Guidance notes
Optimising corrosion protection

Fact sheet
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Background

Metallic (electrochemical) corrosion requires a positive and negative area with a moisture-bearing electrolyte to allow ionic current flow. This flow causes material loss from the positive area.

Chemical corrosion is mainly an oxidation process that happens when a chemical acidic attack occurs on a material.

Biological corrosion is the interaction of microorganisms in typical chemical corrosion processes.

Cavitation and erosive corrosion is the result of vapour pockets that collapse when the working pressure drops below the vapour pressure

Discussion

Corrosion protection involves the removal or separation of one or more of the elements required for the corrosive action to occur. Corrosion protection is not just the treatment of the inevitable result, there are other improvements that can be made to solve or deter corrosion. Some of these methods include:

- Material selection
- Location selection
- Geometric design
- Treatment of the environment
- Providing barriers (e.g. coatings)
- Redirecting the corrosive action (e.g. cathodic protection

Selecting material

- Material selection must consider the operational performance expectations. For example the internal product being conveyed in pipes. Opting for polymer and plastic type materials don't have electromechanical corrosion problems, however, depending on the type of polymer, are not immune to chemical corrosion. An example of this is the oxidation process in polyethylene that is subjected to high concentrations and/or exposure times to chlorine. This makes the pipe brittle. Exposure of PVC or polyethylene to aromatic hydrocarbons will damage the molecular structure.
- The location of the material in relation to an environment leading to the conditions for corrosion should consider both the macro (the location as whole) and micro (the sub-location with particular exposure conditions) environments. An example of this concept is where a component has been designed to deal with a certain chemical reaction but is located in an area that exposes it to a form of biological corrosion, it is not suitable to the environment or conditions.
- When specifying materials and/or corrosion protection systems for an installation, consideration must be given to operational and access constraints should maintenance work need to be carried out. If these constraints are likely to hamper reapplication of a coating system or maintenance of a device, then a higher specification of corrosion protection needs to be considered..
- Avoid dissimilar materials where galvanic corrosion may occur.

References

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- MS – Material supply standard
- DP-07 – Design for transmission water and wastewater pipeline systems

Other

- NACE International
- World Corrosion Organisation
- Oxidative degradation of HDPE pipes from exposure to drinking water disinfectants (Duvall and Edwards, 2011)
- PE100 – Association Reports No.1995; No.2004.

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Optimising corrosion protection

Reducing the chance of corrosion

- Consider retention times (sewer and water quality)
- Manage atmospheric conditions such as location and exposure to dust, wind, temperature and moisture
- Avoid surface geometry (corners, nooks, and crannies) as it will hold moisture and provide moisture run-off
- Correct sizing of equipment and componentry is a must for flow velocity (cavitation) and pressure
- Prevent physical damage to coatings and surfaces by understanding work spaces and effective positioning of components
- During design, consideration should be given to how construction methodologies may effect materials
- Maintenance and replacement considerations i.e. common equipment and availability

Corrosion protection: barriers and treatments

- Both options have a maintenance component. A long-term analysis of the impact of the protection measures must be considered as part of the asset management design. For some, a very high level of protection is required to minimise or eliminate maintenance until the asset has reached the end of its expected service. This may be in the form of a very high-build barrier system.
- Steel pipes with barrier protection and a cathodic protection system will provide sacrificial deterioration of anodes.
- The treatment of the origin such, as bacteria in a sewer system can eliminate the process that causes hydrogen sulphide gas to form. This approach may reduce the need for barriers.
- Alloy treatment of metals, such as galvanizing to improve resistance against corrosion, is another option.

Component interactions

Galvanic action is a good example of the corrosion than can occur when selecting incompatible metallic components. Such interaction requires a barrier to separate the metals. In some cases, the direction of fluid flow between materials may also cause galvanic action.

To prevent this, protection systems and electrical induction should be considered.

Quality of installations

Corrosion protection is only as good as its installation. For example, a stainless-steel pipe may corrode as a result of steel contamination during the manufacturing process, and a coating system may not stick properly due to poor or contaminated surface preparation.

Useful links:

www.watercare.co.nz/Water-and-wastewater/Building-and-developing/Engineering-standards-framework

www.aucklanddesignmanual.co.nz/regulations/codes-of-practice

http://www.legislation.govt.nz/act/public/2009/0032/latest/DLM2044909.html

References

Other

- Infosteel, guide to protection of steel against corrosion indoor and outdoor structures first edition: May 2012
- Society for protective coatings (SSPC)
- www.corrosionpedia.com

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