Abstract

Iraq has a huge network of pipelines, transport crude oil and final hydrocarbon products as well as portable water. These networks are exposed to extensive damage due to the underground corrosion processes unless suitable protection techniques are used. Information of cathodic protection has been collected for pipeline in practical fields, to obtain data base for understanding and optimizing the design which is made by simulation using MATLAB software for the environmental factors and cathodic protection variables.

The first part concerns with field work and simulation Simulink which is enables the designer to build cathodic protection for buried structure and predicting the numbers of anode and its operating voltages and currents under various operational conditions, and compare it with those in practices. In this work a comparison has been made between the field and simulation results which include anode numbers, rectifier voltage and current; it was found that as the number of anode increase the resistance of the anode ground bed decrease and vice versa with some exceptions. The current depends on the length of the section to be protected while the applied voltage depends on the soil resistivity beside the length of the structure. The second concerns about the anode position effect on the cathodic protection system as well as the coating effect and the soil resistivity effect.In cathodic protection system the design of anode ground bed plays very important role since the current distribution and pipe potential will be affected by anode position with respect to the structure position. A comparison have been made between different positions in different soil conditions for coated and uncoated pipe; contours maps for potential distribution are also obtained. The work shows that coated pipe need less voltage to protect than if it is uncoated, dry soil needs more voltage than moisture soil, as the anode distance increase the pipe potential decrease.

In the field work the most economical design for the first pipeline was at station no. 2 which need 2.5 A for protection of the pipeline for that specific length and for second pipeline station no. 4 which need 12 A for protection of the pipeline for that specific length. And the best anode positions was from 50-150 m away from pipeline to give a better protection for the pipeline, and the anode grounded resistance decrease as the number of anodes increases.

In the experimental work the best distance between the anode and the cathode was 30cm away from pipe, and the best depth was at apposition below the pipe surface rather than at the same level.

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Nomenclature

Symbol	Meaning	Units
E	Electrode potential	Volt
IR	Potential drop	Volt
L	Length of protected structure at specified zone	ft
D	Pipe diameter	in
CE	Coating efficiency	dimensionless
I	Required current density	mA/m^2
A	Total structure surface area	ft^2
A1	Corrosion current density	ft^2/anode
I1	Recommended maximum current density out put	mA
N	Number of anodes	dimensionless
l	life	years
W	Weight of anode	lb
La	Length of anode backfill column	ft
K	Anode shape factor	dimensionless
S	Center to center spacing between anode backfill column	ft
Ra	Anode resistance	Ohm
Rw	The ground bed header cable resistance	Ohm

d	Anode /backfill diameter	in
L_{eff}	Effective anode length	ft
Rc	structure to Electrolyte resistance	Ohm
L_{deep}	Anode length in deep anodes ground bed	m
d_{deep}	Anode diameter in deep anode ground bed	m
Rt.	Total resistance	Ohm
V	Voltage	Volt
R	Coating resistance	Ohm

Greek symbols

Symbol	Meaning	Units
ρ	Soil Resistivity	Ohm.cm

Abbreviations

Abbreviation	Meaning
NACE	National Association of Corrosion Engineers
CP	Cathodic protection
DC	Direct current /power supply
RE	Reference electrode
HSCI	High silicon cast iron
CSE	Copper sulfate electrode

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