

Coatings for Corrosion Protection: Offshore Oil and Gas Operation Facilities, Marine Pipeline, and Ship Structures

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Coatings for Corrosion Protection: Offshore Oil and Gas Operation Facilities, Marine Pipeline and Ship Structures

- This workshop of 150 attendees drew participation by internationally recognized:
 - Marine coating experts
 - Material specialists
 - Inspection specialists
 - Coatings manufacturers
 - Maintenance engineers
 - Designers



Coatings for Corrosion Protection: Offshore Oil and Gas Operation Facilities, Marine Pipeline and Ship Structures

- **This workshop was crafted to include multiple view points including:**

- Industrial
- Academic
- Environmental
- Regulatory
- Standardization
- Certification



Coatings for Corrosion Protection: Offshore Oil and Gas Operation Facilities, Marine Pipeline and Ship Structures

- **Workshop is to Assess Opportunities for Research and Development in:**

- Coating Practice
- Coating Materials
- Coating Application
- Repair
- Non-Destructive Evaluation
- Extended Coating Life Prediction



USS Ogden old technology tank coatings after 3years



USS Ogden new technology tank coatings after 6 years

Coatings for Corrosion Protection: Offshore Oil and Gas Operation Facilities, Marine Pipeline and Ship Structures

- **Papers generated during this workshop include:**
 - Keynote
 - Topical Information
 - Discussion Groups



Coatings for Corrosion Protection: Offshore Oil and Gas Operation Facilities, Marine Pipeline and Ship Structures

- **Keynotes and Invited Topical Papers Define State of the Art**
 - To assess current practices and their limitations
 - To discuss field experiences
 - To chart a course for the best corrosion protection methodology
 - Including serving and monitoring



Coatings for Corrosion Protection: Offshore Oil and Gas Operation Facilities, Marine Pipeline and Ship Structures

- **Keynotes and Invited Topical Papers**

- Research and Development of Coatings for Alaska Tanker Company
- Practical Experience to Combat Corrosion on Floating Production Units (FSO/FPSO's)
- Inspection and Repair of Coatings
- Past, Present, and Future “Smart” Protective Coatings
- Risk Assessment and Economic Considerations When Coating Ballast Tanks



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- **Keynotes and Invited Topical Papers**

- Decision Making in Coating Selection in Marine/Offshore Environments
- Corrosion Protection for Offshore Pipelines
- Experience with Coatings for Corrosion Protection from the Norwegian Continental Shelf
- U.S. Navy Ships: Developments and Status
- Single Coat and Rapid Cure Tank Coating Systems



Coatings for Corrosion Protection: Offshore Oil and Gas Operation Facilities, Marine Pipeline and Ship Structures

• Six Discussion Groups:

- To Address Specific Issues Identified
- To Prioritize the Issues
- To Recommend Specific Research and Development Topics for:
 - Government
 - Industry



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Discussion Groups “White Papers”

1. U.S. Shipyard Paint Shops: Current Issues and Future Needs
2. Rationalization and Optimization of Coatings Maintenance Programs for Corrosion Management on Offshore Platforms
3. Coatings for Pipelines
4. Coatings for Port Facilities
5. Near 100 Percent Solids Tank Linings
6. Evaluating the Current State of Inspection Practices for Protective Coatings (In Process and Continued Evaluation) and the Exploration of Opportunities for Improvement of these Practices



Recommendations from the Discussion Groups

- **Research**

- **Quantitative evaluation of the long-term field performance of pipeline coatings.** One project should install coated pipe samples in the field at carefully selected locations representative of different environmental conditions. Several monitoring methods should be used. In addition, the coating performance evaluation should include both consistent and fluctuating temperatures with transient and cyclic temperature fluctuations. A one-day scoping meeting prior to this investigation should be held with good representation of the interested parties.
- **Development of practices for evaluating pipeline coatings for service under extreme conditions** such as: Offshore-deep sea, Offshore-Arctic, Onshore-equator is recommended. These investigations should include three types of coatings: Anti-corrosion coatings, Abrasion-resistant coatings, and Insulation coatings.

Recommendations from the Discussion Groups

- **Research**

- **Development of a non-destructive method of evaluating the application of coating systems.** Programs need to explore the feasibility of thermography, magnetic flux leakage, electrical impedance, and eddy current phase array. Modeling using EIS is not reliable.
- **Development of specific advancements in coating materials.** A project for **non-skid deck coating systems** that will last when applied over less than perfect surface preparations. Parameters that control **coating performance**. Modeling of performance of all coatings (not only FBE). A project should include the evaluation of coatings at higher temperature in the laboratory. Performance of insulation coating should be investigated. Research project to develop coating systems that respond to exposure stresses needs to be performed.

Recommendations from the Discussion Groups

- **Development**

- **Improvement in the effective use of coatings for port facilities and the development of the necessary performance-based specifications. The development of generally accepted design standards and practices for port authorities needs to be established.** These standards and practices need to be beneficial to the owner. Also the program needs to develop generally accepted design standards and acceptances for port facilities. This development may need to be geographically specific such as: blue water specific or brown water specific.
- **Advanced methodologies for applications of coatings.** A project needs to address paint application issues without the use of brushes and rollers to increase productivity, lower costs, and less personnel exposure. The proposed investigation should include concerns of issues such as: curing time compared to burial or immersion time and adhesion of field-applied coatings to mill-applied coatings. An investigation to assess the effects of stockpiling of coating products on pipeline coatings performance including the effect of temperature, ultraviolet light, and time needs to be established. Development of high solid products, which meet VOC requirements that have less tendency to embrittle over time. Develop a mechanism to aid the painter in being able to achieve more uniform film thicknesses with high solid coatings in the field. The use of a capture device at the spray gun versus total encapsulation of the space to be painted should be investigated. Evaluate the need to increase the investment in coating application technology R&D. Establishment of a welding procedure for welding on painted surfaces is recommended.

Recommendations from the Discussion Groups

- **Development**

- **Assessment of new technologies for surface preparation before coating.** This program should include projects on the feasibility of using microwave technology for surface preparation, hand-held x-ray fluorescence system to detect salts on the surface, and a project to improve the dissemination and clarity of information on allowable surface chlorides. Improvement of application equipment to facilitate applying high solid coatings in the field to inaccessible areas. A project investigating the effects of minor variations in surface preparation and effects of variation in composition of surface contamination, including mill scale, on long-term coatings performance is necessary. A project on secondary surface preparation criteria / Standards (example: exceeding the recoat window of an epoxy- Methodology for evaluation) needs to be established. The cost of surface preparation and coating application for underwater hull areas is going up and the designs of coating technology for this area has not kept pace.

Recommendations from the Discussion Groups

- **Administrative**

- **Standardized methodology for data collection and management.** An unbiased third party to compile an industry wide historical data base on pipeline coating performance and evaluate the data critically needs to be established and funded. A program to establish user-friendly standardization needs to be initiated and performed. The program would include a project on the standard/ recommended practices for implementation of inspection for protective coatings projects.
- **Formulation of a roadmap for coatings research and/or development that indicates the proper sequence of projects.** The roadmap needs to be periodically updated by industrial organizations as well as government research agencies and industrial users of coated structures. Such a roadmap would be helpful in prioritizing national and international needs and to assist in obtaining the necessary funding. The roadmap program will need to be annually updated by NACE International and SSPC (The Society for Protective Coatings).

Recommendations from the Discussion Groups

- **Administrative**

- **A working group, national or regional, to increase exchange of information on the performance of coating products and application.** The working group can formulate through user conscience new performance based specifications, design standards, and practices for port facilities. There already exists the working structure for such a working group in the existing coating and corrosion societies. It needs an initiator. (Note: Loosely exists at SSPC).
- **Evaluation of the economic issues of coating materials, their application, and their service behavior.** A specific project on the study of the measurable economic contribution of the inspection of coatings project successes and performance needs to be performed. A project to study economics of coating technology to suggest and recommend the most cost effective use of the present technology should be implemented. The issue is that use and deployment of new coating technology is hampered by high cost of new equipment. Look into what can be done to utilize existing equipment; lower the cost of new equipment; or provide the financial incentives needed. Consumer and coating industry feedback loop needs to be improved. Problems are generally reported and investigated; however, successful applications rarely are investigated to confirm good practice.

Recommendations from the Discussion Groups

• Operations

- **Advanced methods for coating repair.** This program should include a project on standards for quantification of performance and repair criteria and a project to quantify the effect of "repairs" on newly installed coatings system's performance.
- **Training, education, and certification of painters, corrosion engineers, and inspectors in the marine and pipeline industry.** Develop a certification and training program for painters in the marine industry. Help develop an engineering technologist degree / vocational training program for coating specification. Guidelines/Practices/Standards for evaluating In-Service Coatings and the training of Coating Survey Inspectors, with focus on Inspection and Evaluation of In-Service Coatings and tools for evaluation needs to be organized. A special program for educating Coast Guard and MMS inspectors to establish consistency with the offshore industrial standards. Development of a hiring program offering training and certification plus weekly pay, which would have an impact on safety, employee morale, and salary.

Recommendations from the Discussion Groups

• Operations

- **Development of coating/corrosion assessment criteria and acceptable corrosion levels** for use by corrosion engineers and regulators in the development and assessment of Asset Integrity Management Programs. Development of a criteria for determining the most cost effective maintenance effort and tools to quantify: coatings age and degradation, ability to apply over-coatings, and consistent evaluation needs to be established.
- **Address the environmental and health and safety issues regarding paint materials and their application.** A project for the determination of the effects of environmental conditions and variations in coating procedures on the performance of field-applied pipeline coatings needs to be instituted. A project on the development and research of environment tolerant coatings that can be used year round with increased quality. The development of pipeline coatings with anti-microbial properties. This development must achieve coating acceptable ecological concerns.

Pipeline Papers

#1 Corrosion Protection for Offshore Pipelines

By Ernest W. Klechka, Jr., P.E.
CC Technologies, Dublin, Ohio

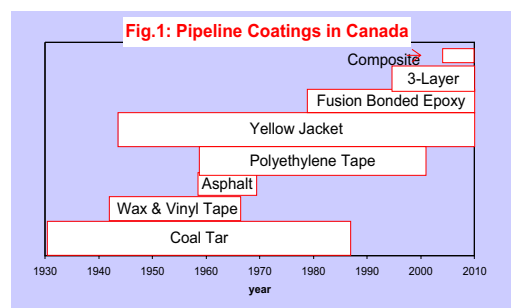
- Corrosion Control - Integrity Management
- Evaluation of Corrosion Potential
- Coating Selection
- Design Considerations
- Cathodic Protection Design
- Monitoring and Inspection



Pipeline Papers: Discussion Group Paper

#2 Coatings for Pipelines

By S. Paapavinasam and R. Winston Revie
CANMET Materials Technology Laboratory
Ottawa, Ontario, Canada



Pipelines Paper: “Coatings for Pipelines”

Identified Research Needs and Opportunities

- Consolidation of laboratory methods to develop generic tests, leading to specific test methods for specific coatings, should be considered.
- A comprehensive model to predict long-term performance of coatings should be developed based on carefully controlled laboratory experiments as well as from field experience with older coatings, such as coal tar and asphalt, and modern coatings, such as FBE and urethane, using the power of modern computers and intelligent systems, e.g., artificial neural networks.
- Based on a systematic study, the temperature limits of existing tests should be explored, and tests to evaluate products for elevated temperature applications should be developed.

Pipelines Paper: “Coatings for Pipelines”

Identified Research Needs and Opportunities

- Whereas many of the issues of mainline coatings are well understood and standards for mainline coatings have been developed, there is now a need to focus on field applied coatings, both repair and joint coatings.
- The effects of minor variations in surface preparation on long-term coatings performance need to be established.
- Relationship between application temperature and coating performance needs to be established.
- Influence of stockpiling on coating performance should be established.

Pipelines Paper: “Coatings for Pipelines”

Identified Research Needs and Opportunities

- A systematic study on the effects of field conditions and variations of procedure during the application of joint coatings, including the field performance of the coating, is recommended. This study should include the cohesive and adhesive strength of joint coatings.
- Realistic backfill impact testing that includes a method to evaluate the compaction produced by backfilling should be carried out to determine the effect of backfilling on coating performance.
- Focused effort to understand soil forces (both physical and chemical) on coating performance will provide useful information for developing strategies to protect coatings.

Pipelines Paper: “Coatings for Pipelines”

Identified Research Needs and Opportunities

- Recommended practices for evaluating coatings for northern pipelines need to be developed and incorporated in standards.
- Tests to evaluate repair coatings, including evaluation of cohesion within the repair coating and adhesion to the mainline coating and to steel pipe, should be developed.
- Development of a remote, accurate monitoring technique to evaluate the status of the coating (including the shielding effect) will greatly enhance pipeline integrity and decrease the number of pipeline incidents caused by corrosion.

Pipelines Paper: “Coatings for Pipelines”

Identified Research Needs and Opportunities

- Development of an industry-wide coating database to share the experience of older and modern coatings is an essential logical step to develop an integrity management program. Continuous updating and sharing of such a database will be very useful.
- The performance of coatings should be compared at constant and fluctuating temperatures.
- An objective study to develop a method that monitors microbial population and coating biodegradation will clarify the effects of microbes on coatings.