Effects of Texture of Austenitic Stainless Steels on Pitting and Crevice Corrosion

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INTRODUCTION

The aim of this study was to assess the corrosion behaviour of austenitic stainless steels used in medicine and dentistry according to the orientation of analyzed surfaces. The corrosion phenomena studied are localized pitting corrosion and crevice corrosion.

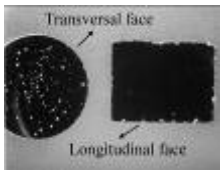

Fig. 1: Specimen #1 after 2 h in $FeCl_3$ at 50°C.

METHODS

Table I. Austenitic stainless steels tested.

#	DIN	AISI	ASTM
1	1.4571	316L Ti	--
2	1.4435	316 L	--
3	1.4441	316 L Med	F138
4	1.4539	904L	--

Pitting resistance by the use of ferric chloride solution (ASTM G48).

After immersion of samples in $FeCl_3$ 0.5 M during 2 h at 50°C, the pitting density is then estimated for every face (transversal and longitudinal) (fig.1).

Evaluation by electrochemical techniques (ASTM G3 ASTM G59)

The test medium is an electrolyte based on the EN 1811 standard (1 ± 0.001 g/l of urea, 5 ± 0.001 g/l of NaCl, 940 ± 10 µl/l of racemic lactic acid, with a pH of 4.5).

General corrosion and pitting corrosion

Investigated electrochemical parameters were open circuit (E_{oc}) in the N2-deaerated electrolyte for 16h, plotting of the polarization curve (± 150 mV vs. E_{oc}), plotting of the overall polarization curve (-1000 mV to +1000 mV) and coulometric analysis by zone.

Crevice corrosion

The test procedure is described in the ASTM F746.

RESULTS

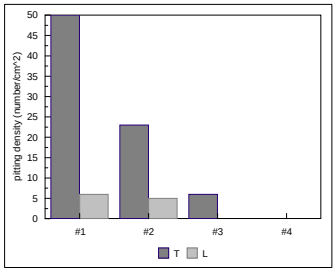

Fig. 2: Pitting test on transversal and longitudinal faces. Test medium 0.5 M $FeCl_3$ at 50°C, 2 hours.

Table II. I_{corr} and coulometric analysis on transversal (T) and longitudinal (L) faces.

	i_{corr} .[µA/cm^2]		Coulometric analysis			
			E_{corr}-300mV (mC/cm^2)		E_{corr}-600mV (mC/cm^2)	
	T	L	T	L	T	L
#1	0.46	0.27	557	192	10670	3523
#2	0.06	0.02	3.0	27.0	198.0	106.0
#3	0.91	0.72	4.8	2.5	1100.0	53.0
#4	0.09	0.06	2.5	1.3	21.0	11.0

$E_{crevice}$ (mV)		
	T	L
#1	-225	-200
#2	50	100
#3	25	75
#4	100	350

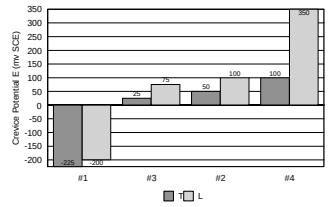

Fig. 3. Crevice potential values measured on the transversal (T) and longitudinal (L) faces.

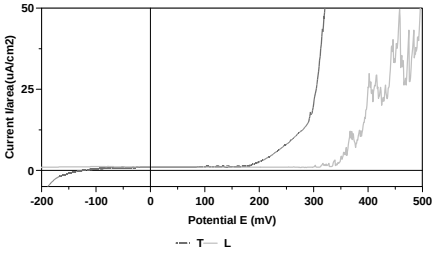

Fig. 4. Potentiodynamic polarization curves on linear axes plotted for the transversal and longitudinal faces for specimen #2.

DISCUSSION & CONCLUSIONS

Surfaces oriented perpendicular to the drawing/rolling direction (transversal faces) are consistently more prone to corrosion than surfaces in the parallel direction (longitudinal faces).