

Active Remediation of Crown Corrosion and Under-Deposit Pitting in Ductile Iron Infrastructure

Executive Summary

While traditional ceramic epoxy barriers have long served as the industry standard for protecting ductile iron pipe, they remain passive shields that are fundamentally vulnerable to localized failure once biofilms establish an electrochemical foothold. Royal Coatings introduces a paradigm shift in infrastructure longevity with **Flex 200-GFCU**. This patent-pending, 100% solids epoxy system moves beyond simple barrier protection to provide **active MIC remediation**. While conventional specialty linings act as a static shield, our system terminates the biological electrical circuit entirely, achieving a total kill of the sulfate-reducing and acid-producing bacteria responsible for "crown corrosion" and under-deposit pitting. Engineered for real-world utility, **Flex 200-GFCU** is fully applicable and curable under immersed conditions, allowing for critical maintenance without asset dewatering. By integrating sustained microbial inhibition into a high-build epoxy matrix, this system provides the active biocidal defense necessary to stop the severe localized metal loss that traditional ceramic barriers simply cannot prevent.

Royal Coatings has developed a proprietary **100% solids epoxy-based coating system** with integrated antimicrobial functionality, specifically engineered to mitigate **Microbiologically Influenced Corrosion (MIC)** in demanding industrial environments. The system has demonstrated robust antimicrobial efficacy against key MIC-associated bacterial classes—including sulfate-reducing, acid-producing, and slime-forming—through multiple independent third-party laboratory validations.

The coating system is:

- Fully applicable and curable under immersed (underwater/submerged) conditions
- Patent-pending (U.S. Patent Application No. 18/626,558)
- EPA-registered as an antimicrobial pesticide 10/3/2024
- Characterized by a very low non-ablative leach rate of **0.313 $\mu\text{g}\cdot\text{cm}^{-2}\cdot\text{d}^{-1}$** (ISO 10890)

Durability testing to **NORSOK M-501** standards shows excellent adhesion retention after cyclic aging and long-term seawater immersion (pull-off values ≥ 11.35 MPa post-exposure). Microbiological testing confirms strong to complete inhibition of target organisms relevant to oil & gas, water/wastewater, power generation, and marine applications.



Key Technical Specifications

- Application and full cure possible under fully immersed (underwater) conditions.
- Patent Pending: U.S. Application No. 18/626,558.
- EPA Registration: 10/3/2024
- Non-ablative antimicrobial leach rate (ISO 10890): **0.313 $\mu\text{g}\cdot\text{cm}^{-2}\cdot\text{d}^{-1}$** .

Third-Party Performance & Durability Testing

Testing Laboratory: KTA-Tator, Project No. 410646-A1 **Standard:** NORSOK M-501

Test Description	Standard	Duration/Condition	Pull-Off Adhesion
			Result
Initial Adhesion	ISO 4624:2016	As-applied	11.91 MPa
Cyclic Aging (accelerated weathering)	ISO 20340:2009	4,200 hours	11.35 MPa
Continuous Seawater Immersion	ISO 2812-2:2007	4,200 hours	18.52 MPa

Third-Party Microbiological Efficacy Testing

Louisiana State University (Chen Lab)

- Method: CLSI M07
- Organism: *Staphylococcus aureus* (slime-forming bacteria)
- Result: Significant growth inhibition

Element Materials Technology – Report No. N1001

- Method: Modified ASTM G22
- Organism: *Desulfovibrio piger* ATCC 29098 (sulfate-reducing, anaerobic)
- Result: Complete growth inhibition; **7.64 mm** zone of inhibition

GTI Energy – Report No. 242749 (Bacteria harvested from failed oil pipeline isolates)

- Method: ASTM E2647-20 (qPCR-based)
- Organisms: *Clostridium* spp. and *Acetobacterium* spp. (acid-producing, anaerobic; pipeline failure isolates)
- Result: **93.75%** reduction in maximum bacterial population

Element Materials Technology - 7 Day total kill

- Method: JIS Z 2801 (surface antimicrobial activity)
- Organisms (multi-class):
 - *Pseudomonas fluorescens* (aerobic, biofilm-forming)
 - *Acetobacter aceti* (acid-producing)
 - *Shewanella oneidensis* (metal-reducing)