

# CORROSION MONITORING TECHNIQUES

Assessment of corrosion in field conditions is complex due to the wide variety of applications, process conditions, and fluid phases that exist in industrial systems.

## 1. Direct Corrosion Measurement Techniques

1.1. Intrusive techniques

1.2. Nonintrusive techniques

## 2. Indirect Corrosion Measurement Techniques

2.1. On-line techniques

2.2. Off-line techniques

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# 1. DIRECT CORROSION MEASUREMENT TECHNIQUES

## 1.1. Intrusive techniques

### ○ Physical techniques

- Mass-loss coupons
- Electrical resistance (ER)
- Visual inspection

### ○ Electrochemical dc techniques

- Linear polarization resistance (LPR)
- Zero-resistance ammeter (ZRA) between dissimilar alloy electrodes: galvanic
- Zero-resistance ammeter (ZRA) between the same alloy electrodes
- Potentiodynamic–galvanodynamic polarization
- Electrochemical noise (ECN)

### ○ Electrochemical ac techniques

- Electrochemical impedance spectroscopy (EIS)
- Harmonic distortion analysis.

# 1. DIRECT CORROSION MEASUREMENT TECHNIQUES (CONT.)

## 1.2. Nonintrusive techniques

### ○ Physical techniques for metal loss

- Ultrasonics
- Magnetic flux leakage (MFL)
- Electromagnetic: eddy current
- Electromagnetic: remote field technique (RFT)
- Radiography
- Surface activation and gamma radiometry
- Electrical field mapping

### ○ Physical techniques for crack detection and propagation

- Acoustic emission
- Ultrasonics (flaw detection)
- Ultrasonics (flaw sizing)

## 2. INDIRECT CORROSION MEASUREMENT TECHNIQUES

### 2.1. On-line techniques

- **Corrosion products**
  - Hydrogen monitoring
- **Electrochemical techniques**
  - Corrosion Potential (Ecorr)
- **Water chemistry parameters**
  - pH
  - Conductivity
  - Dissolved oxygen
  - Oxidation reduction (redox) Potential
- **Fluid detection**
  - Flow regime
  - Flow velocity
- **Process parameters**
  - Pressure
  - Temperature
  - Dewpoint
- **Deposition monitoring**
  - Fouling
- **External monitoring**
  - Thermography

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## 2. INDIRECT CORROSION MEASUREMENT TECHNIQUES (CON.)

### 2.2. Off-line techniques

- **Water chemistry parameters**
  - Alkalinity
  - Metal ion analysis (iron, copper, nickel, zinc, manganese)
  - Concentration of dissolved solids
  - Gas analysis (hydrogen, H<sub>2</sub>S, other dissolved gases)
  - Residual oxidant (halogen, halides, and redox potential)
  - Microbiological analysis (sulfide ion analysis)
- **Residual inhibitor**
  - Filming corrosion inhibitors
  - Reactant corrosion inhibitors
- **Chemical analysis of process samples**
  - Total acid number
  - Sulfur content
  - Nitrogen content
  - Salt content in crude oil