

Corrosion Prevention of Flue Gas Desulfurization Scrubbers and Reaction Tanks

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History of CSCL

- Incorporated in 1950
- Specializes in electrochemical corrosion prevention (i.e. cathodic protection, anodic protection and PAP, potential adjustment protection)
- Worldwide installation base

CSCL Offices and Subsidiaries

- Seven offices in Canada
- One office in UK
- CORRENG Consulting Service Inc.
- Corrosion Service Saudi Arabia LLC
- Agency agreements with Specialists in Solutions, USA and other companies in Nigeria, Libya, UAE, etc.

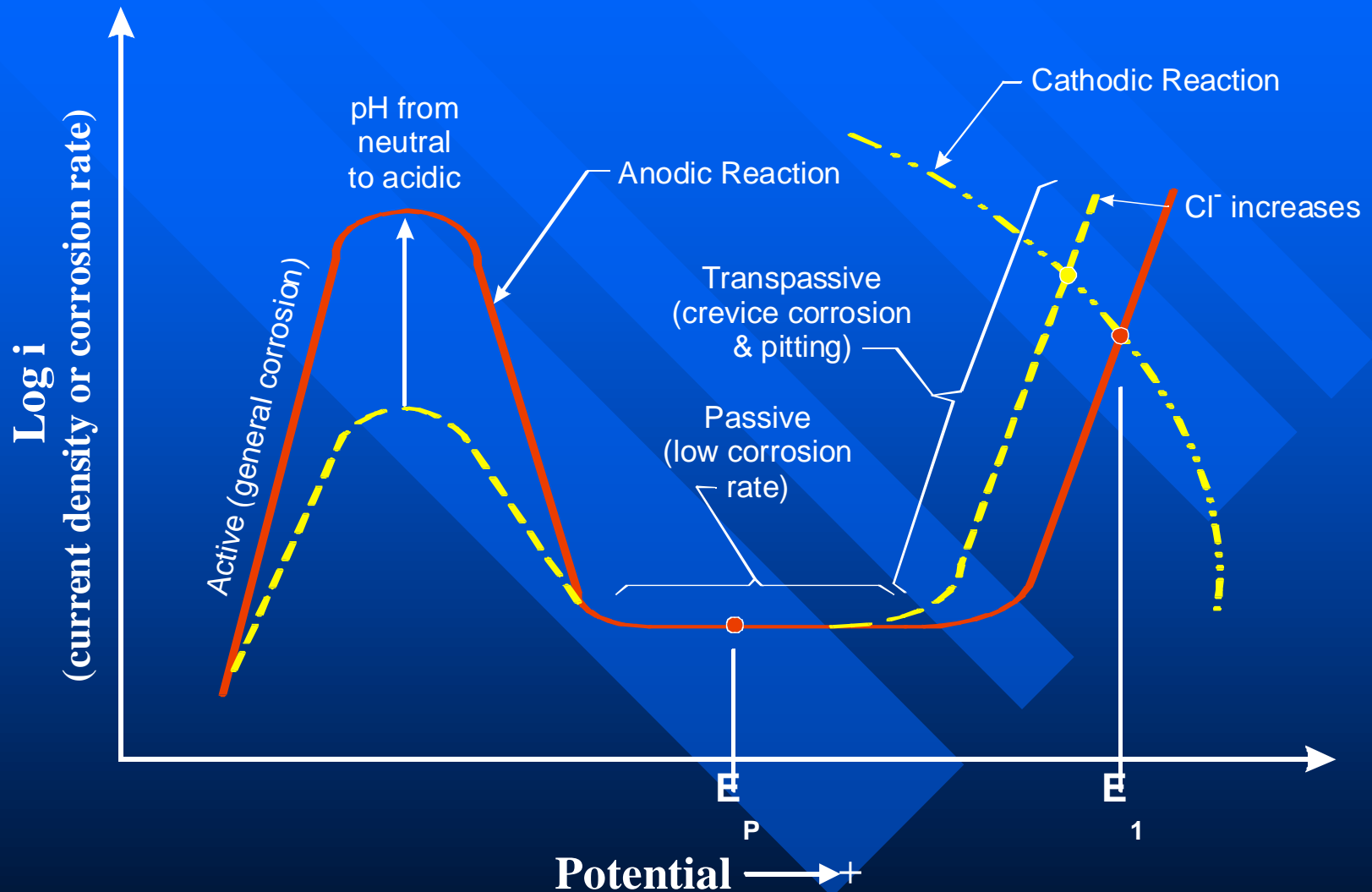
Pitting Resistance of Various Alloys in Chloride Environment

- ❖ $316L < 317LM < 2205 < 904L$
 $< \text{Alloy 255/2507} < 254SMO$
 $= \text{Alloy G3} < \text{Alloy 625}$
 $= \text{Alloy C276}$
- ❖ Higher alloys will have higher “Cost Factors”

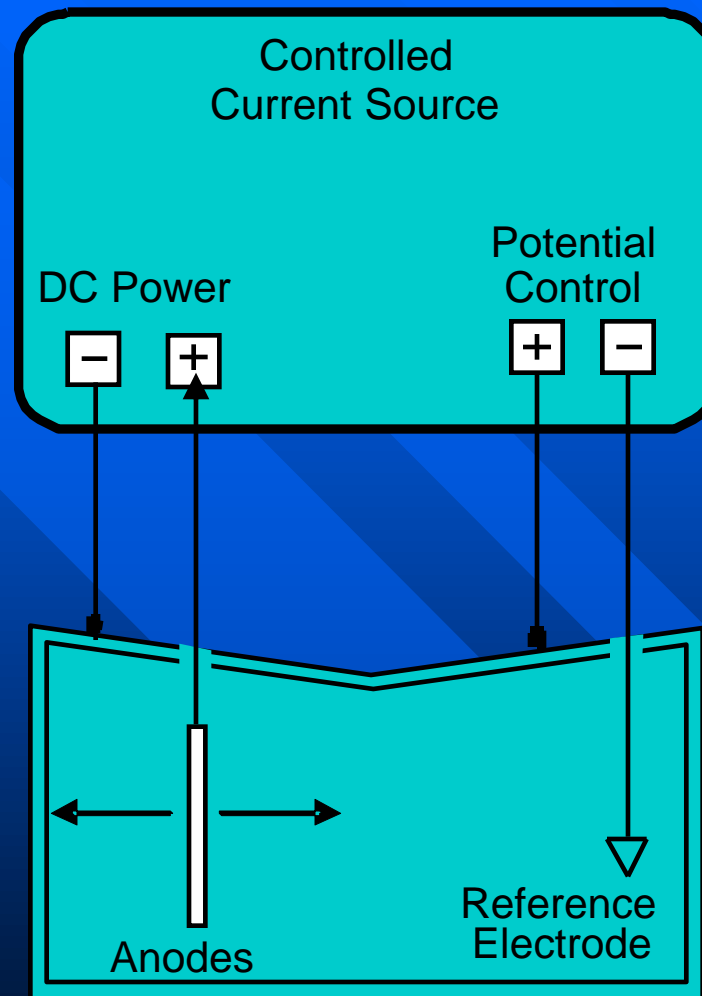
Cost Factors of Higher Alloys

- Cost of materials purchase
- Delivery time and availability
- Special welding technique requirements
- Availability of qualified welders

Idealized Polarization Curve



Schematic Diagram of a PAP* System



*patent pending

Comparison of Alloy and Related Fabrication Costs

(for a 60 ft. dia. X 54 ft. high tank)

Alloy	Cost Ratio
316 L	1
2205	1
317LMN	1.15
255/2507	1.36
254SMO	1.72

Pitting Resistance Equivalent (PRE)* of Stainless Steels

Alloy	%Cr	%Mo	%N	PRE
904L	20	4.5	-	35
317LMN	18	4.1	0.2	36
2205	22.5	3.2	0.15	38
255/2507	23	3.2	0.2	46
254 SMO	20	6.1	0.2	46

*PRE = %CR + 3.3%Mo + 30%N

Ref: Outokumpu Stainless Corrosion Handbook 9TH Ed. p. 1:87

Corrosion Prevention Techniques

- Organic coating
- Thin metallic lining (wallpapering)
- Weld repairs
- Rubber lining
- Potential Adjustment Protection (PAP)

Potential Adjustment Protection (PAP)

- Protect stainless steel from pitting and crevice corrosion in oxidizing chloride environment
- Originally developed for pulp mill bleach washers
- Used in submerged zone
- Effective for welds, HAZ as well as the base metal

Potential Adjustment Protection (PAP)

- 120+ bleach washer systems installed since late 1970's
- 18 systems installed in FGD scrubbers in USA
- Installed in brine concentrators

PAP Installations in Brine Concentrators

- 316L construction
- Chloride concentration: up to 35,000 ppm
- Temperature in excess of 210° F

✱ Successfully protected the concentrators

Cost Savings with PAP

- Retrofit existing scrubbers with PAP
- Construct of new scrubbers in conjunction with PAP
- Proven technology with over 30 years of field service
- Designed by company with over 60 years of history in corrosion prevention business

Case History

- Over \$1,000,000 savings in maintenance costs in first year.
- All PAP systems for FGD scrubbers are still in commission today including 10 from the late 1970's.
- 2 PAP systems commissioned in April 2010

Advantages of PAP

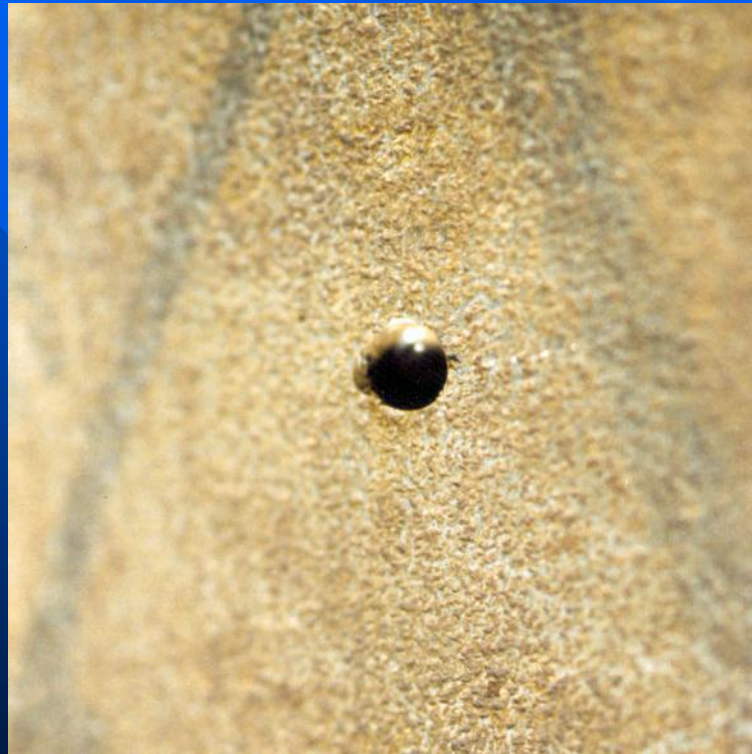
- Proven technology
- Low cost
- Not necessary for existing corrosion to be repaired* prior to installing PAP
- Fast delivery
- Short installation time
- Less reliant on installer's technique
- Automatic potential control
- Operating data monitored by computer

PAP Design Considerations

- Primary current (geometry) distribution is used
- Secondary current (polarization) distribution has a much lower consideration
- As a result: Very conservative designs

Drill Hole Made in Scrubber with PAP Corrosion Protection System

(Note sharp edge after 1 year of exposure)



Coupon Comparison



Scrubber Anode Installed Above Aeration Nozzles



Remote Monitoring

- Computer based monitoring of operating parameters
- Internet based communication
- Relieve plant personnel of daily monitoring of PAP systems
- CSCL specialist reviews operating data on a weekly basis
- Call/email plant representative if PAP system requires attention

CSSL Supplies

- Design and detailed engineering drawings
- Specialty materials including anodes, anode supports, reference electrodes, reference electrode entries, buffers, current sources, remote monitoring computer and software
- Optional on site advisor for installation
- Onsite commissioning
- Remote monitoring service

Customer Supplies

- Labor and equipment for installation of hardware
- Wiring and conduits

CSCL Delivery Schedule

- Design drawings: 2-3 weeks ARO
- Internal Specialty Materials (i.e. Anodes, anode supports, anode entries, reference electrodes, reference electrode entries): 6-8 weeks ARO
- External Electrical Equipment: 12-14 weeks ARO

Delivery & Installation Schedule

Item	Weeks ARO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Design & Specs																
2	Int. Spec. Materials																
3	Installation (Int. & Ext.)																
4	Ext Elec Hardware																

Conclusions

- 1) Significant savings
- 2) Cost effective
- 3) Proven technology
- 4) May be installed in existing FGD scrubbers
- 5) PAP is easier to install than other corrosion protection systems
- 6) Remote Monitoring helps to ensure long term effectiveness

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