



Henkel Adhesive Technologies

WHITE PAPER

CLEANER & COATER TECHNOLOGY

A SINGLE *STEP* TO GREATER **EFFICIENCY** IN **METAL** PRETREATMENT

REDUCE PROCESS STEPS BY HALF TO SAVE ENERGY AND WATER



CONTENT

3	EDITORIAL
4	THE CHALLENGE: CLEANING AND COATING MEET CATAPHORESIS
4	TEST METHODS: WHAT ARE THE PRODUCT REQUIREMENTS FOR METAL SURFACES?
5	THE CONVENTIONAL METHOD: EIGHT STEPS TO THE TREATED SURFACE
6	THE NEW PROCESS: CLEANING AND COATING IN A SINGLE STEP
7	COMPARISON: ADVANTAGES OF CLEANER & COATER TECHNOLOGY
10	Q&A – ANSWERS TO QUESTIONS ABOUT THE CLEANER & COATER PROCESS
11	CHECKLIST: HOW GREAT IS MY OPTIMIZATION POTENTIAL?
12	CONSULTING: CALCULATE POTENTIAL SAVINGS IN ADVANCE
13	BEST PRACTICE BSH: CLEANER & COATER IN PRACTICE
14	ABOUT HENKEL

Editorial

There are two indispensable process steps in metal pretreatment: cleaning and coating. They ensure the quality of metal surfaces in terms of corrosion resistance and coating adhesion, thus making a significant contribution to their performance in later use.

One challenge facing manufacturers – whether of white goods, office furniture or agricultural vehicles – is the large amounts of water and energy required for the cleaning and coating of metal parts. This makes it more difficult for them to meet sustainability targets, such as reducing CO₂ emissions, and drives up process costs at a time when raw material costs are also rising.

Customers are seeking to identify potential savings in order to optimize processes as well as meet their customer's expectations with regard to sustainability and efficiency. In

the case of surface treatment, the plant layout offers many possibilities: The conventional eight to ten process steps, for example in the conversion process with zinc and iron phosphate, can be reduced to four process steps thanks to the latest generation of coaters.

In this whitepaper, we show you exactly how to make this switch. You will learn about the advantages for users in terms of quality, process efficiency and sustainability. In addition, we demonstrate the results of combining cleaning and coating through the best-practice example of home appliance manufacturer BSH Turkiye.

We hope you enjoy reading this whitepaper. Please do not hesitate to contact us if you have any questions.

Your Henkel team



The challenge:

Cleaning and coating meet cataphoresis

Home appliances, office furniture or agricultural equipment must satisfy the highest requirements in terms of quality and safety. Manufacturers generally turn to a powder coating to meet these requirements as well as to achieve an appealing look and feel. Cataphoresis or cataphoretic dip coating is often used here as a base layer, as it ensures particularly high resistance to chemical and environmental corrosion.

To date however, conventional cleaning and coating systems do not provide ideal results in terms of coating adhesion and corrosion performance when used with liquid coating applications such as cataphoresis. The cleaning performance on heavily soiled surfaces is also not optimal.

Test methods: What are the product requirements for metal surfaces?

The following methods are used to check for deficiencies in the metal coating:

Test method	Description	Feature of coating quality	Standard	Performance property
Salt spray test	Metal parts are corroded using a sprayed salt solution, generally sodium chloride.	Corrosion resistance	DIN EN ISO 9227	504 h, max. 2 mm for e-coat and max. 4 mm for e-coat + powder coating
			ASTM B 117	720 h, max. 2 mm for e-coat and max. 4 mm for e-coat + powder coating
Boiling test	Sample plates are placed in boiling demineralized water.	Paint adhesion	ISO 2409	No paint delamination
Detergent test	Performance testing is performed on the sample plates with a 1% solution of phosphate-free powdered laundry detergent for 5 hours / 2 days at 95 degrees.	Paint adhesion performance with cross cut test	Customer standards	No paint delamination
Impact test	The deformation of the coating is tested by drop ball impact.	Elasticity	DIN 55669	No paint delamination
Cross-cut test	A right-angle lattice pattern is cut into the surface. After the vigorous removal of adhesive tapes, the number of squares that have flaked off is measured.	Adhesion and elasticity	DIN EN ISO 2409	No paint delamination

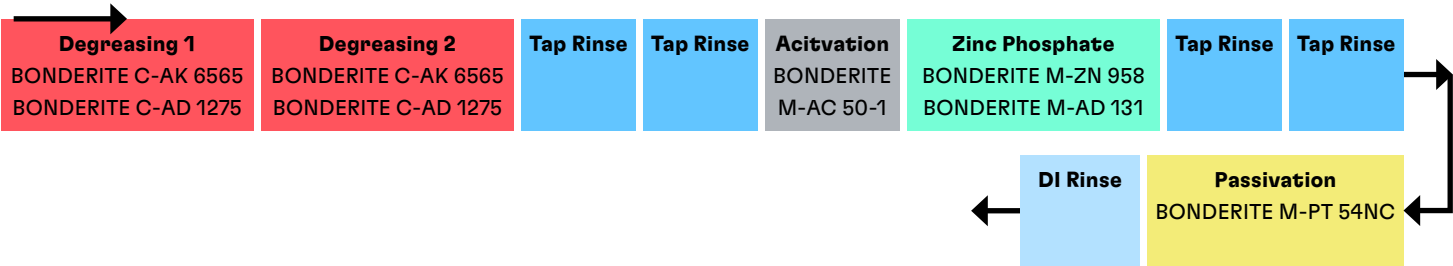
The conventional method: Eight steps to the treated surface

The traditional surface treatment process can comprise eight or more process steps.

NGC conversion & coating process



Zinc phosphate process



When looking at the NGC conversion and coating process, the first and second steps involve the metal parts being degreased with alkalis and surfactants. This removes all residues and deposits such as oil, oxides and dust. By doing this, users prevent subsequent work steps such as painting or conversion coating from being impaired, thus ensuring the quality of the products.

After degreasing, the parts must be rinsed and prepared for conversion coating. Three rinse cycles are required for good cleaning. The parts are rinsed twice with tap water and once with deionized water (DI). This is necessary because the preceding cleaning steps are alkaline and the subsequent conversion coating is acidic.

After coating, surface treatment concludes with two more rinse cycles with deionized water to remove the substrate and to achieve a homogeneous coating rate.

The disadvantages of conventional processes are as follows:

- The cleaning baths for degreasing the parts are usually heated to between 45 and 60 degrees Celsius depending on the line. This results in high energy use followed by water loss via evaporation.
- Water use is generally high due to a total of five rinse cycles.
- Zinc and iron phosphate produce sludge, which precipitates in the baths and may clog the nozzles. This means increased effort for service and maintenance, as the sludge must be removed by filtration and / or wastewater treatment and disposed of separately.

The new process: Cleaning and coating in a single step

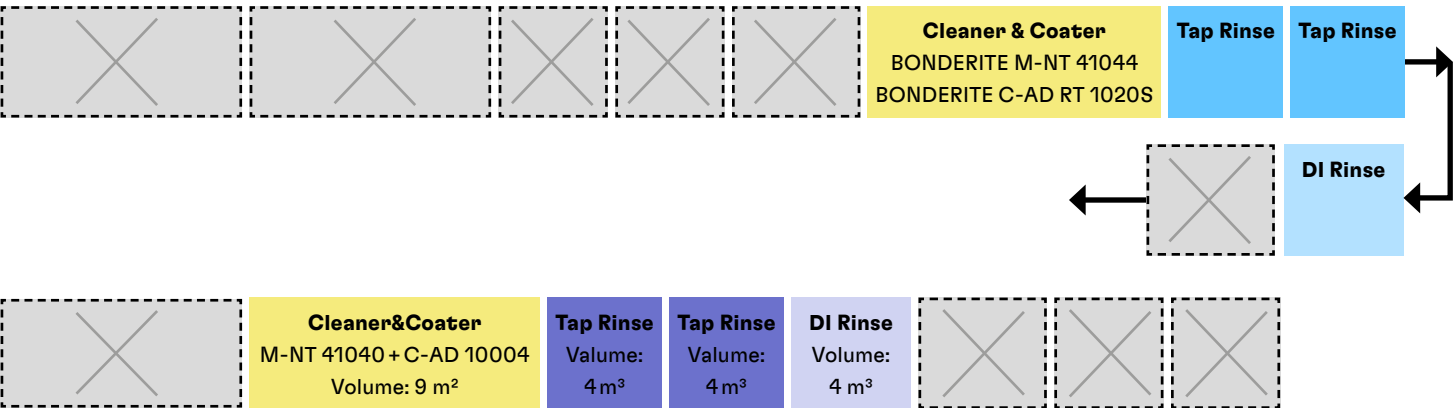
To improve efficiency and foster sustainability, Henkel has developed a new product that reduces the number of steps required to four.

As a cleaner & coater product, BONDERITE M-NT 41044 combines cleaning and coating of the metal parts in one step. The product can be used in combination with powder coating, wet paint or cataphoretic coating applications in industry in

general, for example home appliances, office furniture, heavy equipment and agricultural vehicle manufacturers.

It was possible to combine cleaning and coating through the integration of low-temperature cleaning technology with the chemistry of conversion coating, which was developed specifically for the treatment of steel parts for the white goods industry.

NGC Cleaner & Coater Process Approved



The result is that degreasing stages are eliminated; the metal parts are instead cleaned and coated in the first process step. Surface treatment is already complete after just three rinse cycles – two with tap water and one with deionized water.

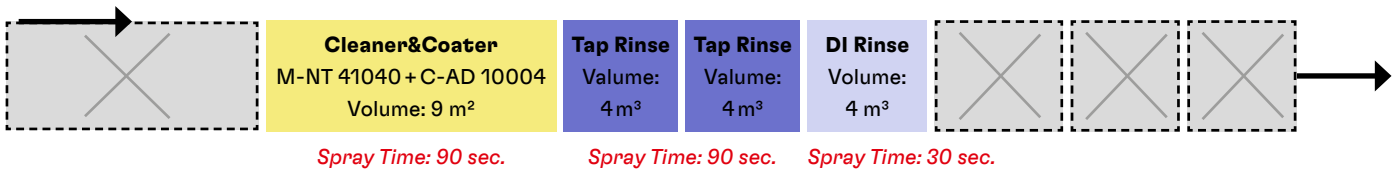
The new process also continues to meet customers' technical and quality expectations without adversely affecting other complementary factors of the processes.

Comparison: Advantages of cleaner & coater technology

Current Prozess



Cleaner & Coater Process



A direct comparison shows that a total of four process steps have been eliminated compared to the traditional process. This offers users various advantages in terms of sustainability and cost-effectiveness due to greater process efficiency.

Process advantages

■ Halve the time required for surface treatment

The conventional process with separate cleaning and coating steps (zinc phosphate) generally takes around eleven minutes. Since four process steps are eliminated with the cleaner & coater technology, the total time required for surface treatment is reduced to between three and four minutes. The shorter treatment time enables users to achieve higher line speeds and thus greater output.

■ Outstanding cleaning performance

The cleaner & coater technology delivers outstanding cleaning performance after the pressing or cold forming of metal parts. Even heavy soiling and oily contamination with pigmented, fatty acid-bearing drawing agents from metal substrates can be removed without residue.

■ Optimal compatibility with cataphoresis

The process combination was developed for optimal corrosion resistance and adhesion following painting. It is therefore compatible with cataphoresis (e-coat) and other liquid paints. There are typically no issues with the thickness of the e-coat on the inside or outside of the metal part, for example.

■ Reduced parameterization effort

With the cleaner & coater technology, the time spent on process control can be reduced as less stages are present that could be monitored (such as acid content, alkalinity, activation and passivation).

■ Fewer process steps frees up space in the plant

Reducing the number of process steps also reduces the physical setup of the pretreatment line. This helps to reclaim space in the production facilities. This is particularly advantageous in smaller halls or if the manufacturer wants a small plant layout.

Ecological advantages

■ Reduce energy and water use

The cleaner & coater product also enables users to achieve significant savings in water and energy use as well as CO₂ emissions. The energy savings occur in the first step due to the ability to perform pretreatment at a low temperature or even room temperature. There is thus no need to use a heating system. Reducing the number of water baths from five to three drastically reduces water use.

■ Reduce service and maintenance work

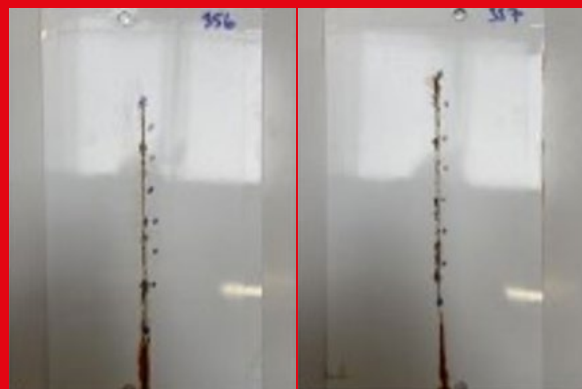
The fact that the product contains no heavy metals prevents the formation of sludges, which largely eliminates the need for wastewater treatment. There are also advantages from the perspective of service and maintenance: No sludge is formed, which means that the nozzles remain clear, the process line has a lower failure rate, and there is less overall maintenance needs. This saves time and effort, and also allows resources to be deployed elsewhere.



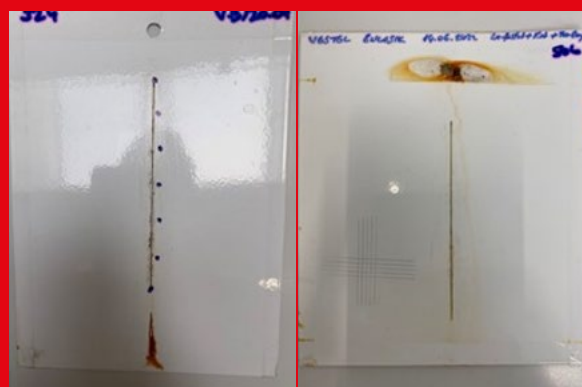
Comparison of corrosion performance after neutral salt spray test (NSS, according to DIN EN ISO 9227) on cold rolled steel substrate



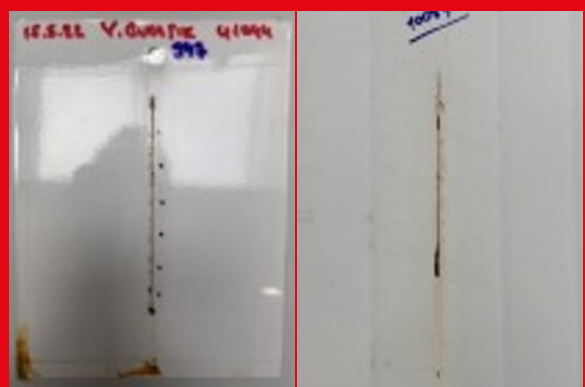
The first picture shows comparison of NSS after 504 hours of an eight stage conversion coating process (left) with the four stage cleaner/coater process (right).



The second picture shows comparison of NSS after 750 hours.



The first picture shows comparison of NSS after 1008 hours of zinc phosphating process (left) with the four stage cleaner/coater process (right).



Q&A – Answers to questions about the cleaner & coater process

Q: As a manufacturer of home appliances, I already use Henkel's classic NGC cleaner & coater product BONDERITE M-NT 41040 for surface treatment and powder coating. Does it make sense for me to switch to the new product?

A: If you are currently working with BONDERITE M-NT 41040 and benefiting from the same process advantages as with BONDERITE M-NT 41044, there is no need to switch. If the aim is to use cataphoresis for painting, however, a switch to BONDERITE M-NT 41044 is recommended. This product has been specially designed for the process with cataphoresis and thus delivers greater performance with respect to corrosion protection and paint adhesion.

Q: How high is the level of investment required for the switch from separate products for cleaning and coating to BONDERITE M-NT 41044? Do mechanical modifications need to be made to the cleaning and pretreatment line?

A: No additional investments are required to switch from separate cleaning and coating products to BONDERITE M-NT 41044. You only need to ensure that pre-cleaning of the process has been performed previously. Irrespective of this, some investments in equipment may be made to benefit the longevity of the baths, such as an oil separator. This applies to all processes, however. The situation is different with zinc or iron phosphating. The supplier conducts a pre-audit to determine whether modifications are necessary.





Checklist: How big is my optimization potential?

These questions are examples of the various criteria that users need to consider with the current setup of their pretreatment line. The evaluation of performance, usage, process costs and the amount of time involved exposes (hidden) cost drivers, productivity losses and, therefore, aspects of the process that need to be adjusted.

- How high is production capacity (square meters per hour or units per day)?
- What does the current process look like (stages, temperature, concentration)?
- What are the company's targets with respect to water and energy savings in the process?
- How much water has to be supplied per hour for all of the rinse cycles?
- How high are the costs per liter of water?
- Are costs incurred for the heating involved in the stages?
- How high are the costs for cleaning and maintenance work?
- How much time is required for sludge treatment and disposal?

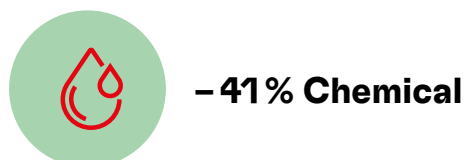
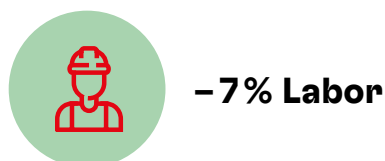
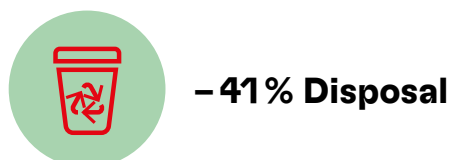
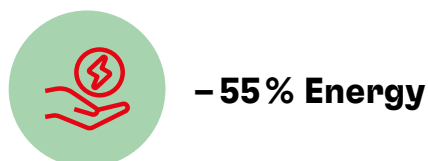
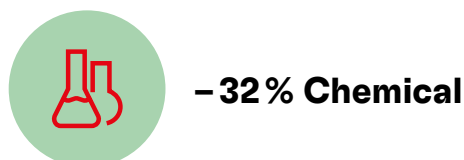
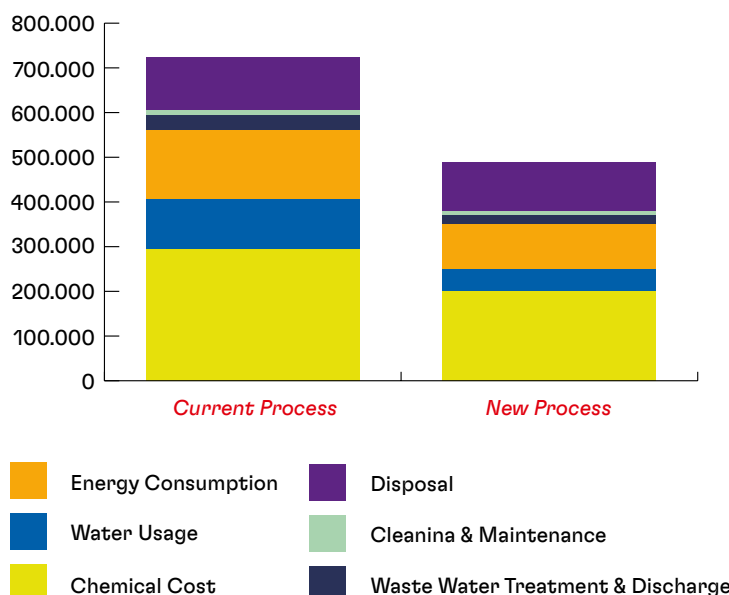
Conclusion: By answering these questions, manufacturers can establish the basis for exploring potential savings and making their own production operations more fit for the future. This is particularly true if companies are pursuing sustainability targets such as saving water and energy or reducing CO₂ emissions in their production facilities and products. The level of savings that can be expected by switching to the cleaner and coater technology will be calculated in consultation with the supplier.

Consulting: Calculate potential savings in advance

Together with the supplier, the potential user evaluates the local conditions at the plant on the basis of production data, chemical products and other parameters. The approximate value is calculated from the following factors:

- Cost of chemicals
- Water use
- Use of energy
- Wastewater treatment and disposal
- Cleaning and maintenance
- Disposal
- Labor costs
- Cost of quality
- Total costs

A comparison of the total annual costs based on an internal Henkel model using fictive costs shows an expected total cost saving of up to 35 percent for the cleaner & coater process compared with the conventional process. This is comprised of savings from the reduced use of chemicals, energy and water, for example.



Best practice BSH: Cleaner & coater in practice

A specific customer project provided the impetus for the development of the cleaner & coater process. BSH, Europe's leading home appliance manufacturer, has been using Henkel's BONDERITE M-NT 41040 for its cleaner & coater applications in the manufacture of ovens and dishwashers since 2020. When the company then wanted to integrate the solution into the manufacture of washing machines in Turkey, it was found that this first version of the product was not optimal with cathaphoretic coatings but delivered successful results in powder coating applications. BSH had also set itself ambitious sustainability targets. To this end, resources were to be conserved and emissions reduced in the paintshop process at its washing machine production facility.

In joint workshops, BSH Türkiye and Henkel developed the new formulation, which offers outstanding corrosion resistance and coating adhesion. As the world's first approved cleaner and coater for cathaphoretic processes, BONDERITE M-NT 41044 enables BSH Türkiye to use 30 percent less water and 6 percent less energy in the process while reducing CO₂ emissions by 100 metric tons per year. As a result, not only washing machine factories but also manufacturers of control panels and agricultural vehicles – in short, anywhere cathaphoresis or wet paint is used – might benefit from this.

You can find the case study here:

<https://www.henkel-adhesives.com/nl/en/industries/metals/metal-pretreatment/bonderite-goes-around-the-world/sustainable-surface-treatment-success.html>



About Henkel

With its brands, innovations and technologies, Henkel holds leading market positions worldwide in the industrial and consumer businesses. The business unit Adhesive Technologies is the global leader in the market for adhesives, sealants and functional coatings. With Consumer Brands, the company holds leading positions especially in laundry & home care and hair in many markets and categories around the world. The company's three strongest brands are Loctite, Persil and Schwarzkopf. In fiscal 2023, Henkel reported sales of more than 21.5 billion euros and adjusted operating profit of around 2.6 billion euros. Henkel's preferred shares are listed in the German stock index DAX. Sustainability has a long tradition at Henkel, and the company has a clear sustainability strategy with specific targets. Henkel was founded in 1876 and today employs a diverse team of about 48,000 people worldwide – united by a strong corporate culture, shared values and a common purpose: "Pioneers at heart for the good of generations." More information at www.henkel.com.



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Thank you.

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An expert team at Henkel is always available to answer your questions.

Please contact your local Henkel sales representative.

We will be happy to help you.