Supplementary Information

Effects of NaCl Concentration on Wear-corrosion Behavior of SAF 2507 Super Duplex Stainless Steel

Gaofeng Han\textsuperscript{a, b}, Pengfei Jiang\textsuperscript{a}, Jianzhang Wang\textsuperscript{a,*}, Fengyuan Yan\textsuperscript{a,*}

\textsuperscript{a} State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Lanzhou 730000, P.R. China
\textsuperscript{b} University of the Chinese Academy of Sciences, Beijing 100049, P.R. China

* Corresponding author. Tel: +86 0931 4968078 (J. Wang), +86 0931 4968185 (F. Yan) E-mail addresses: wjzsci@163.com (J. Wang), fyyan@licp.cas.cn (F. Yan)
\[ T = \frac{m_0 - m_1}{S \times \rho \times t} \]  

[1]

\[ C = \frac{K \times i_{\text{corr}} \times EW}{\rho} \]  

[2]

Where \( T \) is mechanical wear rate, \( m_0 \) is initial mass of material, \( m_1 \) is the final mass of material, \( S \) is the area of corrosion, \( \rho \) is the density, \( t \) is the corrosive wear test duration, \( C \) is the electrochemical corrosion rate. \( K \) is a constant \( 3.27 \times 10^{-3} \) in \( \text{mm} \cdot \text{g} / \mu \text{m} \cdot \text{cm} \cdot \text{yr} \), \( EW \) is the material equivalent weight, \( i_{\text{corr}} \) is the corrosion current density.

The interaction relationship between wear and corrosion is shown as follows:

\[ T = W_0 + C_0 + S \]  

[3]

\[ S = \Delta C_w + \Delta W_c \]  

[4]

\[ W_c = W_0 + \Delta W_c \]  

[5]

\[ C_w = C_0 + \Delta C_w \]  

[6]

Where \( T \) is the total mass loss rate of wear-corrosion, \( W_0 \) is the wear rate without corrosion, \( C_0 \) is the corrosion rate without wear, \( S \) is the sum of the interactions between corrosion and wear determined by Eq. 4, \( \Delta C_w \) is the change in corrosion rate due to wear, \( \Delta W_c \) is the change in wear rate due to corrosion (the units of all the parameters mentioned above are \( \text{mm} \cdot \text{y}^{-1} \)).

According to ASTM G119-09 [19], the dominating effects of the regimes can be
defined as follows:

\[ \frac{\Delta C_w}{\Delta W_c} < 0 \] Antagonistic effects dominate (Corrosion inhibits wear) \[7\]

\[ 0 < \frac{\Delta C_w}{\Delta W_c} < 0.1 \] Synergistic effects dominate (Corrosion is affecting wear greatly) \[8\]

\[ 0.1 \leq \frac{\Delta C_w}{\Delta W_c} < 1 \] The “additive” and “synergistic” interactions are equal (Wear is affecting corrosion to an equal to corrosion is affecting wear) \[9\]

\[ \frac{\Delta C_w}{\Delta W_c} \geq 1 \] Additive effects dominate (Wear is affecting corrosion greatly) \[10\]

Wear-corrosion synergism degree is depicted by three dimensionless factors. They are total synergism factor, corrosion augmentation factor and wear augmentation factor. They are all calculated as follows, respectively.

\[ \frac{T}{T-S} \] \[11\]

\[ \frac{C_0 + \Delta C_w}{C_0} \] \[12\]

\[ \frac{W_0 + \Delta W_c}{W_0} \] \[13\]