

Asset Corrosion Management and the Existing Training Gap

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Successful and effective asset integrity management post-commissioning is based on two discrete disciplines: corrosion engineering and corrosion management. The latter is often neglected because of shortcomings in the training of corrosion engineers. This article explores the potential root causes of this problem and how to address the existing knowledge gap through improved training.

Corrosion engineers are widely employed in the hydrocarbon industry to tackle corrosion and asset integrity issues. While successful and effective asset integrity management should rely on both corrosion engineering (CE) and corrosion management (CM), the latter is often neglected or ignored, mainly because of the existing shortcomings during the training of corrosion engineers both at universities and later in the workplace.

This article explores the potential root causes of such training shortcomings, discusses their implications, and makes proposals on how to overcome such issues by improving the quality and content of training.

The Hydrocarbon Industry and Corrosion Engineers

For the majority of hydrocarbon assets, corrosion poses a major integrity threat. Ideally an asset corrosion management system (CMS) that comprises both CE and CM disciplines should be used to combat and mitigate corrosion. It is often corrosion engineers who are mainly responsible for producing, maintaining, and supervising the implementation of the asset CMS.

In general, the integrity management sector within the hydrocarbon industry (or any other industrial sector where corrosion is an integrity threat) relies heavily on corrosion engineers for successful corrosion prevention and effective asset integrity management.

University vs. On-the-Job Learning

Most corrosion engineers are graduates of various universities where corrosion engineering courses are taught. Such courses often cover topics in the following list. Please note that this is an indicative list covering only the main topics included in such courses.

- Fundamentals of electrochemistry
- Corrosion basics and mechanisms
- Basic metallurgy and alloying systems
- Various corrodents and corrosive environments
- Cathodic protection basics
- Chemical treatments, coatings, and corrosion monitoring

Once a corrosion engineer graduates from such a curriculum and starts working for an operator or service company in the hydrocarbon industry, with responsibility for asset integrity management, he or she will need to be highly conversant with the subjects listed below.

This list is neither exhaustive nor complete, and it is believed that these subjects are included in few, if any, university curricula where corrosion engineering is taught.

- Corrosion failure risk assessment procedure
 - The integrity review process
 - How to split an asset into smaller and manageable units such as systems and subsystems (or corrosion loops)
 - Risk-based inspection
 - Handling, analyzing, trending, and interpreting various inspection and monitoring data
 - Producing inspection scopes
 - Understanding, working with, and using various pertinent national and international standards from such associations as API, NACE International, ASME, etc.
 - Producing asset corrosion management strategy documents and systems
 - Producing corrosion control matrices documents
 - Determining and using corrosion key performance indicators
 - The procedure for identifying, classifying, treating, monitoring, and managing wall thickness anomalies
- The topics included in the first list

could all be incorporated in the CE concept, which is defined as “the design and application of methods to prevent corrosion.”¹ Such topics are mostly associated with the design stage of an asset.

The topics included in the second list, however, are closely associated with the CM concept, which itself is closely linked with the post-commissioning stage in an asset’s lifecycle.

The Existing Training Gap

The comparison of the above two lists reveals a wide training gap in the field of asset integrity management. Most operators or service companies tend to fill this gap by providing mentoring or on-the-job training for their new corrosion engineers by their more experienced and senior corrosion engineers. This approach is based on the assumption that senior corrosion engineers will have enough time to train their new colleagues in an organized, structured, and effective manner and within a certain time frame.

This, unfortunately, is not the case in most instances. The main culprits that deter optimum on-the-job training of new engineers often are:

- The working environment and the work load in the hydrocarbon industry are often such that the more senior colleagues do not have adequate time to properly and comprehensively train their new colleagues and get them acquainted with the basics of CM. It is difficult to conduct CM training in an organized, structured, and progressive manner, in spite of best intentions. In most cases, such on-the-job training can be described as haphazard and random at best.
- The existing confusion between the CE and CM concepts, their principles, and applications.²⁻³ There are

many corrosion engineers who are not very well conversant with the CM concept. For this group of corrosion engineers, CE and CM are an identical concept with similar applications. Therefore, during mentoring they simply and inadvertently transfer the same kind of mentality and approach to their junior corrosion engineer colleagues.

The result for any of the above scenarios will be corrosion engineers who are not at all conversant with the basics of CM in the hydrocarbon industry. This, in turn, will have some grave implications for the hydrocarbon assets and their integrity management.

The Primary and Secondary Implications

The implications of these shortcomings are dire and can be split into primary and secondary ones:

Primary Implication

Because of either the nature of the on-the-job training or the lack of proper appreciation for the CM concept and its applications (by the senior corrosion engineers) or both, the on-the-job training scheme or mentoring is severely flawed. It will produce corrosion engineers with inadequate knowledge, skills, and expertise in the field of asset integrity management.

Secondary Implication

The integrity management for the asset in general or its integrity in particular would continuously and progressively suffer because those in charge of asset integrity management do not have or have not received the proper and adequate training on CM and its applications. This situation is best demonstrated by many assets that are looked after by a corrosion engineer or an asset integrity

management team, but their overall integrity deteriorates over time because of the aforementioned shortcomings and inadequacies. Under such scenarios, assets suffer more progressively from increasing downtime, exacerbating corrosion problems, and increasing inspection, chemical treatment, and maintenance costs. Finally, the increasing risk of failure due to corrosion leads to decreased personnel safety and impaired environmental protection.

The Proposed Solution

To rectify or improve this situation, the following solutions are proposed:

- Universities that offer corrosion engineering courses should incorporate an introduction to asset CM and its basics and applications. This brief introduction should provide the would-be corrosion engineers with the valuable lesson that CM, with its own set of useful applications, is an independent and separate concept from CE. Such university learning should also emphasize the fact that both CE and CM are required to mitigate corrosion successfully and effectively, and achieve asset integrity management post-commissioning.
- Companies that offer on-the-job training should introduce the following changes into their training or mentoring programs:

- Only senior corrosion engineers who are conversant in CM should be elected as training officers or mentors for newly employed corrosion engineers.
- A training framework/template should be produced by senior corrosion engineers that incorporates a scheduled training program encompassing both CE and CM. There should be greater emphasis on CM because of earlier education on CE, with clear and well-defined learning objectives in the field of CM.
- A test or exam should be carried out at the end of the training program to ascertain that the corrosion engineering trainee has become well acquainted with the basics of asset integrity management in general and CM in particular.
- International organizations already involved in corrosion training, research, and education could offer asset integrity management courses that focus on the CM component rather than the CE component, which is often well covered and taught. Such a training course would fill the existing training gap between early university education and inadequate on-the-job training, and provide the overall asset integrity management expertise required to successfully combat and mitigate corrosion.

Conclusions and Recommendations

In spite of the fact that corrosion remains a major integrity threat in the hydrocarbon industry, requiring both CE and CM to tackle it fully and effectively, the CM component of asset integrity management is often missing. This is mainly due to university education and on-the-job training that generally fail to address CM, its significance, and applications in an adequate, structured, and decisive manner. The solution could be an improvement in university and on-the-job training with increased emphasis on the CM concept. Improved CM training could be provided through courses that focus on the role of CM in maintaining and improving asset integrity management for hydrocarbon assets post-commissioning.

References

- 1 D.A. Jones, *Principles and Prevention of Corrosion*, 2nd ed. (1996), p. 5.
- 2 A. Morshed, "Offshore Assets: From Corrosion Engineering to Corrosion Management," *MP* 46, 10 (2007): p. 34.
- 3 A. Morshed, "Corrosion Management for Oil and Gas Assets," *MP* 47, 8 (2008): p. 54.

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