Modern Pipeline Coatings
The corrosion related cost to the transmission pipeline industry has been determined to be $5.4 to $8.6 billion U.S. dollars annually in the U.S.

Cost of a pipeline leak & corrosion

Repair & replacement
Loss of product
Downtime/production loss
Safety & environment
Product contamination
Consumer confidence
High maintenance
The use of protective coating with or without cathodic protection is the most widely used form of corrosion protection in the pipeline sector

- Bituminous/Coal tar enamel
- Cold tapes
- FBE
- Two-layer PE
- Three-layer PE/PP
- Liquid epoxy
- Polyurethane/Polyurea
Comparison of Costs
(High performance coating systems vs. conventional coating systems)

Costs of corrosion protection of the object
--------------------------------------------------------= costs per year
Lifetime of corrosion protection system

**Conventional coating systems:**
500.000 USD material-costs + 1,5 million USD total costs = 2,0 million USD
----------------------------------------------------------------------------------------------------- = 500.000 USD
Lifetime of corrosion protection system: 4 years

**High performance coating system (+40% material-costs):**
700.000 USD material-costs + 1,5 million USD total costs = 2,2 millions USD
-------------------------------------------------------------------------------------------------------- = 110.000 USD
Lifetime of corrosion protection system: 20 years

Additional costs for a high performance coating system can drastically reduce the long-term costs for the corrosion protection.
Factors affecting coating degradation

Poor application
Inadequate QC/QA
Bacterial attack
Chemical spillage

Pipe movement and soil stress
High temperatures
Saline moisture in the soil
Cathodic Disbondment
Ultra violet radiation
The main factors in selection of protective coatings

• Handling and safety characteristics
• Field application and repair attributes
• Surface preparation requirements
• Physical performance requirements
  - Adhesion to pipe substrate
  - Abrasion, impact, & penetration resistance (hardness)
  - Chemical & corrosion resistance
  - Dielectric strength & resistance to cathodic disbondment
  - Flexibility or bendability
  - Stability at low or elevated temperatures & service conditions
  - Water absorption or water vapor permeability

• Case Histories, track records
• Cost analysis
  - Consider life cycle cost, rather than capital cost
  - Coating cost is only 5-15% of the total pipeline cost
  - Of this 5-15%, only < 50% is cost of the coating material
Perfect protective coatings in Oil, Gas, Water & Waste Water industry

Possible to be field-applied
Suitable for girth weld coating
High anti corrosion properties
Contains no hazardous ingredients
Be environmentally friendly
Low risk of mis-metering (off-ratio) problems
Mechanical & chemical Resistant
Polyureas/ Polyurethanes

Advantages

• Excellent handling & safety attributes
• Safe & environmentally friendly
• Contain no solvent, VOC’s, styrene, tar, or other carcinogens
• Rapid curing speed. Very fast gel time
• Can be holiday tested & buried within hours
• Cold temperature curing ability. can be applied at low temperature and retain their performance characteristics
Polyureas/ Polyurethanes

Advantages

- No heat is required during the application process. Pre-heating of substrate not required.
- Coating can be applied to almost any thickness on any diameter or length of pipe.
- Can be field applied.
- High damage resistance.
- Very high physical properties/very high temperature resistance.
- Competitive costs.
- Simple production process.
- Simple field jointing process.
- Inexpensive field jointing costs.
- Pipeline track record.
Polyurea/ Polyurethane Basics

Diisocynate + Polyol \rightarrow Polyurethane

Diisocynate + Amine \rightarrow Polyurea
100% solid Polyurea/Polyurethane technology

Elastomer polyurethanes
Rigid polyurethanes
Elastomer polyureas
Polyurea

durable products
Specified by Multi-National Oil and Gas Companies
Cost Effective
Longer Product Life
Fast setting, immediate back in service
Not sensitive to moisture/temperature
Can be applied wet on wet in any thickness
High flexibility
Ideal for weld joint coatings
Good adhesion
Good corrosion protection properties
Good chemical & mechanical resistance
Ease of application
- Virtually no free Isocyanate in the system;  
  All Isocyanates are pre-polymers
  i.e., pre-reacted to reduce volatility and health hazards

- Environmentally friendly products

- Not toxic

- Not contradictory to individual hygiene and personnel safety
Product Development

High Pressure Plural Component Spray Formulations
Low Pressure Plural Component Spray Formulations
Brush and Roll Formulations
Cartridge Pump and Spray Formulations
Lathe Spray and Pour Formulations
Hand Mix and Pour Formulations
Robotic Technologies Combined with Cutting Edge Polymer Liners
Key Comparison to Competitive Technologies

Capable for diameters from 6” and upwards

Direct to substrate not grouted minimizes diameter and flow reduction

Installs from manhole to manhole or bell holes reducing excavation and traffic control

1000 feet of reach from access point to access point

Spans deteriorated or missing substrate creating tube in tube systems

Extremely durable, flexible and resilient providing design life of 25 Years +

Fast process minimizing down time of integral system capabilities
Robotic Technologies Combined with Cutting Edge Polymer Liners

Large and small diameter application make
CUTTING EDGE PIPE COATING
Application with Pipelines

Seamless Protection
Steam, Oil, Gas
Potable Water
Petrochemicals
Waste Water
Sludge

SAUDI ARAMCO FIELD TRIAL
Experience

Transportation and Infrastructure
Marine Vessel, Port and Container Facilities
Offshore Pipelines
Onshore Storage, Pipelines and Refineries
Manufacturing Plants
Bridges, Tunnels and Dams
Power Generation Plants
Mining, Manufacturing
Waste Water Treatment Plants
Commercial Buildings
Airport & Railway
Seamless Protection
Steam, Oil, Gas
Potable Water
Petrochemicals
Waste Water
Sludge

Underground
Above Ground
Underwater
Anywhere

Seamless Protection
Steam, Oil, Gas
Potable Water
Petrochemicals
Waste Water
Sludge
Field Jointing Process

Reduce jointing time and costs
Installs faster because it sets faster
Completely seamless
Lowers manpower requirements per joint
Faster, better, cost-effective
FBE

Disadvantages:
• Complicated application process
• Appearing local blisters above 90c
• Almost Impossible to be used in field applications
• Rehabilitation & maintenance problems
• Low impact resistance
• High moisture absorption/permeation
• Difficult to field joint
• Easily damaged during transport/install
• Complex application process

Advantages:
• Excellent adhesion
• Excellent corrosion resistance
• Does not shield cathodic protection
• Long track record
• Low cost
POLYUREA

Application with Pipelines

Pre-fabricated
Designed to specifications
Molded to substrate
Variety of Insulation Composites
POLYUREA

Application with Pipelines
POLYUREA

Applications Offshore Rigs

Faster Coating Durations (Lower Costs)
Extended Coating Life (Lower Costs)
Superior Coating Performance (Less Damage & Repair)
Higher Chemical Resistance Levels (Even with Hydro Carbons)
Shorter Turn Around Times (Faster Back in Service Timings)
POLYUREA

Anticorrosion Protection
POLYUREA

Primary Containment Basins