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Diversity of field-applied pipeline coating technologies

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Overview of Canusa-CPS

- Core Manufacturing
- Warehouse/Finishing
- Partner Manufacturing
- Sales Office

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Global projects providing field services & training

- Saudi Arabia
- Scotland
- Algeria
- The Med
- Kazakhstan
- China

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Field applied coatings

Some basics...

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The perfect coating...

- Has no flaws
- Allows no water (electrolyte)
- Will not allow any current flow between the anode and cathode, but...
- Most coatings will be damaged
- Most coatings allow some water (some more than others)
- Regional conditions affect selection

4.2 External Corrosion Control

4.2.1 External corrosion control must be a primary consideration during the design of a piping system. Materials selection and coatings are the first line of defense against external corrosion. Because perfect coatings are not feasible, CP must be used in conjunction with coatings. For additional information, see Sections 5 and 6.

4.2.2 New piping systems should be externally coated unless thorough investigation indicates that coatings are not required (see Section 5).

Section 5: External Coatings

5.1 Introduction

5.1.1 This section recommends practices for selecting, testing and evaluating, handling, storing, inspecting, and installing external coating systems for external corrosion control on piping systems.

The function of external coatings is to control corrosion by isolating the external surface of the underground or submerged piping from the environment, to reduce CP current requirements, and to improve current distribution.

5.1.2 External coatings must be properly selected and applied and the coated piping carefully handled and installed to fulfill these functions. Various types of external coatings can accomplish the desired functions.

5.1.2.1 Desirable characteristics of external coatings include the following:

5.1.2.1.1 Effective electrical insulator;

5.1.2.1.2 Effective moisture barrier;

5.1.2.1.3 Application to pipe by a method that does not adversely affect the properties of the pipe;

5.1.2.1.4 Application to pipe with a minimum of defects;

5.1.2.1.5 Good adhesion to pipe surface;

Mainline coating properties & characteristics

- Resist impact, abrasion, penetration (transport, construct, operate)
- Flexible
- Long term adhesion to the substrate
- Resist environmental conditions
- Resist cathodic disbondment
- Remain functional under operating conditions

Field applied coating properties & characteristics

- Perform at P/L operating temperature
- Withstand soil stress
- Resist impact damage
- Compatible with mainline coating
- Resistant to construction handling
- Withstand environmental conditions during application
- Economics

Typical field joint recommendation

- Field joint systems must meet or exceed mainline coating requirements:
 - FBE: HSS, Liquid Epoxies or FBE
 - PP: Polypropylene systems
 - 3LPE: 3-layer polyethylene systems
 - Pre-Insulated Pipe: Corrosion protection, insulation, sealing system, mechanical protection

ISO activities: Field applied coatings

Table 1 — FJC Types

Code	Class	Type of field joint coating
1A	10	Hot-applied bituminous tapes
1B		Petroleum tapes
1C		Wax tapes
1D		Cold-applied polymeric tapes
2A	11	Heat-shrinkable materials, polyethylene based
2B		Heat-shrinkable materials, polyethylene based, applied over a liquid or fusion bonded epoxy layer
2C		Heat-shrinkable materials, polypropylene based, applied over a liquid or fusion bonded epoxy layer
3A	12	Single layer fusion-bonded epoxy powder
3B		Two layer fusion-bonded epoxy powder
4A	13	Liquid epoxy or derivatives
4B		Liquid polyurethane or derivatives
4C		Fibre reinforced epoxy
4D		Fibre reinforced vinyl ester
4E		Cast polyurethane
5A	14	Flame-sprayed polypropylene powder applied over an epoxy layer
5B		Polypropylene tapesheets hot-applied over an epoxy layer
5C		Injection moulded polypropylene over an epoxy layer
5D		Flame-sprayed polypropylene powder applied over an epoxy layer
5E		Polyethylene tapesheets hot-applied over an epoxy layer
6	15	TSA (Thermal Spray Aluminium)
7	16	Hot-applied microcrystalline wax coatings
8A	17	Electrochromic coatings, polychlorophene based
8B		Electrochromic coatings, EPDM based

NACE activities: Field applied coatings

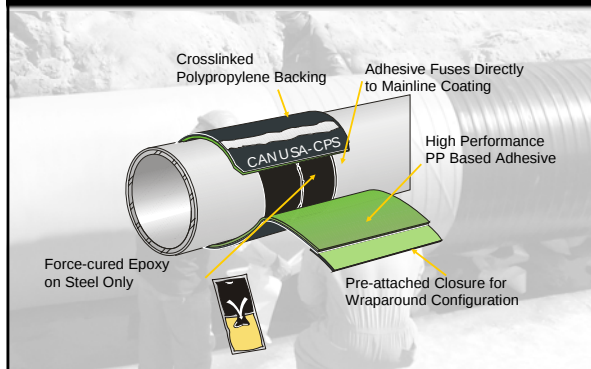


Advances in field applied coatings



- Polypropylene for 3LPP
- Polyethylene for 3LPE
- Ultra high impact resistant systems
- High-build, force-cured epoxy
- Liquid epoxy systems
- High-strength coatings
- Visco-Elastic coatings

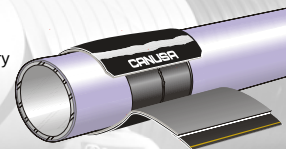
Polypropylene The GTS-PP system



Polyethylene The GTS-PE system



- Advanced PE copolymer adhesive technology
 - Very low installation temperature
 - Fusion to 3LPE factory coating
- Pre-manufactured components
- Easily installed by trained contractor



The GTS-PE technology



- 3-Layer Product Design:
 - Anti-Corrosion Layer: Force cured liquid epoxy
 - Adhesive Layer: PE Copolymer
 - Backing Layer: Cross-linked HDPE
- Comprised of the same materials and provides equivalent performance to 3LPE factory coating
- Performance in accordance with highest standards for 3LPE factory coatings

Impact resistant coatings



3-Layer HSS with High build force cure epoxy



Force curing liquid epoxy with
induction heat



Completed 3-layer HSS

High strength coatings for directional drilling



Liquid epoxy for repair & rehabilitation



"Visco-elastic" adhesive based products

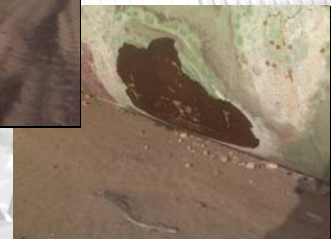


- Most adhesives are considered "visco-elastic"
- Balance adhesion & cohesion
- Basic premise:
 - sticks
 - will not fail adhesively
 - leaves some protection in place
- "Visco-elastic" is a generic term for the coating type
- Primarily rehabilitation focus
- Niche markets

Saudi Arabia

A unique challenge

Coating damage (after excavation)



Coating damage (after excavation)



Visco-elastic description



- Wraparound coating (tape)
- Modified and reinforced visco-elastic adhesive on a carrier film
- Impermeable barrier to water and air
- Supplied in roll form
- Two layer coating system
 - Inner layer of Wrapid Bond™
 - Outer layer of Wrapid Coat™
- Compliant with EN 12068 and Shell requirements for Visco-Elastic materials
- ISO standards being developed
- Manufactured to ISO 9001 standards

Wrapid Bond™



- Adhesive formulation based on Canusa's adhesives experience and latest raw materials
- Base product, Wrapid Bond™
 - 2mm adhesive, embedded mesh, 75µm PE backing
- Complimentary products include:
 - outer wrap PVC tape for soil stress resistance
 - high impact fiberglass outer wrap
 - a filler / seam tape
 - others being developed

Emerging coating option



Conclusions



Diversity of field-applied pipeline coating technologies

