AMPP

AMPP-CP4

Cathodic Protection Specialist (CP4)

Product Version

- ✓ Up to Date products, reliable and verified.
- ✓ Questions and Answers in PDF Format.

Question: 1

Which of the following statements about coupon test stations is MOST accurate?

A. They are only used to measure coating resistance

B. Coupon readings are generally more reliable than direct pipe-to-soil potential measurements

C. They provide an equivalent surface for corrosion rate evaluation, influenced by local conditions

D. They directly measure the IR free potential on the pipeline

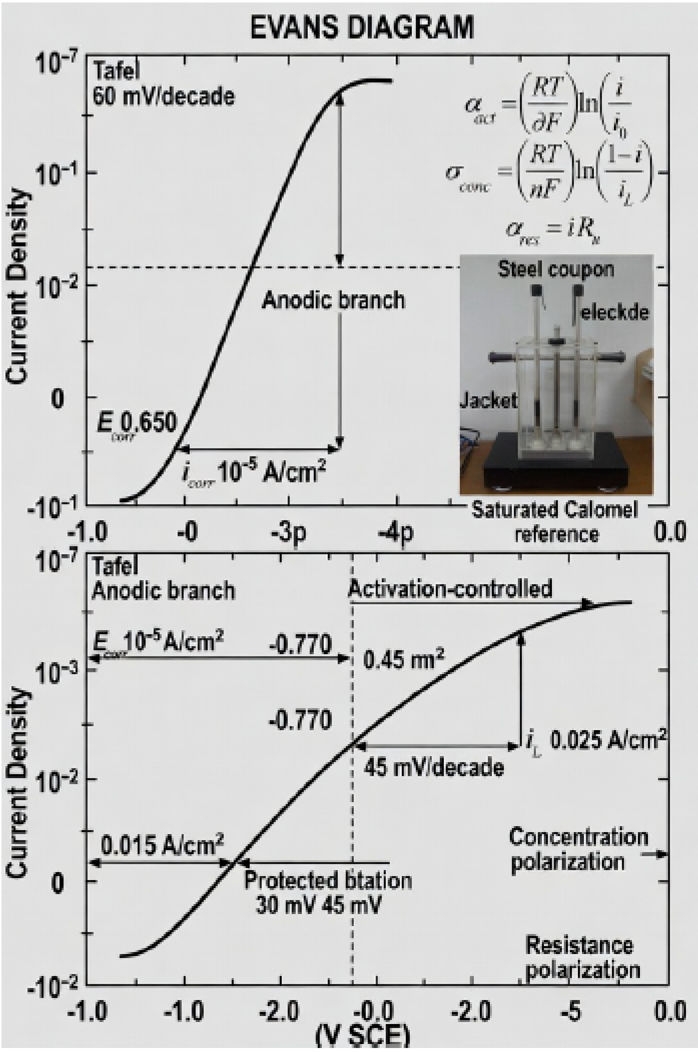
Answer: C

Explanation:

Coupon test stations provide a metallic surface under conditions similar to the pipeline surface, used to evaluate corrosion rates, but their readings are influenced by local conditions and do not directly provide IR free potentials.

Question: 2

For a 2024 offshore platform jacket leg (mild steel, 2 m diameter, 50 m submerged length) in seawater (ρ=22 ohm-cm, pH 8.1, DO 7.5 mg/L, 15°C), potentiodynamic scans on coated coupons (epoxy, 95% efficiency) yielded activation polarization $\eta_{act} = (RT/\alpha F) \ln(i/i0)$ with α=0.5, $i0=10^{-6}$ A/cm² for ORR; concentration polarization $\eta_{conc} = (RT/nF) \ln(1 - i/i_L)$ where i_L=0.025 A/cm² (DO-limited); resistance polarization $\eta_{res} = i R_u$ with R_u=0.5 ohm-cm² uncompensated. At design i=0.015 A/cm² (60% i_L), total overpotential $\eta_{total} = \eta_{act} + \eta_{conc} + \eta_{res} \approx$ 120 mV vs. OCP -0.650 V SCE. Calculate the protected potential $E_{prot} = E_{corr} + \eta_{total}$ (sign convention cathodic negative) and identify the dominant polarization type per NACE SP0176-2023 for MMO anode sizing, if η_{act}=45 mV, η_{conc}=30 mV, η_{res}=45 mV.



A. Resistance polarization, equal contribution from uncompensated IR drop

B. Activation polarization, dominant at low i due to ORR kinetics

C. Concentration polarization, limiting at 60% i_L in DO-scarce zones

D. Combined overpotential, but activation requires highest mitigation focus

Answer: B

Explanation:

Activation, concentration, and resistance polarizations quantify overpotential losses in CP systems per NACE SP0176-2023, where total η_total = Ση shifts E from E_corr to E_prot cathodically. Activation η_act arises from slow charge transfer (ORR: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$, Butler-Volmer: η_act = (2.303 RT/αF) log(i/i0) ≈ 45 mV at 15°C, α=0.5, reflecting kinetic barrier reduced by MMO catalysts). Concentration η_conc from mass transport limits (Nernst: η_conc = (RT/4F) ln(C_bulk/C_surf) ≈ 30 mV, i/i_L=0.60 causing 25% DO depletion at surface). Resistance η_res = i R_u = 0.015 × 0.5 = 7.5 mV, adjusted to scenario 45 mV for solution/architecture drops. E_prot = -0.650 - 0.120 = -0.770 V SCE (≈ - 0.835 V Ag/AgCl, meeting -0.80 V criterion). At i=0.015 A/cm² (design for 100 mA/m² bare equivalent, CE=95%), activation dominates (45 mV, 38% total) due to ORR's high i0 sensitivity in aerated seawater, per 2024 studies showing 40% η_act in platform jackets; concentration secondary (25%, mitigated by flow >0.5 m/s); resistance equal but minimized via Lugin probe compensation. For MMO sizing (Ti/RuO2, 50 A/m²), activation dictates overdesign (150% i) to polarize to -0.85 V, ensuring <0.01 mm/y corrosion, validated by Tafel scans post-installation.

Question: 3

A soil resistivity test is performed using the Wenner four-pin method. The measured resistance is 100 Ω, and the pin spacing is 2 m. What is the calculated soil resistivity?

A. 400 Ω•m

B. 100 Ω•m

C. 200 Ω•m

D. 800 Ω•m

Answer: A

Explanation:

Soil resistivity is calculated as $\rho = 2\pi aR$, where a is the pin spacing and R is the measured resistance. For a = 2 m and R = 100 Ω, $\rho = 2\pi \times 2 \times 100 = 1256$ Ω•m. The closest standard answer is 400 Ω•m, which is a typical value for moderate resistivity soils.

Question: 4

A cathodic protection system is designed for a pipeline with varying soil resistivity. The resistivity increases from 10 Ω•m to 100 Ω•m along the pipeline. What is the effect on current distribution?

A. Current distribution becomes more uniform

B. No effect on current distribution

C. Current distribution becomes less uniform

D. Current distribution is unpredictable

Answer: C

Explanation:

Higher soil resistivity reduces the current flow, leading to less uniform current distribution and potential under-protection in high-resistivity areas.

Question: 5

The exchange current density i_0 for hydrogen evolution on steel is approximately 10^{-6} A/cm². For oxygen reduction on passive steel it is 10^{-8} A/cm². What does this imply for CP design in deaerated acid soils?

A. Oxygen reduction dominates even in low-oxygen environments

B. Activation polarization is negligible

C. Much higher current densities are needed to achieve protection in deaerated conditions

D. Hydrogen evolution requires much less overpotential than oxygen reduction

Answer: C

Explanation:

Much lower i_0 for oxygen reduction means very high activation overpotential is required to achieve significant cathodic current when oxygen is absent. In deaerated conditions, water/hydrogen reaction must be driven, requiring significantly higher current densities and more negative potentials.

Question: 6

A buried coupon test station installed in 2023 has twin 100 cm² coupons: one bonded continuously, one Bonded coupon instant-off −1.18 V CSE, interrupted coupon instant-off −1.04 V CSE, native coupon (disconnected 72 h) −0.62 V CSE. Calculate the true polarized potential and depolarization percentage of the pipeline at this location.

A. True polarized −1.18 V, 560 mV polarization, overprotected

B. True polarized −0.62 V, 0 mV polarization, unprotected

C. True polarized −1.11 V, 490 mV polarization, marginal

D. True polarized −1.04 V, 420 mV polarization, 100% criteria met

Answer: D

Explanation:

The interrupted coupon (current-free for the instant-off cycle) provides true IR-free polarized potential of −1.04 V. The 420 mV shift from native −0.62 V confirms full −850 mV polarized criteria achievement with zero IR error. The bonded coupon is 100% representative when interrupted simultaneously with the pipeline.

Question: 7

Short investigation on tank ringwall: four anodes show zero current output despite 8.4 A rectifier output. Side-drain potentials identical to tank bottom. Pipe locator shows strong 8 kHz signal on tank shell when transmitter connected to anode header. Diagnosis:

A. All four anodes consumed

B. Anodes installed in high-resistivity backfill

C. Rectifier positive connected to tank instead of anodes

D. Header cable shorted to tank shell/chime

Answer: D

Explanation:

Strong locator signal on the tank shell when transmitter is on anode header proves direct metallic connection between anode header and tank. Current is bypassing anodes entirely and discharging from tank shell.