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Research Article

Effect of Polyethylene on Corrosion Protection of Ductile Cast Iron

Mustafa Ahmed Rijab[A] and Ali I .Al-Mosawi[B*]

[A]Technical Institute of Baquba ,IRAQ , [B]Technical Institute of Babylon ,IRAQ

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Abstract

Service life can be increased by using effective bondedcoatings as well as polyethylene encasement and cathodic protection. Theindustry experience of users, engineers, coaters, and manufacturers demonstrates that are good enough even in harsh environments. Experimental evaluationsrevealed from various water utilities showed that demonstrates sufficient servicelife and lower maintained costs against alternatives. Now applymodern pipe management systems. Before application several soil parameters such as resistivity/conductivity, moisture content, chloride and sulphide ionsconcentration, redox potential, presence of landfill, fly ash, coal, peat, mine waste,are searched. After that, if necessary required are taken before burying the pipes.

Keywords: *Harsh Environments, Corrosion Protection, polyethylene, ductile cast iron.*

Introduction

When soil tests and performance history indicate that conditions are corrosive, however, positive corrosion protection is warranted. Utility reports indicate that properly designed and installed iron pipe systems in moderately corrosive soils have demonstrated a performance of more than100 years of service. Offers several advantages including its thick homogenouswall, availability, utility and contractor familiarity, allowing the flexible pipe designand low-cost maintaining. This modern iron , which was discovered in 1948, hasall the qualities of its antecedent grey cast iron, but none of its disadvantages.Ductile cast iron DCI piping has been used worldwide since 1960s forwater transmission and distribution mains. By 1979, ductile iron pipe largelyreplaced cast iron as the predominant pipe material in water industry. Therefore, themajority of DCI pipelines have been operating for 25 years or less. DCI piping failuresthat are caused by corrosion have become more prevalent as the pipelines have aged. Having high tensile strength, high impact resistance, a high yield point and considerable elongation, it has consolidated the position of iron in the pipe market andgained for it the highly valued reputation of a rapidly developing new material. Properly designed and installed iron pipe systems in moderately corrosive soils have.Theexplanation is quite simple: the carbon in grey iron is always present in the form of graphite flakes, which favor crack initiation and render the material brittle. InDuctile cast ironspheroidal graphite iron, the carbon is present in the form of small spheres, thuseliminating the risk of crack propagation.The adaptation of external and internal coating on pipe since the 1960’s widened its usages. Due to these and other developments, the water andwastewater industry has continued and increased its practice of installing. The strength of DIP permits a wide varietyof design applications including shallow bury/heavy traffic loads, deep bury/high soil prism loads, and high operation /surge pressures.

*Corresponding author: **Ali I .Al-Mosawi**

Experimental Producer

Ductile Cast Iron Pipe in Normal and Harsh Environment:

Ductile Iron Pipe(DIP): is one of the most commonly used pipe materials inour modern society.

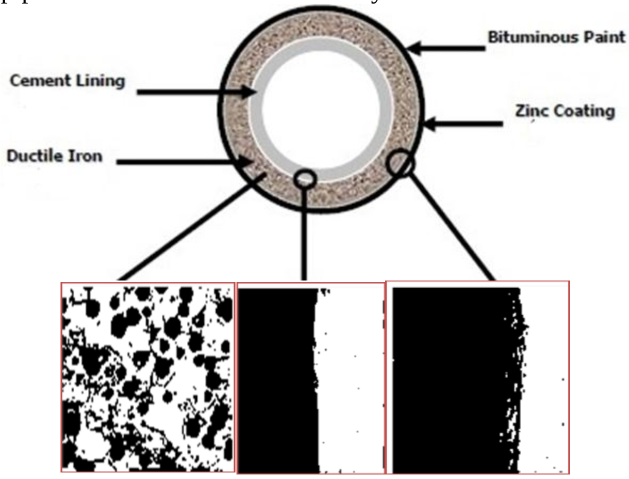

Fig. (1) Cross Section of bonded ductile cast iron with related microstructure

Sandblasted, bare (with annealing oxide), asphalticshoapcoated pipes were used many years. The protection value of these surface conditions is often neglected. However, metallic (like Zinc), (polymeric like epoxy) and ceramic (like cement) coatings or linings have demonstratedvery good corrosion protection for DIP (Figure 1, and Table 1)

Table (1) various features of selected high pressure. Length in (mm), Weight in (Kg)

Total Weightof Standardlength	150	300	2000
CementLiningThickness	2	6	9
Weight(kg/m)	20	60	250
SocketEndWeight	5	20	150
WallThickness	6	8	16
ExternalDiameter	250	450	1000
NominalDiameter	200	400	800
Type	DN 100	DN 300	DN 1000

Table 2 Cement linings

High alumina cement	Sulphate resistingCements (including blast furnaceslag cements)	PortlandCement	Water characteristics
5	5.5	8	Minimum value of pHMaximum content (mg/l) of:
No limit	18	6	Aggressive CO_2
No limit	2500	500	Sulphates (SO_4^-)
No limit	600	100	Magnesium (Mg^{++})
No limit	25	25	Ammonium (NH4-)

Table 3 General pipe protection

External Protection	Internal protection	Internal and externalcondition
Metallic zinc + bituminous paint	Portland cement mortar	Potable water - normal soil
1-Metallic zinc + bituminouspaint + PE sleeve or	High aluminacement mortar	Acidic water - corrosive soil
2- 85Zn-15Al + epoxy paint		
PE (DN≤500) or polyurethane≤(1200) coating	Epoxy or PE+silis (SiO2**)**	Industrial and abrasive liquid extremelycorrosive soil

Harsh Environment and Corrosion Protection

Probably the most common method to assess the corrosivity of soils and the service life of metallic pipes embedded in them is the ANSI/AWWA C105/A21.5 American National Standard for Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids. These include the 10-point system as originally proposed by Ductile Iron Pipe Research Association (DIPRA) (Table 4). This method assigns points for various soil backfill characteristics and defines a soil as corrosive if the some of the points is more than 10. High quality bonded coatings against harsh environment are neither necessary nor practical in many cases. Instead of promoting the use of advanced coatings, standard coating with conjunction of CP can be more appropriate for protection of DIP. For harsh environment users of the pipe have two options. These are either using advanced coating and lining (other than Zn coating and Portland cement lining) or applying of PE sleeve (with or without CP) on bare or standard coated pipes.

Table 4 Soil test evaluation for ductile iron pipe

Points	Soil Characteristic	Points	Soil Characteristic
	Sulphides		Resistivity (ohm-cm)
4	Positive	8	1400
2	Trace	6	1400-1600
0	Negative	4	1600-1900
		2	1900-2600
	Moisture	1	2600-2900
2	Poor drainage, continuouslyWet	0	2900
1	Fair drainage, generally moist		
0	Good drainage, generally dry		PH
		6	0-3
	Redox potential	3	03-May
0	100mV	0	05-Oct
2	50 to +100 mV	3	10
5	0 to +50 mV		
6	Negative		

Protection	Risk assessment zones	
a)Tight bonded Zn coating + PEencasement or b)Zn-Al coating	Severe	Case 1 > 10 point
Asphaltic shop coating+ PE encasement	appreciable	2 ≥ 10point
a)Asphaltic shop coating or b)Bare	Mild	3 < 10point

The contributing likelihood factors are determined by the collection and analysis of soil samples, and can result in a likelihood ‘’point score of 25 or more points. This modified risk assessment method is called the 25 point analysis. The new design decision model is also applicable to DIP transmission and distribution project. Suburban Sanitary Commission (WSSC), the seventh – largest water and wastewater utility uses this approach.

Lifetime Costs

A pipeline with a properly designed material and protection program has lower life-cycle costs than a pipeline that fails prematurely and has to be replaced before design life is met. It should be noted that, although the initial construction and operations and maintenance (O&M) costs are lowest with pipes other than metals (such as PE), other costs such as high leak costs increase the life time burden of them. Tight-bonded coated DI life–cycle costs are always lower than tight-bonded coated steel (CS) with or without CP. It should be noted that DI outlast steel and other pipes in many water transmission system. Buried steel pipe always needs CP in all soil corrosivity zones, while DIP needs it only at very aggressive soils. Lifetime costs for a water supply pipeline are measured not on the basis of the price of the individual pipes, but on the duration of problem-free operation without need for replacements of pipes. If the pipes do not live up the required demands, the investments in new components, the additional costs of the excavation, the working hours used on the replacement, and the re-establishment of the area afterwards increase the life cycle cost.

Conclusions

1-PE encasement as a corrosion-control method is both cost-effective and technically sound

that DIP is the most appropriate material for water transmission. A wide2-The major challenge in the pipeline is choosing appropriate pipe materials and corrosion control methods. By referring the actual life cycle cost.

3-This article has presented different arguments on corrosion protection at harsh environment. Evaluating corrosion risks and selecting and implementing appropriate corrosion control methods allow owners to meet their desired pipe reliability and service life targets

and protect their investment at minimum life-cycle costs.

4-In harsh environments and in case where an extended life is desired, DI pipelines are equipped with a bonded coating and galvanic CP. Galvanic CP has been successfully applied to DI pipelines in corrosive environments and has proven to be cost-effective. Magnesium anodes are installed to provide protective current to areas of the pipe that have been identified as highest risk.

5-The industry experience of users, engineers and manufacturers demonstrates variety of external bonded coatings have been used on pipelines for many Points Protection Risk assessment.

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