Project Management Institute.
Kingdom of Saudi Arabia

Digital Insights:

Optimizing Flange Design and Coating Techniques for Internally FBE-Coated Piping in Complex Plant Systems

By: FARAJ ALENEZI - ABDULLAH BASSAM

Project Management Institute. Kingdom of Saudi Arabia

Table of Content

Project Management Institute.
Kingdom of Saudi Arabia

ABSTRACT

This paper discusses the challenges associated with installing internally Fusion Bonded Epoxy (FBE) coated pipelines in complex industrial environments and presents practical solutions. One major issue is achieving consistent coating thickness at girth weld joints, where the integrity of the coating is critical to prevent corrosion. Additionally, robotic coating tools often face difficulties in coating these joints in tight spaces. To streamline the installation process, it is proposed to use flanges every 12 meters and at key locations where the flow direction changes, such as elbows and tees. this paper also explores innovative robotic technologies that can improve the efficiency of coating girth weld joints in restricted environments.

INTRODUCTION

Internally FBE-coated pipelines are widely used across industries for their excellent corrosion resistance and long-term durability. However, the installation of these pipelines in complex industrial settings presents challenges, particularly when it comes to coating girth weld joints. These joints are critical points in the pipeline where sections are welded together, and ensuring consistent coating at these welds is crucial to maintaining the pipeline's integrity. In addition, tight spaces can limit the effectiveness of robotic tools designed to coat these joints, further complicating the process.

This paper explores the practical issues encountered in coating internally FBE-coated pipelines, with a focus on girth weld joints. It also proposes several design and installation strategies, including the use of flanges at regular intervals and at locations where the flow direction changes.

Project Management Institute.
Kingdom of Saudi Arabia

UNDERSTANDING THE CHALLENGES

FBE coatings are widely used for their ability to protect pipelines from corrosion in harsh environments such as the oil, gas, and water industries. Despite their effectiveness, certain challenges arise when coating pipelines in confined and complex layouts.

- Surface Preparation for Girth Welds: Proper surface preparation is essential for effective FBE coating, especially at girth weld joints. These areas require a high level of cleanliness and surface profile to ensure proper adhesion of the coating. Achieving the necessary conditions in tight spaces can be difficult, potentially compromising the coating's performance.

- Inconsistent Coating Thickness at Girth Welds: Achieving uniform coating thickness is particularly important at girth weld joints. Variations in thickness at these joints can result in uneven protection, leaving some areas vulnerable to corrosion.

- Robotic Coating Limitations: Existing robotic coating tools often struggle in navigating tight, confined spaces, especially around girth weld joints. These tools may have difficulty maintaining consistent coating coverage, particularly in complex plant systems where access is restricted.

IDENTIFYING THE ISSUES

In recent project, Project team faced several specific challenges while installing internally FBE-coated pipelines in a plant with a complicated piping system. The key issues identified include:

- Surface Preparation Challenges at Girth Weld Joints: Cleaning and preparing girth welds for FBE coating in confined spaces was a significant challenge. Achieving the required surface profile and cleanliness for these joints in tight areas was difficult, affecting the overall coating adhesion.

- Coating Thickness Variability: The application of the coating at girth weld joints showed variability in thickness, which is critical for long-term protection. This inconsistency is a common issue when using robotic tools in complex environments.

- Robotic Tool Limitations: The complex plant layout made it difficult for robotic coating tools to operate effectively around girth weld joints, leading to delays and inconsistent application. This was especially problematic in areas with limited access or sharp directional changes in the piping layout.

PROPOSED SOLUTIONS

To address the challenges of coating girth weld joints and installing FBE-coated pipelines in complex industrial settings, the following solutions were utilized:

1. FLANGE DESIGN FOR SIMPLIFIED INSTALLATION

Installing flanges at 12-meter intervals can simplify the assembly and installation process, particularly in environments where long pipeline sections are difficult to navigate. By using flanges, the pipeline can be broken into manageable sections, allowing for better access to girth weld joints for both surface preparation and coating. In addition, positioning flanges at critical points where flow changes, such as elbows and tees, facilitates easier coating application and maintenance.

PARAMETER	ROBOTIC COATING	USING FLANGES (EVERY 12 M)	REMARKS
Time per Joint (hours)	4 hours	1.5 hours	Robotic tools are slow, especially in tight spaces
Total Time (per 100m)	36 hours	12 hours	Significant time saving with flanges

BENEFIT OF USING FLANGES EVERY 12 METERS

- **Time Savings:** Installing flanges every 12 meters significantly reduces the time required for coating girth welds, as robotic coating is typically slower and more labor-intensive in confined spaces. By using pre-coated spools with flanges, the spools can be fabricated and internally coated in advance, leaving only the final assembly and erection on-site. This streamlines the installation process, saving substantial time compared to the slower robotic coating method for each girth weld joint.

- **Reduced Risk of Coating Failure:** Installing flanges every 12 meters eliminates the need for robotic internal coating at girth welds, bypassing the potential failures often associated with robotic coating. Robotic coating can be prone to errors, especially in confined or complex environments, and any coating failure requires time-consuming repairs. In some cases, this can even necessitate cutting and rewelding the girth welds to reapply the coating, further delaying the project. By using flanges, these risks are avoided, ensuring a more reliable and efficient installation process.

2. INNOVATIVE ROBOTIC COATING SOLUTIONS

Existing robotic coating tools are limited in their ability to coat girth weld joints in confined or complex environments. To improve coating consistency at these critical points, it is essential to develop more flexible robotic tools that can adapt to tight spaces and complex geometries. These tools should be capable of applying uniform coatings, particularly at girth welds, where precise application is essential. Future projects should explore the integration of advanced robotic technologies to enhance the efficiency of coating girth weld joints in restricted environments.

CONCLUSION

The installation of internally FBE-coated pipelines in complex industrial settings presents significant challenges, particularly in terms of coating girth weld joints. Ensuring proper surface preparation and consistent coating thickness at these joints is critical for maintaining the pipeline's integrity and preventing corrosion. To improve the installation process, this paper advocates for the use of flanges at 12-meter intervals and at critical flow-changing points, as well as the adoption of innovative robotic tools for coating application in tight spaces.

Looking ahead, incorporating these design improvements and technological advancements will enhance the reliability and durability of internally coated piping systems, particularly when it comes to ensuring uniform protection at girth weld joints.