

# In the SPOTLIGHT:

## S<sup>3</sup>P PROCESSES FOR HARDENING OF DUPLEX STAINLESS STEELS

Duplex stainless steels are used where austenitic steel can no longer meet the requirements for increased strength and corrosion resistance, especially in marine environments and sour gas applications. Although duplex stainless steel has a higher strength than austenitic steels, the use of these steels in applications with abrasive conditions is limited. As with all stainless steel grades, there is also a risk of galling or fretting when the same material is paired. S<sup>3</sup>P methods offer a solution for improving the mechanical properties and avoiding galling while retaining the excellent corrosion resistance of the material.



The S<sup>3</sup>P treatments can be used for all groups of duplex stainless steels. In special low-temperature diffusion processes the ferritic microstructures in the boundary area transform into austenite, and high amounts of carbon can thus be solved. Expanded austenite with high compressive stresses forms and is visible as a white diffusion zone in the boundary area of the microstructure. Since the high surface hardness just results from a supersaturation of the microstructure, and not from the precipitation of hard nitrides as for e.g. classical nitriding, the hardened zone is very ductile. The process control leads to chromium-carbide free and corrosion resistant surfaces on parts and components of virtually any size and shape.

## Advantages

- Surface hardness > 1100 HV<sub>0.05</sub>
- Improve wear resistance
- Eliminate galling
- Increased fatigue resistance
- Maintained corrosion resistance
- No Coating – does not flake or peel off
- Certified to ISO 15156 / NACE MR0175
- Certified to NACE TM 0177 / ASTM G39

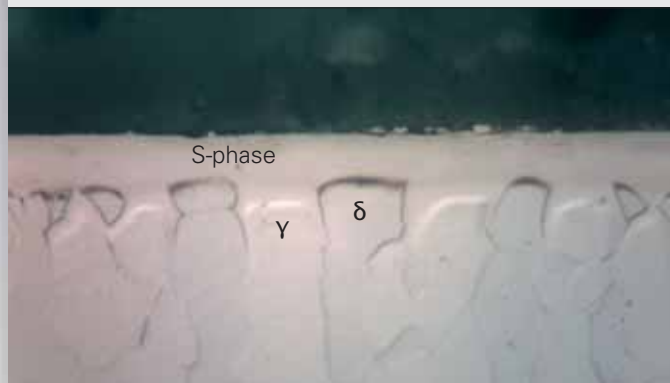
## Material Selection

All duplex materials are suitable for treatment with S<sup>3</sup>P. Bulk goods and serial parts, as well as individual components weighing up to 4.0 t and in lengths of up to 2.0 m, can all be treated. In addition to increasing the surface layer hardness, an increase in the base material hardness based on a decomposition of the ferrite can sometimes be measured in duplex materials. This effect can influence the toughness and should be tested for the individual application.

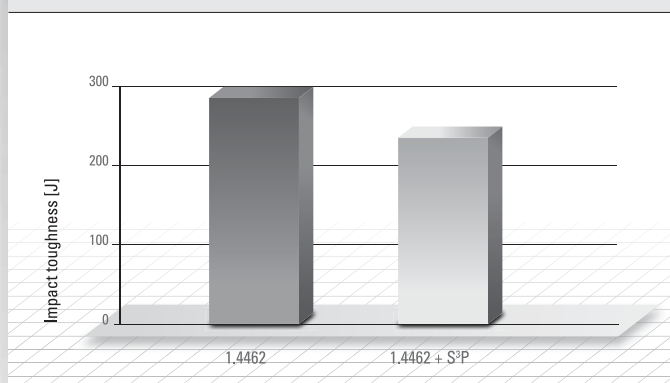
The achievable results are significantly influenced by the alloy and by the processing state of the surface. For a feasibility study, please contact your S<sup>3</sup>P distributors.

## Examples of treatable alloys

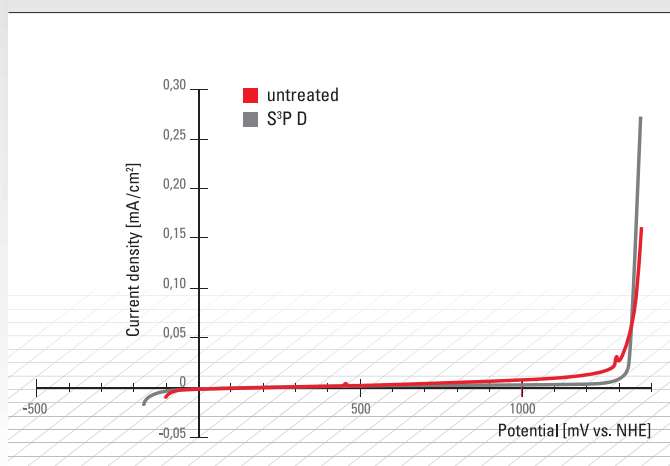
- **22% Duplex stainless steel** (1.4462, ...)
- **25% Super duplex** (1.4501, ...)
- **Lean Duplex** (1.4362, ...)



Structure of an S<sup>3</sup>P D-treated duplex steel 1.4462; wider diffusion zone in the austenitic phase.



Slight lowering of the impact toughness of the material 1.4462 due to a partial decomposition of the ferritic phase.



Summation-current density-potential curve of the standard duplex steel 1.4462 in 3% NaCl solution.