FAPESP Week SPAIN 2024 Nov 27-28th

GROUP ACW
ASEPSIS • CORROSION • WELDING

UNIVERSIDAD COMPLUTENSE MADRID

FAPESP SÃO PAULO RESEARCH FOUNDATION

High Performance Surfaces to Tanks and Pipelines of Pharmaceutical and Food-grade Industries

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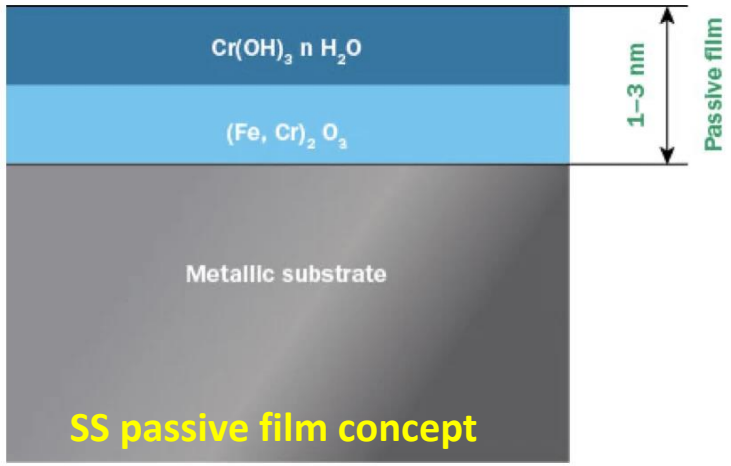
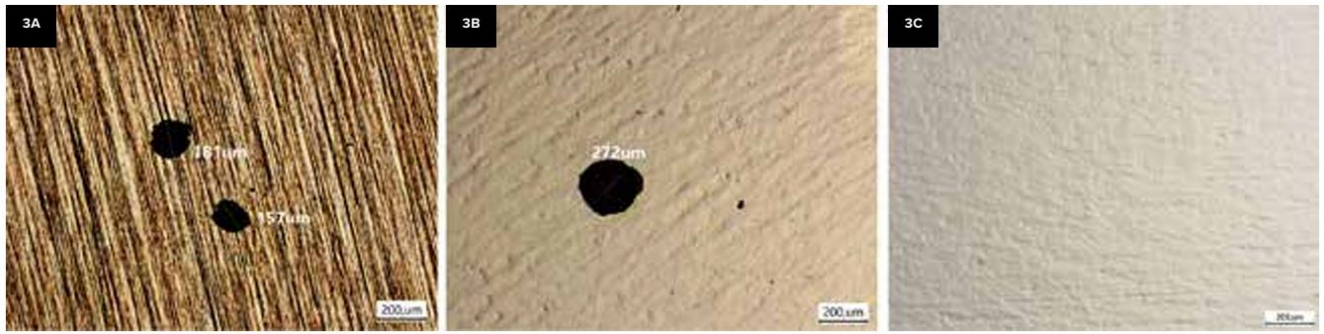
FAPESP SÃO PAULO RESEARCH FOUNDATION

- ACW is a Materials Science & Engineering company
- Specialized in stainless steels facilities for bioprocessing (tanks / pipelines) – in contact with life science & food-grade products
- Delivery its services as Chemical Passivation Treatments and Electropolishing





Life science & food-grade products

Expectation vs. reality

Pharmaceutical

Cosmetics

Food

Beverage, juice and water

Brewery

Biotechnology and Fermentation

Dairy

Agriculture

Chemical and ingredients

Smooth and cleanability surface are a must!

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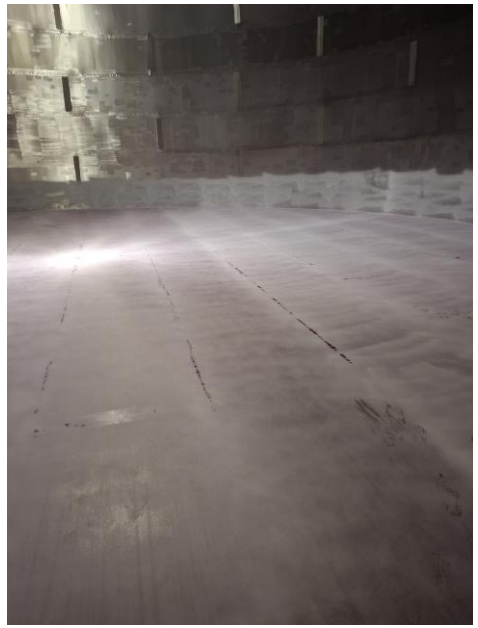
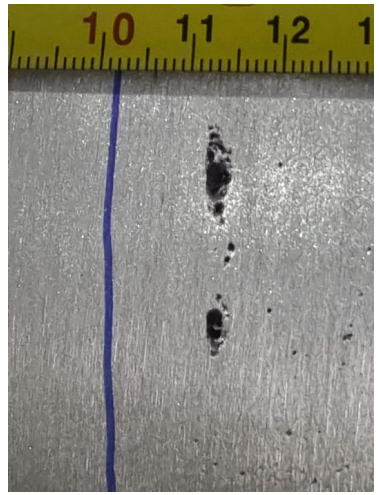
1) Mandatory problems are:

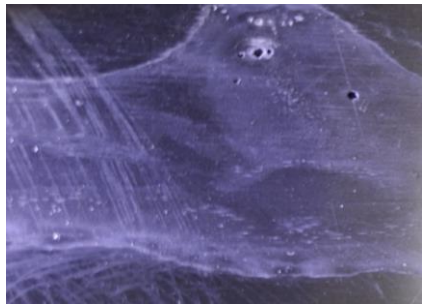
- Localized corrosion
- Rouge contamination
- Biofilm adhesion

2) Corrective maintenance

3) GAP OF TECHNOLOGY: No way to measure the passivation properties



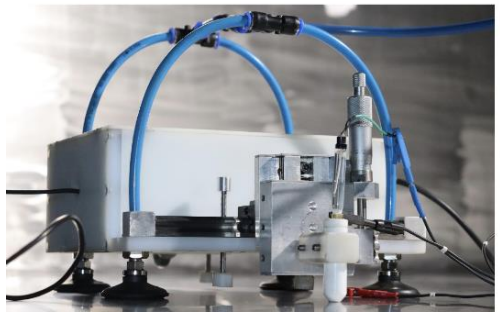



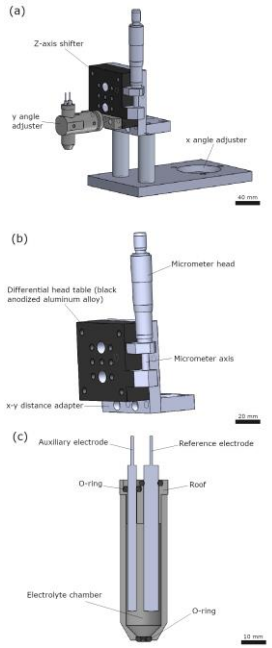



ACW's Science Based Solutions

PassivityScan: qualify surfaces for bio-operation

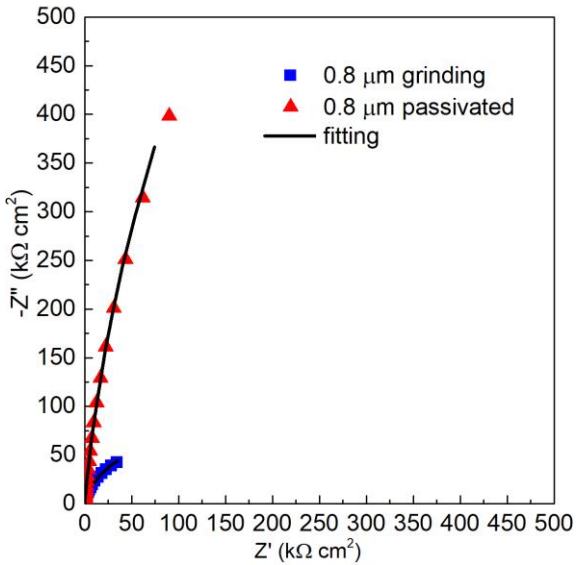
- Customized Portable electrochemical micro-cell
- It is a system able to measure the passivation properties
- Surface is qualified according to a clear acceptance criteria
- System has a granted patent





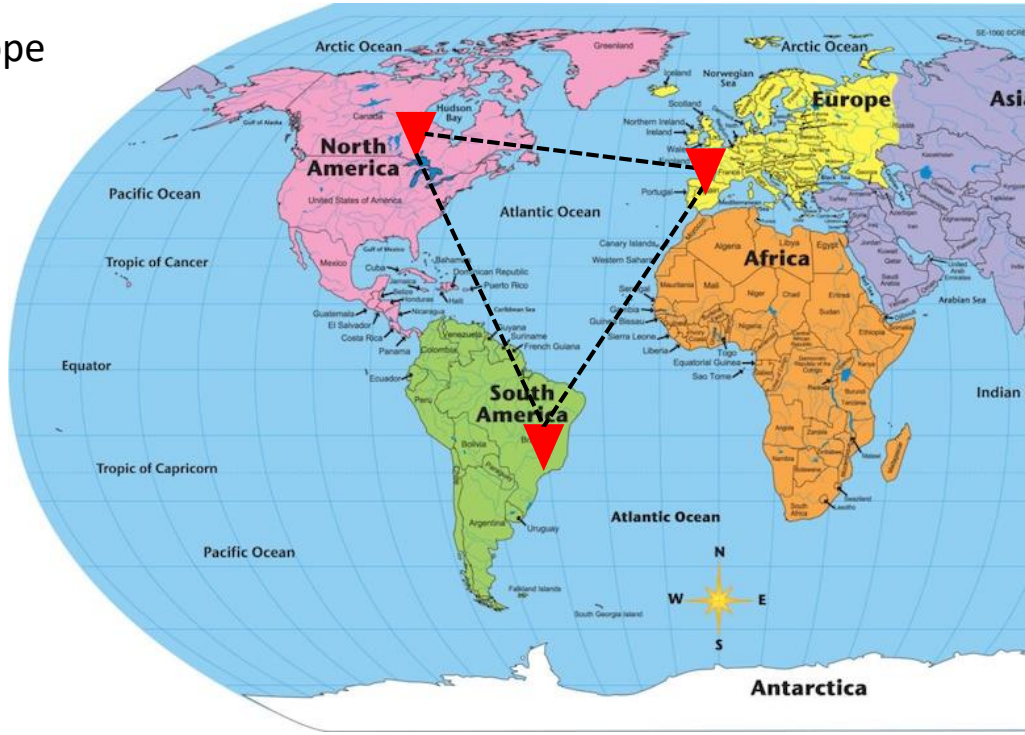
Galvanostatic passivation treatment

- Grow a passive film under controlled conditions
- Combine a specific weak acid, current density and high °C
- Reach the highest Chromium level on the passive film
- Cr:Fe > 2.5:1 for large areas



ACW Market & Strategic Plan

- **ACW's headquarter is based on São Paulo / Brazil**
  - Multinational clients with industrial units in South & North America and Europe
  - All industrial sites branches apply the same/best tecnologies
- **ACW North America**
  - Started a new branch in Canada in 2023
  - Began with a collaborative research with McMaster University
  - Move to the McMaster Innovation Park as an INTERNATIONAL STARTUP
  - Run projects to Pharmaceutical industries at the Great Toronto Area
- **ACW Europe up to 2027**
  - Follow the same way applied to North America
- **Spain**
  - Pharmaceutical Industries (€27.9B in 2022)
  - FIAB - Federación Española de Industrias de la Alimentación y Bebidas: turnover of €120B and employs 436,700 people



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Thank you!

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CHEMYUNION

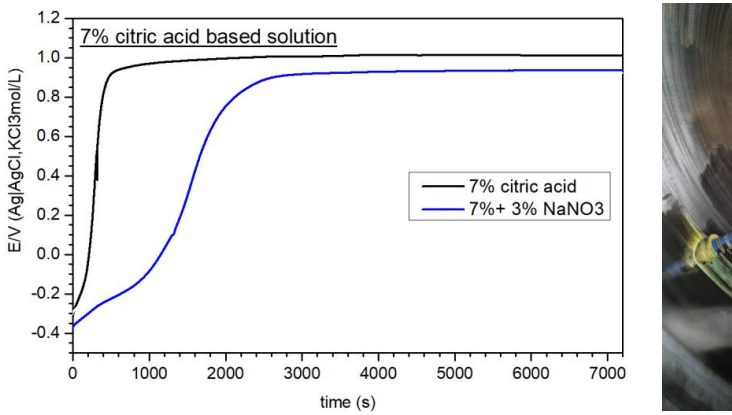
What are ACW doing to help?

How to measure ON-SITE the passivation properties

PassivityScan – granted patent portable electrochemical micro-cell

How to improve the stainless steel surface throught chemical treatment

Galvanostatic passivation treatment



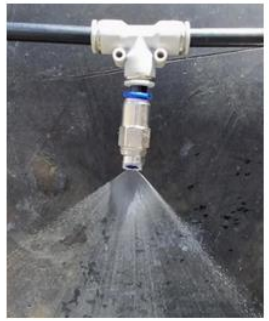
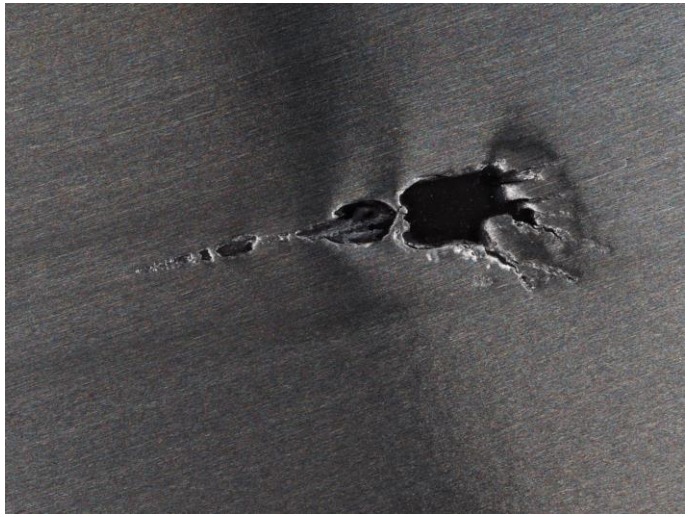
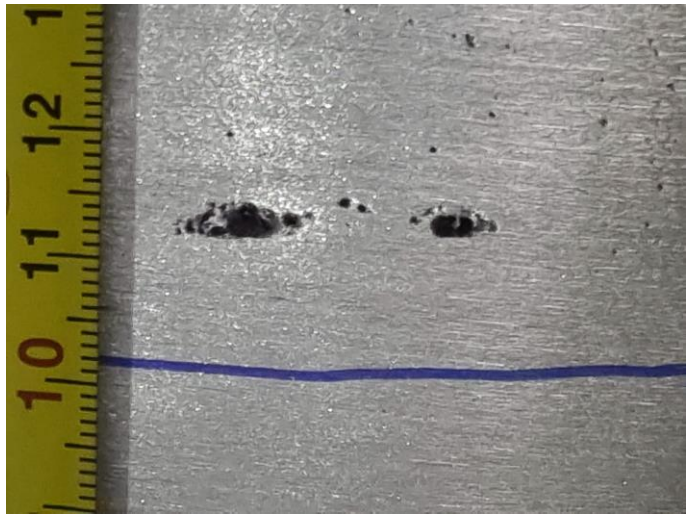


Figura 8. SKID 100 e bico aspersor diâmetro 0.66 mm e ângulo 95°.

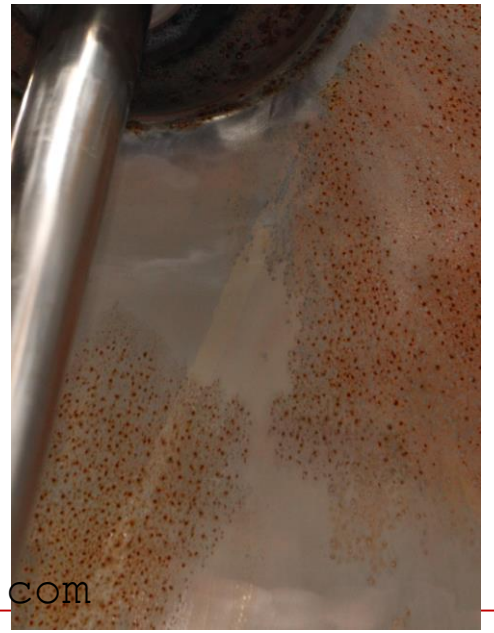
Both applied science researchs were supported by FAPESP Innovative Research in Small Business (PIPE)

Localized corrosion





Rouge & oxidation



Biofilme & Fungus

Galvanostatic Passivation Treatment

Table 5: Atomic composition of 316L stainless steel surfaces obtained by XPS.

Sample	Cr (at.%)	Fe (at.%)	Ni (at.%)	Molybdenum (Mo) (at.%)	Manganese (Mn) (at.%)	Cr:Fe Ratio	
As received	23.9	65.2	5.7	3.0	2.2	0.4	
0.8 µm grinding	29.7	62.1	2.1	5.1	1.0	0.6	Conventional technique
0.8 µm passivated	52.6	34.9	5.6	5.6	1.3	1.5	Conventional technique
0.3 µm EP	51.2	31.4	4.7	11.6	1.2	1.6	Conventional technique
0.3 µm EP passivated	55.1	27.5	10.7	5.6	1.1	2.0	ACW technique
0.2 µm grinding	35.1	59.7	1.2	3.8	1.2	0.6	
0.2 µm passivated	61.9	25.2	4.8	7.1	1.0	2.5	ACW technique
0.05 µm EP	34.0	50.6	6.8	7.8	0.8	0.7	
0.05 µm EP passivated	57.4	28.5	7.2	5.1	1.8	2.1	ACW technique

Figure 3: Optical micrographs of 316L stainless steel scanned surface area after CPP measurements of A: Ra = 0.8 µm grinded surface with E_{pit} = +365 mV; B: Ra = 0.3 µm electropolished surface with E_{pit} = +716 mV; and C: Ra = 0.3 µm electropolished and passivated surface without E_{pit}. Electrolyte: 3.5% (m/v) NaCl.

How does ACW run the business?

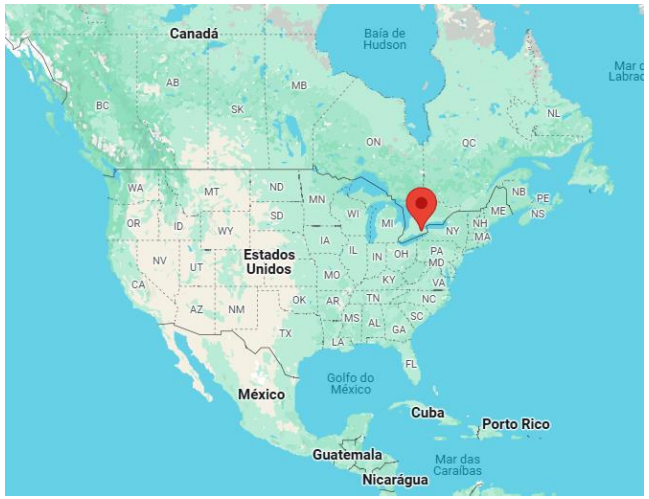
2020

Headquarter: Araraquara city, São Paulo State, Brazil

- Based on a factory 450 m^2
- Pharma, Food, Beverage, Dairy, Biotechnology
- 72+ projects in 2024

2023

Branch in North America: Hamilton, Ontario, Canada.



- Based on The Innovation Park of McMaster University (International startup)
- Pharma & cosmetic industries
- 15+ projects in 2024

2027

Branch in Europe

- Start from the collaborative research
- Lanch as international startup up to 2027

ASME BPE and the requirements for surface com into contact with product or raw material:

- ✓ No oxidation: Stainless steel (normally grade 316)
- ✓ Smooth: Surface finished SF1 or SF4
- ✓ Passivated: Cr:Fe ratio > 1.3:1 (X-Ray Photoelectron Spectroscopy)
- ✓ Regular monitored: product microbiology analysis, boroscope, visual inspection, ferroxyl test
- ✓ Regular chemical passivation treatment (interval of 12 – 24 months)

What is the problem??

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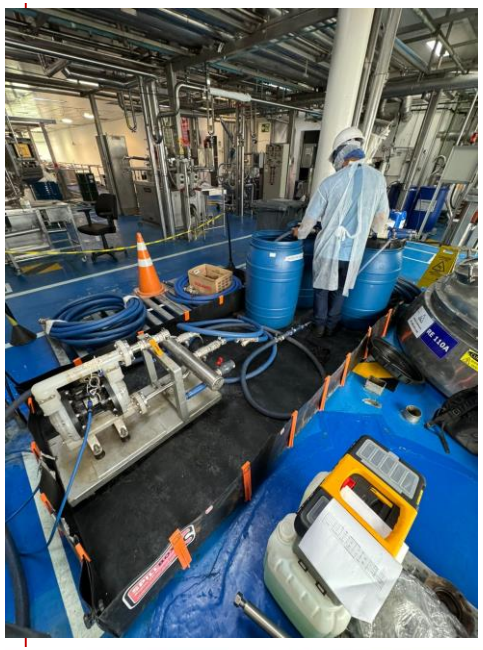
Galvanostatic Passivation Treatment



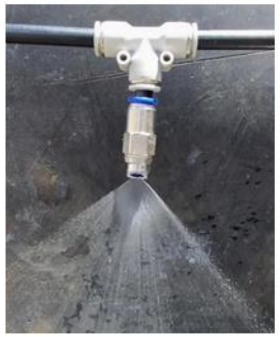
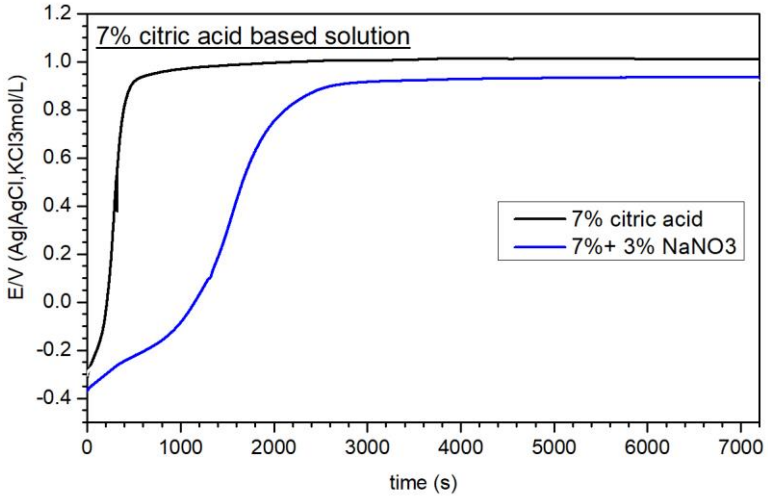


Figura 8. SKID 100 e bico aspersor diâmetro 0.66 mm e ângulo 95°.



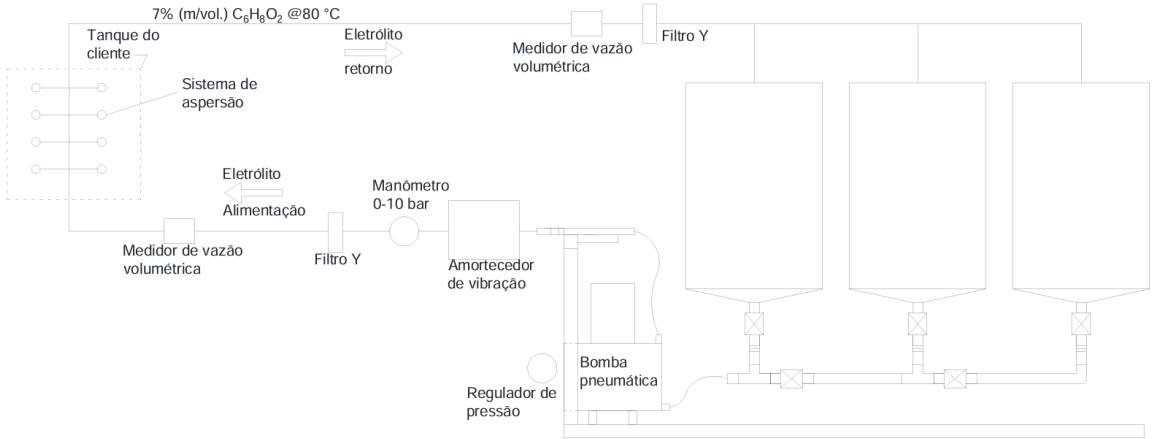


Figura 2. Desenho esquemático do SKI-500 e seu *set-up* para o tratamento de passivação galvanostática.

PassivityScan

Table 2: Electrochemical techniques and respective acceptance criteria for 316L stainless steel.

Tank Conditions	Objective	Technique	Performance Parameters	Acceptance Criteria
Passivated surface in qualification	Passivation level	EIS	R_p, Q_{CPE}, η^1, C_{eff}	Passive film thickness (δ): 1 nm < δ < 3 nm
				$R_p \geq 2.0$ MΩ cm^2
		CPP	E_{corr}, E_{pit}, E_{prot} passivation level	E_{prot}-E_{corr} > 350 mV
In operation process	Early rouge and corrosion detection	Combining OCP and EIS	E_{corr}, R_p, Q_{CPE}, η^1, C_{eff}, EEC (equivalent electrical circuit)	OCP ≥ + 10 mV (Ag|AgCl|KCl 3 mol/L)
				$R_p \geq 0.5$ MΩ cm^2
				1 nm < δ < 3 nm

[1] Constant phase exponent.

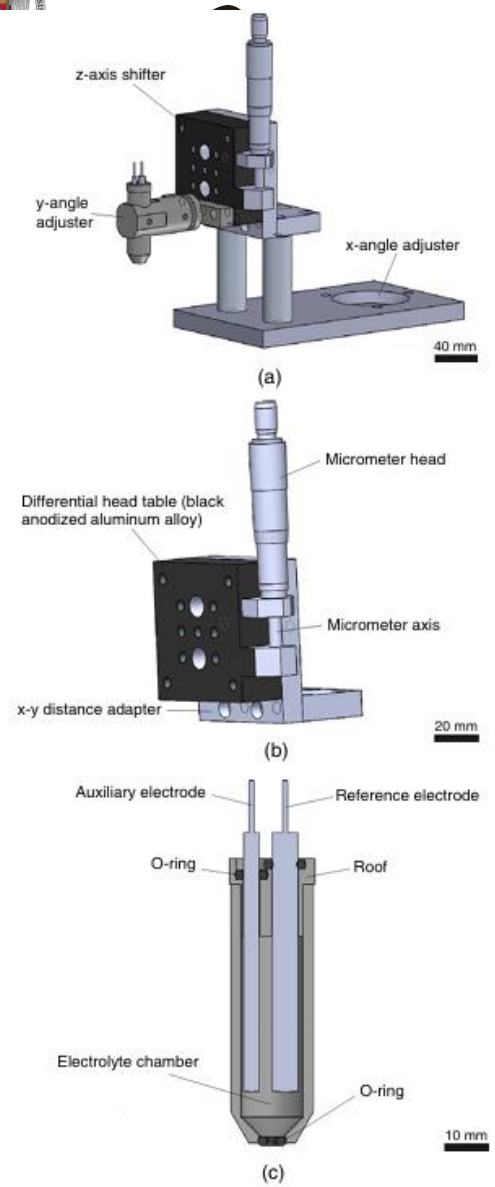


FIGURE 1. *Portable electrochemical microcell and its parts, showing (a) 3D design, (b) z-axis shifter using a sliding stage micrometer, and (c) microcell body section.*

PassivityScan