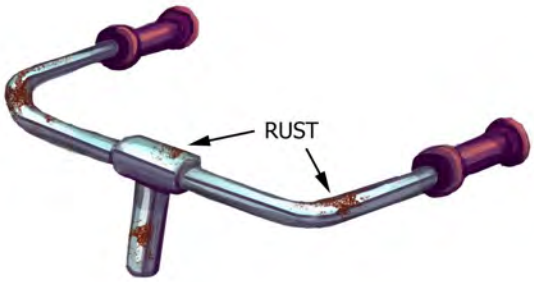
Corrosion

Canada has thousands of kilometers of steel pipelines which could be damaged or crack as a result of corrosion. This is prevented by protecting and monitorig the pipelines. If the pipelines become damaged they must be dug up and repaired to prevent release of products fromn the pipeline.

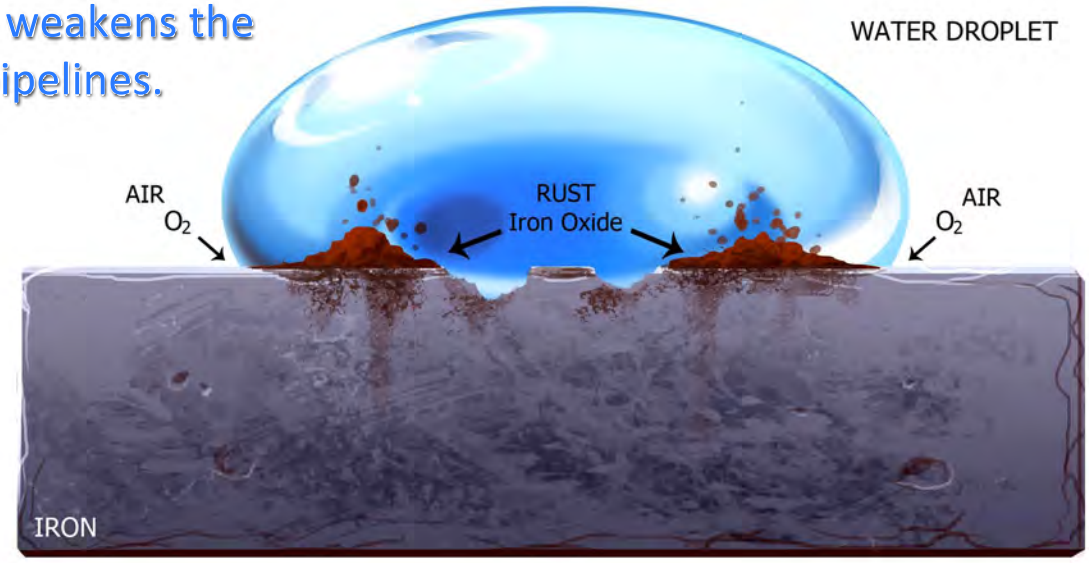
What is Corrosion?

Corrosion is the result of a chemical reaction between a metal and its surroundings which causes the metal to breakdown. One example of corrosion is rust. You might have seen rust on your bike.



Rust occurs when iron undergoes a chemical reaction in which the iron combines with both oxygen and water to form iron oxide. The iron oxide is a solid but, is more porous, weaker and brittle compared to the original metal.

Corrosion weakens the metal in pipelines.



The outside of a pipeline may corrode because the pipe is in contact with the surrounding environment. The inside of a pipeline may also corrode because of contact with the fluids it is transporting. Internal corrosion can occur due to sludge or build up on the pipeline wall. Internal corrosion can be prevented by including corrosion inhibitors in the fluids that are being transported in the pipeline.

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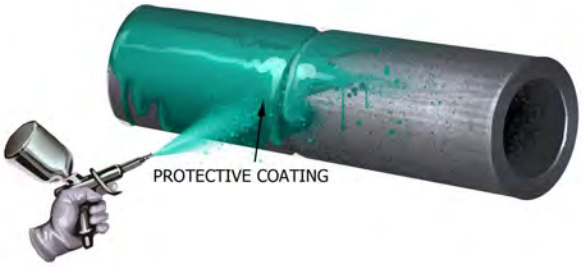
Preventing Corrosion

There are many different ways that corrosion can be prevented. These techniques all try to prevent the chemical reaction from occuring and keeping the pipeline in good working order.

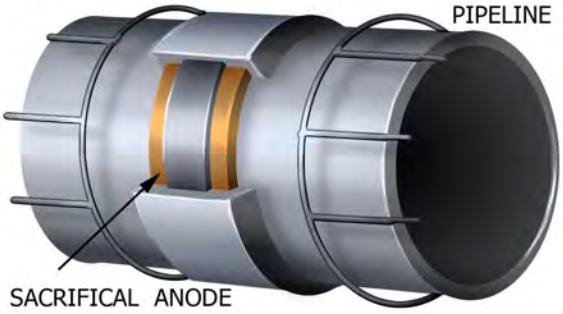
Coating

Materials Engineers can apply a protective coating to the pipeline. This protective coating physically blocks the metal from coming in contact with the environment. This is just like the paint on your bike preventing rust. If the paint on your bike is scratched, the metal underneath may get wet and corrode (rust).

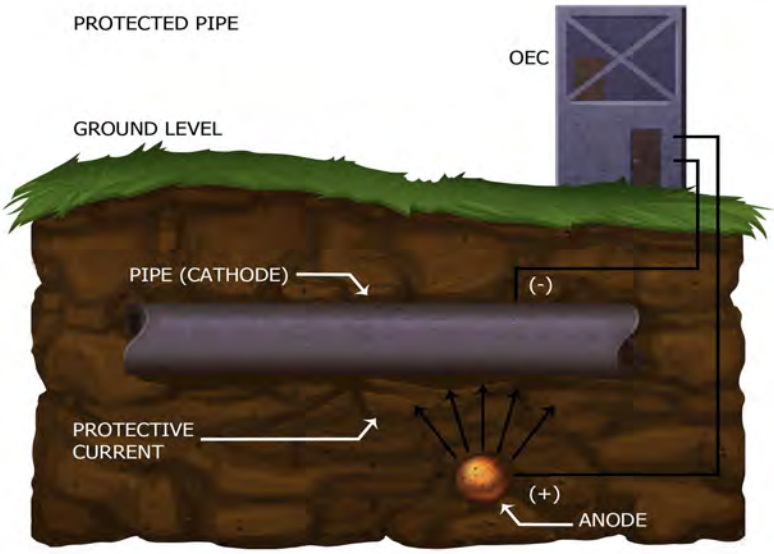


Sacrifical Anode

The pipeline can also be protected from corrosion by using a sacrificial anode. The sacrifical anode is another type of metal that is connected to the pipeline that corrodes more easily then the metal in the pipeline. The more reactive metal sacrifies itself and reacts with the air and water and corrodes. This protects the pipeline itself from corrosion.



Cathodic Protection



Corrosion is an electrochemical process. Introducing a direct current to the pipeline prevents corrosion. The current flows onto the pipe through breaks in the outer coating and protects the bare metal from water and other corrosive agents.

This process called, cathodic protection, is a technique to control the corrosion of a metal surface by making it work as a cathode of an electrochemical cell rather than the anode, where corrosion occurs.

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Monitoring

Even though there are methods to reduce the impacts of corrosion, it is still important to monitor and check the conditions of the pipeline. Pipeline operators use in-line inspection tools called “intelligent pigs” (PIGs) that can detect corrosion, determine the size of dents in a pipeline, and determine changes in alignment of the pipeline. Corrosion detecting pigs use ultrasonic technology which uses high frequency sound waves to detect corrosion and measure the thickness of the pipe wall in a non destructive way or they may use magnetic flux leakage. In this way they can identify potentianl issues before they become a problem.

Inline Inspection Tool

Experimenting with Corrosion

Use this experiment to make your own sacrificial anode.

Materials
- 4 iron nails
- 4 test tubes
- Copper wire
- Zinc wire
- Aluminum wire or aluminum foil

*Note: if you have other materials available try them out to see how they work at preventing rust.

Methods
1. Wrap each nail with one of the metal materials, leaving one nail bare.
2. Place each nail in a test tube filled with water.
3. Make a hypothesis about what will happen.
4. Wait 4 days.
5. Observe the results.
   Was your hypothesis correct?

How do your nails look after 4 days. Is there a difference in how much each nail corrode? This is due to the properties of the metal you attached to the nail. The more reactive your metal is the better protection it will provide for the other metal, your nail.

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