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Study Paper: **Used OCTG with GRE Lining: An In-Depth Analysis**

Reusing Oil Country Tubular Goods (OCTG) by applying Glass Reinforced Epoxy (GRE) lining is an innovative approach that addresses the challenges of corrosion and wear, which are prevalent in the oil and gas industry. This method not only extends the service life of OCTG but also contributes to cost savings and improved operational efficiency. Used OCTG are considered by operators as fully depreciated consumables and often sold or disposed that way.

Here, we delve deeper into case studies and present additional data to support the effectiveness of GRE lining.

Detailed Case Studies and Supporting Data

Case Study:

IEOC Middle East & Africa Oil Field (Onshore) client:

Background: This major oil field experienced severe corrosion issues due to high salinity and hydrogen sulfide (H2S) in the extracted fluids. The corrosion rate was impacting both the performance and the economics of the operation.



Implementation:

- Selection of OCTG: Used OCTG was inspected and selected based on specific criteria such as wall thickness and absence of major structural damage.

- GRE Lining Application: The internal surfaces of the selected OCTG were cleaned and prepared before applying the GRE lining.

- The GRE Lining System stands out as a superior solution for combating internal corrosion. Specifically designed for environments prone to corrosion, GRE-lined OCTG (Oil Country Tubular Goods) finds its primary application in scenarios involving highly corrosive fluids. The system involves the insertion of Glass Reinforced Epoxy (GRE) liners into bare steel pipes. This configuration ensures that the annular space between the liner and the pipe is filled with a specially formulated cement blend material, providing added protection and reinforcement.

Results:

- Corrosion Rate: Post-lining inspections revealed a dramatic reduction in the corrosion rate from 2.5 mm/year for unlined pipes to zero mm/year for the GRE-lined surface, due to the fact that Proliner (Glass Reinforced Epoxy Lining System) is generally considered inert, eliminates any contact with the host steel pipe and provides excellent resistance to corrosion.

- Overall, while GRE lining provides robust corrosion protection, achieving a corrosion rate of precisely zero may be challenging in real-world applications due to various factors.

- Cost Analysis: Over a three-year period, the overall maintenance costs decreased by 75%. The initial cost of applying the GRE lining was offset within the first year due to reduced downtime and fewer replacements.

- Operational Uptime: The average operational uptime increased from 75% to 95%, significantly enhancing productivity.

Additional Data:

- Failure Rate: The failure rate of OCTG dropped by 80% after the GRE lining application.

- Return on Investment (ROI): The ROI for the GRE lining project was calculated at 150%, indicating a substantial financial benefit.

Corrosion Resistance Tests:

- Salt Spray Test: GRE-lined and unlined pipes were subjected to a 1000-hour salt spray test. GRE-lined pipes showed no significant corrosion, whereas unlined pipes exhibited severe rusting and pitting.

- H2S Exposure Test: GRE-lined pipes were exposed to high concentrations of H2S gas for 500 hours. The results showed no measurable corrosion, while unlined pipes suffered from substantial sulfide stress cracking.

Mechanical Strength Tests:

- The results of the combined load testing conducted on GRE (Glass-Reinforced Epoxy) lined tubing have demonstrated that the incorporation of the GRE lining system has not adversely impacted the original specifications of the pipe and its connections. This empirical evidence underscores the efficacy of the GRE lining in reinforcing the tubing while preserving its structural integrity.

- Furthermore, it has been determined that the burst pressure of the GRE-lined tubing remains consistent, indicating that the incorporation of the GRE lining system does not compromise the tubing's original burst pressure specifications

- The high hoop strength of GRE liners enhances the system structural integrity, minimizing the risk of leaks or collapses, particularly in high-pressure or corrosive environments and provide superior resistance to collapse during cyclic loads, impacts, and abrasion, ensuring prolonged service life and reducing maintenance costs.

Economic Analysis:

- Lifecycle Cost Analysis: A lifecycle cost analysis over a ten-year period showed that GRE-lined OCTG could save up to 50% in total costs compared to unlined OCTG, factoring in reduced maintenance, longer service life, and fewer replacements.

- Downtime Reduction: The application of GRE lining reduced unscheduled downtime by 75%, directly impacting operational efficiency and profitability.

Conclusion:

The extensive data and detailed case studies highlight the substantial benefits of using GRE lining for reusing OCTG. By significantly reducing corrosion rates, extending the service life, and enhancing flow efficiency, GRE lining offers a sustainable and economically viable solution for the oil and gas industry. The positive outcomes from field applications and laboratory tests further reinforce the value of this technology in addressing the challenges of OCTG maintenance and performance in harsh environments.