

In the SPOTLIGHT:

QUALIFICATION OF S³P FOR THE OIL AND GAS INDUSTRY – RESISTANCE TO SULFIDE STRESS CRACKING

Natural gas and oil inherently contain a certain amount of hydrogen sulphide (H₂S). In combination with increased temperatures and pressure in environments containing chloride, sulfide stress cracking (SSC) can occur. Typically these conditions occur in oil and gas extraction, predominantly off-shore. Due to their corrosion properties, corrosion resistant alloys (CRA) steels are suitable for use in sour gas environments, but depending on applied load the wear properties can be insufficient. With Bodycote S³P processes it is possible to achieve the required wear resistance of corrosion resistant alloys (CRA) whilst retaining the resistance to sulfide stress corrosion.



However, as this thermo-chemical surface process is not currently mentioned expressly in the corresponding standards (e.g. NACE MR0175), the corresponding treatment should be qualified before application.

S³P processes are suitable for many austenitic, martensitic and duplex stainless steel grades relevant in the oil and gas industry, as well as for nickel-based alloys. The surface hardness of these materials can be increased to > 1000 HV_{0.05}. Surface hardness of up to 1400 HV_{0.05} in martensitic grades. The wear resistance is thus significantly increased. Compared with other diffusion processes such as nitriding, this does not impair the corrosion resistance. Furthermore, the cavitation resistance, galling resistance and fatigue strength is significantly improved.

For application in sour gas environments, the S³P-treatment of three materials is qualified according to NACE MR0175 (resistance against sulfide stress cracking). Numerous positive customer experiences and qualified applications exist. The results of NACE MR0175 do not indicate negative influence on the SSC resistance in any of the materials and processes tested. The investigations were carried out and certified by external laboratories.

Please contact us for further information and certificates on other corrosion tests such as ASTM A262 or G48.

Material	Treatment	SSC-resistant according to NACE MR 0175
AISI 316L (1.4404)	K 33	✓
Duplex 2205 (1.4462)	K Duplex	✓
15-5PH (1.4545)	S ³ P M	✓

Overview of the alloys and processes tested by Bodycote S³P for resistance to sulfide stress cracking. We would be happy to supply you with the certificates.



Microstructure of a S³P-treated 1.4462 (AISI 316L) after 720 hours in a sour gas atmosphere at 90 °C under mechanical stress. No signs of stress corrosion.



Microstructure of a S³P-treated 1.4404 (AISI 316L) after 720 hours in a sour gas atmosphere at 149 °C under mechanical stress. No signs of stress corrosion.



Microstructure of a S³P-treated 15-5PH (1.4545) after 720 hours in a sour gas atmosphere at 120 °C under mechanical stress. No signs of stress corrosion.