for hard chrome plating**

- Plating to size
- No post-grinding required
- Reduced exposure and risk to staff
- Minimal resource consumption and waste

**Comparison of DynaChrome® Plus vs. HEEF® conventional hard chrome process**

![Graph showing comparison of DynaChrome® Plus vs. HEEF® conventional hard chrome process](image-url)
Our commitment

At Atotech, we have set a clear goal for ourselves: to be the leading supplier of sustainable plating and surface finishing systems.

We are committed to remove toxic substances from our product portfolio.

Our systems are designed to efficiently use water, energy and raw materials, which reduces waste and delivers greater savings for our customers.

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