Preventing Corrosion Failures of Machinery by Design

Ideally, the corrosion mechanisms and other factors that can affect the reliability of machinery can be anticipated and minimized during the original design process. Nevertheless, system failures and subsequent failure investigations have become increasingly important in our modern societies. Besides liability issues, an important reason for conducting a failure investigation is to identify the mechanism(s) and cause(s) of a problem to prevent its recurrence.

Corrosion engineers are often confronted with a corroded sample taken from an apparatus that has failed. Usually, some stopgap action must be immediately taken so that the apparatus can be returned to service. Decisions must then be made on further action to avoid a recurrence of the failure. Determining which factors were most responsible for the failure often involves planning and conducting a test program under simulated conditions.

To provide the desired functional qualities for the required period of service, a structure should be neither underdesigned (too risky) nor overdesigned (too costly). Thoughtful design requires more than the provision of adequate initial strength. The part or system must also maintain the strength and tolerances to function properly throughout the design life.

Rudiments of Corrosion Failure

Neglecting to identify the underlying causes of corrosion failures and to take corrective action can expose an organization to litigation, liability, and loss of customer and public confidence in its product(s) or services. Such risks are unacceptable in the modern, global, competitive business environment. The term “failure” is defined as “a falling short, a deficiency or lack, an inability to perform.” For the corrosion engineer, the success or failure of a material is defined in terms of how well or poorly it fulfills all of the functional requirements of the application for which it was selected. The use of correct and consistent terminology is a vital part of accurately communicating the information in failure analysis reports.

Conducting a failure analysis is not always an easy or straightforward task. Early recognition of corrosion as a factor in a failure is critical, because much important corrosion information can be lost if a failure scene is altered or changed before appropriate observations and tests are made (e.g., the removal of characteristic corrosion products during cleaning to improve or restore operation). To avoid these pitfalls, certain systematic procedures have been proposed to guide an investigator through the failure analysis process. Ultimately, extensive practical experience with a variety of investigations and solutions is an essential part of the education for a failure analyst.

The depth of the analysis into the root causes of a failure is the key to accurately unearthing all of the factors that contributed to the failure. In considering machinery breakdowns, it is possible to separate these factors into categories:

- Physical roots: the physical reasons why the parts failed
- Human roots: the human errors of omission or commission that resulted in the physical roots
- Management system (latent) roots: the deficiencies in the management systems or the management approaches that allow the human errors to continue unchecked

The more detailed an analysis is, the easier it is to understand all the events and mechanisms that contributed to the root of the problem. This information can form the basis for the design of replacement components or modified operating procedures that will avoid future failures.

Reference


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