



Ni Flash Surface Enhancement of Cold Rolled Steel

Coating Description

ArcelorMittal has been the premier supplier of cold rolled continuous annealed steel in North America for unexposed and critical exposed applications in automotive, appliance and other demanding markets. Susceptibility to corrosion is inherent on cold rolled steel (CRS), so users rely on coatings like paint to protect against corrosion and enhance appearance. Nearly all cold rolled steel sheets undergo zinc phosphate pre-treatment prior to paint application. Ni Flash is a treatment where elemental nickel is incorporated into the surface of the cold rolled steel between annealing and tempering rolling which enhances the phosphate formation and coverage during phosphate pretreatment stage. Improved phosphatability is achieved through a physical interlocking of the nickel sites with the paint resin polymers, resulting in improved adhesion and corrosion resistance of the cold rolled steel in part service.

Production Source in North America

The non-continuous atomic nickel layer or "flash coating" is applied by electrolytic bath and is currently being supplied from AM/NS Calvert mill at the continuous annealing line 2 (CAL2). CAL2 runs the new Gen 3 AHSS product chemistries that contain high Si (plus Mn, Cr, Al) and therefore pickling is needed to remove oxides of these metals post annealing. Pickling was installed at the end of the CAL line for Gen 3 and non-Gen 3 grades which results in a very clean and excessively uniform surface. Ni flash surface enhancement technique is applied post the pickling and rinse step. Schematic below in Figure 1 below shows the process of Ni flash application.

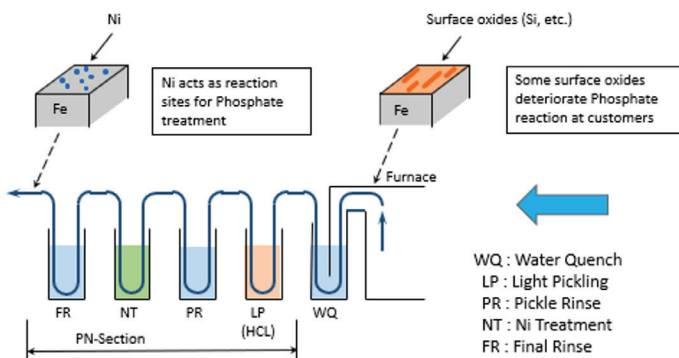
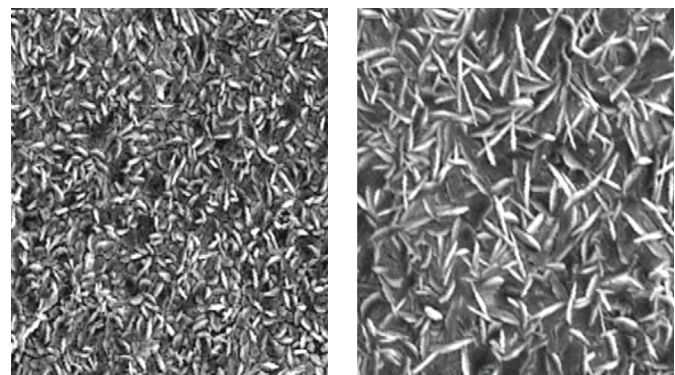


Figure 1: Ni Flash Process Overview

Benefits for a Continuous Annealed Steel Substrate

The applied Ni coating weight ranges from 3-40mg/m² its levels optimized based on the steel grade and type of phosphate system being utilized. The total amount of nickel on one coil is about 1 ounce compared to 200+ pounds of zinc on a typical G30 coil. The main benefit of the Ni flash coating stems from the engineered surface, post the CAL cycle, where Ni application forms a well-distributed non continuous deposit of cathodic crystal nucleating sites that optimize phosphate crystal growth and coverage. Figure 2 shows the comparison in phosphating treatment with and without Ni flash on CRS.



Ni Flash CRS

Conventional CRS

Figure 2: Typical Zinc Phosphate coverage at 750X magnification

A) Conversion Coating Effectiveness:

Improved phosphatability results in significant improvement in paint adhesion and corrosion resistance of Ni flash CRS substrate as compared to standard CRS. There is also a potential to reduce the paint film thickness due to increased performance of the coating system.

Figure 3 show in service Ni flash application benefit of increased corrosion protection due to better paint adherence post Ni flash and zinc phosphate treatment.

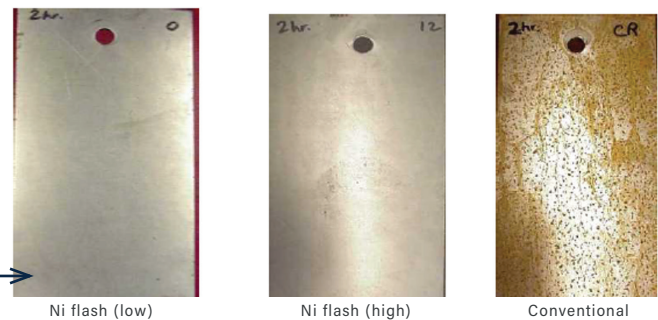
Figure 3: Four years outdoor exposure - Zinc Phosphate, two coat appliance grade paint



B) Improved Rust Prevention:

A second order benefit of Ni flash coating is that it holds onto the monolayer of oil rust inhibitors after degreasing which delays flash rusting in cases of paint line stoppages. Customers have noted reduction in scrapped parts between the alkaline cleaning/degreasing operation and phosphating with Ni flash CRS, however no additional rust protection is provided with Dry CRS with Ni flash over conventional CRS without Ni Flash. Figure 4 shows an example of improved flash rust prevention.

Figure 4: Cleaned CRS "stalled" in paint treatment line for 2 hours



C) Improved Stamping and Assembly Performance:

Continuous anneal process allows for consistency in mechanical properties resulting in consistent geometries of stamped parts. Continuous annealing provides a cleaner product that typically is not achieved with batch annealing process, which reduces the load on cleaning systems. The surface engineering with Ni flash treatment has no effect on existing weld setups of conventional CRS. Electrode life and weld fumes is same as conventional CRS. Adhesive bonding characteristics is also identical to conventional CRS.

Availability

ArcelorMittal has been commercially supplying Ni Flash cold rolled Mild steel, AHSS steel and Gen 3 grades from the AM/NS Calvert facility for automotive applications since 2016. In general, the coating is available for all grade specifications that are currently in commercial production at AM/NS Calvert CAL2 line. The performance improvements with Ni flash surface treatment provide cold rolled steel sheet users the opportunity to capture considerable cost savings through reduction of processing costs, scrap reduction and less raw material usage.

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