Corrosion Control

Review of the procedures of Rand Water

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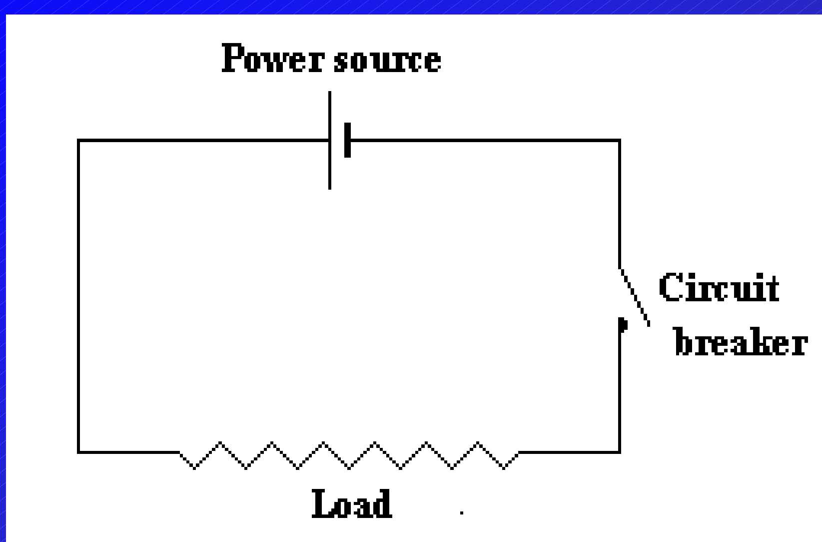
Introduction

- Leaks on pipelines at Rand Water are analysed by dividing them into three main categories namely: holes, joints and other.
- Holes would be those which were caused by corrosion, joints are those caused by lead joints shifting and finally others would be contractor damage, broken valves, faulty or broken air valves, etc.
- The major forms of corrosion control applied are:-
  - Natural current drainage bonds
  - Forced current drainage bonds
  - Impressed current systems
  - Magnesium anodes
  - Crossbonding
  - Communication

The pipeline / rail network

- Since 1903 the Rand Water's pipeline network has grown to some 2700 km of pipeline
- The railway network was electrified during the 1930's using a direct current (DC) system
- The steel pipe work becomes part of the railway network electrical circuit which results in stray current corrosion

Basic Electrical Circuit



RW pipeline in particular area

Rail and substations added

Other Services Included

Complex Cathodic Protection area

The cost of pipelines

- Cost of pipeline installation has risen dramatically.
- In 1972 it cost R92 000 to lay a kilometre of 1120-mm diameter pipe.
- Today the estimated cost to lay a 1200-mm diameter pipeline is R2 000 000 per kilometer.
- The cost of corrosion control to Rand Water is ± 2% of the the total maintenance budget per year

The principles of cathodic protection and assimilation of data

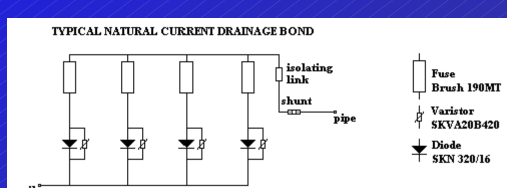
- Relatively simple and requires that all buried structures have a pipe to ground potential more negative than 0,85V.
- Simplest and most well known - the use of magnesium or zinc anodes
- More controllable form - impressed current system
- Accumulation of data is vital to an effective corrosion control system
- Co-ordinates of each leak onto a set of drawings – reflects the pattern of leaks can be determined
- Plan of action devised for protecting pipelines
- Reducing the number of leaks.
- Ground potential survey is a proactive procedure
- Soil resistivity surveys are conducted on a new pipeline route where there are no existing pipelines.

Co-operation, consultation and communication

- Rand Water's area of of supply is 16 785 km²
- Constant monitoring to provide an efficient corrosion control and by communicating the purpose of cathodic protection to staff who are directly involved with pipeline distribution and construction
- A little basic training, able to recognize the difference between an internal or external leak.
- Construction in consultation with the Electrolysis section will design in anti corrosion procedures
- Precautions when pipes are placed on pedestals to avoid differential aeration cells

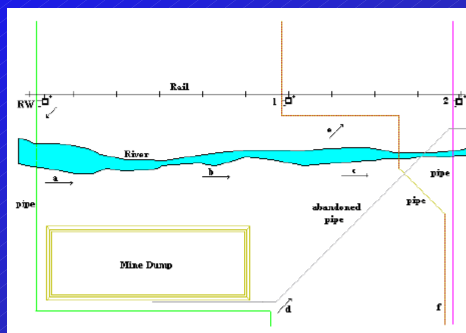
Natural pipe to rail current drainage bonds

- The greatest source of stray currents is Transnet's extensive electrified DC traction network
- Every effort is made by Transnet to insulate the return track
- However metal dust from brake shoes, moisture and level crossings provide current leakage paths to ground that tend to thwart their efforts



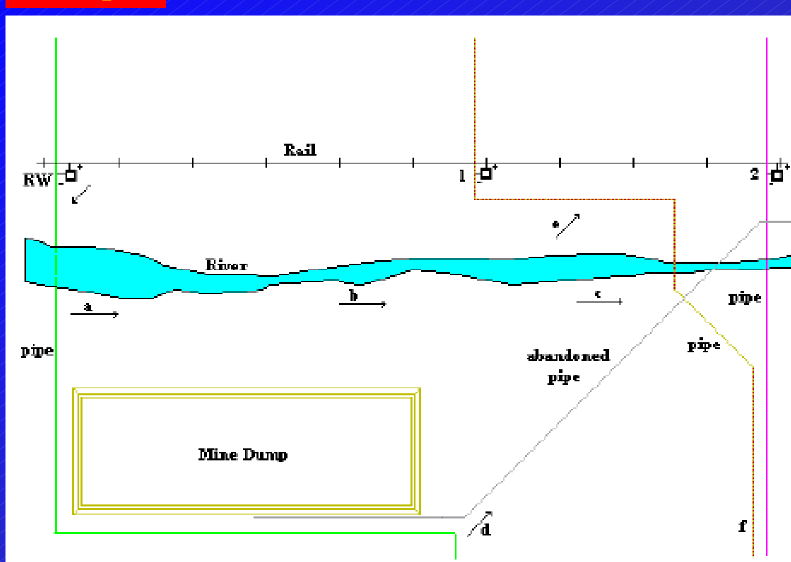
Forced current drainage bonds

- Forced current drainage bond is one of the tools in the armoury of cathodic protection operators
- An understanding of circuits involved in interference currents is of vital importance in analyzing pipe to ground potential readings



Forced current drainage bonds

Example

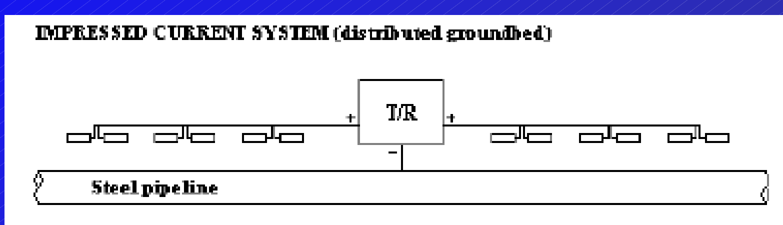


Impressed current systems

- Most conventional method of cathodic protection
- Selection of groundbed is critical
- Groundbed area should be damp and have a very low resistance (less than 3 000 ohm-cm)
- The ground between the groundbed and the pipeline should be of the order of 10 000 - 20 000 ohm-cm.
- With these conditions cathodic protection can be achieved over a length of up to 5 km.
- Groundbed can consist of silicon iron anodes imbedded in coke and all electrical joints to the groundbed (+ leg) should be above ground and carefully insulated
- The positive terminal of the T/R is connected to the groundbed and the negative terminal to the pipeline.

Impressed current (cont)

- For low resistively areas the following option is applicable
- A distributed groundbed impressed current system can be used
- this requires a cable parallel to the pipeline and the silicon iron anodes connected approximately 50m apart at a distance 1m from the pipeline



The South African Electrolytic Corrosion Committee

- Application of cathodic protection will affect other underground services
- Electrolytic corrosion and the mitigative measures to be implemented, is conducted by the South African Electrolytic Corrosion Committee was formed in 1966
- An extract of a document recently released by the Committee is attached
- It describes the bonds application
- Code of conduct

Instrumentation

- The following minimum instrumentation is required:
  - Digital Multimeter
  - Chart Recorders and data loggers
  - Megger Nul balance detector
  - Pipe/cable locator
- The following is additional but specialized:
  - The magnetoscope
  - The microvoltmeter
  - The DCVG.
  - The corrosometer

Prevention of corrosion without cathodic protection

- **Some built in problems:**
  - Lead Joints
  - Bolted clips
  - Holes in steel pipelines
  - Valve Chambers
  - Parallel pipelines

Coatings and Linings

- **First line of defence is the coating**
- **Costs of cathodically protecting a pipeline is almost directly related to the integrity of the coating**
- **Applying coatings for large diameters is a complex problem**
- **A second problem is the repair of the lining when ancilliary equipment is installed after a pipeline has been put into service**
- **Application of cathodic protection applied to the external surface will not protect the internal surface**

Microbiologically Induced Corrosion

- Externally MIC has been found where the pipelines pass through water-logged soils and around pumpstations where coating damage is most prevelent
- It is accepted practice to install cathodic protection which in turn creates an alkaline condition on the steel surface and inhibits MIC

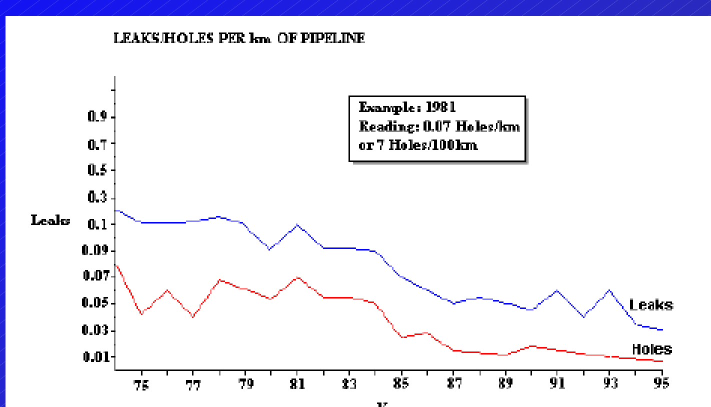
Microbiologically Induced Corrosion

4 Bacterial growth in valve flange

Microbiologically Induced Corrosion

Does it work?

- 2700 km of pipeline in its distribution network
- 116 major cathodic protection installations



Corrosion Control

Thank you

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