COST OF CORROSION –
DEGENERATIVE EFFECTS IN INDIA

BY

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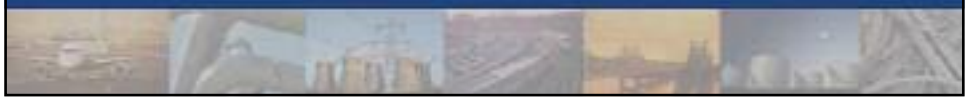
Cost of Corrosion

Presentation Outline

- CORROSION IN INDIA - Background
- Study Goals
- Previous Studies
- Study in India
  - Method 1 – Corrosion Control Methods & Services
  - Method 2 – Industry Sector Analysis
- Highlights of Selected Sectors
- Preventative Strategies

BACKGROUND

- Corrosion is inevitable in any large industrialized society – India is no exception.
- With >7000 Km of coastline, India has significant issues with salt water corrosion of its infrastructure.
- Air pollution issues also contribute to corrosion.
- Humid climate in much of the country contributes to metallic corrosion as well.
- The cost of corrosion in India has been estimated to be 3% of its GDP – $30 Billion.



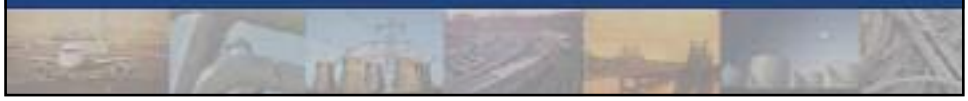
CORROSION MITIGATION TECHNOLOGIES

- Protective coatings and linings
- Metallic coatings and claddings
- Corrosion resistant alloys
- Corrosion inhibitors
- Cathodic protection
- Corrosion resistant composites

It is estimated that 30% of annual corrosion costs could be saved if optimum corrosion management practices were employed.

INDIA : ON THE MOVE

- India is the 12th largest economy in the world today with a GDP exceeding $1 Trillion (USD) or in ppp terms more than $4 Trillion.
- Economic growth has been in excess of 8% over the last 3 years and 9.4% in the last year – making India the 2nd fastest growing economy in the world.
- India's share in world trade more than quadrupled from 0.4% in 2004 to 1.5% in 2006.
- Ernst & Young estimate that Indian firms will spend $35 B USD this year buying and merging with foreign companies. That's up from only $15B in 2006.

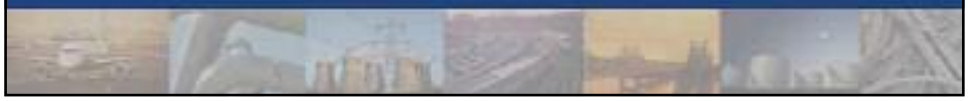


INDIA – WELL POSITIONED FOR GROWTH

- The world's largest democracy and 2nd most populous country is well positioned for growth.
- It possesses a large well-educated and skilled workforce.
- India is experiencing tremendous expansion in the infrastructure, oil and natural gas, power, chemicals, transportation and petrochemical sectors.
- Its markets have opened up to foreign investment and foreign technology.

INDIA - SUMMARY

- The Cost of Corrosion is significant to all industrialized nations – India is no exception.
- This creates enormous opportunities for firms practicing in corrosion mitigating technologies.
- Rapidly growing economies like India present the corrosion market with even greater business opportunities.
- There are a wide variety of corrosion controlling technologies available in the world today each with its own special advantages, economics and market fit.



Cost of Corrosion – Study Goals

•Determines the cost of corrosion control methods and services

• Determines the cost of corrosion for specific industry sectors

• Extrapolate individual sector costs to a national total corrosion cost

• Assess barriers to progress and effective implementation

• Develop strategies for realizing cost savings

Cost of Corrosion – Previous Studies

- 1950 H.H. Uhlig – US Study: 2.1% of GNP
- 1970 T.P. Hoar – UK Study: 3.5% of GNP
- 1974 Japan Study: 1.2% of GNP
- 1975 Battelle/NBS – U.S. Study: 4.5% of GNP
- 2003 – NACE International - $276B in USA

Cost of Corrosion – Method 1 – Methods & Services

- All costs are direct corrosion costs
- Disadvantage: many costs are missed
  - Costs of labor attributed to corrosion management activities
  - Cost of the equipment required because of corrosion-related activities
  - Loss of revenue due to disruption in supply of product
  - Cost of loss of reliability

Cost of Corrosion

Method 1 – Methods & Services

Protective Coatings

Corrosion Resistant Alloys

Corrosion Inhibitors

Engineering Plastics/Polymers

Cathodic & Anodic Protection

Corrosion Control Services

Research & Development

Education & Training

Cost of Corrosion

Method 2 – Industry Sector Analysis

- For each sector, details of analysis are different
  - Government Reports
  - Publicly Available Documents
  - Industry Experts
  - India Census
  - Existing Industrial Surveys
  - Trade Organizations
  - Industry Groups
  - Individual Companies

Cost of Corrosion

Method 2 – Industry Sector Analysis

- 26 Sectors in 5 Categories
  - Infrastructure
  - Utilities
  - Transportation
  - Production & Manufacturing
  - Government

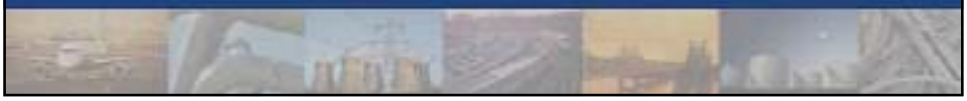
Cost of Corrosion

Method 2 – Industry Sector Analysis

Cost of Corrosion

Category: Infrastructure

- Highway Bridges
- Gas & Liquid Transmission Pipelines
- Waterways & Ports
- Hazardous Materials Storage
- Airports
- Railroads



Cost of Corrosion

Category: Utilities

- Gas Distribution
- Drinking Water and Sewer Systems
- Electrical Utilities
- Telecommunications

Cost of Corrosion

Category: Transportation

Motor Vehicles

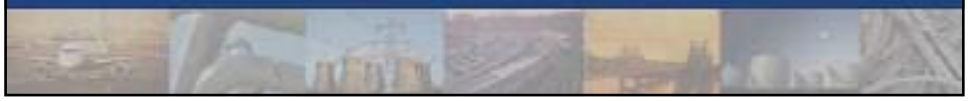
Ships

Aircraft

Railroad Cars

Hazardous Materials

Transport



Cost of Corrosion

Category: Production & Manufacturing

Oil & Gas Exploration & Production

Mining

Petroleum Refining

Chemical, Petrochemical, & Pharmaceutical

Pulp & Paper

Agricultural Production

Food Processing

Electronics

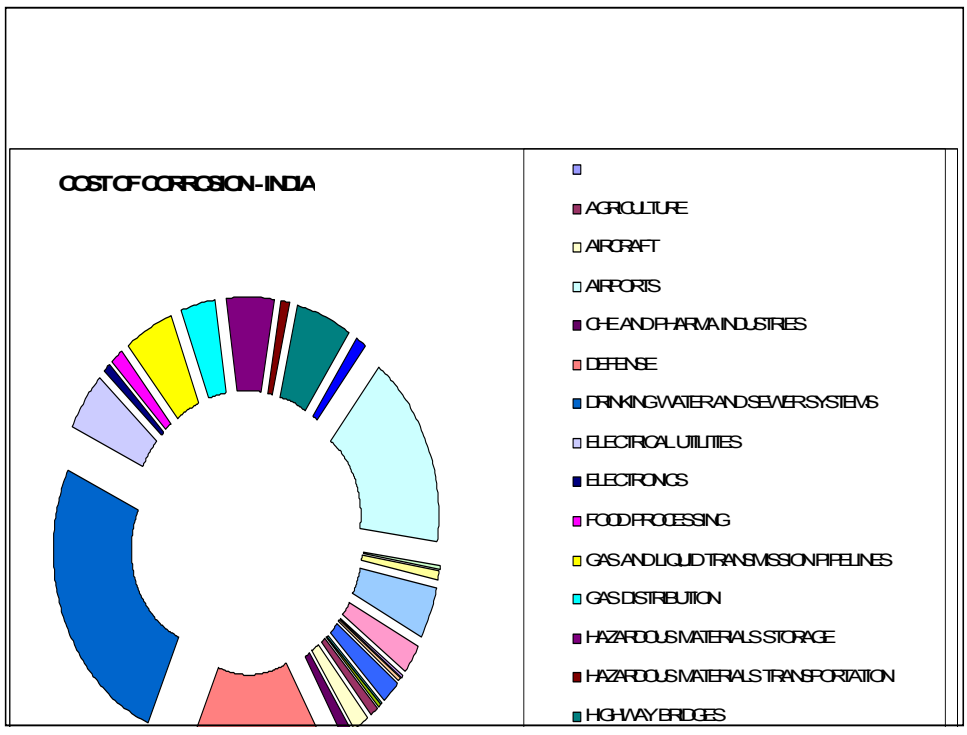
Home Appliances

Cost of Corrosion - Government

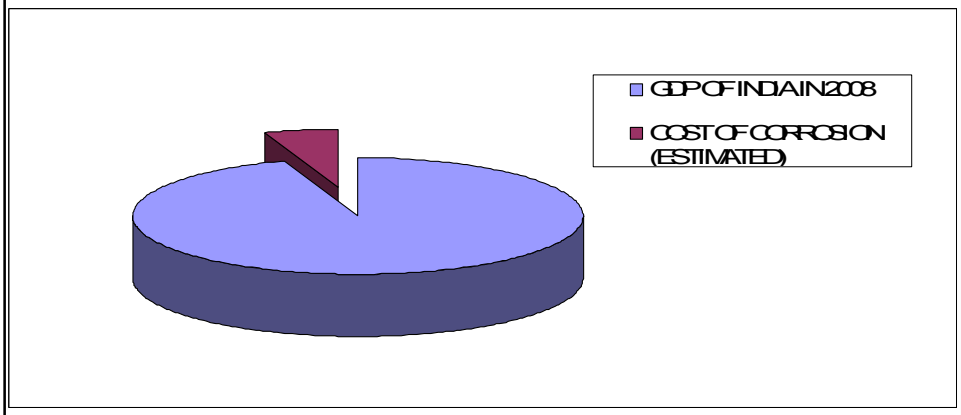
Defense

Nuclear Waste Storage

Estimates of corrosion costs in selected Sectors



COST OF CORROSION TO INDIA V/S GDP
B $ 200/YEAR = 5 % OF GDP B $



Non-Technical Preventive Strategies

- Increase awareness of the large corrosion costs and potential savings
- Change the misconception that nothing can be done about corrosion
- Change policies, regulations, standards, and management practices to increase corrosion savings
- Improve education and training of staff

Technical Preventive Strategies

- Advance design practices for better corrosion management
- Advance life prediction and performance assessment methods
- Advance corrosion technology through research, development, and implementation

THANK YOU FOR YOUR ATTENTION