

Fingerprinting Forum Rapporteurs Report

COATINGS FINGERPRINTING TASK FORCE FORUM NO.2

Date	11th October 2013
Time	2:30pm - 6.00 pm
Venue	Tanjung Puteri Golf Resort, Pasir Gudang, Johor.
Jointly organised by	IMM Polymer Committee & IMM Coatings Committee.
Co-organized by	Malaysian Offshore Contractors Association (MOCA) & IMM Southern Chapter.
Participants	105 representatives from Hempel, Shell, Petronas, MMHE, KCC Paint, Jotun Paint, Kansai Paint, PPG, MOCA, ETC-CP, Sea Horse Service, UiTM, UKM, UTM, (Revision needed)
Co-sponsored by	1. Hempel (M) Sdn. Bhd. 2. Kansai Coatings Malaysia Sdn. Bhd. 3. Research Instruments Sdn. Bhd.

Introduction

Many years ago, the Oil & Gas industry discussed the idea of establishing a QA/QC system to check on the quality of polymeric paints supplied to the oil & gas industry. There were concerns regarding the cost reduction initiatives - that paint manufacturers may supply "cheapened formula" products labeled as the actual high quality products which was approved by the oil companies. Scientific testing technologies were not available then for the protective coatings to be "fingerprinted" like metals & alloys, which can be checked against its mill certificates obtained via spectrometers and in-house laboratory QC tests. The idea naturally died off. It is believed that the oil & gas industry continues to be plagued with supply of non-conforming protective coatings due to fierce price competition. Material testing technologies have advanced exponentially over recent years that it may be possible for polymers to be "fingerprinted" in the near future.

This was the second in the series of such forums, as the initiative towards "Fingerprinting" technology for polymeric coatings will require many rounds of discussion amongst interested parties. The forum is aimed at dispelling the notion that there is no way to fingerprint the polymer coatings on the steel structures & pipelines in oil and gas industry. The first Forum of "Towards Fingerprinting of Polymer Coatings" held on 22th March 2013 by Institute of Materials, Malaysia (IMM), had sent out the clear message that there are ISO standards for fingerprinting of the polymer coatings and most importantly, the users are urging the paint manufacturers to provide "Mill Certificates & QC test reports" for the products supplied in order to ensure conformity of the approved specifications.



This forum was attended by 105 participants from the oil companies, fabricators, paint manufacturers, blasting & painting contractors, scientific instrument specialists, academicians, paint suppliers, researchers and university students.

Summary of the presentation sessions:-

Speaker 1	Prof. Dr. Mohamad Kamal Harun, Universiti Malaysia Kelantan and Universiti Teknologi MARA
Topic	Chemical Analysis Approaches in Polymeric Coating Identification

The objective of this presentation is to provide the audience with knowledge of the components of an epoxy coating in regard to the resin, additives, solvents and curing compounds. The presentation is aimed at providing information on the many possible types of components of an epoxy coating ranging from a lower quality grade to a higher quality grade component. In essence, this presentation



will highlight that an epoxy coating can have many grades of formulation and yet look and smell the same, even though the quality is different. In other words, like stainless steels, they all look alike and unless there is a method of scientific fingerprinting the product, one cannot tell if the product is the same as its original formulation.

The speaker introduced basic paint constituents and elaborated possible mechanisms of paint failure. He mentioned that the main challenge to overcome coating failure is to improve/increase polymer ionic resistance. Study shows that out of six properties of good quality paint, five are closely related to the properties of binder as follow:

- Good wetting properties (binder)
- Good adhesion on wet or dry substrate (binder)
- Low H₂O, O₂ and ionic permeability (binder)
- Minimize internal stress
- Good neutralization of chloride and sulfate salts (binder)

- High electrical resistivity to isolate cathode and anode (binder)

He described on basic principles of FTIR by giving some example how IR spectra can differentiate polymer products with different chemical components/functional groups. He also concluded his presentation stating that there is possibility to fingerprint a basic polymeric resin using FTIR and the data may help purchasers to determine the quality of products received.

Speaker 2	Mr. Frankie Chua Cheng Huat , PLC Laboratory Sdn. Bhd.
Topic	Production and Quality Control of Paint

The objective of this presentation is to highlight to the audience that the paint manufacturers carry out batch quality control testing on every batch of products produced in their factory on a daily basis. Thus, every batch of paint manufactured has its own batch quality control test report containing results of density, viscosity, hardness, opacity, pigment-volume-concentration, volume solids, thixotropy, etc. Such test results can be provided by the paint manufacturers to their customers at no extra costs as they are part of the batch QC tests conducted daily. Currently, paint manufacturers do not provide such QC test reports to their customers. These test results can be part of the fingerprinting document in addition to the FTIR results. The FTIR or other spectroscopic testing will be a new QC process for the paint manufacturers and the costs of such tests can be determined from the cost of the equipment amortized over the life of the equipment against the number of tests to be conducted over its lifetime. The paint manufacturers' existing technical staff can be trained by the equipment suppliers on how to operate the equipment while the paint manufacturers' chemists can be trained to interpret the results.

The speaker introduced paint basic compositions (as listed below) that are blended homogeneously

- Solvent/water
- Resin/binder – binds all elements in the product and provides adhesion to substrate
- Fillers/pigments
- Additives – in small quantities to achieve certain traits of the product

He shared on the paint manufacturing process flow and testing conducted throughout the manufacturing process. Physical properties, including specific gravity, density, rheology, opaque, and colour, are the main concern in the paint production currently. Rejected batches may be subjected to further formulation adjustment to achieve the acceptable criteria for intended purpose. He concluded that every course of production is checked for quality assurance and goes through standard quality assessments

Speaker 3	Mr. Muhd Hawari Hassan, PETRONAS GTS Dept
Topic	Qualification for New Maintenance Painting System and Products for Offshore Application

The objective of this presentation is to highlight to the audience that despite so much attention being emphasized on the surface preparation and QC inspection, the

number and degree of paint failures in the Oil & Gas industry continues to be a serious & costly issue. In the 1970s & 80s, the blame for paint failures fell primarily on the blasters & painters who are from low education background. So, the painting industry conducted training & certification programs for the blasters & painters as well as Paint Inspectors to improve quality control. Blasters and painters were blamed for not consistently achieving good blasted surfaces to minimum SA 2.5 quality. Nevertheless, paint failures continue to plague the industry. So, in the 1980s, the Steel Structures Painting Council (SSPC-



USA) promoted an initiative to paint manufacturers to research & develop surface-tolerant coatings. The major paint manufacturers such as International Paints, Ameron, PPG, Hempel and Jotun developed surface-tolerant epoxy coatings which performed excellently on not-so-well prepared surfaces such as SA 2 quality or lower quality standard. Such surface-tolerant epoxy coatings exhibited performance of more than 10 years on not-

so-well prepared surfaces. Then, in the 1990s, due to stiff competition amongst the paint manufacturers, paint failures became common again. The Oil & Gas companies in Malaysia and other countries focussed on training and certification of blasters & painters again. In Malaysia, the IMM Blaster & Painter Certification Scheme was specified by Petronas in their Petronas Technical Standards (PTS) for Painting in 2000. At that time, IMM proposed to establish a "Mill Certificate" for the coatings as well but due to lack of available spectroscopic testing technologies, the idea was abandoned.

The speaker started his presentation by explaining real-life situations of how corrosion on offshore oil-rig topside facilities has been devastating with some coatings failing after six months of application. Due to this issue, PETRONAS has looked into application and surface preparation of external coating extensively to resolve one aspect of this problem. PETRONAS is looking seriously into coating issues and trying to cover all possible aspects. Since 80's, PETRONAS has looked into surface preparation and application and even now they are deliberating possible ways of minimizing failures arising from surface preparation and coating application. Aiming at effective, best solution for reduction of downtime, in-service application and flexible technical requirements for better result, PETRONAS GTS with collaboration from SIRIM and Petronas Carigali have encouraged paint manufacturers to propose new methods/options in coatings technology which can perform better and reduce maintenance cycles.

To compliment this effort, the Speaker highlighted that Fingerprinting using FTIR or other spectroscopic technologies is a serious consideration by PETRONAS to ensure the product received is as per specification.

Speaker 4	Ms. Renee Teo Yong Yin, Research Instruments Sdn. Bhd.
Topic	FTIR Application in Coating Industry.

The objective of this presentation is to demonstrate to the audience that FTIR method can be used successfully to

provide a fingerprint for polymeric materials such as paint. There had been concerns that the FTIR method will be a tedious, time-consuming and complicated method requiring highly skilled technicians and chemists to conduct the test and interpret the results. There had also been concerns that the results will not be reproducible and accurate. There were also concerns that the equipment will be bulky and expensive.



The speaker started her presentation by briefly introducing the components of a paint. She explained how FTIR can identify paint contents by looking at few parameters from the spectrum, such as intensity, absorbance peaks, and wavenumbers. FTIR is possible for fingerprinting of raw material identification and even can be used for QA/QC and failure analysis. With current technology, FTIR is

a good tool for identification which takes minimal time consumption and high repeatability. The new sampling technique which is ATR (Attenuated Total Reflectant) sampling technique sounded amazing to the audience. ATR sampling technique needed hardly any sample preparation before analysis, fast cleaning steps and has the benefit of low maintenance cost. She concluded the presentation with a demonstration of fingerprinting of primers and hardeners as well as finished goods of epoxy coatings. The demonstration session successfully showed to all participants how the FTIR instrument can generate IR spectrum within a minute with high repeatability and minimum sample preparation. The identification of the raw materials and detection of the different grades of end product had caught audience's attention. The audience was keen to know more about the capability of FTIR.

Speaker	Ms. Nurul Asni Mohamed, Fingerprinting Task Force Chairman
Topic	Taskforce Update on Coatings Fingerprinting



The objective of this presentation is to inform the audience of the progress of the Fingerprinting Task Force activities since its formation in April 2013 after the 1st Forum was initiated by IMM in March 2013 and the roadmap of the Task Force to complete its task and implement the Fingerprinting requirement for the industry. The Task Force had held a number of meetings which included practical sessions

using the FTIR equipment to conduct tests on various paint samples to determine the sample preparation time, test time, results reporting time, accuracy of the results, reproducibility of the results, differentiation of results of different test samples, and identification capability. The Task Force also looked into the costs of the equipment, its operating costs and also availability of portable equipment for in-situ testing on-site. The Task Force will eventually establish a Fingerprinting Template which will contain all the essential QC elements required for the "Fingerprint" of a paint product.

The speaker informed on the establishment of the Fingerprinting Task Force Team that will look up into the fingerprinting implementation. The Task Force team is still

discussing the scope of tests to be included and testing methods. The milestone and deliverables were explained which is looking at pilot execution in 2014 and possible deployment in 2015. The first draft of the Fingerprinting "Mill Certificate & QC test report" (Template) was presented to the audience.

Q&A Session



Q1. Ir. Max Ong (IMM) asked the presenters whether FTIR spectra can tell the difference between a low quality and a high quality epoxy. Prof. Dr. Kamal Harun explained that FTIR can only differentiate the different type of epoxy, in term of chemical functional groups, instead of the cost or quality.

The Task Force Committee will review the availability of technical libraries of low grade and high grade epoxy resins in the industry. Such libraries will provide useful reference for the industry to conduct quality assurance and failure analysis studies.

Q2. Mr. Frank Wright from Sabah Shell PC raised the concerned about where the fingerprinting is going to be deployed and can this FTIR method define the minimum-maximum range or envelope that can be adhered to. Ms. Nurul Asni explained that the task force committee, comprising paint users including the PSCs, manufacturers and academics, are still discussing the scope of deployment and the acceptance criteria of the test.

The Task Force Committee will initially establish the quality requirements for the production of paints in the factory similar to the Mill Certificate requirement for metal products which is a quality document produced by the steel mill during the production of its product in the factory. In-situ site quality analysis using advanced FTIR equipment will be considered subsequently.

Q3. A paint manufacturer representative asked about the quantity/frequency of the products in normal production to be analysed for the fingerprinting purposes? Ms. Nurul Asni answered that the fingerprinting has yet to be implemented and it is in plan for deployment in the near future and the plan is to have every batch of production to undergo the tests.

The Task Force Committee recommends that every batch of production shall be tested and provided with the Fingerprinting Birth Certificate.

Q4. Dr. Chan Chin Han from IMM asked the presenters about the current practice whether there are any certification/documents to ensure products supplied are as per contract spec. Ms. Nurul Asni explained that currently the paint manufacturers provide a Certificate of Quality without fingerprinting information when they supply the paint to the site. As such, currently, the customer has no means to identify if the product supplied is the product ordered in terms of product formulation and quality.

The Task Force Committee intends to finalize the format of the Fingerprinting Birth Certificate and present it

during the next Fingerprinting Forum scheduled in June 2014 in Kuala Lumpur.



Q5. Dr. Chan Chin Han also asked the opinion from Mr. Muhd. Hawari about how beneficial a fingerprinting certificate in quality control and monitoring between different supplied paints will be for PETRONAS and other oil companies. Mr. Muhd Hawari explained that, with current practise, sampling/audit can be done anytime according to the clause listed in PTS to check

on the quality of a paint product should there be failures on a project during application. The supplier will be blacklisted if they failed the audit. However, he acknowledged that only physical tests can be conducted on the product supplied and the current testing methods cannot fingerprint the product to its original formulation.

The Task Force Committee will identify all the necessary physical, chemical and spectroscopic testing methods to be conducted by the paint manufacturers for every batch of production and discuss them during the next Forum.

Q6. A paint manufacturer's representative raised the concern about revealing of the paint formulation if paint fingerprinting is implemented. Dr. Chan Chin Han from IMM explained that it is not the intention of Fingerprinting to intrude into the paint formulation. The paint manufacturers' product formulation will remain a secret as FTIR analysis will not be able to expose the product formulation. FTIR will be able to match a graph of the newly produced product to the original product with an accuracy of >90%.

The Task Force Committee assures paint manufacturers that the Fingerprinting initiative is not aimed at identifying the secret formulation of the paint product. Fingerprinting test methods will offer customers with quality assurance that what they bought is what they will get, even though they cannot know what are inside the product formulation.

Q7. Mr. Mohd Asyraf from MMHE raised a concerned about the price factor in securing a project and how does the implementation of fingerprinting assist the paint manufacturer. Dr. Chan Chin Han explained that the fingerprinting is for quality assurance. It should be viewed as an initial investment of a project. Ir. Max Ong highlighted that the 2 equipment suppliers (Research Instruments and Agilent Technologies) have indicated that the laboratory-scale FTIR equipment costs around RM100,000.00-RM150,000 while the portable FTIR unit costs slightly more and the equipment can perform for 10 years. When amortized over 10 years in a paint manufacturing factory which produces say, 2 batches of 1,000 litres of paint each day (average of 40 batches a month = 40,000 litres a month i.e 4.8 million litres in 10 years), the cost of the FTIR testing equipment works out to be 3 sen per litre of paint produced, excluding the costs of operation, consumables & maintenance.

The Task Force Committee acknowledges that the FTIR testing costs may vary from one paint manufacturer to another due to the volume of products manufactured in a year. Nevertheless, the major reputable paint manufacturers of high quality products with the larger volume of production will have a very insignificant increase to their production costs. The impact will be higher on the smaller paint manufacturers who do not produce the higher quality products. The Task Force Committee will also embark on initiatives to offer training programs for operations and interpretation of the FTIR equipment through the IMM so that the currently-employed staff of the paint manufacturers can be trained to carry out their new job scopes.

Q8. Mr. Sumardi from Sarawak Shell asked about who should be the body to prepare the Birth certificate and whether there will be monitoring by a third party. Ms. Nurul Asni answered that the actual implementation is yet to be finalized.

The Task Force team will discuss on the mechanism of implementation in the forthcoming meetings. The 3rd Fingerprinting Forum scheduled in July 2014 will highlight further progress of the Task Force towards implementation of the Fingerprinting exercise. The Fingerprinting process shall follow the practice of the metals industry for the Mill Certificate where the manufacturer takes the responsibility to prepare the Mill Certificate for the product manufactured in their factory. The customer has the right to conduct a third-party quality control inspection in the manufacturer's factory to ensure compliances.



Q9. Dr. Chia Chin Hua, the forum chairperson, asked opinion from Mr. Muhd Hawari about the usefulness of FTIR fingerprinting of polymer coating materials in the supplier selection process. Mr. Muhd Hawari explained that the selection is carried out in many angles; among others are application methods and product quality. Having

FTIR, it will play its role in the later process of the purchase and may as well impact the selection process.

The Task Force Committee will establish Fingerprinting specifications for the Oil & Gas industry to adopt for their paint products pre-qualification and selection process. Such a specification will assist the oil & gas industry to improve its quality assurance program in ensuring the effective corrosion protection of its facilities onshore and offshore in severe corrosive environments. It will also ensure that the quality of the anti-corrosion paint products supplied throughout the qualification period will not be compromised and changes to the product quality can be detected prior to application.



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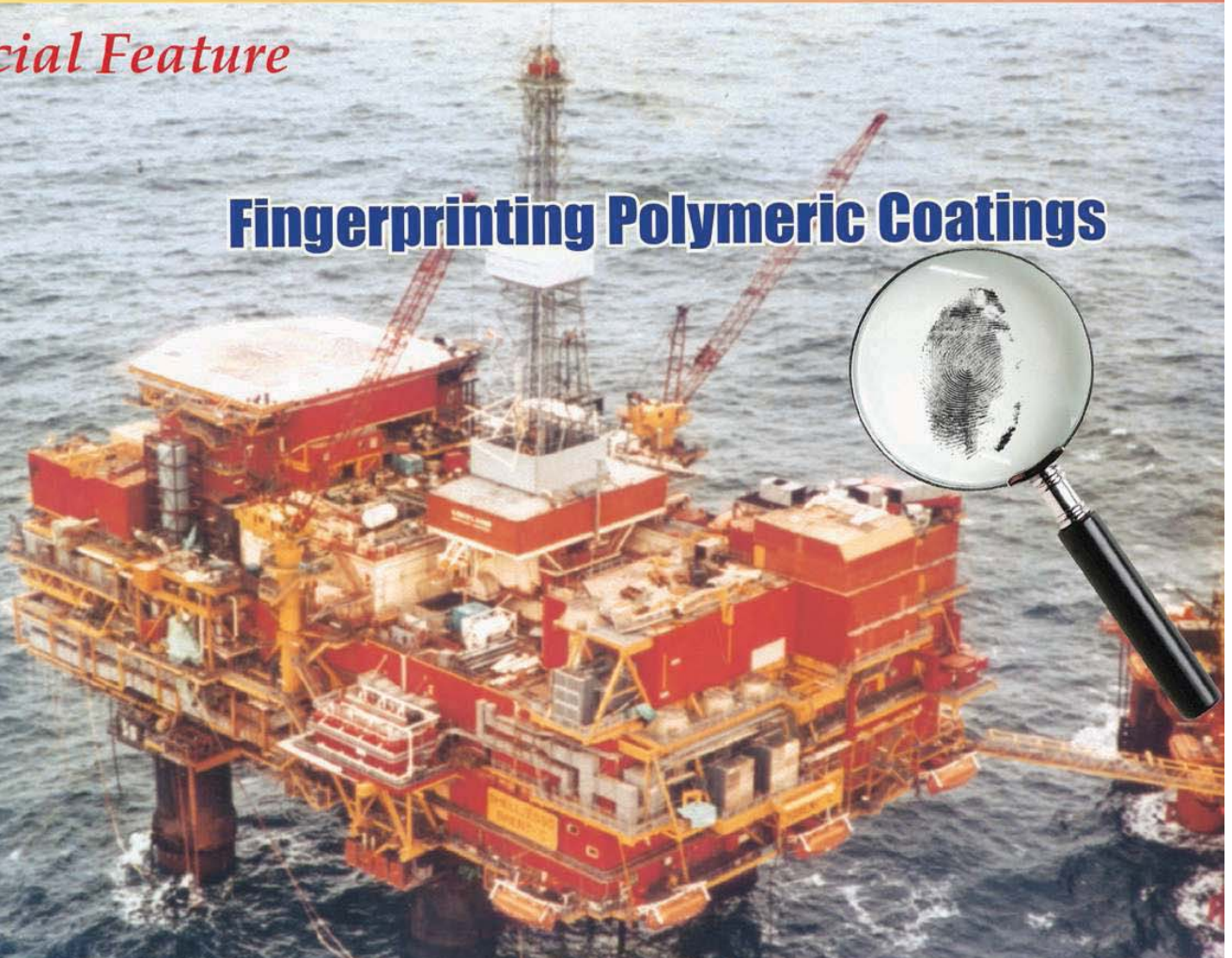
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Cover Story

IMM and PETRONAS have initiated Fingerprinting of Polymeric Protective Coatings supplied to the Oil and Gas Industry in a same way as Mill Certificates for metals.

Guideline for submission of articles (Academic papers as well as Industry technical papers) can be downloaded from www.iomm.org.my