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CEEL Projects

- **Green Technology for Corrosion Protection**
  Cr^{6+}-free inhibitors, conversion coatings and polymer coatings for Al alloys and galvanized steel

- **Environmentally Friendly Anti-Foul Coatings**

- **Development of new electrochemical techniques for corrosion research and corrosion monitoring**
  electrochemical impedance spectroscopy (EIS), electrochemical noise analysis (ENA)

- **Corrosion Sensors**
  zero resistance ammeter (ZRA), barnacle cell, atmospheric corrosion monitor (ACM)

- **The Performance of Polymer Coatings in Natural Seawater (Gulf of Mexico)**

- **Microbiologically Influenced Corrosion (MIC) and Microbiologically Influenced Corrosion Inhibition (MICI)**

- **The Microbial Fuel Cell**

Corrosion Management

- Evaluation of corrosion behavior
- Corrosion monitoring
- Corrosion prevention
- Periodic inspection
- Re-qualifying of pipeline, tubing, etc.

Corrosion Monitoring

- Direct inspection –

  visual inspection, measurement of wall thickness, pit depth, corrosion pattern

- Indirect methods – (NDT) –

  ultrasound, coupon tests, electrical resistance, polarization resistance, hydrogen probe

- Smart pigs –

  Magnetic Flux Leakage (MFL) – loss of well thickness

  Ultrasonic Sensors – coating disbondment, cracks, dents, gouges

  GPS – exact location of corrosion problems

  Problem: limited use due to high cost

Corrosion Protection

- Coatings
- Inhibitors
- Cathodic Protection

Power Requirements

- Rechargeable battery systems
- Power for sensors, data conditioning and recording
- Marine fuel cells

C.E. Reimers, L.T. Tender, S. Fertig and W. Wang, “Harvesting Energy from the Marine Sediment – Water Interface”, Environ. Sci. Technol. 2001, 35, 192.

D.R. Bond, D.E. Holmes, L.M. Tender and D.R. Lovley, “Electrode – Reducing Microorganisms that Harvest Energy from Marine Sediments”, Science, 206, 486 (2002).

Problem: Very low power densities ($<1\mu W/cm^2$)

Pressing Issues

- Safe inhibitors –
  "green technology", "zero harmful discharge" to sea
- Remote corrosion monitoring –
  Non-destructive techniques
- Corrosive environments –
  H_2S, CO_2, production water, salt deposits
- Ultra – deepwater composite risers