

Corrosion Control of Storage Tanks Liabilities to Assets

Presented by:

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Corrosion Control of Storage Tanks Liabilities to Assets

- **Cost of Corrosion**
- **Definition of Corrosion**
- **Common Causes of Corrosion**
- **Corrosion Control**

The Costs of Corrosion

According to a Study Conducted by The U.S. Department of Transportation's Federal Highway Administration and NACE International the Total Cost of Corrosion in the USA is \$276 Billion/Year

- Utilities: \$47.9 billion/year (34.7%)
- Transportation: \$29.7 billion/year (21.5%)
- Infrastructure: \$22.6 billion/year (16.4%)
- Government: \$20.1 billion/year (14.6%)
- Product & Manuf: \$17.6 billion/year (12.8%)

The Costs of Corrosion



Definition of Corrosion

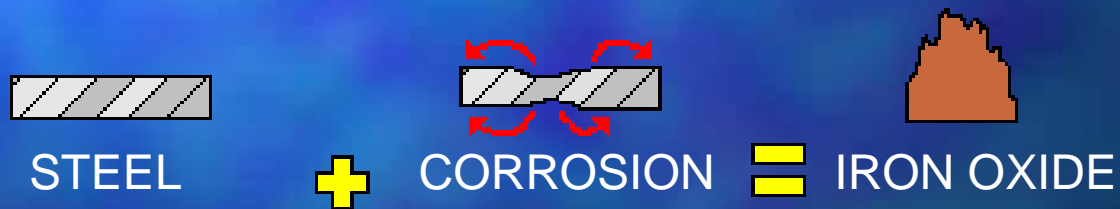
- ▶ **Practical**

 - Tendency of a Metal to Revert to its Native State**

- ▶ **Scientific**

 - Electrochemical Degradation of Metal as a Result of a Reaction with its Environment**

Definition of Corrosion



Definition of Corrosion

- Electrochemical Reactions



Why Provide Corrosion Control?

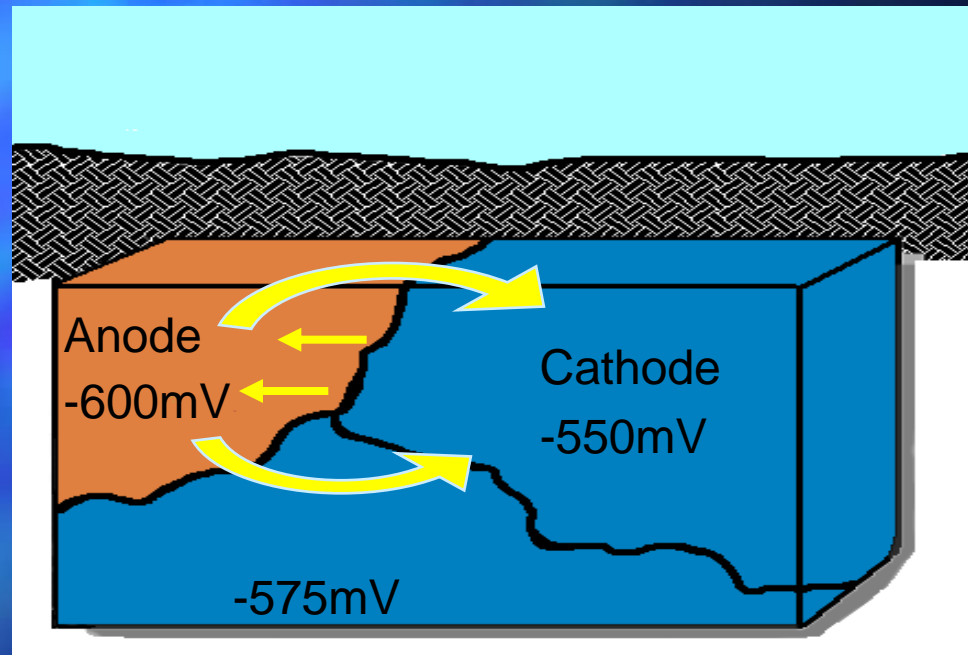
- **Regulatory Compliance**
- **Preserve Assets That Could Become LIABILITIES!**
- **Dramatically Reduce Likelihood of Product Releases**
- **Significantly Reduce Maintenance Costs**
- **Environmental Preservation**

Common Causes of Corrosion

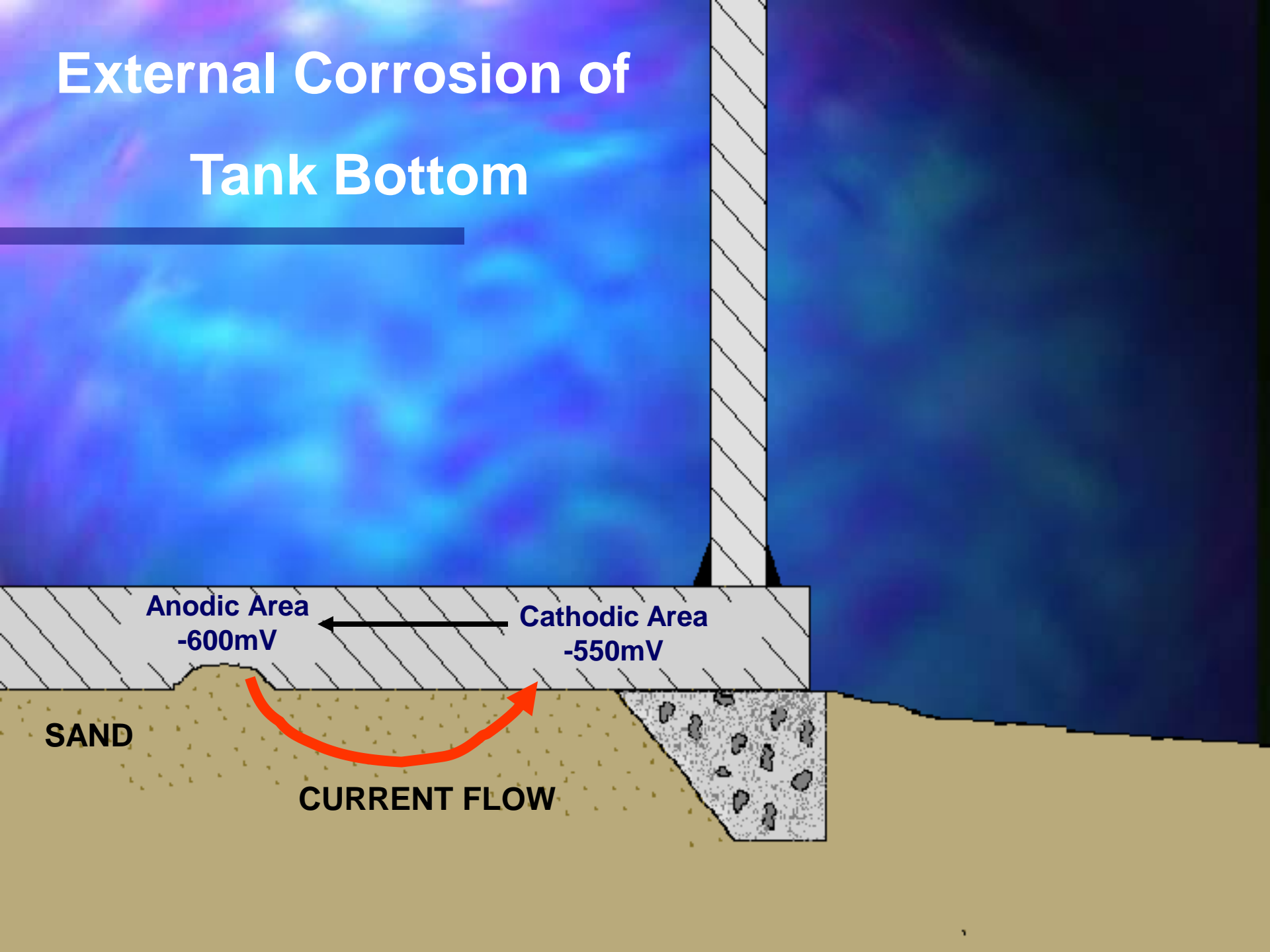
- Metallurgical Differences
- Heterogeneous Electrolyte
- Low Resistivity Electrolyte
- Dissimilar Metals
- Oxygen Concentration
- Stressed Areas

Elements of a Corrosion Cell

- 1) ANODE
- 2) CATHODE
- 3) ELECTROLYTE
- 4) ELECTRICAL CONNECTION



External Corrosion of Tank Bottom



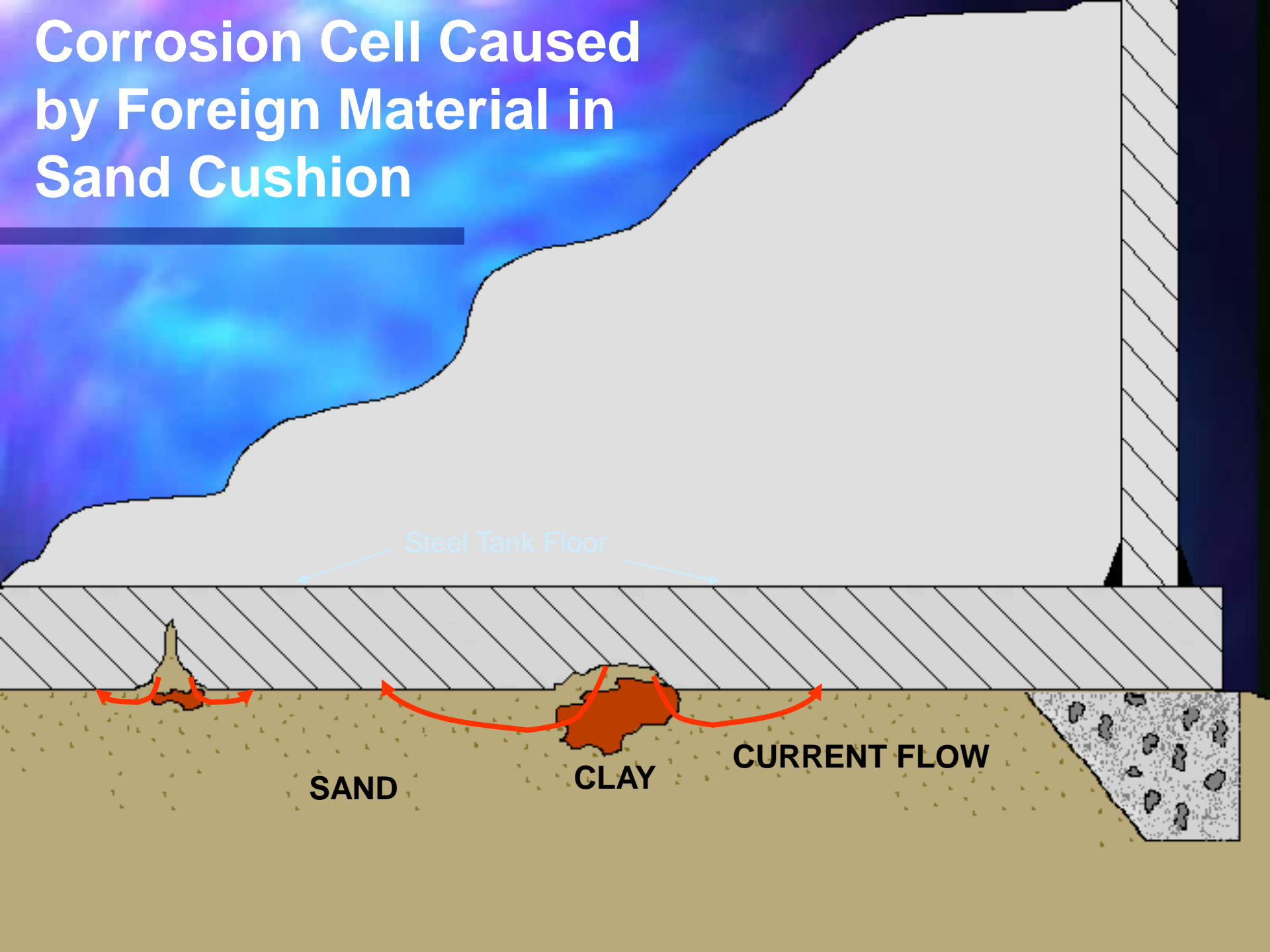
Anodic Area
-600mV

Cathodic Area
-550mV

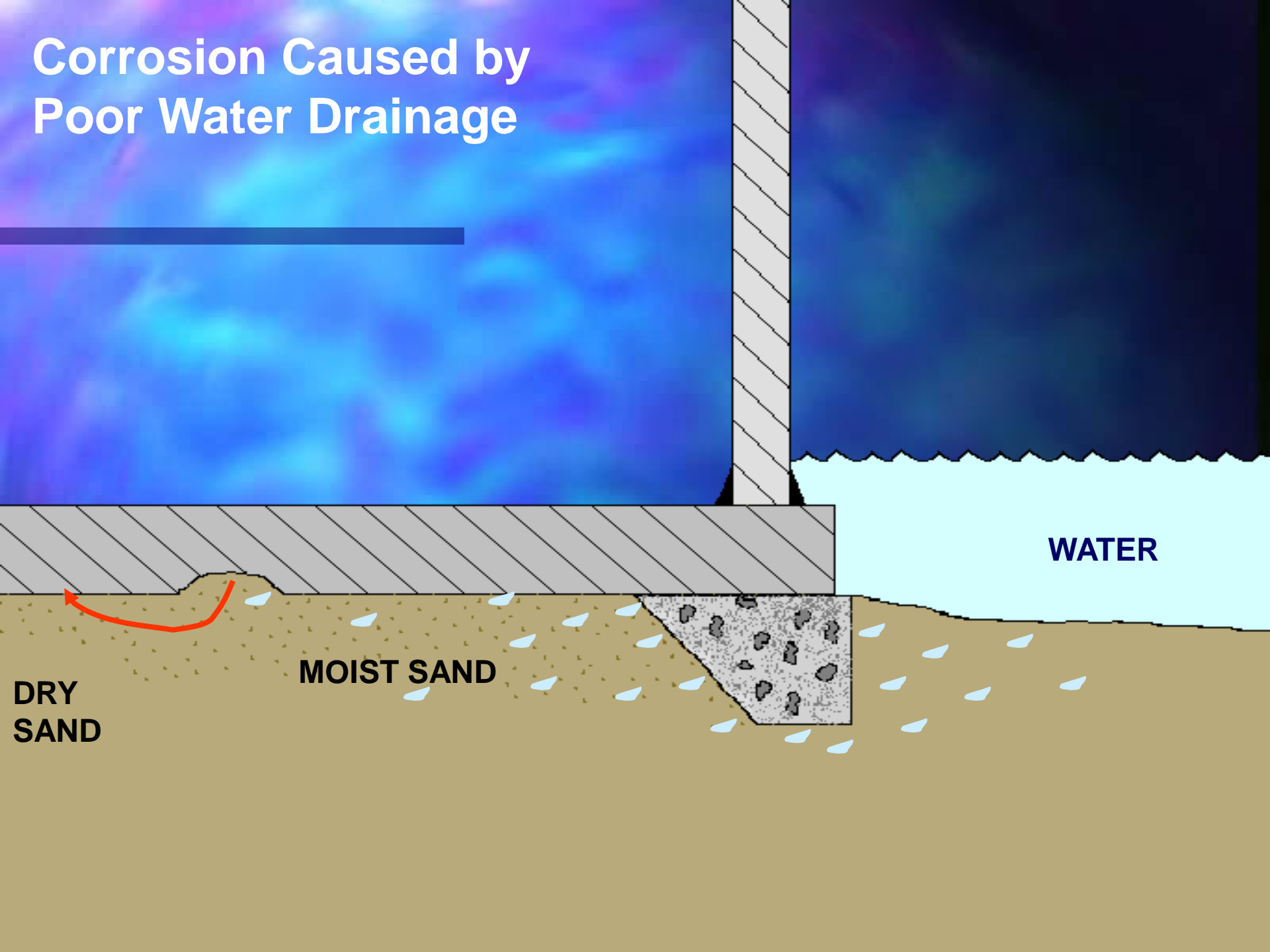
SAND

CURRENT FLOW

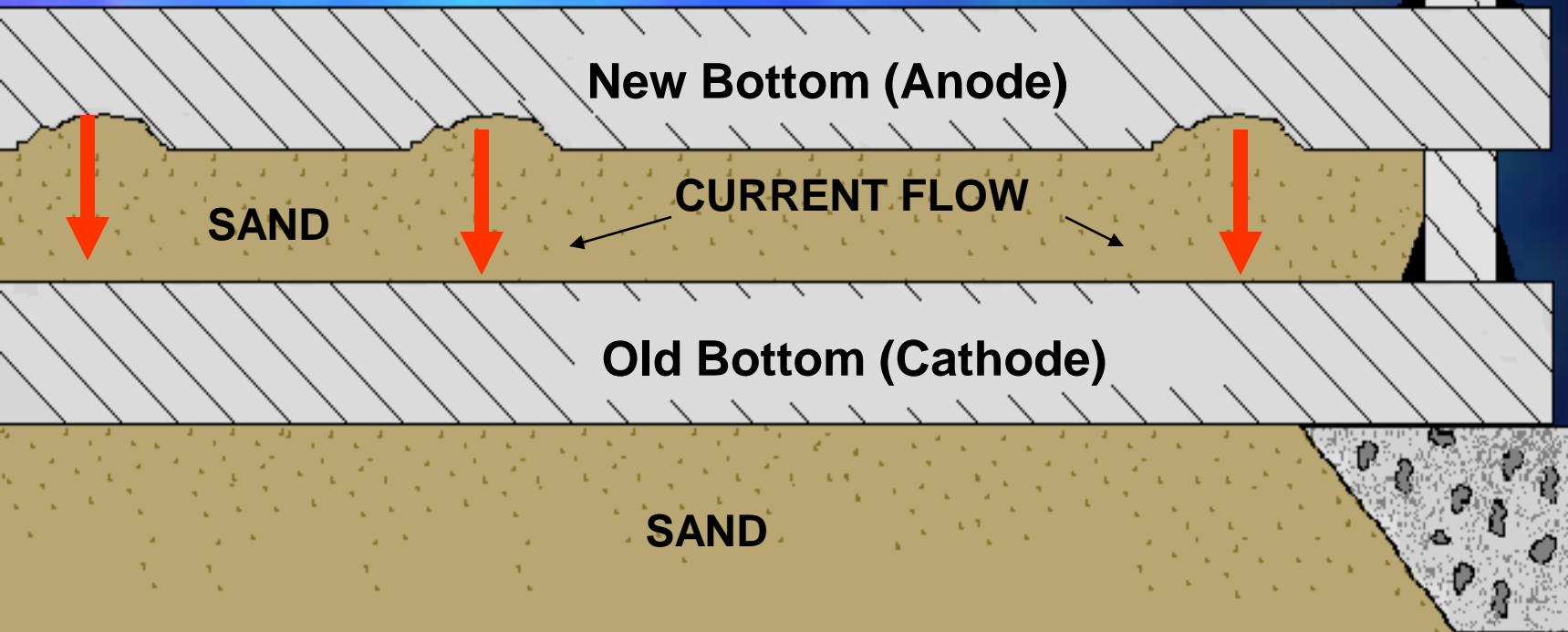
Corrosion Cell Caused by Foreign Material in Sand Cushion



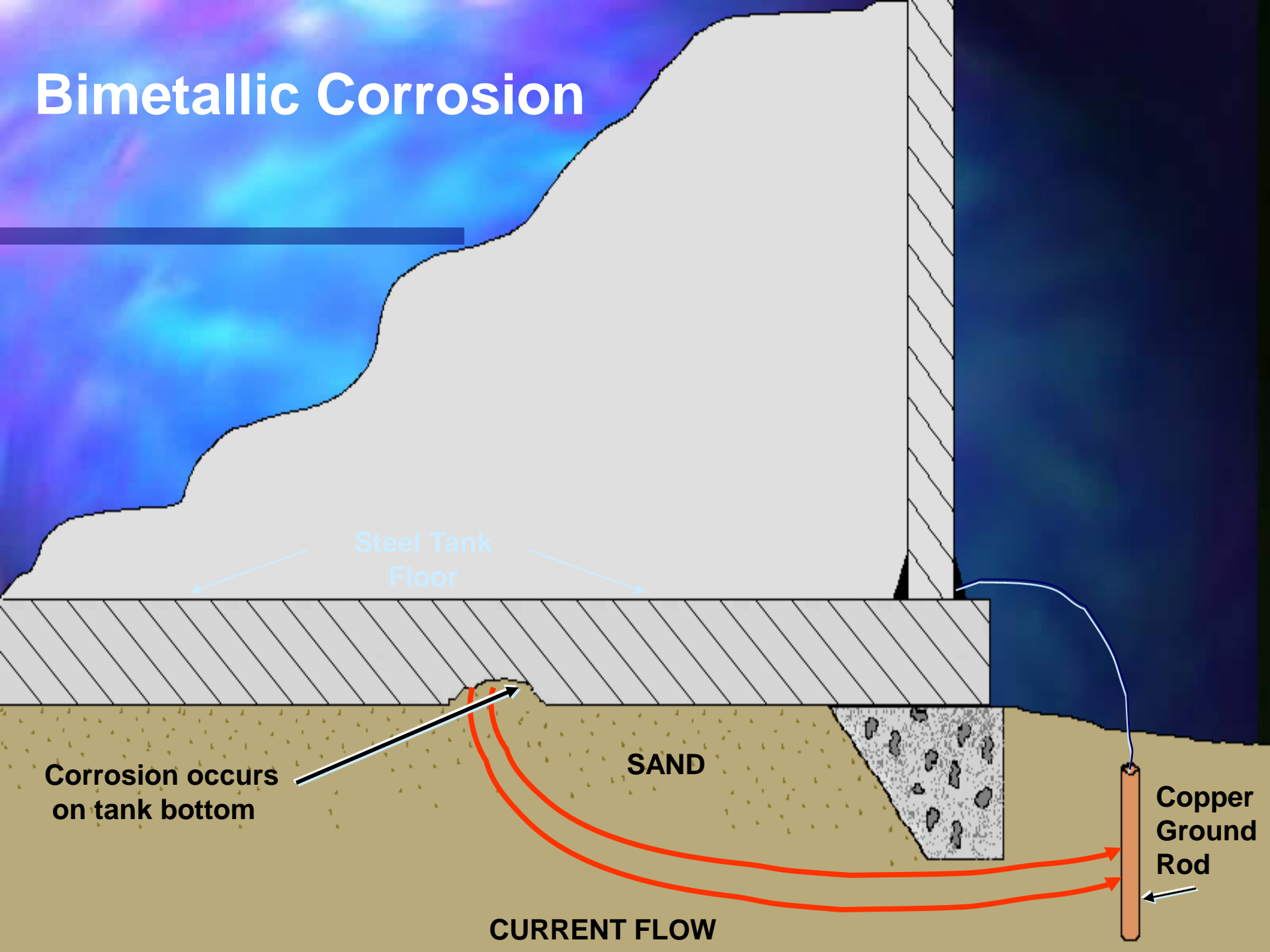
Corrosion Caused by Poor Water Drainage



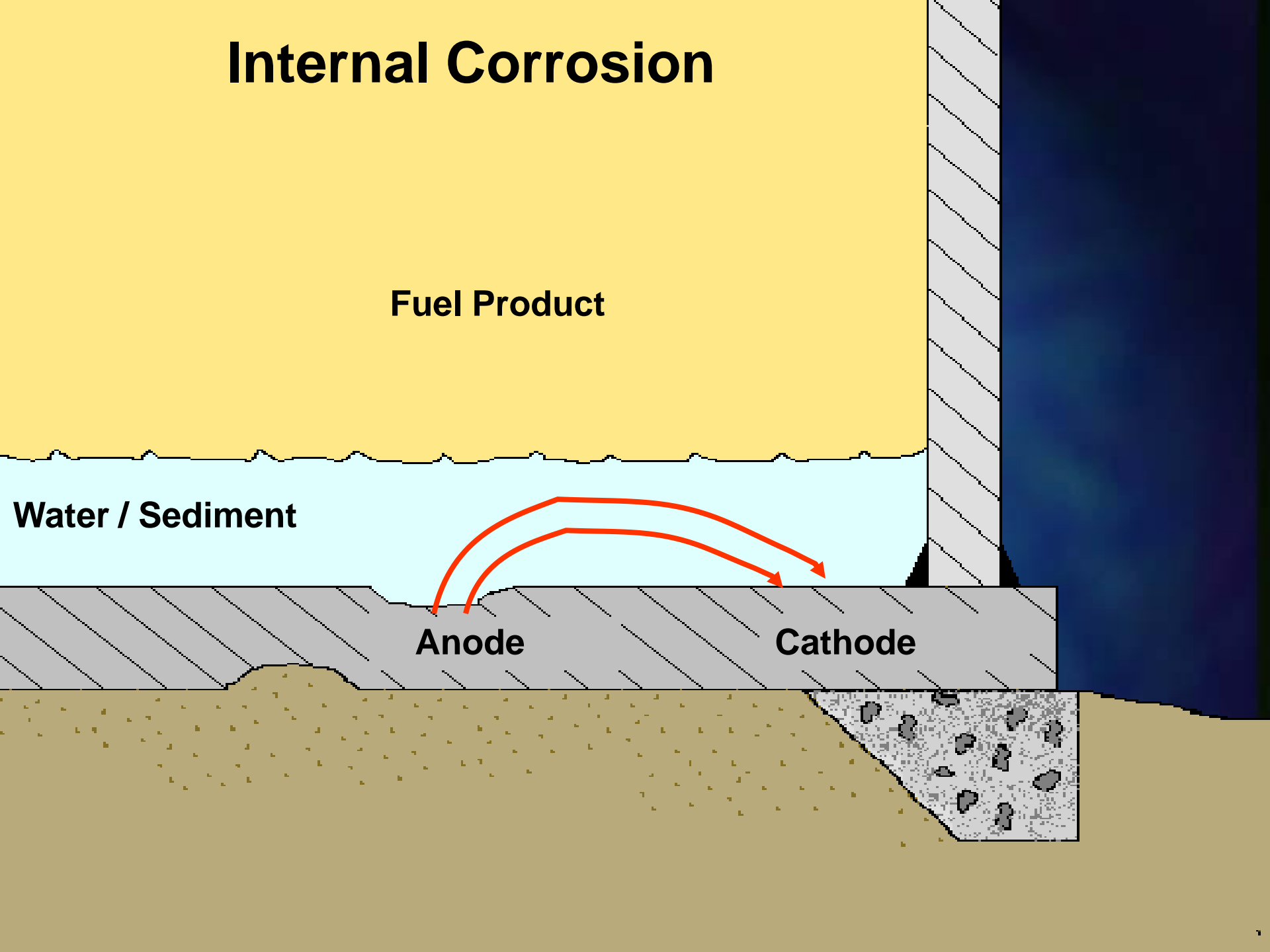
New Steel Coupled to Old Steel



Bimetallic Corrosion



Internal Corrosion



Fuel Product

Water / Sediment

Anode

Cathode

Effect of Corrosion



Importance of Corrosion Control

- **Preserve Assets**
- **Reduce Maintenance Costs**
- **Reduce Inspection Costs**
- **Environmental Compliance**
- **Preserve The Environment**

State Level Requirements

- **Approximately 25% of States now require cathodic protection be installed and maintained on new, refurbished, or repaired tanks in contact with soil or sand foundations.**
- **A number of other states are in the process of implementing regulations governing AST's.**

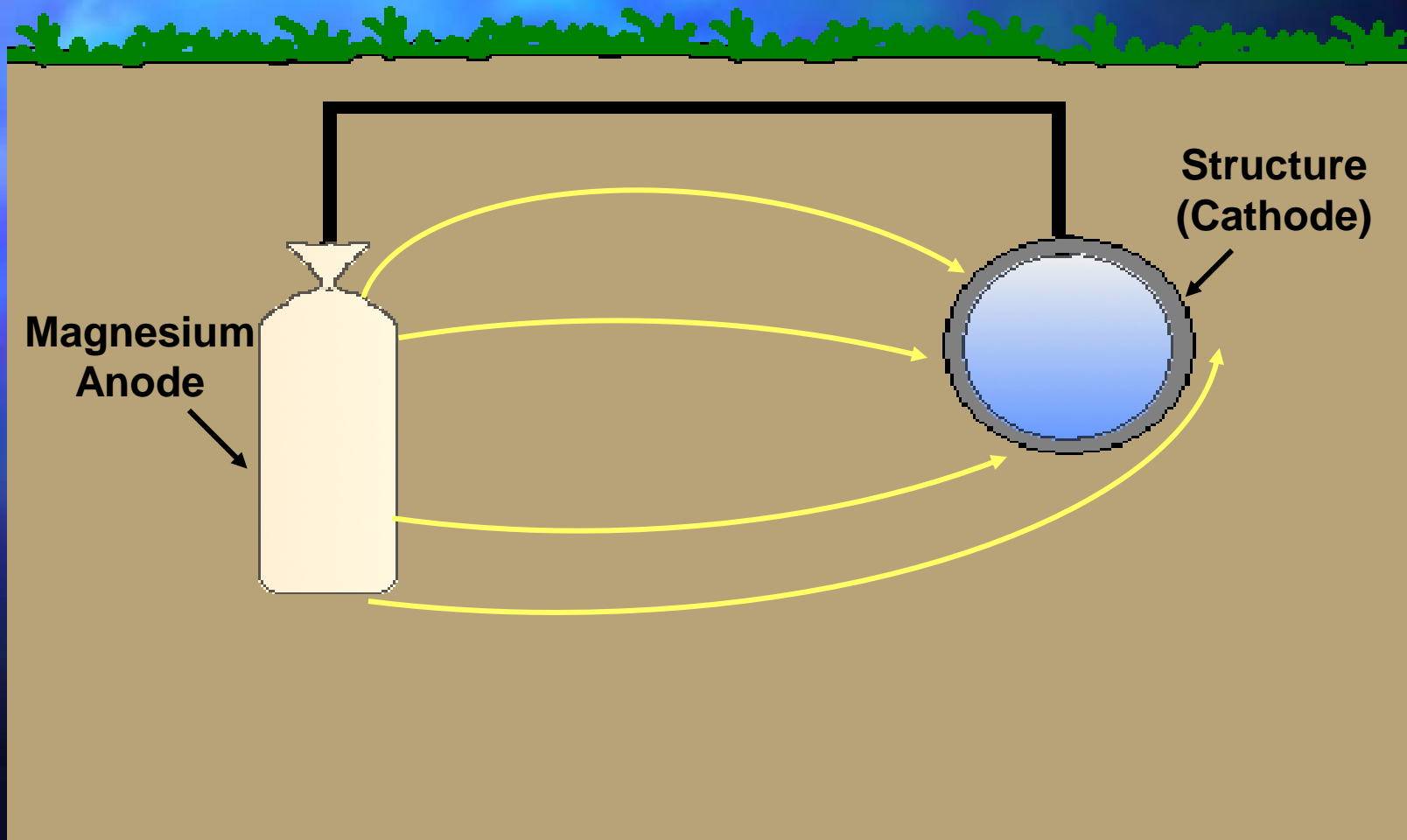
Cathodic Protection

- **Proven electrochemical technique to stop corrosion**
- **Used extensively in the oil and gas industry**
- **Applied to new or existing structures**
- **Cost effective**
- **Minimum maintenance and easy to test**

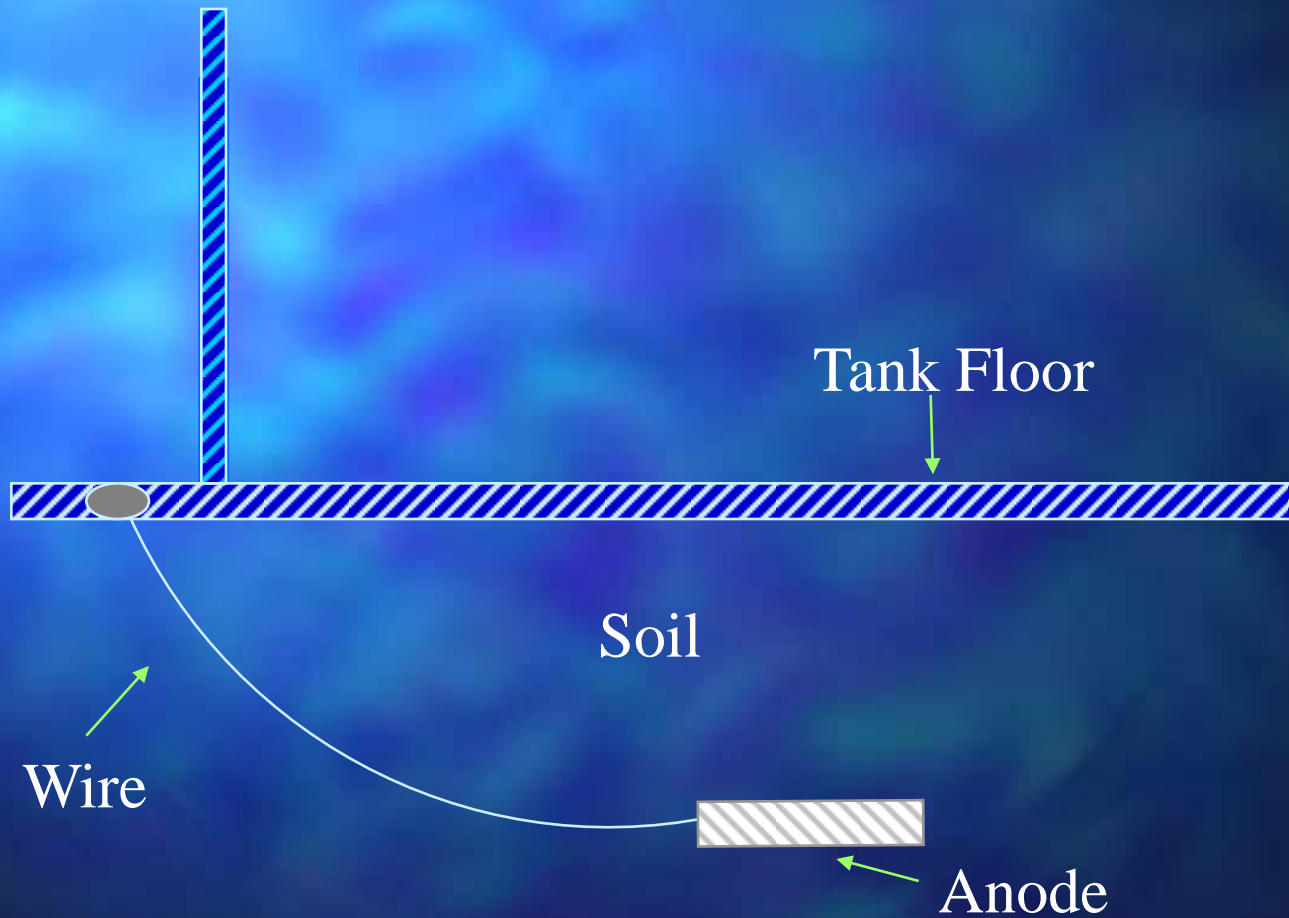
Cathodic Protection

- **Galvanic Anode Cathodic Protection**
- **Impressed Current Cathodic Protection**

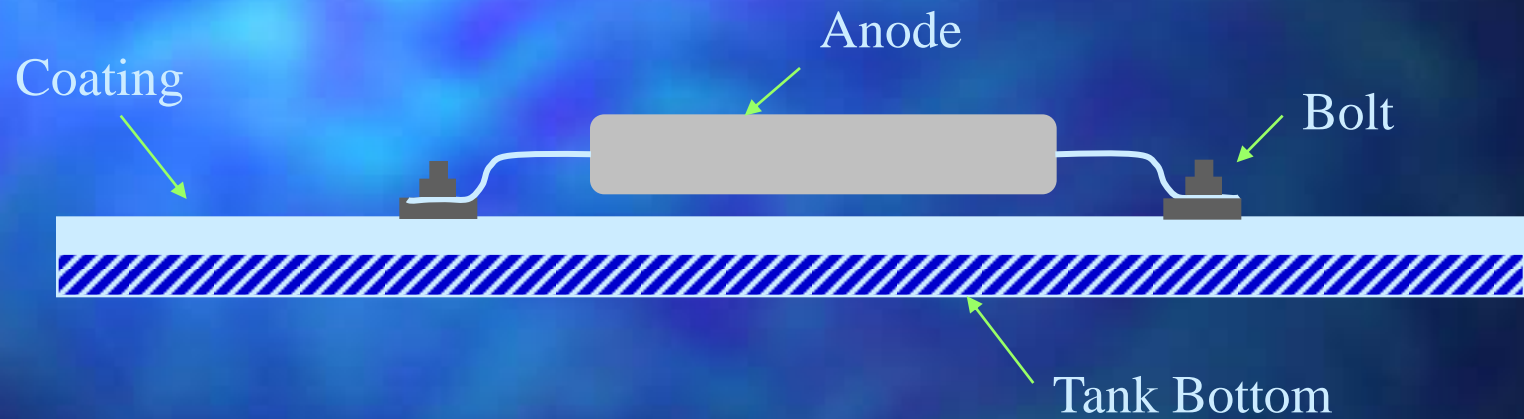
Galvanic Anode Cathodic Protection



External Galvanic Protection



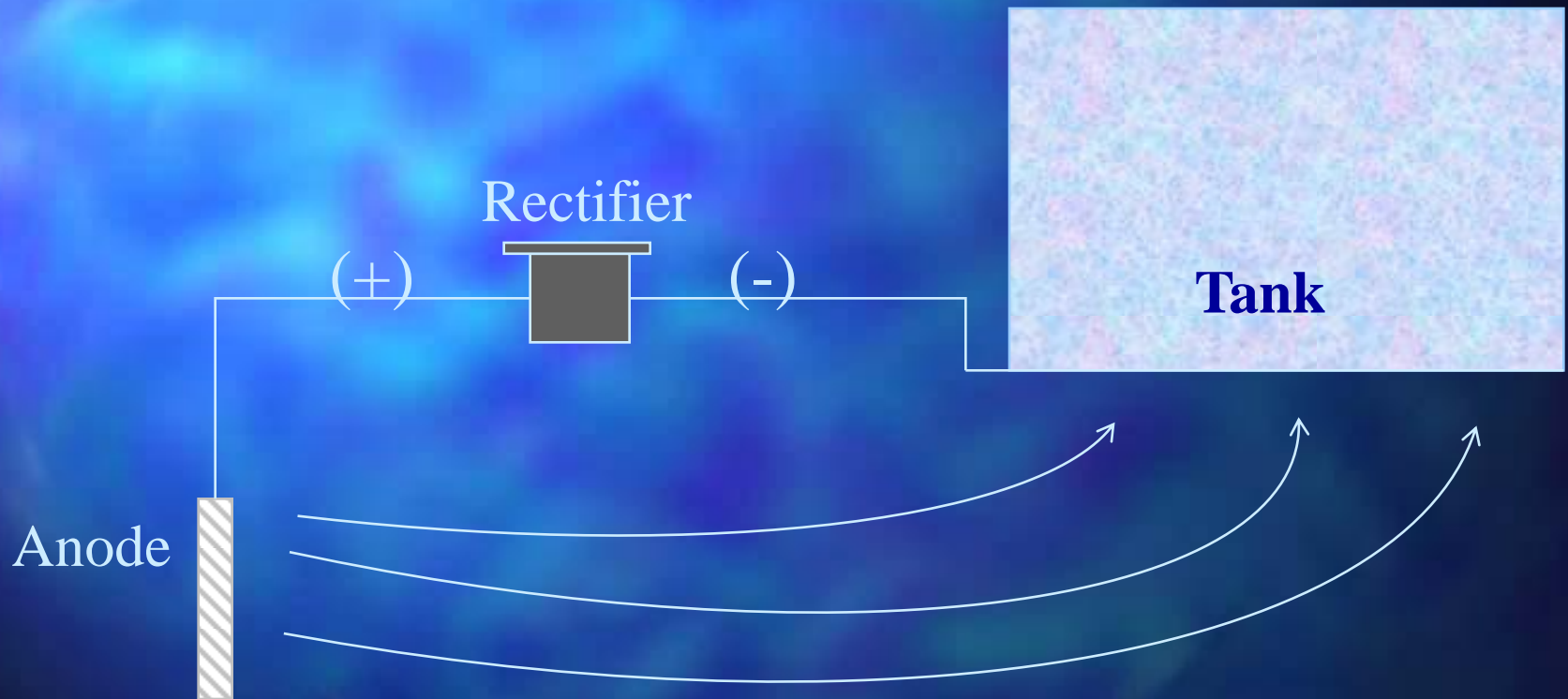
Internal Galvanic Protection



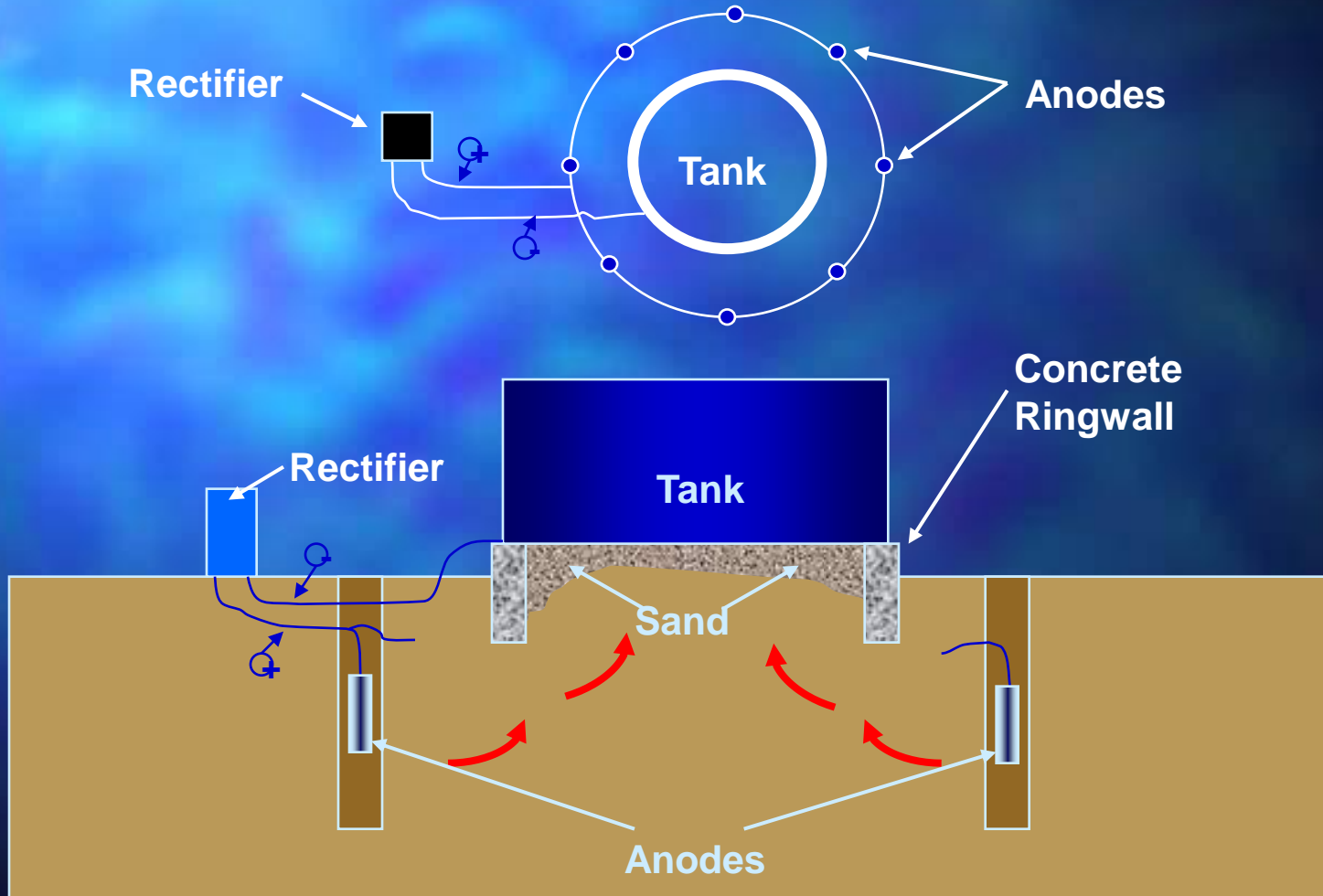
Galvanic System

- **Difficulty in meeting NACE -850mV Criteria**
- **Sand Quality impacts anode performance / life**
- **Typically Very Short Life / Poor Track Record**
- **Not recommended for large diameter AST's**

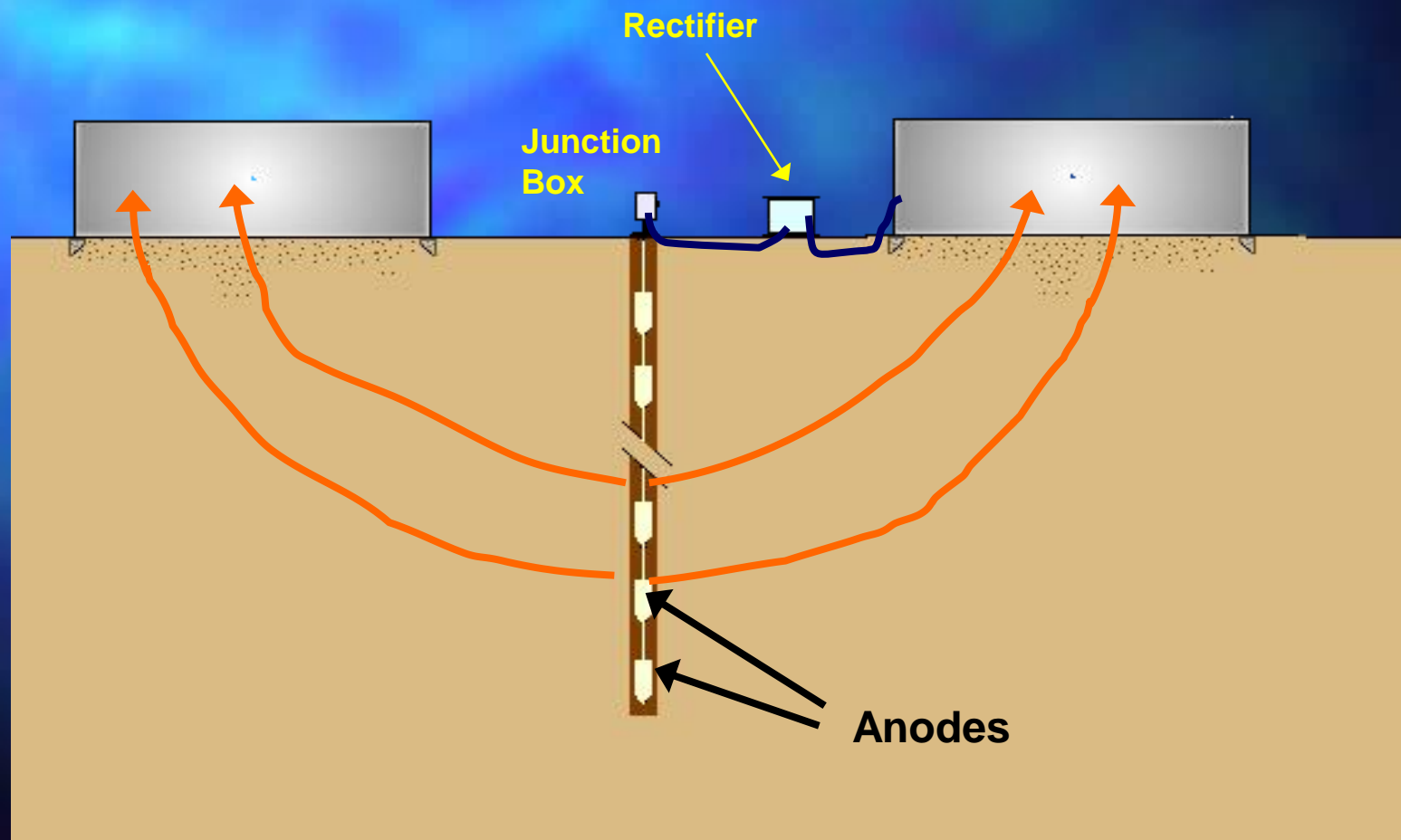
Impressed Current Cathodic Protection



Distributed Anode CP System



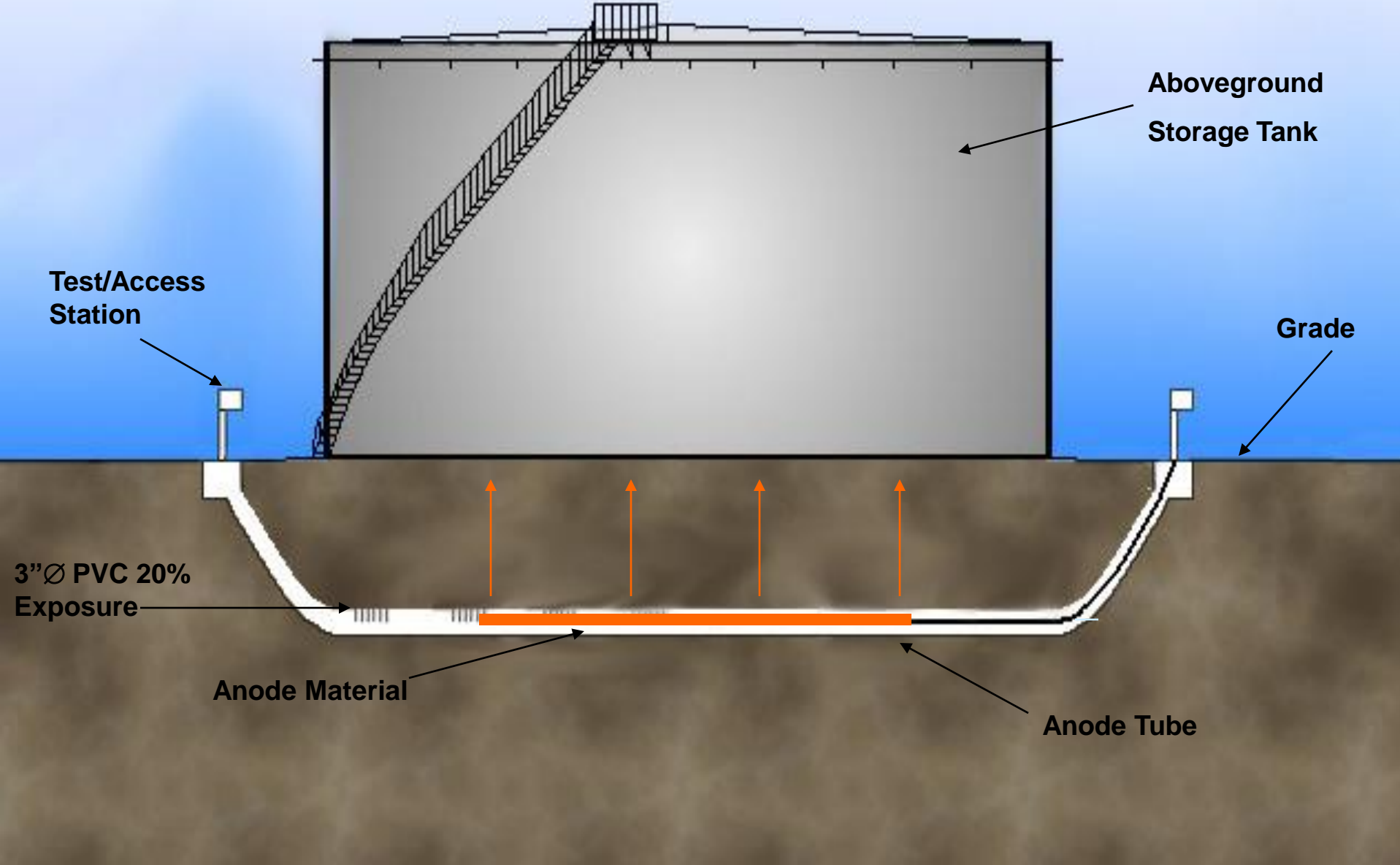
Deep Anode CP System



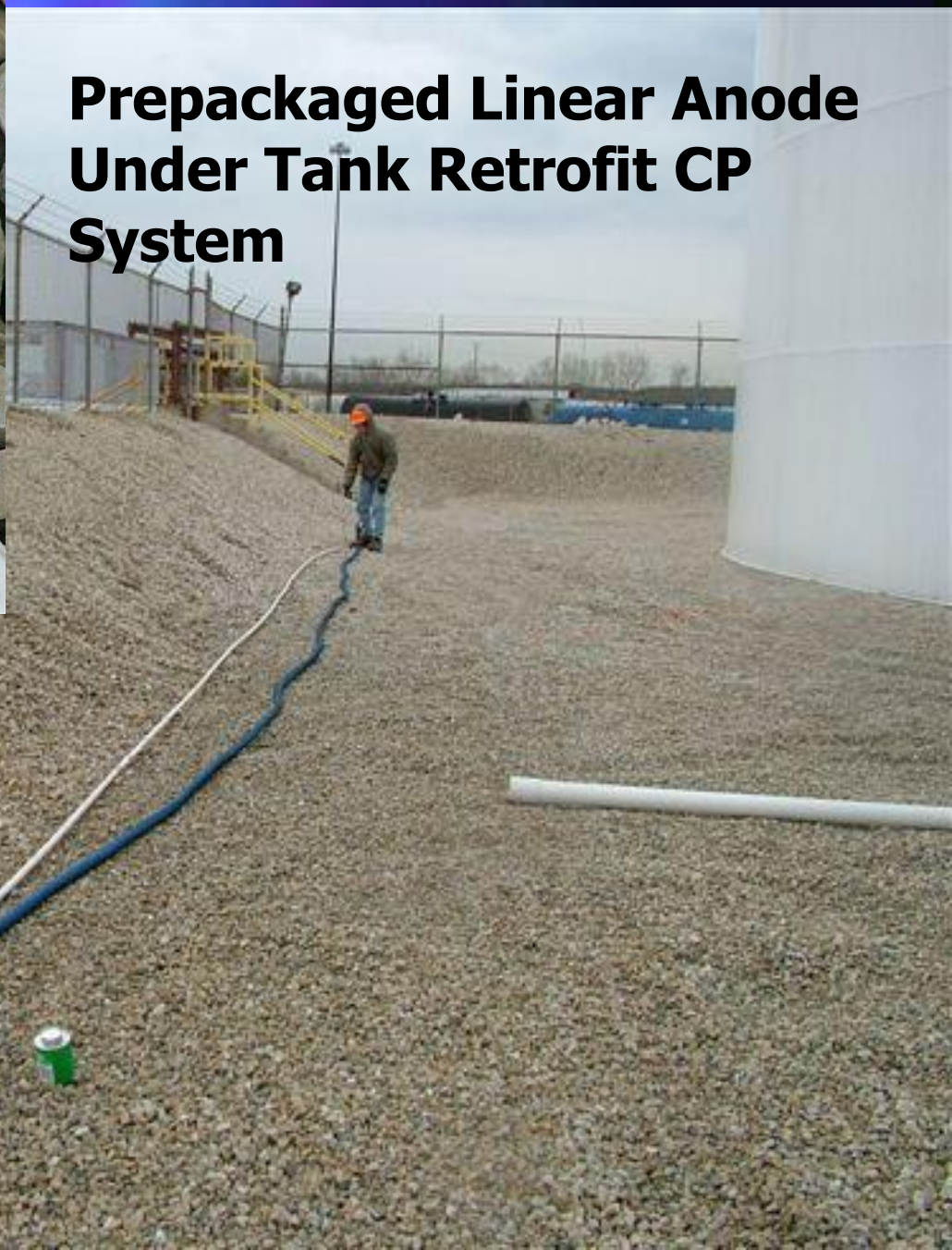
Directional Bore Under Tank for Anode or Reference Cell Placement



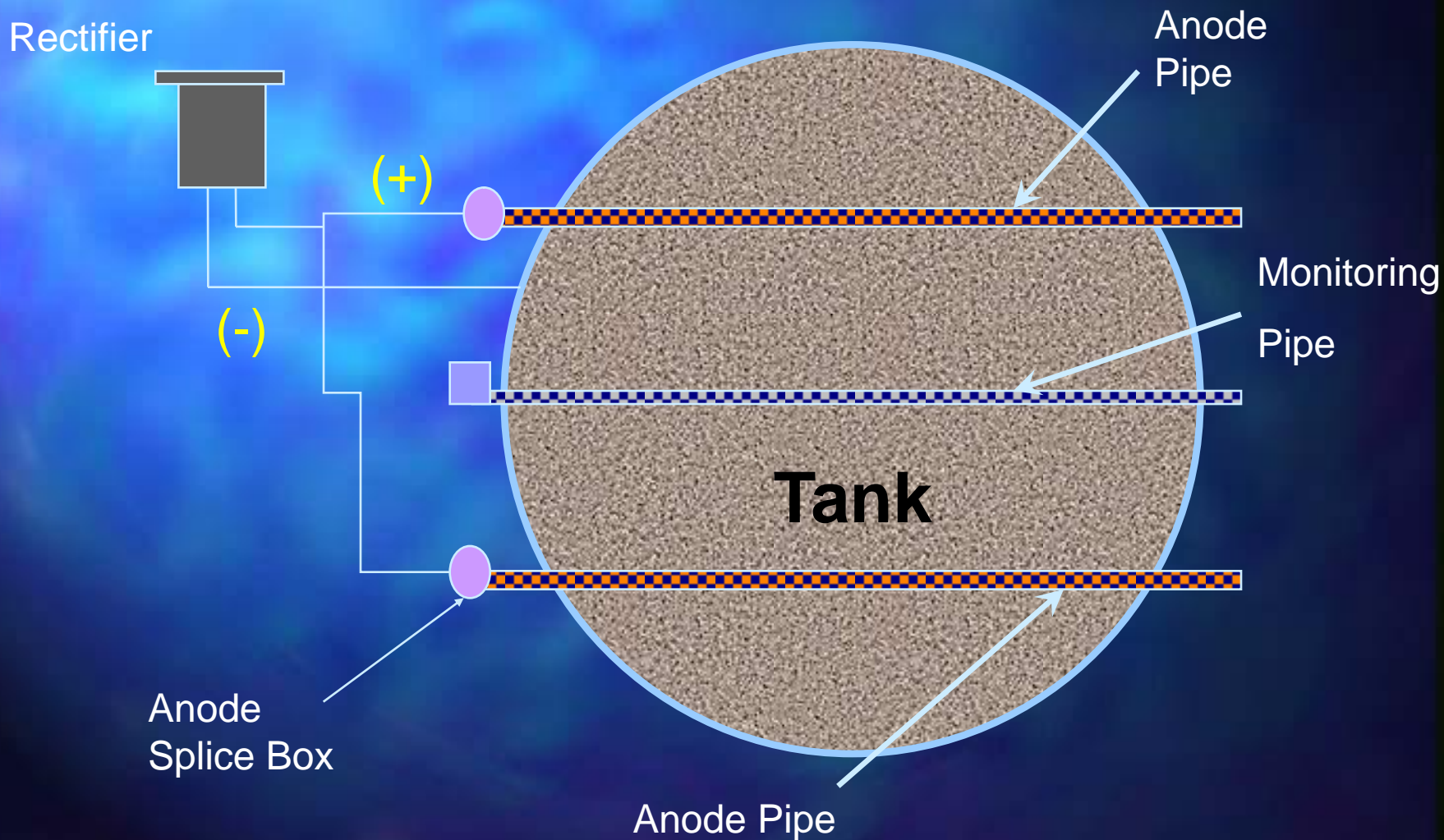
Directional Bore Under Tank



Prepackaged Linear Anode Under Tank Retrofit CP System



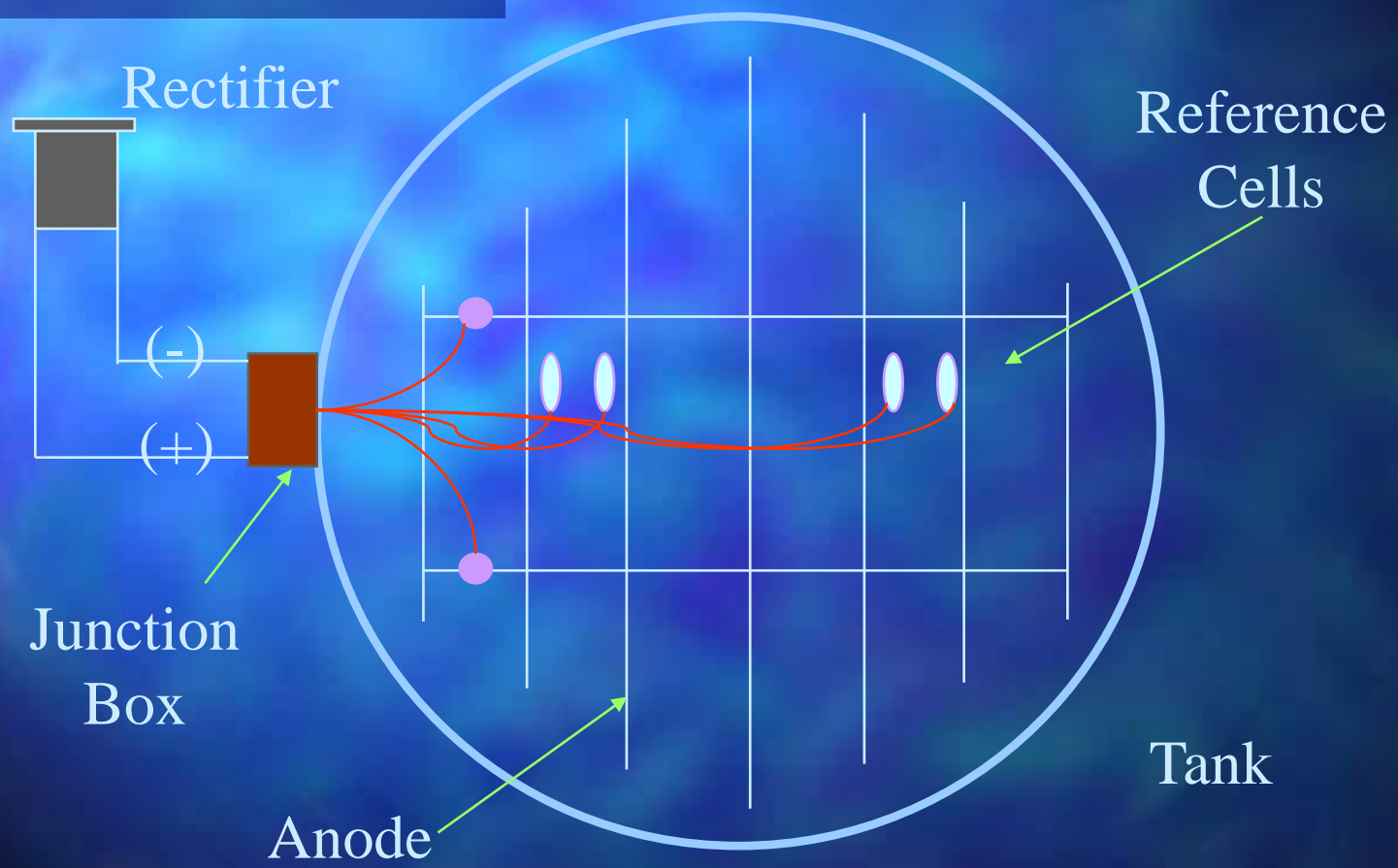
Computer Guided Horizontally Bored Anode System

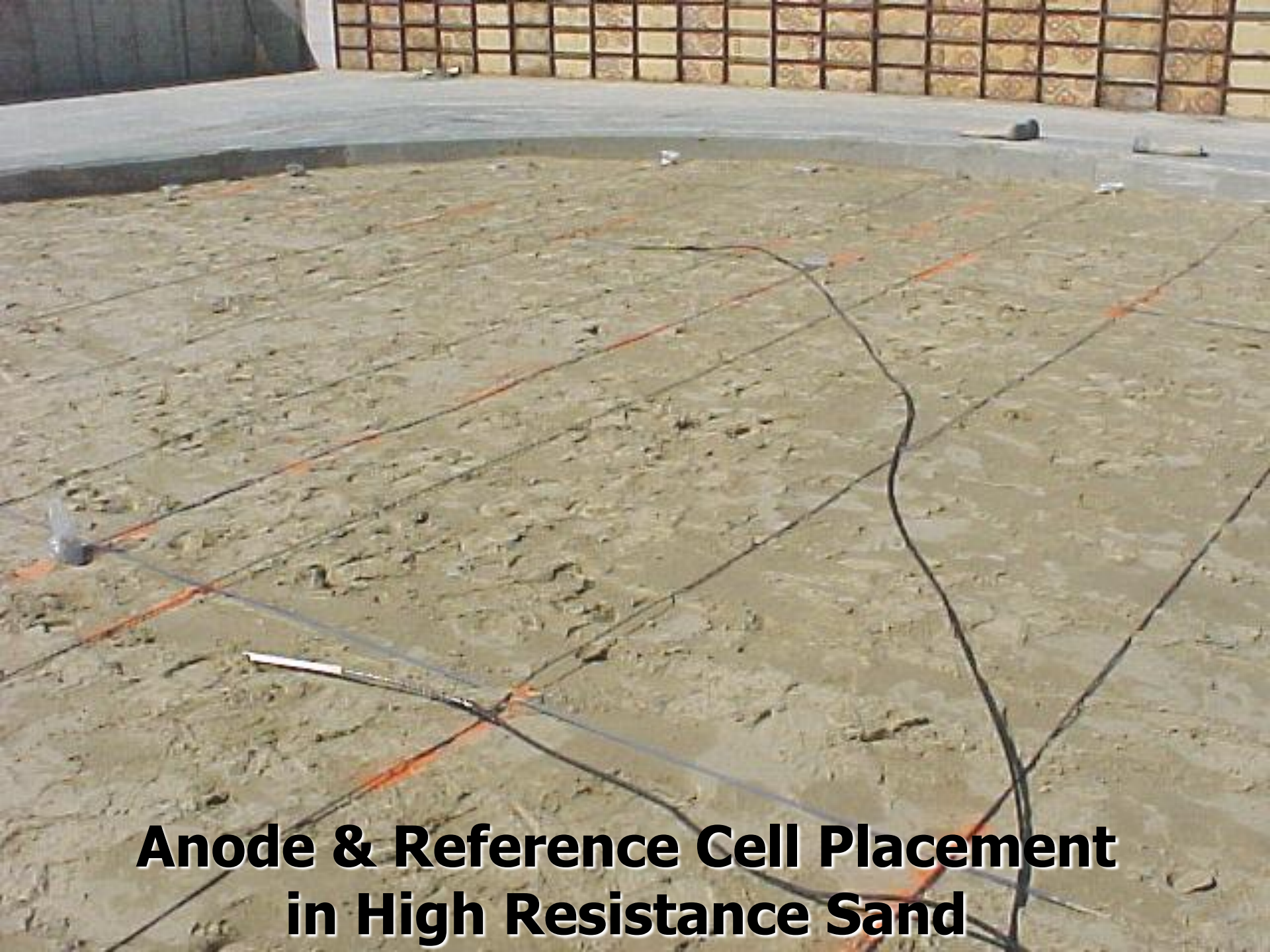




New Tank Construction with Liner

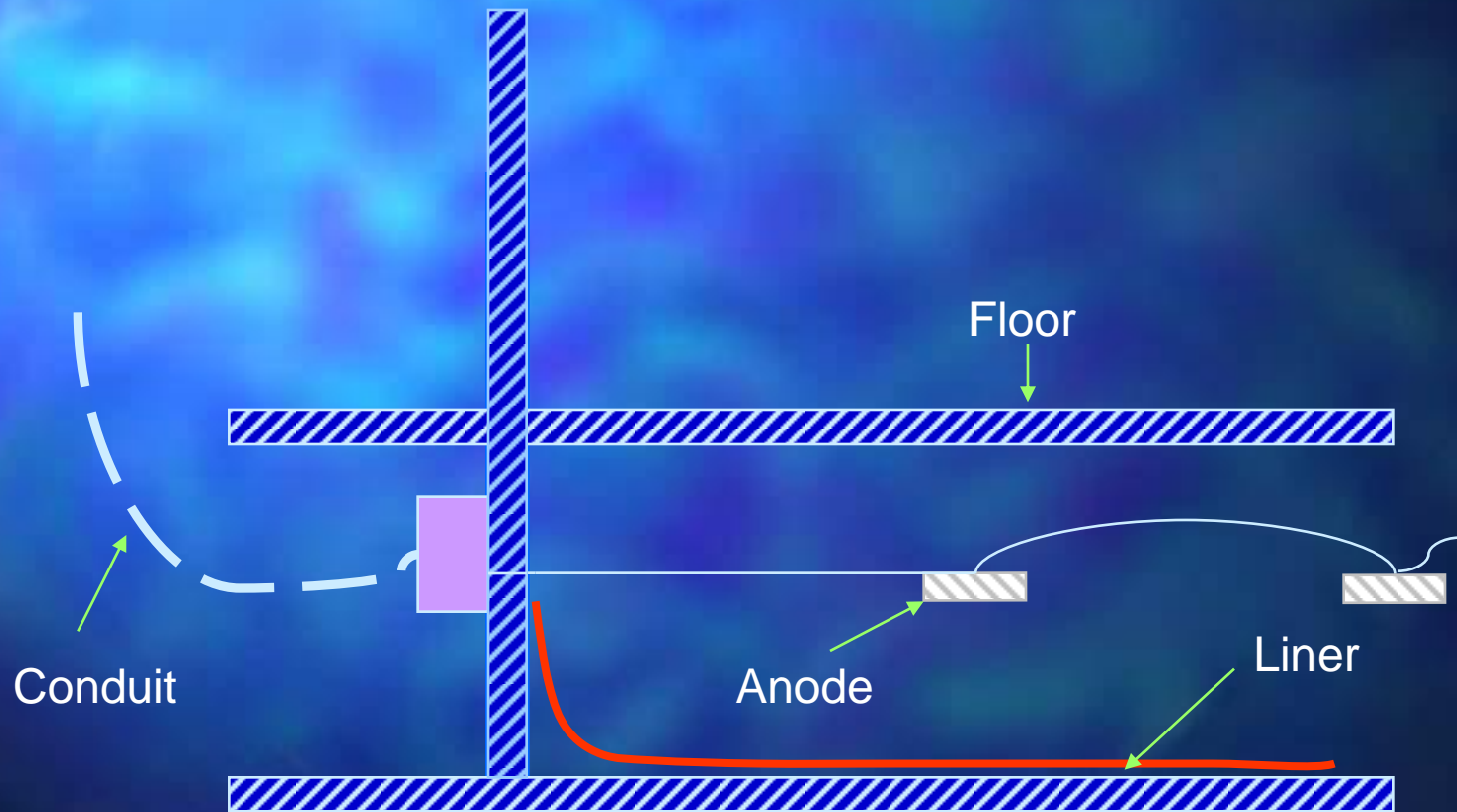
Impressed Current CP Storage Tanks with Liner





**Anode & Reference Cell Placement
in High Resistance Sand**

CP Installation on Double Bottom Tank



Inspection of CP System



Cathodic Protection Testing

- Easy test methods
- Established criteria



Recommended Practices

- API-651 - Cathodic Protection of Aboveground Petroleum Storage Tanks**
- NACE RP0193 - External Cathodic Protection of On-Grade Carbon Steel Tank Bottoms**

NACE Standard Recommended Practice

- **NACE Standard RP0193**

Section 4.3.1.1. A negative cathodic potential of at least 850 mV-CSE with the cathodic protection applied. Voltage drops other than those across the structure to electrolyte boundary must be considered...

Section 4.3.1.2. A negative polarized potential of at least 850 mV-CSE

Section 4.3.1.3. A minimum 100 mV of cathodic polarization

Summary

- **Be aware of all regulations that may pertain to your tanks and piping. When in doubt talk to the governing agencies.**
- **Engage NACE qualified & experienced personnel to engineer/maintain your cathodic protection system.**
- **Refer to NACE/API Standards for guidance.**

THANK YOU

QUESTIONS?

Corrpro

An Insituform Company