For Members Only
Issue 7

MATERIALS MIND

April - June 2014

www.iomm.org.my

Institute of Materials, Malaysia

HIGHLIGHTS

IMTCE2014

IMTCE2016

IMM COURSES

COATINGS COURSES	DURATION (DAYS)
▪ Diploma of Applied Science (Coatings Technology)	10
▪ Thermal Spray Coatings Inspector	4
▪ Coatings Inspection Certification Scheme (L2)	4
▪ Coatings Quality Control Technician (QC)	4
▪ Blasting & Painting Supervisor	2
▪ Marine Painting Inspection	3
▪ Corrosion Control by Protective Paint	2
▪ Thermal Spray Coatings Applicator (TSA)	2
▪ Protective Coatings Technician Certification Scheme (C3)	4

WELDING COURSES	
▪ Welding Inspection Scheme	5
▪ Associate Welding Engineer (JWES) *	7
▪ Welding Engineer (JWES) *	7
▪ Senior Welding Engineer (JWES) *	8
▪ Common Welder Certificate Scheme	1
▪ Calculation of Strength of Welded Members	1
▪ Cost & Estimation of Welding Projects	1
▪ Interpretation of Weld Quality by Welding Codes	1
▪ Interpretation of Weld Quality by Radiographic Method	1

CORROSION COURSES	
▪ Corrosion Control by Cathodic Protection	2
▪ Cathodic Protection Technologist	4
▪ Corrosion Technician	4

VIBRATION SPECIALISTS

▪ Level 1 - 4

COURSES AVAILABLE UPON REQUEST	
▪ Blasting & Painting Course Training	5
▪ Welding – SMAW, GMAW, GTAW (1G - 6G)	5
▪ API-570 Piping Inspector API-510 Pressure Vessel Inspector API-653 Above Storage Tank Inspector	
▪ Microbiologically Influenced Corrosion (MIC) Management of MIC	2
▪ Welding and Joining Technology for Non Welding Personnel	1

INSTITUTE OF MATERIALS, MALAYSIA

No 10-1, Jalan Bandar 3, Pusat Bandar Puchong,

47160 Puchong, Selangor Darul Ehsan, MALAYSIA

Tel: +603-5882 3574 Fax : +603-5882 3524

Website : www.iomm.org.my

Email : admin@iomm.org.my

MATERIALS TECHNOLOGY EDUCATION SDN BHD

No 10-1, Jalan Bandar 3, Pusat Bandar Puchong,

47160 Puchong, Selangor Darul Ehsan, MALAYSIA

Tel: +603-5882 3574 Fax : +603-5882 3524

Website : www.mte.com.my

Email : admin@iomm.org.my

MATERIALS MIND
April - June 2014 Issue 7

Contents

INSTITUTE OF MATERIALS, MALAYSIA
No 10-1, Jalan Bandar 3,
Pusat Bandar Puchong, 47160 Puchong,
Selangor Darul Ehsan,
MALAYSIA
Tel: +603-5882 3574
Fax : +603-5882 3524
Website : www.iomm.org.my
Email : admin@iomm.org.my

2014 - 2016 IMM COUNCIL MEMBERS

Advisor:	Datuk Ir. (Dr) Abdul Rahim Hj. Hashim - Universiti Teknologi PETRONAS
President:	Prof. Dr. Mohamad Kamal Harun - Universiti Malaysia Kelantan/UiTM
Dep. President:	Ir. Mohd. Azmi Mohd. Noor - PETRONAS Asset Integrity Dept.
Hon. Secretary:	Ir. Abd Razak Abu Hurairah - Morecap Sdn Bhd
Hon. Treasurer:	Ir. Mohd Suradi Yasin - Materials Technology Education Sdn Bhd
Imm. Past President:	Dato' Dr. Ong Eng Long - Kossan Rubber Industries Bhd
Council Members:	Dato' Ir. Mohd Jai Suboh - Velosi Sdn Bhd
	Datuk Ir. Wahiruddin Wahid - PRA Services Sdn Bhd
	Prof. Dr. A. S. Md. Abdul Haseeb - Universiti Malaya
	Prof. Dr. Esah Hamzah - Universiti Teknologi Malaysia
	Prof. Ir. Dr. Ramesh Singh - Universiti Malaya
	Assoc. Prof. Dr. Chia Chin Hua - Universiti Kebangsaan Malaysia
	Assoc. Prof. Dr. Melissa Chan Chin Han - Universiti Teknologi MARA
	Assoc. Prof. Dr. Rajkumar Durairaj - Universiti Tunku Abdul Rahman
	Dr. Andrew Spowage - Woodgroup Intetech Malaysia
	Dr. Hasnah Abdul Wahab - SIRIM
	Dr. Karen Wong Mee Chu - Universiti Tunku Abdul Rahman
	Dr. Tan Winie - Universiti Teknologi MARA
	Ir. Dr. Edwin Jong Nyon Tchan - Jurutera Perunding Akal Sdn Bhd
	Ir. Lai Kah Chung - PETRONAS RAPID Project
	Ir. Lee Swee Eng - KNM Group Bhd
	Ir. Max Ong Chong Hup - Norimax Sdn Bhd
	Ir. Mohd Raziff Embi - Malakoff Corporation Bhd
	Ir. Pau Kiew Huai - PETRONAS GTS Dept
	Bernard Maxmillan Sim - Bureau Veritas (M) Sdn Bhd
	David Lim Chee Cheong - Independent Consultant
	Halimah Pit - Shell Malaysia
	Harry Woon Tar Woi - Bredero Shaw (M) Sdn Bhd
	Maimunah Ismail - Materials Consultant
	Eur. Ing. Nigel Brewitt - Norimax Sdn Bhd
	Nurul Asni Mohamed - PETRONAS GTS Dept

Working Committee Chairpersons:

Advanced Materials	Dr. Chen Kar Pin* - Universiti Tunku Abdul Rahman
Biomaterials	Prof. Ir. Dr. Mohd Rafiq Dato' Abdul Kadir* - Universiti Teknologi Malaysia
Book Publications	Assoc. Prof. Dr. Chia Chin Hua - Universiti Kebangsaan Malaysia
Coatings	David Lim Chee Cheong - Independent Consultant
Education	Ir. Max Ong Chong Hup - Norimax Sdn Bhd
Golf	Ir. Pau Kiew Huai - PETRONAS GTS Dept
Green Materials	Prof. Dr. Saifollah Abdullah* - Universiti Teknologi MARA
IMTCE2016	Assoc. Prof. Dr. Melissa Chan Chin Han - Universiti Teknologi MARA
Journal Scopus Indexing	Dr. Valliyapan David Natarajan - Universiti Teknologi MARA
Magazine Publications	Ir. Max Ong Chong Hup - Norimax
Materials & Asset Integrity	Mohd. Azmi Mohd. Noor - PETRONAS Asset Integrity Dept
Materials Competitions	Prof. Dr. Esah Hamzah - Universiti Teknologi Malaysia
Memberships	Mohd. Azmi Mohd. Noor - PETRONAS Asset Integrity Dept
Nanomaterials	Dr. Azmi Idris* - SIRIM
Polymer	Assoc. Prof. Dr. Melissa Chan Chin Han - Universiti Teknologi MARA
Student Chapters	Eur. Ing. Nigel Patrick Brewitt - Norimax Sdn Bhd
Vibration	Noor Hisham* - UTM/PJSB
Welding	Ir. Dr. Edwin Jong Nyon Tchan - Jurutera Perunding Akal Sdn Bhd
Corrosion & Materials Degradation	Halimah Pit - Shell Malaysia
Examination, Certification & Accreditation Panel (ECAP)	Assoc. Prof. Dr. Rajkumar Durairaj - Universiti Tunku Abdul Rahman
Industry-Academia Collaboration Panel	Prof. Ir. Dr. Ramesh Singh - Universiti Malaya

Regional Chapter Chairpersons:

East Coast	Harry Woon Tar Woi - Bredero Shaw (M) Sdn Bhd
Southern	Prof. Dr. Esah Hamzah - Universiti Teknologi Malaysia
Sabah	Ir. Edward Anyek* - PETRONAS Carigali (Sabah)
Bintulu	Yii Ming Sing* - Malaysia LNG Sdn Bhd
Miri	Ir. Dr. Edwin Jong Nyon Tchan - Jurutera Perunding Akal Sdn Bhd

IMM Council Representatives:

Academy of Sciences Malaysia (ASM)	Datuk Fateh Chand* - Retired
IMM Overseas China Representative	Ir. Luiz Liew* - Shell China

*** Non-Council Members appointed to Chair positions and invited to attend Council Meetings**

IMM Working Committees and Regional Chapters

EDUCATION COMMITTEE

Chairman: Ir. Max Ong Chong
Deputy Chairman: Assoc. Prof. Dr. Melissa Chan Chin Han
Advisor / IJIMM Editor-in-Chief:
Prof. Dr. Mohamad Kamal Harun
Secretaries: Ainil Fidrah Mohd. Ghazali
Kirk Keng Chuan
Members: Prof. Dr. Esah Hamzah
Prof. Ir. Dr. Ramesh Singh
Assoc. Prof. Dr. Rajkumar Durairaj
Dr. Valliyappan David Natarajan
Assoc. Prof. Dr. Chia Chin Hua
Dr. Karen Wong Mee Chu
Dr. Tan Winie
Eur.Ing. Nigel Brewitt
Ir. Mohd Suradi Yasin
Dr. Mahesh Kumar Talari
Nurul Asni Mohamed
Ir. Lai Kah Chung

MATERIALS & ASSET INTEGRITY COMMITTEE

Chairman: Ir. Mohamad Azmi Mohd Noor
Dep. Chairman: Eur.Ing Nigel Brewitt
Secretary: Ir. Maimunah Ismail
Members: Dato' Ir. Mohd. Jai Suboh
Dr. Andrew Spowage
Dr. Mahesh Kumar Talari
Giridharan Anandan
Justin Nga
Maria Nita Bt A Nawawi
Mohamad Azwin Osman
Mohd Khairul Mohamad Nazor
Nor Fazri Nordin
Nurul Asni Mohamed
Padmanabhan Govindarajalu
Rosnani bt. Rasadi
Zamir Mohamed Daud

ADVANCED MATERIALS COMMITTEE

Chairperson: Dr. Chen Kah Pin
Dep. Chairman: Ting Chen Hunt
Advisor: Professor Dr. Che Husna Azhari
Members: Dr. Liang Meng Suan
Dr. Khaw Chwin Chieh
Dr. Lai Soon Onn
Assoc. Prof Dr. Rajkumar Durairaj
Dr. Huang Nay Ming
Chew Chee Sean
Chin Sheue Pin
King Yeong Jin
Liu Chin Chin
Yeo Wei Hong

NANOMATERIALS COMMITTEE

Chairman: Dr. Azmi Idris
Dep. Chairman: Prof. Dr. Ahmad Fauzi Mohd Noor
Secretary: Dr. Talib Ria Jaaar
Members: Dr. Aziz Mohamad
Dr. Mat Husin Saleh
Dr. Mohd Radzi Mohd Toff
Dr. Teng Wan Dung
Dr. Ang Bee Chin

POLYMER COMMITTEE

Chairperson: Assoc. Prof. Dr. Melissa Chan Chin Han
Dep. chairperson: Assoc. Prof. Dr. Chia Chin Hua
Secretary: Dr. Tan Winie
Treasurer: Dr. Valliyappan David Natarajan
Members: Dr. Chew Kong Chin
Shamsul Farid Samsudin
Imizan B A Bakar
M Shahril Atiqi B M Sharip
Rohana Jaafar

WELDING COMMITTEE

Chairman: Ir. Dr. Edwin Jong Nyon Tchan
Dep. Chairman 1: Abdul Ghani Ismail
Dep. Chairman 2: Hj. Ghalib Tham
Secretary: Md Hafidzuddin Bin Mohd Salleh
Asst. Secretary: Mohd Shahrizal PKM Seeni Mohd
Members: Prof. Dr. A. S. Md. Abdul Haseeb
Dr. Andrew Spowage
Dr. Mahesh Kumar Talari
Dr. Samsul Bahar Sadli
Abu Bakar Mohd Arif
Barry Edmonds
Bernard Maxmillan Sim
Darren Lim
Ismail Abu Bakar
Kelvin Chan Kin Wa
Nigel Brewitt
Padmanabhan Govindarajalu
Tan Yew Min
Thomas Teo

GOLF COMMITTEE

Chairman: Ir. Pau Kiew Huai
Dep. Chairman: Ir. Lai Kah Chung
Secretary/Treasurer: Ir. Max Ong Chong Hup
Members: Prof. Dr. Mohamad Kamal Harun
Dato' Ir. Mohd Jai Suboh
Datuk Ir. Wahiruddin Wahid
Ir. Mohd Azmi Mohd Noor
Ir. Tiong Huo Chiong
Ir. Mohd Suradi Yasin
Ir. Abd Razak Abu Hurairah
Ir. Ahmad Nazari Ashari
Zaki Sibaweh
Ir. Chang Kin Moh
Eng Kim Leng
Junaidy Abdullah
Kuldip Seine Singh
Frankie Chua Cheng Huat

EAST COAST CHAPTER COMMITTEE

Chairman: Harry Woon Tar Woi
Secretary: Azman Bidin
Members: Vincent Owi Fong Keong
Cheong Kok Loong
Ang Hui Kiang
Soo Shiaw Yee

MIRI CHAPTER COMMITTEE

Chairman: Ir. Dr. Edwin Jong Nyon Tchan
Dep. Chairman: Giridharan Anandan & Wong Siong Pin
Secretary: Bernard Maxmillan Sim
V. Sec.: Derick Ung
Treasurer: Lee Chung Khiong
Members: Dr. Beena Giridharan
Andrew Ling
Desmond Chin
Liew Wei Yiew
Liew Shann Ching
Teng Hui Chung

SOUTHERN CHAPTER COMMITTEE

Chairman: Prof. Dr. Esah Hamzah
Dep. Chairman: Mohd Khairul Mohd Nazor
Secretary: Dr. Tuty Asma Abu Bakar
Members: Dr. Ali Ourdjini
Dr. MuhammadAzizi Mat Yajid
Engku Mohd Nazim Engku Abu Bakar

SABAH CHAPTER COMMITTEE

Chairman: Ir. Edward Anyek
Dep. Chairman: Ahmad Tirmizi Ali Amat
Secretary: Dr. Chong Siaw Fung
Treasurer: Natalie Fung
Members: Prof. Dr. Yeo Kiam Beng
Dr. Sazmal Effendi Arshad
Dr. Sivakumar Kumaresan
Dr. Moh Pak Yan
Ir. Lee Hung Sang
Chung Tze Kong
Devyne Koh
Jeffrey Ngau Uvang
Mohd Khairudin Mohd. Naser
Simon Thien Fook Chin
Valerie Fung Yin Li

VIBRATION COMMITTEE

Chairman: Noor Hisham Ab Hamid
Dep. Chairman: Ir. Dr Mohd Abdul Karim Abdullah
Secretary: Farida Hanom Hussin
Members: Dr. Gary. Y. Lee
Ir. Abd Razak Abu Hurairah
Affandi Abd Hamid
Mokhtar Tahir
Rusli Wahab

STUDENT CHAPTER COMMITTEE

Chairman: Eur. Ing. Nigel Brewitt
Dep. Chairman: Dr. Karen Wong Mee Chu
Committee Members: Dr. Andrew Spowage
Mr. Kang Kim Ang

EXAMINATION, CERTIFICATION & ACCREDITATION PANEL

Chairman: Assoc. Prof. Dr. Rajkumar Durairaj
Dep. Chairman: Dr. Andrew Spowage
Secretary: Kirk Keng Chuan
Committee Members: Dr. Mahesh Kumar Talari
Eur.Ing. Nigel Brewitt
Ir. Mohd Suradi Yasin
Kirk Keng Chuan
David Lim Chee Cheong
Kang Kim Ang
Ir. Maimunah Ismail
Haji Ghalib Tham
Zamaluddin Ali
Frankie Chua Cheng Huat

CORROSION COMMITTEE

Chairman: Halimah Pit
Dep. Chairman: Nurul Asni Mohamed
Secretary: Kang Kim Ang
Committee Members: Elizah Samat
Dr. Lee Chee Cheong
Ir. Dr. Mokhtar Bin Che Ismail
Junaidy Abdullah
Syarifah Nazilah Syed Abdul Rahman
Eric Lay
Mohd Khairi Kadir
Dr. Andrew Spowage
Nurul Asni Mohamed

COATINGS COMMITTEE

Chairman: Mr. David Lim Chee Cheong
Dep. Chairman: En. Muhammad Hawari Hassan
Secretary: Mr. Ting Lai Hong
Committee Members: Dato' Udani bin Dato' Seri Mohd Daud
Frankie Chua Cheng Huat
Junaidy Abdullah
Lim Wai Bin
Tan Ju Liang
Wong Ing Chiew
Terence Wee
Mark Hew
Selvandran
Ahmad Badli Shah Aziz
Robert Lo Ting Ming

BINTULU CHAPTER COMMITTEE

Chairman: Mr. Yii Ming Sing
Dep. Chairman: Mr. Leong Yin Chin
Secretary: Mr. Felix Bantin Ak Amit
Committee Members: Steward Siran
Steve Ting
George Kua
Firdaus Maarop
Fauzamsaari Geran

TRAINING PROGRAM COMMITTEE

Chairman: Ir. Mohd Suradi Yasin
Dep. Chairman: Dr. Mahesh Kumar Talari
Secretary: Kirk Keng Chuan
Committee Members: Eur.Ing Nigel Brewitt
Bernad Maxmillan Sim
Noor Hisham Ab. Hamid
David Lim Chee Cheong
Frankie Chua Cheng Huat
Kang Kim Ang

GREEN MATERIALS COMMITTEE

Chairman: Prof. Dr. Saifollah Abdullah
Secretary: Ir. Abd Razak Abu Hurairah
Committee Members: Dr. Ang Bee Chin
Dr. Amalina Muhammad Afifi
Hahnas Mahbut
Muhammad Nurdin Ghazali
Eng Kim Leng
Dr. Aziz Muhammad

Signing of Agreement between Institute of Materials, Malaysia and ECMI ITE Asia Sdn Bhd for Coat & Corrosion Asia 2016

Reported by
Ir. Max Ong Chong Hup and
Assoc. Prof. Dr. Melissa Chan Chin Han, Editors of Materials Mind

An agreement between Institute of Materials, Malaysia (IMM) and ECMI ITE Asia Sdn. Bhd. for Coat & Corrosion Asia 2016 was signed on 20th Jun 2014 at Glenmarie Golf & Country Club, Shah Alam, Selangor, Malaysia on **Coat & Corrosion Asia 2016**.

IMM has conducted the International Materials Technology Conference and Exhibition (IMTCE) on a biennial basis and it is one of signature events of IMM with a record of more than 400 participants for 9th International Materials Technology Conference and Exhibition (IMTCE2014), where more than 50% of the participants were originated from roughly 40 countries.

"Coat & Corrosion Asia" Exhibition will be held from 17 – 19th May 2016 in conjunction with IMTCE2016 at Putra World Trade Centre (PWTC), Kuala Lumpur, Malaysia. This first-of-its-kind 3-day Exhibition on Specialized Products & Services relating to Coatings, Corrosion, Materials Degradation, Asset Integrity, Insulation, Fire Protection, Materials Testing, Failure Analysis, Welding & Inspection Services will be held in Malaysia for the first time in 2016!

Coat & Corrosion Asia 2016 – a biennial exhibition, jointly organized by IMM and ECMI ITE Asia Sdn. Bhd. serves as an important trade platform for an utmost variety in innovation and technologies in coating and corrosion industry. This exhibition will be showcasing the latest coating and corrosion technologies for the region's environmental, manufacturing and industrial needs, ranging from raw materials for coatings, printing inks and adhesives to laboratory and production equipment and the latest technologies for test and measurement.

Coat & Corrosion Asia is a great way to expand your network with high quality leads, and it is an ideal platform for suppliers to meet influential decision makers under one roof within 3 days. In conjunction with this exhibition, technical conferences focussed on three symposiums comprising topics of actual industry and academic interest themed "Synergising Industry & Academia: Design, Research & Inventions" will be held at IMTCE 2016.

We urge you to mark your calendar from 17 – 19th May 2016 for the first edition of Malaysia's International Exhibition on Coating and Corrosion at PWTC, Kuala Lumpur, Malaysia!

For exhibiting, sponsorship and visiting enquiries, kindly contact ECMI ITE Asia Sdn. Bhd. at +603 8023 0820 or email to enquiry@ecmi.com.my.

Figure 1 Signing of MOA by Assoc. Prof. Dr. Melissa Chan (IMTCE2016 Conference Organizing Chairperson) in the centre, flanked by ECMI Directors, Mr. Cheong (left) and Mr. Saw (right) and witnessed by Ir. Max Ong (standing).

Figure 2 Exhibition organized by ECMI ITE Asia Sdn. Bhd

Figure 3 Exhibition organized by ECMI ITE Asia Sdn. Bhd.

IMTCE2016

10th International Materials Technology Conference & Exhibition

THEME : Design. Research & Inventions

16 - 19 May 2016
Putra World Trade Centre (PWTC), Kuala Lumpur, Malaysia

Organised by :

IMM
Institute of Materials, Malaysia

Synergising Industry & Academia

Design, Research & Inventions

10th International Materials Technology Conference and Exhibition (IMTCE2016)

INVITATION

The 10th International Materials Technology Conference & Exhibition (IMTCE2016) is scheduled to be held from 16 – 19 May 2016 at the Putra World Trade Centre (PWTC), Kuala Lumpur. IMTCE2016 will provide a platform to academicians and industrialists to showcase their knowledge and expertise in the area of "Design, Research & Inventions" in these progressions of technology:-

- **Current Technologies** - performance of materials, facilities & assets
- **New Technologies** - trials & tribulations encountered
- **Future Evolution**- research & inventions for the future

The collaboration of industrial practitioners and academic researchers have led to the development of new sustainable innovative products and services in the oil & gas, marine, power, petrochemical, chemical, water resources, transportation, construction, automotive, equipment manufacturing, electrical & electronics, agriculture, food & beverage processing, and furniture industries. IMTCE2016 covers both economic issues and technical aspects on materials science, engineering and technology, ultimately affecting all industries globally. It intends to highlight the requirement, challenges and uncertainties in 2016 and beyond for the survival of premium products and services.

CONFERENCE OBJECTIVES

- To provide a patform for the exchange of knowledge and expertise among industrial practitioners, industry's professionals and higher learning institutions.
- To provide a forum or discussion and exchange of views on the opportunities that arises in the challenging material processing and applications through collaborations between industry and academia

www.imtce2016.org

IMTCE2016

10th International Materials Technology Conference & Exhibition

CALL FOR PAPERS

3 Technical Symposiums

ISAPM2016 : International Symposium on Advanced Polymeric Materials
ISMAI2016 : International Symposium on Materials & Asset Integrity
ISCC2016 : International Symposium on Coatings & Corrosion

The Technical Conference focuses on the three symposiums above comprising topics of industry and academia interests. The Conference programme consist of plenary, keynote, invited, oral and poster presentations. **Ample time is provided for free discussion between industry and academia within each symposium.**

With the theme of "Synergising Industry & Academia : Design, Research & Inventions" IMTCE2016 invites academics, scientists, engineers, researchers, industrialists and service providers to present their latest research findings in technology and innovation, and current development in materials scieces which include metals and alloys, polymers and plastic, rubber and elastomers, ceramics, timber and wood, concrete, minerals, nanomaterials,advanced materials, electronic materials and textiles. Papers are cordially invited from industry and academia.

"Coat & Corrosion Asia Exhibition" will be held from 17 - 19 May 2016 in conjuction with IMTCE2016. This first-of-its-kind 3-day exhibition on Specialized Product and Service relating to Coatings, Corrosion, Materials Degradation, Insulation, Fire Protection, Materials Testing, Failure Analysis, Welding and Inspection Service will be held in Malaysia for the first time in 2016!

Some 800 speakers, presenter, exhibitors and delegates are expected to participate in IMTCE2016. We welcome you to IMTCE2016!

COAT & CORROSION ASIA
The Malaysia International Exhibition on Coating and Corrosion

Co-Organizer

UTM RESEARCH UNIVERSITY
UNIVERSITI KEBANGSAAN MALAYSIA The National University of Malaysia
UNIVERSITI MALAYSIA KELANTAN
SSPC
UNIVERSITI TEKNOLOGI MARA
MOCA MALAYSIAN OFFSHORE CONTRACTORS ASSOCIATION

www.imtce2016.org

IMTCE2014 Report

Authored by Ir. Max Ong Chong Hup and Assoc. Prof. Dr. Melissa Chan Chin Han, Editors of Materials Mind

9th International Materials Technology Conference and Exhibition (IMTCE2014)
Organised by the Institute of Materials, Malaysia (IMM)

Date: 13th - 16th May 2014
Venue: Putra World Trade Centre (PWTC), Kuala Lumpur, Malaysia
Theme: Synergising Industry & Academia: Innovations for Industrial Applications

9th International Materials Technology Conference and Exhibition (IMTCE2014), the signature event of Institute of Materials, Malaysia (IMM), was successfully organized with an impressive record of 402 conference participants. A total of 2 plenary, 26 keynote, 102 invited, 150 oral, 79 poster presentations and 43 delegates were noted. IMTCE2014 was the first Conference and Exhibition of this kind in Asia with a good combination of participants from academic institutions and industries; as well as from local and overseas, which provided an effective platform in establishment of sustainable industry-academia linkages in materials technology. The summary of participation in IMTCE2014 is depicted in *Appendix 1*. The winners of Poster awards are listed in *Appendix 2*. Peer-reviewed manuscripts authored by the conference presenters will be published in 7 identified journals and 1 edited book.

The opening ceremony of IMTCE2014 was graced by Y.B. Dato' Seri Haji Idris Bin Jusoh, Education Minister II, Ministry of Education, Malaysia. Datuk Mohd Anuar Taib, Vice President and CEO, PETRONAS Development and Production and Ir. Pramod Kumar Karunakaran, Vice President of Infrastructure & Utilities, Gas & Power Business PETRONAS presented special lectures. Prof. Dr. Sabu Thomas, Mahatma Gandhi University, India and Universiti Teknologi MARA, Malaysia and Dr. Liane Smith, Director of Woodgroup-Intetech Ltd, UK shared their latest research findings and vast experience during their plenary lectures.

	Datuk Mohd Anuar Taib, Vice President and CEO, PETRONAS Development **Special lecture:** Cost Effectiveness in the Oil & Gas Industry – Quality & Safety Assured
	Ir. Pramod Kumar Karunakaran, Vice President of Infrastructure & Utilities, Gas & Power Business PETRONAS **Special lecture:** Achieving Effective Project Delivery through a Structured QA & QA Approach
	Prof. Dr. Sabu Thomas, Mahatma Gandhi University, India and Universiti Teknologi MARA, Malaysia **Plenary lecture:** High Performance Epoxy Nanocomposites for Coating Applications
	Dr. Liane Smith, Director of Woodgroup-Intetech Ltd, UK **Plenary lecture:** Putting Theory into Practice – Lessons Learnt from the Oil and Gas Industry

The objectives of the conference are to:

1. Provide a platform for the exchange of knowledge and expertise among industrial practitioners, industry's professionals and higher learning institutions.

2. Provide a forum or discussion and exchange of views on the opportunities that arise in the challenging material processing and applications through collaborations between industry and academia.

FIVE international symposiums were organised under the auspices of IMTCE2014. They were:

1) ISAPM2014	International Symposium on Advanced Polymeric Materials 2014
2) ISMCT2014	International Symposium on Materials Characterisation and Testing 2014
3) ISCT2014	International Symposium on Coatings Technology 2014
4) ISMWT2014	International Symposium on Metallurgy and Welding Technology 2014
5) ISCMD2014	International Symposium on Corrosion & Materials Degradation 2014

The Pre-Conference Friendly Golf Competition was held on 13th May 2014 morning at Templer Park Golf & Country Resort, a very scenic golf course in Rawang, Selangor (about 15 minutes drive from PWTC). A total of 24 avid golfers from Malaysia, Singapore, Japan and UK attending the conference enjoyed themselves for a morning golf outing. The Winner of the First Bi-Monthly IMM Golf Medal was Mr. Raza Amin (DNV-GL company) and Runner-up was Dr. Leonard Wanigasooriya (Geeble Simulation Testing Solutions).

Also, on 13th May 2014, a group of 10 conference delegates went on a pre-conference Tour to Melaka, a day-trip to this historical town down south of Kuala Lumpur. On 16th May 2014, 10 Masterclasses were conducted as post conference activities (list of Masterclasses is shown in *Appendix 3*). On the same day, Technical Visits to the THHE Oil & Gas Fabrication Yard in Pulau Indah, Port Klang and the Royal Selangor Pewter Plant in Kuala Lumpur were conducted for conference delegates. Endless supports from our co-organizers and sponsors marked the success of this prominent event of IMM.

Of course, this is not the first IMTCE organized by IMM. Since IMM's official registration in 1987, IMM has conducted the IMTCE on a biennial basis, drawing like-minded individuals from all walks of life to partake in the exchange of substantial information and the sharing of findings which will ultimately play a key role in the progress of the international science fraternity. As part of our cumulative range of

THE PRE-CONFERENCE FRIENDLY GOLF COMPETITION

At PWTC

activities, the IMTCE has grown to become our flagship event, which keeps growing bigger by the year. The memory lane of IMM's International Materials Technology Conferences is tabulated in Table 1.

Table 1 Record of IMM's International Materials Technology Conferences

DATES	CONFERENCE NAME	Remarks
1-3 March 1990	1st Regional Conference on Materials Science & Technology. Putra World Trade Centre, Kuala Lumpur.	*Attended by 100 delegates.* Opened by YB Datuk Amar Stephen Yong, Minister of Science, Technology & the Environment.
11 & 12 December 1997	Joint IMM-OSFAM Conference on Oil & Gas Fabrication Technology. Pan Pacific Hotel, Kuala Lumpur.	*Attended by 100 delegates.* Opened by YB Datuk Mohamed Nazri Abdul Aziz, Deputy Minister in the Prime Minister's Department.
25 March 1999	2nd Regional Conference on Materials Technology. Sheraton Hotel, Subang Jaya.	*Attended by 100 delegates.* Opened by the Conference Organizing Chairman.
30 & 31 October 2001	3rd Materials Conference & Exhibition. Mandarin Oriental Hotel, K.L.	*Attended by 100 delegates.* Opened by YB Dato' Law Hieng Ding, Minister of Science, Technology & the Environment.
23-25 March 2004	4th IMTCE2004 Istana Hotel, K.L.	*Attended by 100 delegates.* Opened by the Conference Organizing Chairman.
17-20 July 2006	5th IMTCE2006 Crowne Plaza Hotel, K.L.	*Attended by 100 delegates.* Opened by Dato'Dr. Mohd Ariffin Aton, IMM Advisor.
24-27 August 2008	6th IMTCE2008 Park Royal Hotel, K.L.	*Attended by 100 delegates.* Opened by TB Tuan Fadhillah bin Yusof, Deputy Minister of Science, Technology & Innovation.
13-16 June 2010	7th IMTCE2010 Hilton Hotel, Kuching, Sarawak.	*Attended by 100 delegates.* Opened by YAB Pehin Sri Haji Abdul Taib Mahmud, Chief Minister of Sarawak.
9-12 July 2012	8th IMTCE2010 Sunway Resort Hotel, Selangor.	*Attended by 150 delegates.* Opened by the Conference Organizing Chairman.
13-16 May 2014	9th IMTCE2014 Putra World Trade Centre, Kuala Lumpur.	*Attended by 400 delegates.* Opened by YB Dato' Seri Idris Jusoh, Minister of Education II.

In view of the success of IMTCE2014, IMTCE2016 will be planned to strengthen the discussion and collabarative works between industrialists adn academia. IMTCE2016 will provide a platform to academicians and industrialists to showcase their knowledge and expertise in the areas of "Design, Research & Inventions" in these progressions of technology:-

1. Current Technologies – performance of materials, facilities & assets
2. New Technologies – trials & tribulations encountered
3. Future Evolution – research & inventions for the future

10th International Materials Technology Conference and Exhibition (IMTCE2016)

Date: 16 – 19 May 2016 (Mon to Thurs)
Venue: Putra World Trade Centre (PWTC), Kuala Lumpur, Malaysia
Motto: Synergising Industry & Academia
Theme: Design, Research & Inventions

There will be 3 Technical Symposiums:-

ISAPM2016: International Symposium on Advanced Polymeric Materials.
ISMAI2016: International Symposium on Materials & Asset Integrity.
ISCC2016: International Symposium on Coatings & Corrosion.

"Coat & Corrosion Asia" Exhibition will be held from 17 – 19 May 2016 in conjunction with IMTCE2016. This first-of-its-kind 3-Day Exhibition on Specialized Products & Services relating to Coatings, Corrosion, Materials Degradation, Asset Integrity, Insulation, Fire Protection, Materials Testing, Failure Analysis, Welding & Inspection Services will be held in Malaysia for the first time in 2016!

See you all again in 2016.

Appendix 1
Summary of participation in IMTCE2014

Symposium	Number of Presenter
ISAPM2014	143
ISMCT2014	80
ISCT2014	44
ISMWT2014	38
ISCMD2014	54
Delegates of IMTCE2014	43
TOTAL :	402

Symposium	Plenary	Keynote	Invited	Oral	Poster	TOTAL
ISAPM2014	1	8	58	26	50	143
ISMCT2014	0	6	6	55	13	80
ISCT2014	0	3	6	28	7	44
ISMWT2014	0	5	6	22	5	38
ISCMD2014	1	4	26	19	4	54
TOTAL	2	26	102	150	79	359

Symposium	Academic papers	Industry papers	TOTAL	Local papers	International papers	TOTAL
ISAPM2014	130	13	148	65	78	143
ISMCT2014	50	30	80	51	29	80
ISCT2014	35	9	44	27	17	44
ISMWT2014	29	9	38	15	23	38
ISCMD2014	42	12	54	19	35	54
TOTAL	286	73	359	177	182	359

Abstract submission based on countries

No	Country	Number of presenter
1	Australia	6
2	Belgium	1
3	Botswana	1
4	Canada	1
5	China	8
6	Czech Republic	2
7	Egypt	2
8	France	6
9	Germany	6
10	India	28
11	Indonesia	2
12	Iran, Islamic Republic of	6
13	Iraq	1
14	Italy	3
15	Japan	21
16	Korea, Republic of	1
17	Kuwait	1
18	Libyan Arab Jamahiriya	2
19	Malaysia	177
20	Netherlands	4
21	Nigeria	2
22	Oman	3
23	Pakistan	1
24	Philippines	1
25	Poland	2
26	Portugal	1
27	Saudi Arabia	3
28	Singapore	10
29	Slovakia	2
30	South Africa	2
31	Spain	1
32	Taiwan	9
33	Thailand	2
34	Tunisia	1
35	Turkey	6
36	United Arabia Emirates	4
37	United Kingdom	9
38	United States	4
39	Venezuela	1
	Total	359

Appendix 2
List of Best Poster Competition/Award Winners
14-15 May 2014, PWTC, Kuala Lumpur

FIRST PRIZE (RM 1,000 + Certificate)
Name : Ms. Vidhyaa Paroo Indran
Id Code: ISMCT_PP_0225
Symposiums: International Symposium on Materials Characterization and Testing 2014 (ISMCT2014).
Institution: Universiti Malaysia Pahang (UMP), Malaysia.
Poster Title: Green synthesis of Glycerol Carbonate from Glycerol Catalysed by Boiler Ash.

SECOND PRIZE (RM 500 + Certificate)
Name : Mr. Martijn Beljaars
Id Code: APM-036-PP-BELJAARS
Symposiums: International Symposium on Advanced Polymeric Materials 2014
(ISAPM2014)
Institution : Universitiy of Groningen, Netherlands.
Poster Title : Biobased and Renewable Polymeric Materials.

THIRD PRIZE (RM 300 + Certificate)
Name : Dr. Mek Zah Salleh
Id Code: APM-064-PP-SALLEH
Symposiums: International Symposium on Advanced Polymeric Materials 2014
(ISAPM2014)
Institution : Malaysian Nuclear Agency, Malaysia
Paper Title: The Production of Hyperbranched Curable Palm Oil Oleic Acid.

CONSOLATION PRIZES (RM 200 + Certificate)

1. International Symposium on Advanced Polymeric Materials 2014 (ISAPM2014)

Name : Ms. Soo Ah Nam
Id Code: APM-033-PP-NAM
Institution : Korea Advanced Institute of Science and Technology, Republic of Korea.
Poster Title: Performance Enhancement in Organic Solar Cells with Cabon Nanotubes.

Name Ms. Jing He
Id Code: APM-038-PP-HE
Institution : China Unviersity of Petroleum, China.
Poster Title: Liquid Phase Deposition Silica Film.

Name : Mr. Tae Yeong Yun
Id Code: APM-032-PP-YUN
Institution : Korea Advanced Institute of Science and Technology, Republic of Korea
Poster Title: Chemically Modified Graphene as substrate for DNA Origami Nanopatterning

2. International Symposium on Materials Characterization and Testing 2014 (ISMCT2014)

Name : Ms. Jiin Woei Lee
Id Code: ISMCT_PP_0670
Institution : University of Nottingham Malaysia Campus, Malaysia
Poster Title: Characterisation of silicon-substituted hydroxyapatite on titanium for biomedical applications.

3. International Symposium on Coatings Technology 2014 (ISCT2014)

Name : Ms. Ai Loon Ooi
Id Code: ISCT_PP_0492
Institution : Universiti Teknologi Malaysia (UTM), Malaysia.
Poster Title: Cutting performance of hfcvd diamond coated and uncoated tungsten carbide inserts on stainless steel workpiece.

4. International Symposium on Metallurgy and Welding Technology 2014 (ISMWT2014)

Name : Mr. Alborz Fathi
Id Code: ISMWT_PP_0570
Institution : MAPNA Turbine Engineering & Manufacturing Co. (TUGA), Iran.
Poster Title: Failure Analysis of a Fuel Oil Pipe in MGT-70 Gas Turbine Auxiliary System.

5. International Symposium on Corrosion & Materials Degradation 2014 (ISCMD2014)

Name : Dr. Yuan-Hsiang Yu
Id Code: ISCMD_PP_0379
Institution : Fu Jen Catholic University, Taiwan
Poster Title: Polystyrene/Graphene-Based Nanocomposites with Advanced Anticorrosive Properties Prepared Using In Situ Miniemulsion Polymerization.

Poster Award organising Committee;
Professor Dr Esah Hamzah (UTM) : Chairperson
Professor Dr Ahmad Fauzi Mohd Nor (USM) : Co-Chairperson
Mohd Fauzi Mamat (UTM) : Committee member
Wee Ying Ci (UTM) : Committee member
Muhammadu Masin Muhammadu (UTM) : Committee member

Appendix 3
List of masterclasses

No.		Trainer	Tittle
1		Prof. Dr. Sabu Thomas	Performance and Fingerprinting of EpoxyNanocomposites for Coating Applications
2		Dr. Russell J. Varley	Sustainable Materials Research at CSIRO Materials Science and Engineering
3		Dr. Liane Smith	CRA Materials Selection
4		Mr. Thomas A. Jones	Quality Control for Coating Inspection Projects
5		Dr. David Hassell	Fundamentals and Application of Rheology
6		Dr. Reza Javaherdashti	Microbiologically Influenced Corrosion (MIC): Knowledge and Practice
7		Ir. Dr. Edwin Jong Nyon Tchan	How to Consistently Sustain Quality Welds During Welding Production
8		Prof. Dr. Mohamad Kamal Harun Mr. Frankie Chua	Coatings and Coatings Technology: Practical and Applications
9		Ir. Ronald J. Parrington	Practical Fractography
10		Mr. Kang Kim Ang	Cathodic Protection Technology

A BRIEF REPORT ON

THE MATERIALS LECTURE COMPETITION 2014 (MLC 2014) FINALS

14 May 2014, Kuala Lumpur, Malaysia

Reported by; Prof. Dr Esah Hamzah Chairperson, MLC 2014
Institute of Materials, Malaysia (IMM) 14 May 2014

1.0 INTRODUCTION

The Materials Lecture Competition 2014 (MLC 2014) is the third Materials Lecture Competition organised by the Institute of Materials, Malaysia (IMM) after the successful first edition, MLC 2012 and the second competition, MLC 2013. The first winner of the MLC 2013, Ms Farahani Irna Nazari, went to Hong Kong in October 2013 to compete in the Young Persons' World Lecture Competition (YPWLC 2013) as Malaysia Finalist. The YPWLC 2013 was Organized by IOM3, UK. The Materials Lecture Competition (MLC) is an initiative intended to give the opportunity to the young students and researchers, particularly in the area of materials, to showcase their presentation skills and share their knowledge on issues pertaining to materials to a diversified audience. The MLC is open to all registered Malaysian and international students (except academic staff) in the public and private universities in Malaysia and should be under the age of 28 in the year of the competition. Each university is allowed to send one candidate to compete in the MLC. Topics of the presentation maybe from the following areas of interest (but not limited to): materials development, characterization, properties, processing and applications.

2.0 MATERIALS LECTURE COMPETITION 2014 (MLC 2014) SEMI FINAL

The MLC 2014 Semi Final was organized by IMM due to an overwhelming response from the institutions of higher learning in Malaysia to participate and compete in the MLC 2014. The Semi Finals of MLC2014 competition was held on the 3rd April 2014 from 8.30 am to 5.00 pm at Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia. The main objective was to select the top five winners to compete at the MLC 2014 Finals. The whole competition was sponsored by PETRONAS and co-organised by Universiti Teknologi MARA. The 13 semifinalists from 13 different universities in Malaysia are as follows and the details of the abstracts of the presentation and the students' background were printed in the MLC 2014 Semi Final booklet; The judges were selected among well-

1) Ms. Amirah Farhana Buhari	Universiti Teknologi MARA (UiTM)
2) Ms. Nur Nadia Mohd Kassim	Universiti Putra Malaysia (UPM)
3) Mr. Kudzai Nigel Chitewe	Asia Pacific University of Technology & Innovation (APU)
4) Ms. Haliza Jaya	Universiti Malaysia Perlis (UNIMAP)
5) Mr. Mohd Saidina Dandan Satia	Universiti Sains Malaysia (USM)
6) Ms Tan Teng Teng	Universiti Teknikal Melaka (UTEM)
7) Mr.Gregory Thien Soo How	Universiti Kebangsaan Malaysia(UKM)
8) Ms. Leong Chee Huan	Universiti Tun Hussein Onn Malaysia (UTHM)
9) Mr. Lee Te Chuan	Universiti Tun Hussein Onn Malaysia (UTHM)
10) Ms. Izaan Marina Mohd Aluwi	Universiti Teknologi Malaysia (UTM)
11) Mr Azhar Fakharuddin	Universiti Malaysia Pahang (UMP)
13) Ms. Losini A/P Amarasan	Multimedia University (MMU)
13) Mr Muhammad Syahmi Hamizol	Universiti Teknologi Petronas (UTP)

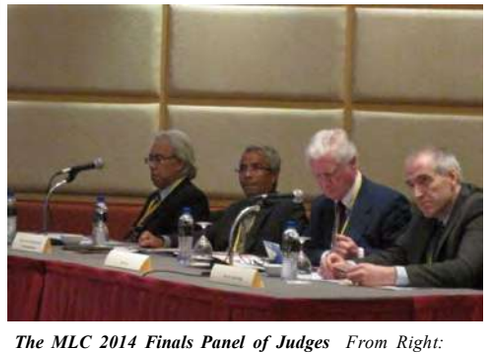
The judges were selected among well-known figures in the Malaysian Industries and an academic from non-participating university;

1) Ir Max Ong Chong Hup – Norimax Sdn Bhd (Moderator)
2) Ir Maimunah Ismail – Materials Consultant
3)Eur. Ing. Nigel Patrick Brewitt – Norimax Sdn Bhd
4) Prof. Dr. Megat Mohd Hamda Megat Ahmad - National Defence University of Malaysia

***Guest of Honour**: Datuk Ir. Abdul Rahim Hashim (IMM Advisor and the Vice Chancellor & Chief Executive Officer of Universiti Teknologi PETRONAS)*

3.0 MATERIALS LECTURE COMPETITION 2014 (MLC 2014) FINALS

The Materials Lecture Competition 2014 (MLC2014) Finals was jointly organized by the Institute of Materials, Malaysia (IMM) and Institute of Materials, Minerals and Mining (IOM3) Malaysia Branch, sponsored by PETRONAS, was held on the 14 May 2014 from 2.00 to 4.30 pm at the Seri Pacific Hotel in Kuala Lumpur, Malaysia. The MLC 2014 final officiated by Datuk Ir Abdul Rahim Hashim (IMM Advisor and the Vice Chancellor & Chief Executive Officer of Universiti



***The MLC 2014 Finals Panel of Judges** From Right: Prof. Dr. Ahmad Faizal, Ir. Assoc. Prof. Dr. Nahrul, Mr Barry Lyle and Prof. Dr. David Rugg.*

Teknologi PETRONAS) was held in conjunction with the International Materials
Technology Conference & Exhibition (IMTCE 2014). The appointed judges for the competition were both from Malaysia and the UK. They are as follows;

1) Prof. Ir. Dr. Ahmad Faizal Mohd Zain - Universiti Sains Islam Malaysia (Moderator)

2) Prof. Dr. David Rugg – Rolls Royce
Mr Barry Lyle – IOM3, UK

3) Assoc. Prof. Ir. Dr. Nahrul Khair Alang Md Rashid – International Islamic University of Malaysia

The judging criteria was similar to those set by IOM3 for the YPWLC which mainly focuses on the structure of lecture, clarity of explanation, standard of presentation, clarity of diction, relevance of visual aids used, competence in handling questions, technical content, summary and relevance of the entrant's abstract. Each finalist was given 15 minutes for the presentation followed by a question from each judge. The programme details, abstracts of the presentation and a brief background of each finalist were given in the MLC 2014 Finals booklets which were distributed to all participants and guests of the MLC2014 Finals.

The MLC 2014 five finalists and winners are as follows;

1) Ms. Losini A/P Amarasan
– Multimedia University (First Winner)
2) Mr. Kudzai Nigel Chitewe
– Asia Pacific University of Technology & Innovation (Second Winner)
3) Mr. Mohd Saidina Dandan Satia
–Universiti Sains Malaysia
(Third Winner)
4) Mr. Gregory Thien Soon How
– Universiti Malaya
5) Ms. Leong Chee Huan
– Universiti Kebangsaan Malaysia

The first, second and third winners of the MLC 2014 Finals received plaques and cash prizes of RM 3000, RM 2000, and RM 1000 respectively. The last two finalists received cash prize of RM 500 each. All the five finalists received certificates of participation and the whole competition was sponsored by PETRONAS. The first winner of MLC2014 Final will represent Malaysia at the IOM3's Annual Young Persons' World Lecture Competition (YPWLC) to be held in California, USA on the 23 October 2014.

The First Winner of MLC 2014 Finals, Ms Losini A/P Amarasan and Mr Barry Lyle (IOM3)

The Second Winner of MLC 2014 Finals, Mr Kudzai Nigel Chitewe and Mr Barry Lyle

The Third Winner, Mr Mohd Saidina Dandan Satia and Mr Barry Lyle (IOM3)

The MLC 2014 Finalist, Ms Leong Chee Huan and Professor Dr David Rugg

The MLC 2014 Finalist, Mr Gregory Thien Soon How and Professor Dr David Rugg

The Five MLC 2014 Finalists

From Right: Leong Chee Huan (UKM), Gregory Thien Soon How (UM), Kudzai Nigel Chitewe (APU),

The MLC 2014 Finals: The Finalists, Judges and organizing committee

MLC 2014 Organising Committee
Left: Prof. Dr. Esah Hamzah (Chairperson)
Right: Dr. Norakmal Fadil (Co Chairperson)

IJIMM
INTERNATIONAL JOURNAL OF THE INSTITUTE OF MATERIALS MALAYSIA

IJIMM (International Journal of the Institute of Materials Malaysia)

International Journal of the Institute of Materials Malaysia
ISSN: 1511-8487

Compiled by Dr. David. N. V. , Universiti Teknologi MARA, Shah Alam and Dr. Tan Winie, Universiti Teknologi MARA, Shah Alam

To IMM Members – please do your institute a good service and help the IMM to get its International Journal of the Institute of Materials Malaysia (IJIMM) ready to be indexed in the Scopus database in the next two years!! Do your part by contributing technical papers to the IJIMM Editorial Board now!

IMM prides itself as the only professional society in Malaysia dedicated and committed to bringing the academics and industry professionals together to share technological knowledge, experience and expertise so that academic-industry collaborative research and development programs can be beneficial to the university lecturers & students while offering benefits to industries in Malaysia to be globally competitive.

Materials Science & Engineering is the fore-front of innovations for products & services.

The International Journal of the Institute of Materials Malaysia (IJIMM) is an initiative by the Institute of Materials, Malaysia (IMM) to provide a publication platform for sharing and disseminating of primary research findings in Materials Science and Engineering, and its extended application in areas including Energy, Sports, Biomedical Engineering and the Built Environment. The Editorial Board of IJIMM comprises international members who are recognized experts in the subject areas. Since May 2013, IMM has organized and held two International Materials Symposium series (IMS), and selected papers from the IMS series have been reviewed and published in IJIMM. In addition, papers from the International Materials Technology Conference & Exhibition (IMTCE) which is held biennially in Malaysia will also be considered for publication in IJIMM.

Published twice a year, IJIMM considers research papers that report new or original work that has not been published elsewhere. The editorial solicits theoretical, analytical, experimental and/or computational manuscripts that contribute to new scientific knowledge or expand existing knowledge into industrial applications for review. IJIMM also features review articles and technical notes. All submissions will be single-blind peer reviewed by appointed technical reviewers from the academia, field professionals and experts.

Editorial Board

Invitation for submission of manuscripts

Dear scholars, researchers, professionals and academicians,I am pleased to inform you that the International Journal of the Institute of Materials Malaysia (IJIMM) has published its inaugural issue in January 2014. This journal aims to provide a publication platform for sharing and disseminating of primary research findings in Materials Science and Engineering, and its extended application in areas including Energy, Sports, Biomedical Engineering and the Built Environment.

The IJIMM journal emphasizes speedy and quality publications of original research articles, review articles and technical notes dealing with the above subject. Manuscripts are subject to review by appointed technical reviewers from the academia, field professionals and experts. Authors are advised to follow the Author Writing Guidelines in preparing the manuscript before submission. Please visit www.ijimm.org for more information. Manuscripts should be emailed to hongngee@upm.edu.my.

On behalf of the IJIMM Editorial Board, I am pleased to invite you to submit technical papers for publication in IJIMM.
Thank you.

Prof. Dr. Mohd Kamal Harun
Editor-in-Chief
International Journal of the Institute of Materials Malaysia

IMM Student Chapters

Reported by Eur. Ing. Nigel Brewitt, Norimax Sdn Bhd

Simply put, students are our future. We need to ensure that everything possible is done to provide Malaysian industry with the best, top grade, well grounded and comprehensively taught professionals that the country's educational establishments can provide. It falls upon the Universities of Malaysia to ensure that courses and curriculum are correctly geared to take up the challenges posed by industry. However, it is not a task they can do alone. Universities need support and input from industry. It is one of the roles of the professional societies to collate this industry input and channel industrial support to where it is needed. The Institute of Materials Malaysia (IMM) are no strangers to the requirements of industry and the needs of higher educational establishments. We aim to install IMM student chapters in all the universities of Malaysia and engage students in the exciting world of materials. IMM already plays an active role in shaping the nature of materials focused education in a number of Universities and is always willing to assist others. The institute is in talks with top tier industries in Malaysia to facilitate the links between industry and academia. IMM aims to provide support in the form of student seminars, technical visits, materials awards, participation in industrial advisory boards, competitions and other activities to show Malaysian students that we understand the challenges they face and to ensure them they are not on their own. The IMM calls upon all professional engineers, scientists and technologists to support us in this endeavor.

Figure 1: Nigel with students from Nottingham University and The University of Tunku Abdul Raman helping to make IMTCE2014 a great success

IMM, MALAYSIAN NUCLEAR AGENCY AND ROLLS-ROYCE SEMINAR ON NUCLEAR MATERIALS AND RESEARCH

Reported by Eur. Ing. Nigel Brewitt, Norimax Sdn Bhd

Some of the participants.

The IMM (Institute of Materials, Malaysia), MNA (Malaysian Nuclear Agency) and Rolls-Royce organized a half-day Seminar on 20 May 2014 at the Malaysian Petroleum Club. The Seminar was attended by 72 participants from MNA, MOSTI, DOSH, TNB Research, Universities Researchers and Lecturers , IMM members, and Oil & Gas companies as well as service providers.

In his opening remarks, the Director General of MNA, Dato' Dr. Muhamad Lebai Juri, welcomed more interactions with industries such as Rolls-Royce in order for MNA to become updated on the latest advances in materials for the nuclear industry. He indicated that IMM can play a significant role in facilitating this.

Topics covered in the presentations and the panel discussions were on the Rolls-Royce recent research progress; the present status in Malaysia of the material science and technology knowledge and capabilities to support the nuclear industry, and use of Silicon Carbide (SiC) material as a potential materials for fusion reactor.

The Director General of MNA, Dato' Dr. Muhamad Lebai Juri delivering his opening remarks



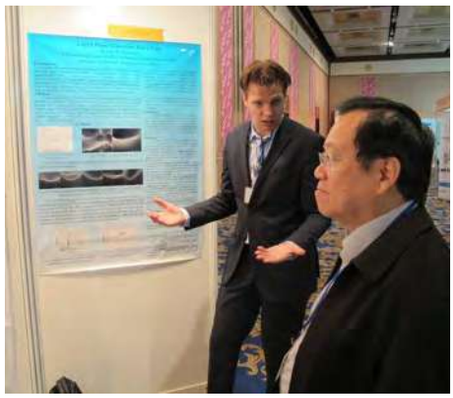



IMTCE2014










Created in
Monotonic
cleavage
Arrest lines
propagation


IMTCE2014





23
22

Final Forum on "Towards Fingerprinting of Polymeric Coatings" III

Reported by Anas Kamarundzaman, Materials Technology Education

Edited by Ir. Max Ong Chong Hup and Assoc. Prof. Dr. Melissa Chan Chin Han, Editors of Materials Mind

Date	:	**20th June 2014 (Friday)**
Time	:	**2.30 pm – 6.00 pm**
Venue	:	**Glenmarie Golf and Country Club, Shah Alam, Selangor**
Jointly organized	:	1) IMM Polymer Committee 2) IMM Coatings Committee 3) Universiti Teknologi MARA, Faculty of Applied Sciences, Shah Alam, Malaysia
Co-chairs of forum	:	1) Assoc. Prof. Dr. Chia Chin Hua, Universiti Kebangsaan Malaysia 2) Mr. David Lim Chee Cheong, IMM
Co-sponsor	:	1) Research Instrument Sdn. Bhd. 2)Agilent Technologies Sales (M) Sdn Bhd 3) Perkin Elemer (M) Sdn. Bhd. 4) PPG Sigma Sdn. Bhd.

The IMM Polymer Committee, IMM Coatings Committee and Universiti Teknologi MARA, Malaysia (UiTM) jointly organized the Final Forum on "Towards Fingerprinting of Polymeric Coatings" III at Glenmarie Golf and Country Club, Shah Alam. The forum served as a follow-up to the highly publicized first (Mac 2013) and second (Oct 2013) Fingerprinting Forums that took place in the year of 2013.

This event on Friday, 20th June 2014 was sponsored by Research Instrument Sdn. Bhd., Agilent Technologies Sales (M) Sdn. Bhd., Perkin Elemer (M) Sdn. Bhd. and PPG Sigma Sdn. Bhd. The consecutive series of Fingerprinting Forums serve as a mean for the academicians and industry practitioners to discuss the innovative procedures of "fingerprinting" polymeric coatings, which were not possible in the past as the QA and QC tool for the paint manufacturing plant.

Through the effective platform from IMM, university researchers managed to pick-up this relevant industrial problem (i.e. **Can we fingerprint polymeric coatings??**), which were unsolved for the last 30 years through the collaborative works with oil & gas users, paint manufacturers, instrument suppliers, laboratory testing bodies etc. After 1 ½ years, this final forum was sending out a clear message that **fingerprinting of polymeric coatings is possible and practical** by using Fourier-transform infrared (FTIR). Fingerprinting regions of FTIR for epoxy resin and hardener are proposed and the confidence level of acceptance for QA & QC control is proposed at ≥ 90.0%. The updates for fingerprinting findings on epoxy coatings were presented, but there are lots more other types of coatings, finished goods, coatings with aging effects and so on will have to be addressed to near future.

The Final Fingerprinting Forum drew a considerable number of participants, with more than 120 in attendance from the paint industries, oil & gas companies as well as the academicians (c.f. Table 1). The forum comprised of a total of 4 presentations by Mr. Muhammad Hawari Hassan from PETRONAS Malaysia, Ms. Michelle Lee Jia Yin from Research Instruments Sdn. Bhd., Ms Chow Mee Ling from Agilent Technologies Sales (M) Sdn Bhd, and Ms. Nurul Asni Mohamad, the chairperson of IMM Fingerprinting Task Force from PETRONAS Group Technical Solutions, Malaysia.

The forum started with the welcoming address by IMM Deputy President, Mr. Muhamad Azmi bin Mohd Noor from PETRONAS Carigali Sdn Bhd. Mr. Azmi spoke on IMM's plans, directions & activities towards enhancing awareness, and technological progress in materials science & engineering. This was followed by the opening remarks by Prof. Dr. Khudzir Ismail, the Dean of Faculty of Applied Science, UiTM. He highlighted that the faculty and university are looking forward to establishing more sustainable industry-academia linkages in materials technology.

The first speaker, Mr. Muhammad Hawari Hassan, spoke on "Qualification for New Maintenance Painting System and Products for Offshore Application". Mr. Hawari's presentation touched on how the corrosive external environment at offshore facilities poses a great deal of challenges for the operators to sustain high integrity and reliability of equipment and piping. He included the visual inspection results and proposed ways to improve the coatings performance. Among the points discussed embraced surface preparations, simulation of real conditions during applications, testing protocol, challenges and opportunities.

Ms. Michelle Lee Jia Yin discussed the "FTIR Spectroscopic Method for Laboratory Analysis of Polymeric Coatings" and highlighted the many tests conducted on various epoxy coatings used in the oil & gas industry. In her presentation, she discussed the sampling procedures and FTIR analysis procedures for epoxy resins and hardeners. The interpretation of the FTIR results was assisted by Assoc. Prof. Dr. Melissa Chan Chin Han from UiTM. She concluded that FTIR is a simple and reliable tool for the study of reproducibility of the epoxies and hardeners as well as to differentiate different types of epoxies and hardeners without any intrusion of paint formulations. **Batch-to-batch reproducibility of the epoxies and hardeners** is magnificently high.

"Advanced Technology for Polymeric Coatings" was the subject of presentation by Ms. Chow Mee Ling. The working principle of FTIR Spectroscopy was briefly discussed by Ms. Chow Mee Ling. In her presentation, she shared the advanced

technology of FTIR handheld analyzer which captured the attention and rekindled interest of the audiences.

The forum continued with live demonstrations on the FTIR analyses, both bench-top and handheld. A number of paint samples were used during the demonstrations and the forum participants garnered a chance to witness the simplicity in operating the FTIR spectrometer (both hardware and software) as well as the QA and QC tools of the software for the reproducibility analyses.

The last speaker, Ms. Nurul Asni, stressed on "Coating Fingerprint Certificate for Every Batch of Paint Manufactured". Ms. Nurul gave a summary of the task force activities since it was first set-up in April 2013. Ms. Nurul also gave her review on the available standards and specifications requiring fingerprinting of polymeric coatings in the oil & gas industry. Finally, she presented the tentative version of Coating Fingerprint Certificate for epoxy coatings.

The presentations were followed by an open discussion. Many important points were brought up by the audiences and addressed by the speakers and the committee members, resulting in a stimulating and productive exchange between speakers and participants.

The session chair of the Fingerprinting Forum cum the Chair-person of the Polymer Committee, Assoc. Prof. Dr. Melissa Chan Chin Han of UiTM provided a summary of the task force activities and hoped that the implementation of coating fingerprint Certificate would proceed as scheduled. She expressed her heartfelt appreciation for the efforts of the joint- and co-organizers, as well as the speakers, sponsors, forum secretariat and participants for making this event a smooth-sailing and fruitful affair.

This final forum had succeeded in create awareness for the practicality of the fingerprinting of the polymeric coatings. The well acceptance from the Malaysia oil & gas users for the Coating Fingerprint Certificate as one of the effective approaches for QA & QC tools for the enhancement of the overall painting coating quality assurance was noted.

Table 1 Summary of participation in Final Forum on "Towards Fingerprinting of Polymeric Coatings" III

No	Organization/University	Number of Participants
1	Agilent Technologies Sales (M) Sdn Bhd	1
2	Asia Pacific University, Malaysia	1
3	Beckers Group, Malaysia	3
4	CTRM Aero Composites Sdn Bhd, Malaysia	2
5	DuTech Instrument Sdn Bhd, Malaysia	1
6	Dyna Segmen Sdn Bhd, Malaysia	2
7	ECMI ITE Asia Sdn Bhd	2
8	Institute of Materials, Malaysia	3
9	International Paint Sdn Bhd, Malaysia	1
10	Jotun (M) Sdn Bhd, Malaysia	3
11	Kansai Coatings Malaysia Sdn Bhd	5
12	KCC Coating Sdn Bhd, Malaysia	3
13	Malaysia Marine and Heavy Engineering Holdings Berhad, Malaysia	2
14	Materials Technology Education Sdn Bhd, Malaysia	6
15	Nippon Paint (M) Sdn Bhd, Malaysia	2
16	Norimax Sdn Bhd, Malaysia	5
17	Perkin Elmer Sdn Bhd, Malaysia	7
18	PETRONAS, Malaysia	20
19	PPG Coatings (M) Sdn Bhd, Malaysia	5
20	QES (Asia-Pacific) Sdn Bhd	1
21	Research Instruments Sdn Bhd, Malaysia	6
22	Shell, Malaysia	4
23	Sirim QAS International Sdn Bhd, Malaysia	5
24	Tunku Abdul Rahman University College, Malaysia	1
25	Technip, Malaysia	2
26	TNB Research Sdn Bhd, Malaysia	1
27	Universiti Teknologi MARA, Malaysia	18
28	Universiti Kebangsaan Malaysia, Malaysia	3
29	Universiti Malaysia Perlis, Malaysia	1
30	Universiti Putra Malaysia, Malaysia	6
31	Universiti Sains Malaysia, Malaysia	1
32	Universiti Teknologi PETRONAS, Malaysia	1
	Total	124

Rapporteurs' Report of Final Forum on "Towards Fingerprinting of Polymeric Coatings" III

Compiled by Assoc. Prof. Dr. Chia Chin Hua, Universiti Kebangsaan Malaysia

Edited by Ir. Max Ong Chong Hup and Assoc. Prof. Dr. Melissa Chan Chin Han, Editors of Materials Mind

Date	:	**20th June 2014**
Time	:	**2:30 pm - 6.00 pm**
Venue	:	**Glenmarie Golf and Country Club, Shah Alam, Selangor**
Jointly organised by	:	IMM Polymer Committee IMM Coatings Committee Universiti Teknologi MARA
Partici-pants	:	124 representatives from Petronas, Shell, MMHE, KCC Coating, Jotun, Kansai Coatings, International Paint, Nippon Paint, PPG, Berkers Group, QES (Asia-Pacific), Dyna Segmen, DuTech, CTRM Aero Composites, Technip, SIRIM, MOCA, ETC-CP, ECMI, UiTM, UKM, USM, UPM, UTM, UiTM, UniMAP, TAR UC, TNB Research, etc.
Co-sponsored by	:	Research Instrument (M) Sdn. Bhd. Agilent Technologies Sales (M) Sdn Bhd Perkin Elemer (M) Sdn. Bhd. PPG Sigma Sdn. Bhd.

Introduction:

This is the final forum on "Towards Fingerprinting of Polymeric Coatings". The first and second forums were conducted on 22nd March 2013 and 11th October 2013, respectively. The main objective of this final Forum is to present the outcome of the IMM Task Force on Coatings Fingerprinting, i.e., tentative Coating Fingerprint Certificate for 2-component intermediate materials of epoxy coatings.

The third forum was attended by 124 participants from oil and gas companies, paint manufacturers, fabricators, blasting and painting contractors, scientific instrument specialists, academicians, researchers and university students .

the presentation session :-Summary of

Speaker 1	**:**	**Mr. Muhd Hawari Hassan, PETRONAS GTS Dept**
Topic	**:**	**Qualification for New Maintenance Painting System and Products for Offshore Application**

The objective of the presentation is to share with audience the progress of previous initiative done by the GTS group in qualifying new coating system to improve the coating performance. Paint failures continue to plaque the industry with real-life examples of how corrosion on offshore oil-rig topside facilities, which has a devastating impact to the oil and gas production. Due to this issue, PETRONAS has looked into application and surface preparation of external coating extensively to resolve one aspect of these problems. PETRONAS is looking seriously into coating issues and trying to cover all possible aspects. PETRONAS GTS with collaboration from SIRIM and Petronas Carigali has encouraged paint manufacturers to propose new methods/ options in coating technology for better coatings perform and reducing maintenance cycles. The main key criteria of improvement were to establish a system which has the following features:

- Short time application, e.g. better spread rate
- Simple surface preparation (light blast or power tool)
- On stream application (sweating condition, wet condition and elevated temperature)
- Flexible (no restriction to number of layers, thickness and formulation type)

The speaker closed out his talk by notifying audience that there were successful systems which have passed the acceptance criteria and many more systems are undergoing trial and evaluation.

Speaker 2	**:**	**Ms. Michelle Lee Jia Yin, Research Instruments (M) Sdn. Bhd. Assoc. Prof. Dr. Melissa Chan Chin Han, Universiti Teknologi MARA & IMM**
Topic	**:**	**FTIR Spectroscopic Method for Laboratory Analysis for Polymeric Coating.**

In this session, Ms. Lee covered the theoretical explanation about how FTIR works, its principle and simple demonstration on how sample of coating was tested to obtain its fingerprint signature. After that, Dr. Chan co-presented the FTIR results for samples of epoxy and hardener obtained from the many trials conducted on different epoxy and hardener samples supplied by local paint manufacturers. The presentation also covered the interpretation of all of the obtained spectra on the following hypothesis:

1. To check if FTIR can confirm homogeneity of epoxies and hardeners obtained from the top, middle and bottom of mixing tank using QCheck High sensitivity feature.
2. To check if FTIR can produce reproducible fingerprint of epoxies and hardeners of different batches.
3. To check if FTIR can provide signature print and correlation between different type of epoxies and polyurethane and hardeners.

The speaker concluded that reference FTIR spectra for epoxies and hardeners can be easily generated; homogeneity of epoxies and hardeners can be observed at the top, middle and bottom of the paint mixing tanks; results are batch-to-batch reproducible and FTIR could differentiate different types of epoxies and hardeners. This presentation

highlighted that fingerprinting of epoxies and hardeners using FTIR in the paint laboratory is possible, simple, reliable, and the results are reproducible.

Speaker 3	:	**Ms. Chow Mee Ling, Agilent Technologies Sales (M) Sdn. Bhd.**
Topic	:	**Advanced Technology for Polymeric Coatings – What is FTIR Mobile Measurement?**

The objective of this presentation is to highlight to the participants that it is possible for onsite assessment of polymeric samples by handheld FTIR spectrometer. Traditionally, polymeric samples are collected and brought to a laboratory for FTIR analysis. The rationale for the development of handheld FTIR spectrometer, i.e. a mobile measurement approach is to enable the analysing instrument to be brought directly to the site and the samples can then be assessed non-destructively. The software and hardware design of a handheld FTIR spectrometer enable both experienced and less experienced users to obtain the required data easily and quickly.

Speaker 4	:	**Ms. Nurul Asni Mohamed, Chairperson of IMM Task Force on Coatings Fingerprinting**
Topic	:	**Coatings Fingerprint Certificate for Every Batch Manufactured**

The objective of the presentation is to present to the audience a template of the Coating Fingerprint Certificate prepared by the Fingerprinting Task Force committee which was formed in April 2013.

The speaker shared the chronology of event on how Task Force on Coatings Fingerprinting was formed in 2013 and how the members have evolved where active participation was sought from various relevant stakeholders. Members of the task force committee consist of representatives from Oil and Gas companies (Petronas, Shell and ExxonMobil), paint manufacturers, SIRIM and scientific instrument specialists. Academicians from Universiti Teknologi MARA, Universiti Kebangsaan Malaysia and IMM are taking part as advisors for the task force. The speaker touch based on the available international standards and specification requiring fingerprinting of polymeric coatings and highlighted that the absence of clear guide in the existing standards on how and what should be reported in the coating fingerprint certificate which fits and satisfies all the key stakeholders.

The speaker presented that the results for different batches of samples are highly reproducible with 90.0% matching criteria. Additional tests were conducted for samples of different shelf life, different priced epoxies and pigments. The speaker presented a matching percentage of 75% for different grades of epoxy with small price difference and a matching percentage of 6% for different grades of epoxy with large price difference. In addition, a matching percentage of 49% was found for epoxy with 3 months and >2 years shelf lives. Thus, the speaker concluded that significant reduction in FTIR matching percentage can be attributed to the use of different grades and different shelf lives of epoxies. The speaker again proposed that the level of acceptance for QA & QC control is 90.0%.

Lastly, the tentative Coating Fingerprint Certificate for 2-component intermediate materials of epoxy coatings was presented. The speaker proposed that the FTIR testing shall be included in addition to the existing QA & QC tests.

Q&A Session

Q1. Assoc. Prof. Dr. Melissa Chan Chin Han from IMM asked paint manufacturer attendees about their opinion of adopting the Coating Fingerprinting Certificate into their future quality control procedure. Mr. Robert Lo Tung Ming (KCC) had responded that the FTIR method is indeed easy and doable.

Q2. Dr. Chew Khoon Hee (TAR-UC) asked the purpose of checking the homogeneity of the paint in the mixing tank using FTIR. Assoc. Prof. Dr. Melissa Chan Chin Han from IMM explained that the purpose of doing this is to double confirm the homogeneity of the mixing tank in the paint manufacturing process, in which paint samples acollected for various analyses and tests. In fact, the FTIR scan results obtained from paint samples provided by a paint company confirmed that the mixing is indeed homogeneous. Ir. Max Ong Chong Hup from IMM also added that the paint manufacturers would have focused very well in keeping the homogeneity of the paint mixing in the production.

The task force committee believed that homogeneity of the paint mixing is not an issue. However, the collection of paint samples from top, middle, and bottom of mixing tank is required for the FTIR scans, which can be a good reference if failure happens in future.

Q3. Ir. Max Ong Chong Hup (IMM) asked opinion from Mr. Muhd Hawari Hassan (PETRONAS GTS Dept), why despite all the vigorous checking and testings on the paints for prequalification by the oil companies there continue to be many paint failures prematurely on the oil & gas structures and facilities? Mr. Muhd Hawari answered that the reason of conducting various prequalification tests on the paints is to ensure that the correct paint systems will be specified for the designed applications. However, what is actually supplied to a project site has been assumed to be the correct type of paints specified. Now that the issue of possible incorrect paints being supplied to the project site has been highlighted, the initiative to fingerprint paints is most welcomed by the industry. Once the quality of paint is assured to be good through fingerprinting, then focus can be enforced on other aspects which need to be addressed more thoroughly, such as paint applications and so on.

The task force committee strongly believed that this Fingerprinting will help the paint user monitor the quality of paint supplied. At the same time, it can also help in eliminating problem and ensure good quality of paints and application.

Q4. Ms. Teng Hui Chung from Sarawak Shell Bhd. raised her concerns about the passing rate of more than 90.0% and the basis behind. Ms. Nurul Asni Mohamed, chairperson of IMM Task Force on Coatings

Fingerprinting, answered that the passing rate 90.0% was decided after many cycles of discussion among the task force members, including paint manufacturers, paint users, FTIR specialists, and academia. This passing rate is not available in any standard and IMM is the first party to initiate this standard. The task force committee believed that 90.0% would be a good starting point and it is subjected to further adjustment for better quality control in near future. Assoc. Prof. Dr. Melissa Chan Chin Han from IMM added that the random errors, such as sampling and handling of samples are taken into account. She emphasised that the correlation search algorithm of the FTIR software must depend on both *x*- (wavenumber) and *y*- (absorbance) vectors. In other words, the wavenumber represents structural components for organic materials, while the absorbance represents concentration of the organic materials. Ir, Max Ong Chong Hup from IMM added that currently they are looking at individual component of the intermediate materials of epoxy and hardener only.

The 90.0% is reasonable value as the matching ratio at this point in time. It is subjected to further revision in the future for further improvement by considering feedback from the paint manufacturers and users.

Q5. Mr. Terence Wee from PPG Malaysia raised his concern that the Coating Fingerprint Certificate may force paint manufacturers to buy raw materials from a single supplier/source. Attempt to achieve the standard may lead to the price increment along the supply chain.. This standard is to maintain the consistency of the paint supplied; although the failure may not due only to the quality of the paint supplied. Mr. Muhamad Azmi Mohd Noor, IMM Deputy President and PETRONAS agreed that there are many factors causing failures in paint coatings, including human and technical errors. The paint users have been suffering from coating failures for many years; therefore, criteria and specification of the paint supplied has to be tightened. Paint manufacturers need to identify more than one supplier of raw materials of the same quality and standard to comply with fingerprinting specifications

There are many factors affecting the failure of coatings. This is an issue of inconsistency; hence, this fingerprinting certificate is one way of reducing inconsistency. The price increment should be borne by the paint manufacturers.

Q6. Dr. Mohd Firdaus bin Yahaya from USM asked about the mode of scanning using the handheld FTIR and the depth of scanning for cured/uncured portion. Ms. Chow Mee Ling, Agilent Technologies Sales (M) Sdn. Bhd., answered that the handheld FTIR is for surface analyses, which is about 1- 2 mm depth. For checking the uncured portion of the polymeric coating, other testings, such as DSC and HPLC, will be more suitable. In addition, Assoc. Prof. Dr. Melissa Chan Chin Han from IMM also added that the FTIR fingerprinting spectra presented were obtained using ATR-FTIR, so they are referring to surface analyses of the samples.**The curing degree of the coatings is not the objective of the forum and task force. It can be considered as one of the future tasks.**

Q7. Mr. Theng Soo Siong from KCC Coatings Snd. Bhd. mentioned that the tolerance can also be affected by the pigment, such as PVC. He asked the task force members whether the samples tested are verified on the pigment (PVC) content. Assoc. Prof. Dr. Melissa Chan Chin Han from IMM answered that there is no clear information of the paint samples supplied by the paint manufacturers. The task force committee had just received general information of the paint samples. Among the samples received, including high and low pigment contents, the samples were verified using FTIR, discrepancies were detected if different pigments were used.

The Coating Fingerprinting Task Force acknowledges that there are many other factors to consider in the fingerprinting process and PVC is one of them. More areas need to be looked at in the future tasks of the Task Force. For the start, the implementation of the Coating Fingerprinting Certificate for Epoxy Coatings has been established and will form the basis for all other paints to be fingerprinted.

Q8. Mr. Yip Han Wei from Sarawak Shell Berhad asked whether the paint will work as expected if the test result achieved 90.0%. Assoc. Prof. Dr. Melissa Chan Chin Han from IMM clarified that the high correlation is to make sure the paint manufacturers supply what they had promised, so they can comply with the promised criteria for next and future products with high consistency. This correlation will not able to tell the performance of the coatings. Ms. Nurul Asni Mohamed, chairperson of IMM Task Force on Coatings Fingerprinting, added that the fingerprinting only for the manufacturing standpoint, other performance tests shall not be eliminated as per usual practice.

Fingerprinting is a QC tool like the Mill Certificate for Metal products. It will not guarantee the performance of the product. The Fingerprinting certifies that the product has been manufactured to the correct specifications. Performance of the product will depend on many other factors such as the correct application, environment, design, etc.

Rapporteurs:
Assoc. Prof. Dr. Chia Chin Hua, Universiti Kebangsaan Malaysia (leader)
Ms. Elizah Samat, Sarawak Shell Bhd.
Dr. Tan Winie, Universiti Teknologi MARA
Mr. Shahril Atiqi, PETRONAS GTS
Ms. Rohana Jaafar, PETRONAS GTS
Mr. Mohd Shaiful Sajab, Universiti Kebangsaan Malaysia
Mr. Chook Soon Wei, Universiti Kebangsaan Malaysia

Tentative Coating Fingerprint Certificate for 2-component intermediate materials of epoxy coatings

By Ms. Nurul Asni Mohamed,
Chairperson, IMM Task Force on Coatings Fingerprinting
Principal Engineer (Corrosion), Group Technical Solutions, Technical & Engineering Division, PETRONAS GTS, Malaysia.

Coating Fingerprint Certificate

Section 1: General Information

	Physical analyses		Structural analysis
Date of Issue:		**Base Material**	**Curing Agent (Hardener)**
Trade name			
Generic			
Manufacturer			
Batch number			
Production Date			
Shelf Life			

Section 2: Test Methods and Results

Parameters	Method	Specification (state method used)	Result	Specification	Result
Viscosity	ASTM D4287 ASTM D5125 ASTM D562 ISO 288ISO 2431 4-1				
Density	ISO 2811-4				
Colour Code	BS 4800 OSHA				
Infrared spectra (Wet sample as supplied in can)	ASTM D7588	600-4000 cm^{-1} (matching criteria ≥90.0%)		600-4000 cm^{-1} (matching criteria ≥90.0%)	
	ASTM D7588	1000-1300 cm^{-1} (matching criteria ≥90.0%)		1000-1400 cm^{-1} (matching criteria ≥90.0%)	
	ASTM D7588	700-900 cm^{-1} (matching criteria ≥90.0%)			
Non-volatile matter (by mass)	ISO 3251				
Weight Solid: Zn metal/Total Zn Note: submit certificate of % purity by manu-facturer	ISO14680-2				

Section 3: FTIR Test Details (as per ASTM D7588)				
Analyst/Company Name				
Brand & Model of FTIR				
ATR Crystal Material				
Spectral Correction (e.g. automatic baseline correction)				
Spectral Range (cm^{-1})				
No. of Sample Scans (min 32)				
Resolution (min 4 cm^{-1})				
Correlation search algorithm for matching % in absorbance mode	**Note:** Correlation search algorithm of the FTIR software must depend on both *x*- (wavenumber) and *y*- (absorbance) vectors.			
	Dependence on *x*-vector (wavenumber / cm^{-1})	YES / NO	Dependence on *y*-vector (absorbance / a.u.)	YES / NO
Trade name and batch number of reference spectrum for Base Material (Epoxy)				
Trade name and batch number of reference spectrum for Curing Agent (Hardener)				

Note:

1. Full range of FTIR spectra for both Base and Hardener after automatic baseline correction and in absorbance mode are to be attached with this report (raw data).
2. Compliance to matching criteria values does not exclude meeting the requirements of other QA/QC checks e.g. drying time, gloss, hiding power etc.
3. Methods used shall reference latest published documents.
4. Authorised QA/QC Executive,
   [Signature & Date]

INDICATIVE COSTING FOR FTIR FINGERPRINTING ON COSTINGS FINGERPRINTING

The Task Force on Coatings Fingerprinting has calculated an indicative costing for the testing of paint batches using the FTIR method as follows:-

Option 1 (Paint Manufacturer In-house Laboratory)

Cost of FTIR-ATR equipment = RM150,000.00 amortized over 10 years
Durability = RM15,000.00 per year.
Annual equipment maintenance cost = RM2,000.00
Laser source replacement every 3 years = RM2,00.00 per year equivalent.
One technician cost = RM24,000.00 per year.
Airconditioning & electricity = minimal impact.
Total cost per year = RM43,000.00
Average paint production per year = 2,000,000 litres.
Average number of paint production batches per year = 2,000.

Testing cost per batch = RM21.50
Testing cost per litre = RM0.02 i.e. 2 sen.

Option 2: Testing by 3rd Party Laboratory

Universities / SIRIM / Private Laboratories = RM100.00 per sample.
Based on smallest batch size of 1,000 litres,
cost per litre = **RM0.10 i.e. 10 sen.**

NEW FACE IN MTE

Ainil Fidrah Mohd Ghazali is the new Manager – Conference, Events & Publications Division in Material Technology Education (MTE) Sdn Bhd. She has over 17 years of work experience in various companies in various industries. Being a global professional she has vast experience of working at Japanese MNCs based in Malaysia as well as in Japan. Her work experience were mostly related to project management and some of the industries that she has served were manufacturing, foreign government institution, Business Process Outsourcing and education consultancy. She is well versed in Japanese Language as well as Japanese Culture. Her skills includes project management, data analysis, training development and Japanese language interpretation as well as translation. She's an avid outdoor person who loves nature and adventurous activities .

Business Opportunities in the Sabah Oil & Gas Indusry

Reported by Kirk Keng Chuan, Materials Technology Education

IMM Miri Chapter Meets

Miri, 17th June 2014

The IMM Miri Chapter met during a dinner with special guests Kho Yok Chong, Tom Richi Jong, Ngan Diong Tung and Wong Yie Chiew in attendance. The chairman, Ir. Dr. Edwin Jong, briefed the meeting on the various development and IMM events which included the new lineup of the IMM council for the 2014-2016 session, 9th International Materials Technology Conference and Exhibition (IMTCE2014) and the meeting at the Asian Welding Federation in Tokyo.

Members present were informed and advised to participate in the bigger and better IMTCE2016 which will be held at the Putra World Trade Centre in Kuala Lumpur in May 2016, where 100 exhibitors are expected.

The Miri chapter will organise the 5th Regional Materials Technology Conference and exhibition in 2015. Desmond Chin, the Organising Chairman, will advise of the venue and date of this event soon.

As there is a high demand for the Welding Engineer training programme offered by Japanese Welding Engineering Society (JWES) in Miri, IMM has been requested to organise the programme in Miri in October 2014.

Miri, 18th June 2014

IMM paid a courtesy visit to Ruzlan Bin Hashim of PETRONAS Carigali Sdn Bhd. Abang Adenan was present when discussions cntred on the training needs. IMM has served and met the various training courses to PETRONAS Group of companies over the years.

IMM Sabah Chapter Meets

Kota Kinabalu 18th June 2014

The Institute of Materials, Malaysia hosted a dinner for the IMM Sabah chapter on 18th June 2014 when the Ir. Abd Razak Abu Hurairah (Hon. Secretary), Ir. Suradi Yasin (Hon. Treasurer) and Ir. Max Ong (Chairman of the Education Committee) were in Kota Kinabalu to support the jointly organised seminar on Business Opportunities in the Sabah Oil & Gas Industry.

Kota Kinabalu, 19th June 2014

A one-day seminar on "Business Opportunities in the Sabah Oil & Gas Industry" was jointly organised by the Institute of Materials, Malaysia, Institution of Engineers, Malaysia (Sabah Branch) and Society of Petroleum Engineers in Kota Kinabalu, Sabah on 19th June 2014. Members of the audience were mainly engineers, contractors, suppliers, service providers and businessmen.

This seminar highlighted current and future development in the oil and gas sector in Sabah. It seeks to assist Sabahan professionals, engineers and businessmen gain knowledge of available technical training programs and business opportunities that exist in the growing oil and gas industry in the state. Topics covered included an update of PETRONAS activities, opportunities in projects, operation, maintenance, the field of corrosion and coatings, and training.

The presenters were Ir. Abd Razak Abu Hurairah (Honorary Secretary of IMM), Yii Ming Sing (Chairman of IMM Bintulu Chapter), Ir. Mohamed Firouz Asnan (Head, PETRONAS Sabah Operations) and Dr. Dasline Sinta of CEO and Principal Consultant (Oil & Gas) for Dream Catcher Energy

Following the seminar, several participants made a technical visit to the Sabah Oil and Gas Terminal (SOGT) in Kimanis. SOGT is an important catalyst to the Oil and Gas Industry in Sabah. The visit was hosted with the courtesy of Petronas Carigali Sdn Bhd. Jeffrey Ngau Uvang, IMM Sabah Chapter Committee Member, served as the guide during the visit.

Attentive audience at the seminar

Eye-opener: Participants at the visit to the Sabah Oil and Gas Terminal, Kimanis

Technical article 1

FTIR structural analysis of epoxy paints on steel structure for coating fingerprinting certificate as benchmark for paint industry

CHAN Chin Han[1*], Max **ONG** Chong Hup[2], **TAN** Winie[1], Mohamad Kamal HARUN[1], **LEE** Jia Yin[3]
[1]Universiti Teknologi MARA, Faculty of Applied Sciences, 40450 Shah Alam, Selangor, Malaysia
E-mail: cchan@salam.uitm.edu.my and cchan_25@yahoo.com.sg (*corresponding author)
tan_winie@yahoo.com, mkharun@gmail.com
[2]Norimax Sdn Bhd, 2, Jalan TPP 5/17, Taman Perindustrian Puchong, Seksyen 5, 47160 Puchong, Selangor, Malaysia
E-mail: maxong54@gmail.com
[3]Research Instruments (M) Sdn. Bhd., D7-1-G, Block D7, Pusat Perdagangan Dana 1, Jalan PJU 1A/46, 47301 Petaling Jaya, Selangor, Malaysia
Email: michelle.lee@ri.com.my

Abstract

Most of the oil and gas companies in Malaysia are facing challenge to ensure the fabrication & construction works are carried out in full compliance to the specifications. The general phenomenon is the jobs or projects offered by the oil and gas companies are secured at rock-bottom prices by the suppliers. The question is: has it been possible to maintain (or improve) the quality of the jobs despite the challenge of lower prices or sometimes below the cost prices of suppliers. One of the identified and common challenges for the oil and gas companies is the failure of polymeric coatings on steel structures, which has led to huge cost of repainting jobs. This progressive study showcases the practicality and simplicity of the provision of **Coating Fingerprint Certificate** for 2-component epoxy coatings for the supply of polymeric coatings from local paint manufacturers as quality assurance requirement of the coatings supplied. This will reduce the possibility of failures of the polymeric coatings and hence enhance the quality, integrity and safety. Fourier-transform infrared (FTIR) is a simple and reliable tool for the study of reproducibility of the epoxies and hardeners as well as to differentiate different types of epoxies and hardeners without any intrusion of paint formulations. Simple (and software assisted) step-by-step guides are proposed in this work for the generation of reference FTIR spectrum from one sample, which subsequently is used to estimate the degree of similarity (r) with the FTIR spectra from other samples. We note here, FTIR can be used to fingerprint different types of coatings. In other words, FTIR structural analysis shall be extended to inorganic zinc coating, epoxy-zinc coating, polyurethane coating, acrylic coating, polyester coating etc.

Introduction

The urge for provision of **Coating Fingerprint Certificate** for polymeric coatings supplied to the oil and gas companies soars since 2000 in Malaysia. This is the consequence of the users of the oil and gas companies suffering from high cost of repainting the steel structures and pipelines when the coatings fail. One of the attributing factors for the failure of the coatings is the reformulation of polymeric coatings or in other words adulterated polymeric coatings supplied, where the quality of the coatings deviates from the submitted specifications for prequalification and tender purpose.

The background for the urgent call of **Coating Fingerprint Certificate** for polymeric coatings from the oil and gas companies and the up-to-date progress of the FTIR structural analysis of epoxy paints initiated by Institute of Materials, Malaysia (IMM) are summarized in Table 1.

We note here, the complete **Coating Fingerprint Certificate** for polymeric coatings consist of two parts, *i.e.* **(1)** physical analyses (e.g. viscosity, solids, specific gravity, opacity, finess-of-grind, pigment-volume-concentration, adhesion test, pencil hardness test, color etc. are performed in the in-house laboratory during the paint manufacturing process [1]) and **(2)** structural analysis by Fourier-transform infrared (FTIR) (which shall be carried out immediately after each batch of the production in the paint factory).

We direct our discussion on the structural analysis by FTIR on polymeric coatings in this study. Previous study on single-component systems (the color organic pigment) and multi-component systems (the epoxy paints) [2] concludes that different chemical structures of the four yellow color organic pigments and different paint formulations of the two epoxy paints can be deduced by referring to the fingerprint region of FTIR spectra.

There are existing standards on sampling standards of the intermediate materials of the polymeric coatings from the mixing tank immediately after each batch of the production in the paint factory, e.g. ASTM D3025-02 [3], ISO 1513 [4], ISO 15528 [5] and so on. To fingerprint polymeric coatings, ASTM D7588-11 [6] standard is followed. As mentioned before [2], there is lack of guide in ASTM D7588-11 for the interpretation of FTIR spectra, *i.e.* the practical approaches on estimation of the degree of similarity between two FTIR spectra for the same or different polymeric coatings.

Intermediate materials of epoxy resin (or base) and hardener (or curing agent) were studied. The objectives of this study are:

1. To generate the *reference FTIR* spectra from **T**op, **M**iddle and **B**ottom of the mixing tanks from Batch 1 for epoxies and hardeners.

2. To check the homogeneity of epoxies and hardeners at **T**op, **M**iddle and **B**ottom of the mixing tanks by estimation of correlation (or degree of similarity) (r) using *QCheck High Sensitivity* feature by Thermo Nicolet FTIR at fingerprinting regions.

3. To check the reproducibility of the epoxies and hardeners of Batch 2 as compared to Batch 1 by estimation of correlation (r).

4. To estimate the correlation (r) for Epoxy1 as compared to other two different epoxies or polyurethane (PU).

5. To estimate the correlation (r) for Hardener1 as compared to other two different Hardeners or isocyanate (CNO).

Although numerous FTIR analyses were carried out on various epoxy, hardener, PU and CNO coating samples, this paper highlights the results of the FTIR analyses on selected samples.

Table 1 Background of **Coating Fingerprinting Certificate**

Years	Description
1970s & 1980s	The oil and gas industry used to blame the blasters & painters for paint failures.
1980s	The Steel Structures Painting Council "SSPC" in USA, the authority on Paints worldwide, proposed to the industry to develop "surface-tolerant coatings" *i.e.* an epoxy coating which can be applied on not-so-well prepared steel surfaces and yet can perform for >10 years offshore. *Why?* the blasters and painters were not very educated people and there were no proper training programs those days, the industry decided to take this direction to improve painting quality.
Late 1980s	The major international anti-corrosion paint manufacturers such as Ameron, International Paints, Sigma, Jotun and Hempel developed excellent surface-tolerant epoxy coatings which performed for >10 years offshore in USA, Europe & Asia.
1990s	Stiff competition amongst all these manufacturers because of many new-comers (PPG, Berger, Sherwin-Williams, Leighs, Corrocoat, Crown, etc), the prices of the surface-tolerant epoxies fell year after year, and paint failures became a norm. The blame continued to be put on the blasters & painters.
1999	PETRONAS and IMM initiated the **IMM Blaster & Painter Certification** Program to improve the skills of the blasters & painters. The **IMM Coating Inspector Certification** program was also conducted to help the blaster & painters improve quality of paints applied. Hence, "surface preparation & application" and quality assurance & quality control measures were enhanced. Despite these efforts, paint failures continue both onshore & offshore in the oil and gas facilities.
1997-2000	During the "Cost Reduction Alliance" or "CORAL", the concern of paint product quality was raised if paint companies begin to drop their product prices. A preliminary proposal to initiate a "mill certificate" for protective coatings in the oil and gas industry was not supported by the paint manufacturers. *Why?* 2 key reasons **(i)** international paint companies have a reputation to upkeep and will never adulterate or change paint formulation abruptly & **(ii)** it was impossible or too time-consuming & too costly to try to produce mill certificates for every production batch unlike metal products.
2000 - now	The industry has seen numerous cases of paint product price-dropping below production costs and poor performance of protective coatings. Coatings which passed the Qualification Tests of PETRONAS, Shell & ExxonMobil have often failed within months or less than 2 years after commissioning of a facility when they are supposed to perform for more than 5 years. Much of the blame continues to be aimed at the surface preparation & application. As such, it would appear that the products approved after the qualification testing, despite improved QA/QC on surface preparation & application can still perform poorly. The urge for provision of **Coating Fingerprint Certificate** for polymeric coatings supplied to the oil and gas companies soars.
22nd March 2013	*Forum on "Towards Fingerprinting of Polymeric Coatings" I* **Question asked: Can we fingerprint polymeric coatings?** Highlighted the prime concerns of the local paint manufacturers, e.g. the protection of product formula, lack of expertise on spectroscopic analyses and interpretation of results. The users of the oil and gas companies suffer from high cost of repainting the steel structures and pipelines when the coatings fail.
April 2013	A Task Force on Coatings Fingerprinting formed. The end deliverable of this Task Force is to enhance the overall painting coating quality assurance [7, 8].
11th October 2013	*Forum on "Towards Fingerprinting of Polymeric Coatings" II* [9, 10] Fingerprinting of intermediate materials of epoxy coatings, i.e. epoxy resin (or base) and hardener (or curing agent) using FTIR spectrometer is possible and reliable. The FTIR spectroscopy testing shall be performed on these intermediate materials **immediately after production in the paint factory**, in addition to the standard quality control tests conducted on the produced intermediate materials. Presentation of the draft of the **Coating Fingerprint Certificate** by Chairperson of the Task Force, Ms. Nurul Asni Mohamed from PETRONAS GTS was attempted.
20th June 2014	*Final Forum on "Towards Fingerprinting of Polymeric Coatings" III* Fingerprinting of intermediate materials of epoxy coatings, i.e. epoxy resin (or base) and hardener (or curing agent) using FTIR spectrometer is reliable and reproducible. Fingerprinting regions of FTIR for epoxy resin and hardener are proposed and the **confidence level of acceptance** for QA & QC control is proposed at **≥ 90%.**

Experimental

FTIR sample collection

Polymeric coatings, *i.e.* epoxy resin (or base) and hardener (or curing agent) from local Paint Manufacturer A were analyzed. A total of 3 samples/batch or 3 samples/mixing tank with minimal of 50 g of sample mass for epoxy resin as well as hardener were supplied. Sampling of samples at the end stage of production (before packing) shall be done from **T**op, **M**iddle and **B**ottom of the mixing tanks (refer to Figure 1). Samples were sent for FTIR analysis within 4 days after sample collection. A total of 2 batches of samples were used for this study on the reproducibility of the results. These samples were analyzed as received. Summaries of epoxy and hardener samples were depicted in Tables 2 and 3. By visual inspection, the three different epoxies are opaque and the three different hardeners are translucent as displayed in Figures 2 and 3.

Epoxy_**B***x***T**(or **M** or **B**)*y-z* denotes epoxy resin of x^{th} **B**atch for y^{th} sample at the location of **T**op (or **M**iddle or **B**ottom) and with the z^{th} FTIR scanning. Analogue sample coding was adopted for Hardener_ **B***x***T**(or **M** or **B**)*y-z*.

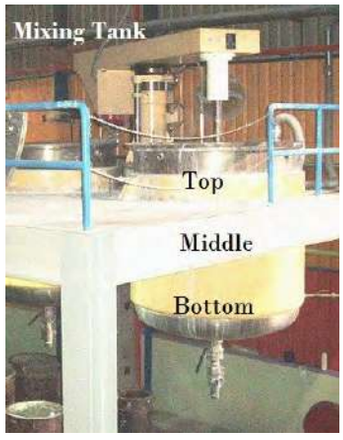


Figure 1 Mixing tank of the immediate material (e.g. epoxy or hardener)

Table 2 Epoxy samples from Paint Manufacturer A

Sample code	1st Batch Date received (*analysis date*)	2nd Batch Date received (*analysis date*)
Epoxy1_B1B1	7/3/14 (*11/3/14*)	
Epoxy1 _B1M1		
Epoxy1 _B1T1		
Epoxy1 _B2B1		13/3/14 (*13/3/14*)
Epoxy1_B2M1		
Epoxy1_B2T1		
Epoxy2_B1B1	7/3/14 (*11/3/14*)	
Epoxy2_B1M1		
Epoxy2_B1T1		
Epoxy2_B2B1		13/3/14 (*13/3/14*)
Epoxy2_B2M1		
Epoxy2_B2T1		
Epoxy3_B1B1	7/3/14 (*11/3/14*)	
Epoxy3_B1M1		
Epoxy3_B1T1		
Epoxy3_B2B1		13/3/14 (*13/3/14*)
Epoxy3_B2M1		
Epoxy3_B2T1		

Table 3 Hardener samples from Paint Manufacturer A

Sample code	1st Batch Date received (*analysis date*)	2nd Batch Date received (*analysis date*)
Hardener1_B1B1	7/3/14 (*11/3/14*)	
Hardener1_B1M1		
Hardener1_B1T1		
Hardener1_B2B1		13/3/14 (*13/3/14*)
Hardener1_B2M1		
Hardener1_B2T1		
Hardener2_B1B1	7/3/14 (*11/3/14*)	
Hardener2_B1M1		
Hardener2_B1T1		
Hardener2_B2B1		13/3/14 (*13/3/14*)
Hardener2_B2M1		
Hardener2_B2T1		
Hardener3_B1B1	7/3/14 (*11/3/14*)	
Hardener3_B1M1		
Hardener3_B1T1		
Hardener3_B2B1		13/3/14 (*13/3/14*)
Hardener3_B2M1		
Hardener3_B2T1		

Epoxy1 **Epoxy2** **Epoxy3**

Figure 2 Three different epoxies (50 g each)

Hardener1 **Hardener2** **Hardener3**

Figure 3 Three different hardeners (50 g each)

FTIR analysis

Spectroscopic studies were performed on the intermediate materials of polymeric coatings, *i.e.* epoxy resin and hardener independently. FTIR analysis was carried out using the Attenuated Total Reflection accessory (ATR) on Nicolet iS5 (Madison, UK). FTIR spectra were recorded in the transmittance mode over the range of 600 - 4000 cm^{-1} by averaging 32 scans at a maximum resolution of 4 cm^{-1}.

Triplicate analysis for each sample was carried out, where a fresh sample was used for each analysis. The material of ATR crystal is Diamond coated with ZnSe germanium. The spectra of FTIR were analyzed by OMNIC Software Suite (Madison, UK).

Quality control of the intermediate materials

Absorbance spectra were baseline corrected. The "average" FTIR spectrum of sample from **T**op, **M**iddle and **B**ottom of the mixing tank was adopted as the reference spectrum. The degree of similarity, which is termed as *correlation* (*r*), of a spectrum was generated by comparing the spectra of the samples to that of the reference using the *QCheck High Sensitivity* feature of the FTIR software. Brief description of *QCheck High Sensitivity* feature is discussed in Appendix A. We emphasize here, high sensitivity feature (or equivalent, where the correlation search algorithm of the FTIR software shall depend on both *x*- (wavenumber) and *y*- (absorbance) vectors) should be used in all cases for the purposes of quality assurance and quality control. Quantities *r* (from 0 to 1) were estimated firstly for spectrum with wavenumbers from **(i)** 600 - 4000 cm^{-1}, and subsequently from **(ii)** 1000 – 1300 cm^{-1} (C-O-C) & **(iii)** 700 – 900 cm^{-1} (C-O-C) for epoxy resin; and **(iv)** 1000 – 1400 cm^{-1} (C-N) for hardener. Degree of similarity is directly proportional to quantities of *r*, i.e. $r = 1$ represents complete matching of the sample spectrum to that of the reference spectrum.

Results and discussion

Generation of reference FTIR spectrum from Top, Middle and Bottom of the mixing tank

ASTM D7588-11 is limited to the scope of FTIR analysis as described in sub-section of FTIR analysis. It is silent on the generation of reference spectrum to be used for the comparison of the degree of similarity between two FTIR spectra and the appropriate fingerprint regions for different samples. Moreover, nothing is mentioned on the confidence level of the acceptance of a sample for the purpose of quality assurance and quality control. Here, we firstly propose a reliable and simple approach to generate the reference FTIR spectrum from **T**op, **M**iddle and **B**ottom of the mixing tank.

After automatic baseline correction, the spectra in transmittance mode shall be converted to absorbance mode (which can be done easily by using any commercial FTIR software). The three spectra from **T**op, **M**iddle and **B**ottom were "averaged" using the commercial FTIR software for the generation of reference spectrum. A step-by-step guide of the procedure is revealed in Appendix B.

Homogeneity of epoxies and hardeners at Top, Middle and Bottom of the mixing tanks

The degree of similarity (*r*) (in term of paint formulation), of Epoxy1_B1 collected from **T**op, **M**iddle and **B**ottom of the mixing tank was generated by comparing the spectra of the sample to that of the reference spectrum (Epoxy1_B1) using the *QCheck High Sensitivity* feature of the FTIR software. Quantities *r* were estimated firstly for spectrum with wavenumbers from i) 650 - 4000 cm^{-1} (the whole spectrum), and subsequently from **(ii)** 1000 – 1300 cm^{-1} (C-O-C) & **(iii)** 700 – 900 cm^{-1} (C-O-C) for epoxy resin; and are tabulated in Table 3. A simple step-by-step guide of the procedure is revealed in Appendix C.

The quantities *r* in this study may be correlated to the paint formulation. It is relatively common to set $r \geq 0.90$ as the acceptable tolerance in order to suggest the similarity of different samples or different batches of similar samples. By taking in all the considerations of the random errors derived from the operator performing the analysis, consistency of sample preparation, allowing the paint manufacturers to adjust paint rheology by using solvents etc.; quantity $\boldsymbol{r \geq 0.90}$ is proposed as the acceptable tolerance in this case.

For the whole FTIR region [Figures 4(a)] and fingerprinting regions [Figures 4(b) and 4(c)], quantities $r \geq 0.90$ are noted for Epoxy1_B1 (as well as for Epoxy1_B2) collected from **T**op, **M**iddle and **B**ottom of the mixing tank as compared to Reference for Epoxy1_B1 (or Epoxy1_B2). In other words, all epoxies are homogenous in the mixing for Epoxies 1, 2 and 3 for Batches 1 and 2 at different locations of **T**op, **M**iddle and **B**ottom of the mixing tanks.

The FTIR spectra of Hardener1_B1 for whole region [Figure 5(a)] and fingerprint region [Figure 5(b)] are shown. Referring to Table 4, quantities $r \geq 0.90$ are recorded for Hardeners 1, 2 and 3 for Batches 1 and 2 at different locations of **T**op, **M**iddle and **B**ottom of the mixing tanks. Hence, all hardeners are homogenous in the mixing tanks.

Table 3 Estimation of *r* for Reference Epoxy1_B1 to Epoxy1_B1**T**(or **M** or **B**) for 1st FTIR scanning

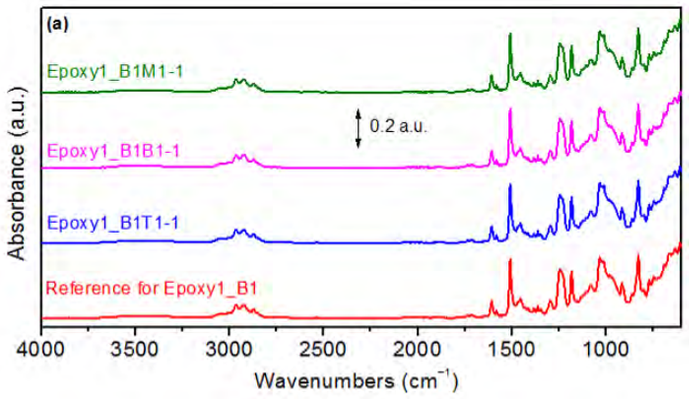
Sample code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1300 cm^{-1} **(C-O-C)**	*r* 700 – 900 cm^{-1} **(C-O-C)**	Reference spectrum used
Epoxy1_B1B1	0.996	0.9996	0.9997	Reference for Epoxy1_B1
Epoxy1 _B1M1	0.991	0.999	0.9996	
Epoxy1 _B1T1	0.987	0.999	0.999	
Epoxy1 _B2B1	0.997	0.999	0.999	
Epoxy1_B2M1	0.994	0.997	0.999	
Epoxy1_B2T1	0.993	0.999	0.997	

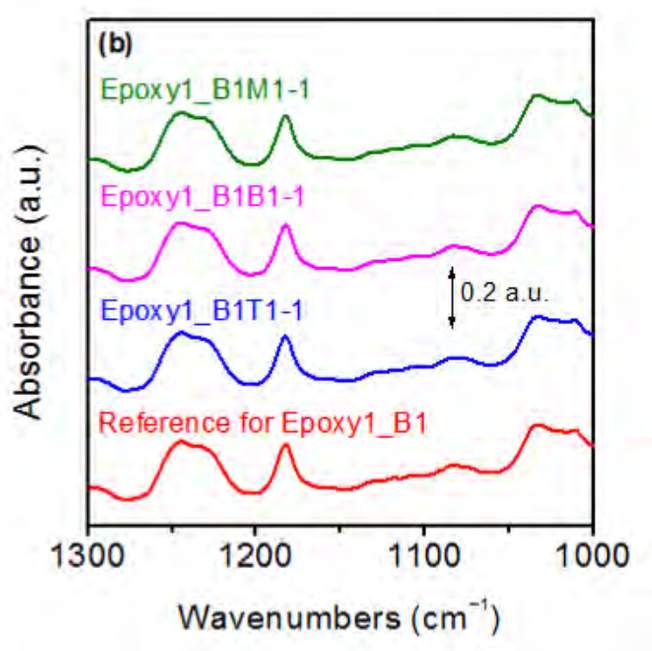
Table 4 Estimation of *r* for Reference Hardener1_B1 to Hardener1_B1**T**(or **M** or **B**) for 1st FTIR scanning

Sample code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1400 cm^{-1} **(C-N)**	Reference spectrum used
Hardener1_B1B1	0.995	0.9998	Reference for Hardener1_B1
Hardener1_B1M1	0.993	0.999	
Hardener1_B1T1	0.993	0.999	
Hardener1_B2B1	0.998	0.9997	
Hardener1_B2M1	0.994	0.9995	
Hardener1_B2T1	0.994	0.9996	

Reproducibility of the epoxies (or hardeners) of Batch 2 as compared to Batch 1 by estimation of r

One of the prime concerns from paint manufacturers is the reliability and the reproducibility of the estimation of degree of similarity of paints by FTIR with similar paint formulations but from different batches.





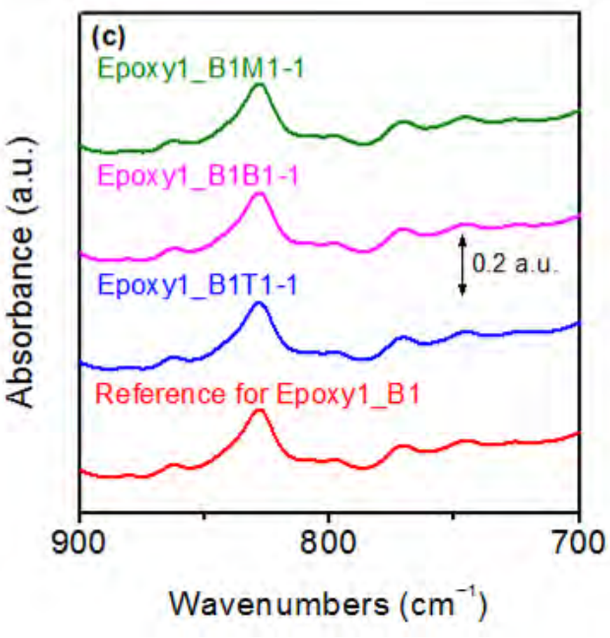


Figure 4 Comparison of Reference Epoxy1_B1 to Epoxy1_B1**T**(or **M** or **B**); (**a**) whole region and; (**b**) **&** (**C**) fingerprint regions

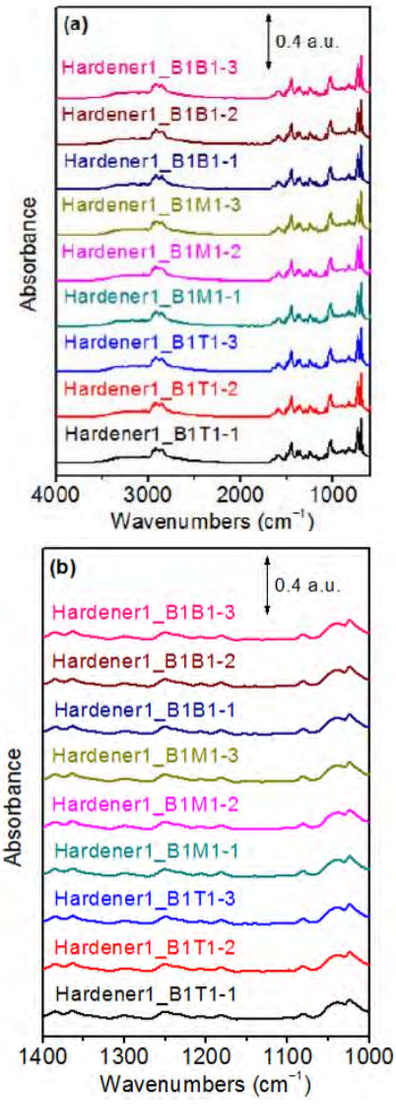


Figure 5 FTIR spectra of Harderner1_B1 for (**a**) whole region and (**b**) fingerprint region

With reference to Tables 5 and 6, quantities $r \geq 0.90$ are recorded for Epoxies (or Hardeners) 1, 2 and 3 when Batch 1 was compared to Batch 2 at different locations of **T**op, **M**iddle and **B**ottom of the mixing tanks. Results of Batch 1 and Batch 2 for all epoxies (hardeners) are reproducible. In short, fingerprinting of polymeric coatings using FTIR spectrometer is possible and reliable.

Table 5 Estimation of *r* for Reference Epoxy_B1 to Epoxy_B2**T**(or **M** or **B**)

Sample code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1300 cm^{-1} (C-O-C)	*r* 700 – 900 cm^{-1} (C-O-C)	Reference spectrum used
Epoxy1 _B2B1	0.979	0.991	0.991	Reference for Epoxy1_B1
Epoxy1_B2M1	0.979	0.991	0.992	
Epoxy1_B2T1	0.982	0.993	0.995	
Epoxy2 _B2B1	0.982	0.992	0.980	Reference for Epoxy2_B1
Epoxy2_B2M1	0.979	0.995	0.979	
Epoxy2_B2T1	0.969	0.995	0.978	
Epoxy3 _B2B1	0.989	0.995	0.995	Reference for Epoxy3_B1
Epoxy3_B2M1	0.986	0.997	0.987	
Epoxy3_B2T1	0.973	0.992	0.978	

Table 6 Estimation of *r* for Reference Hardener_B1 to Hardener_B2**T**(or **M** or **B**)

Sample code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1400 cm^{-1} **(C-N)**	Reference spectrum used
Hardener1_B2B1	0.994	0.997	Reference for Hardener1_B1
Hardener1_B2M1	0.988	0.996	
Hardener1_B2T1	0.976	0.992	
Hardener2_B2B1	0.947	0.987	Reference for Hardener2_B1
Hardener2_B2M1	0.926	0.987	
Hardener2_B2T1	0.900	0.982	
Hardener3_B2B1	0.977	0.997	Reference for Hardener3_B1
Hardener3_B2M1	0.972	0.996	
Hardener3_B2T1	0.963	0.998	

To estimate the of r for Epoxy1 as compared to Epoxy2, Epoxy3 and PU

Epoxy1, Epoxy2, Epoxy3 and poly(urethane) (PU) are with different paint formulations. Without the intrusion of the paint formulation, the FTIR spectra of the samples reveal the dissimilarity of the paint formulation for these samples (c.f. Table 7) with $r < 0.90$. Values of *r* (less than 0.1) of PU are extremely low, because the chemical structures of the main ingredients of PU are of marked difference as compared to that of the epoxy. We suggest here, FTIR analysis is a simple tool to differentiate different types of epoxies; and between epoxy & PU.

Table 7 Estimation of *r* for Reference Epoxy1_B1 to Epoxy2, Epoxy 3 and PU

Sample code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1300 cm^{-1} **(C-O-C)**	*r* 700 – 900 cm^{-1} **(C-O-C)**	Reference spectrum used
Epoxy2 _B1	0.5	0.5	0.5	Reference for Epoxy1_B1
Epoxy3_B1	0.6	0.8	0.6	
PU_B1	0.05	0.07	0.06	

Estimate the of r for Hardener1 as compared to Hardener2, Hardener3 and NCO

Hardener1, Hardener2, Hardener3 and isocyanate (NCO) are with different paint formulations. Again, FTIR analyses is a simple tool to differentiate different types of hardeners; and between hardener & NCO with $r < 0.90$ (c.f. Table 8)

Table 8 Estimation of *r* for Reference Hardner1_B1 to Hardener2, Hardener3 and NCO

Sample code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1400 cm^{-1} **(C-N)**	Reference spectrum used
Hardener2_B1	0.3	0.2	Reference for Hardener1_B1
Hardener3_B1	0.3	0.1	
NCO_B1	0.04	0.002	

Conclusion

We conclude here, the structural analysis by FTIR for complete **Coating Fingerprint Certificate** for epoxy resin and hardener is practical, simple and reproducible. Fingerprint regions for epoxy and hardener are recommended in this study. We summarize our findings as below:

1. **Reference FTIR** spectra for epoxies and hardeners can be easily generated.
2. **Homogeneity of epoxies and hardeners** can be observed at **T**op, **M**iddle and **B**ottom of the mixing tanks for Paint Manufacturer A.
3. **Reproducibility of the epoxies and hardeners** of Batch 2 as compared to Batch 1 is recorded.
4. **FTIR** is a **simple and reliable tool** to differentiate different types of epoxies, hardeners, epoxy with PU and hardener with NCO.

Currently, the 2-component epoxy coating was used in the evaluation of the practicality of the structural analysis by FTIR for complete **Coating Fingerprint Certificate.** We note here, this FTIR analysis shall not be limited to 2-component epoxy coating, but has to be extended to inorganic zinc coating, epoxy-zinc coating, polyurethane coating, acrylic coating, polyester coating etc. FTIR can be used to fingerprint all these types of coatings. Progressive reports of the FTIR fingerprinting studies on these types of coatings will be published in the forthcoming issues of Materials Mind.

Acknowledgement

The authors gratefully acknowledge the research funding by Knowledge Transfer Programme Grants [100-CAN(ICAN/AIC.37/2/14) provided by Ministry of Education for parts of the experimental works. Special thanks go to Dr. Chew Kong Chin from Becker Industrial Coatings (M) Sdn. Bhd., who provided useful tips and consideration in selection of fingerprint regions for epoxy and hardener.

References

Note: all the documents related to the background of "Coating Fingerprint Certificate" can be viewed at http://www.iomm.org.my/v1/index.php/fingerprint

1. Mills, D.J., *Laboratory testing of anti-corrosive paints.* Corrosion Management, 2000. **36**: p. 10-15.
2. Chan, C.H. and Teo, Y.Y., *Forurier-transform infrared analysis of polymeric coatings as benchmark for paint industry*, in *Materials Mind*. 2013, Institute of Materials, Malaysia: Selangor, Malaysia. p. 21-23.
3. ASTM D3925 - 02, *Standard practice for sampling liquid paints and related pigmented coatings*. 2010, ASTM International: United States.
4. ISO 1513:2010(E), *Paint and varnishes - Examination and preparation of test samples*. 2010, The International Organization for Standardization: Switzerland.
5. ISO 151528:2013(E), *Paints, varnishes and raw materials for paints and varnishes - Sampling*. 2013, The International Organization for Standardization: Switzerland.
6. ASTM D7588 - 11, *Standard guide for FT-IR fingerprinting of a non-aqueous liquid paint as supplied in the manufacturer's container*. 2011, ASTM International: United States.
7. Asni, N., *Coatings fingerprint certificate*, in *Materials Mind*. 2013, Institute of Materials, Malaysia: Selangor, Malaysia. p. 13.
8. Asni, N., *Coatings birth certificate*, in *Materials Mind*. 2013, Institute of Materials, Malaysia: Selangor, Malaysia. p. 11.
9. Chia, C.H., Winie, T., Samat, E., M Sharip, M.S.A., and Jaafar, R., *Fingerprinting forum rapporteurs report*, in *Materials Mind*. 2013, Institute of Materials, Malaysia: Selangor, Malaysia. p. 17-20.
10. Ong, M.C.H., *Fingerprinting Forum II in Johor*, in *Materials Mind*. 2013, Institute of Materials, Malaysia: Selangor, Malaysia. p. 14-16.

Biodata

CHAN Chin Han is an associate professor at Universiti Teknologi MARA, Malaysia. Her research interest is devoted to physical properties of macromolecules. She was appointed as Visiting Scientist at China University of Petroleum, Beijing, China (2011 – 2012), as Chair Professor on Advances in Hybrid Materials at Mahatma Gandhi University, Kottayam, India (2014), National Representative (Malaysia) of Intertional Union of Pure and Applied Chemistry (IUPAC) for Polymer Division (2014-2015) etc. She has been one of the editors of Malaysian Journal of Chemistry, Berita IKM – Chemistry in Malaysia, Deputy Editor of Materials Mind of Institute of Materials, Malaysia and books published by Royal Society of Chemistry (2013) and Apple Academic Press (2014) (distributed by CRC Press).

Ir. Max ONG Chong Hup graduated from Queen Mary University of London in 1977 with B.Sc.(Hons) in Materials Engineering. He has over 30 years experience in Corrosion Control covering Protective Coatings, Decorative Paints, Cathodic Protection, Corrosion Monitoring & Inspection, Fire Proofing Coatings, Thermal Spray Coatings, and Materials Selection - as a manufacturer, service contractor, and technical consultant. He was involved in paint manufacturing in Dimet/Ameron Protective Coatings (1982-1989) and Leighs Paints (2006-2009). He is currently the Chairman of the Education Committee of the Institute of Materials, Malaysia.

TAN Winie is a senior lecturer at School of Physics and Material Science, Universiti Teknologi MARA, Malaysia. Solid State Ionics are her main research areas. She is an Associate Fellow of the Malaysian Scientific Association (2012–present), Council Member of I nstitute of Materials, Malaysia (2014-2016) and member of Malaysian Solid State Science and Technology Society (2009-present). She is appointed as one of the editors in International Journal of Institute of Materials, Malaysia (IJIMM), Science Letters, Materials Research Innovation (2009) and American Institute of Physics (2009). Her contribution is also in the form of written chapter in books and over 40 International journal publications. Her research outcomes won her several medals and awards in international and national events.

Prof. Dr. Mohamad Kamal HARUN is currently the Deputy Vice Chancellor (Research, Innovation and Entrepreneurship) and head the Global Entrepreneurship Research and Innovation Centre at University Malaysia Kelantan. He was the Deputy Vice Chancellor (Industrial and Community Networking at University Teknologi MARA from 2007 – 2010. He is also the President and Fellow of the Institute of Materials Malaysia, Fellow of the International Institute of Plantation Management, Chairman of the Malaysian Accredited Certification Body for the Asian Welding Federation, Member of the Industrial Consultative Council, Malaysian Petroleum Resource Cooperation under Pemandu and currently is also the Cluster Head for Industry and Innovation, National Council of Professors. His areas of research are in corrosion protection by paints and inhibitors including the study of polymeric barrier coating degradation under atmospheric conditions

LEE Jia Yin has worked in commercial testing lab as a Technical Chemist. She is experienced in handling various analytical instruments such as HPLC, LCMS, FTIR and UV spectrometer. Currently, she works as an Application Chemist in Research Instruments, and specializes in Thermo Fisher Scientific FTIR. She is responsible for installation, application training and troubleshooting.

Appendix A

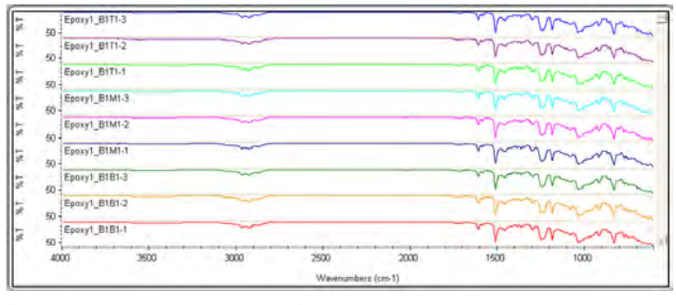
Check High Sensitivity feature of the FTIR software

The standard correlation search algorithms commonly used in infrared (IR) spectroscopy are well suited to identify unknown materials or to discriminate between materials that are significantly different. However, these standard algorithms often lack the sensitivity required when the materials being compared only exhibit very minute differences, e.g. for routine quality assurance and quality control of batch-to-batch production of the intermediate materials of the epoxy paints. The *high sensitivity* function in OMNIC *QCheck* is highly recommended as a searching function, which effectively provides better sensitivity when the degree of similarity between samples is high. This algorithm depends on *x*- (wavenumber) and *y*- (absorbance) vectors.

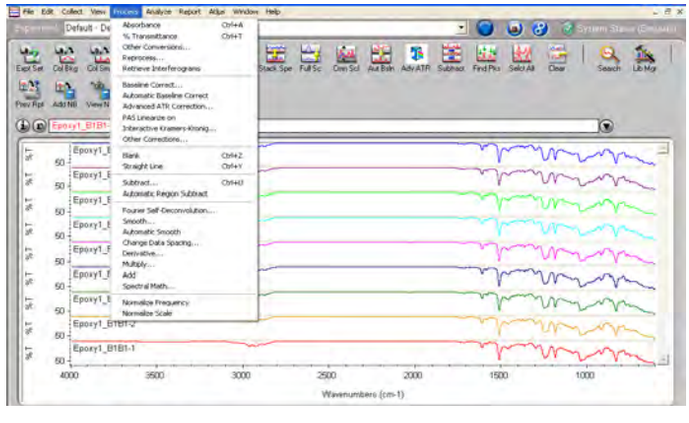
Private communication to Mr. Ferdinand von Stein, Asia Pacific Commercial Manager - Molecular Spectroscopy Chemical Analysis Division, Thermo Fisher Scientific.

Appendix B

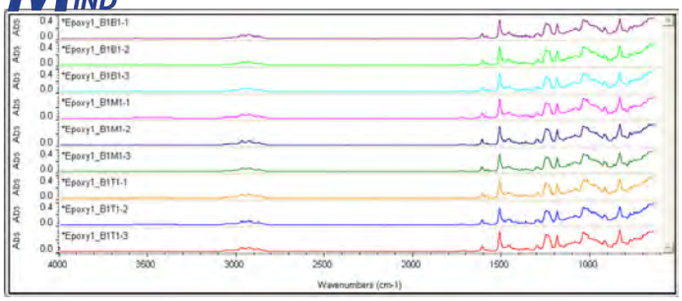
A step-by step guide for generation of reference FTIR spectrum from Top, Middle and Bottom of the mixing tank



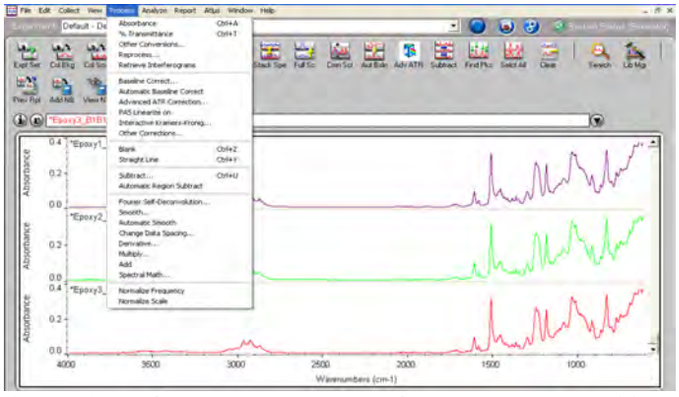
Step 1 Transmittance mode: **Epoxy1_B1**



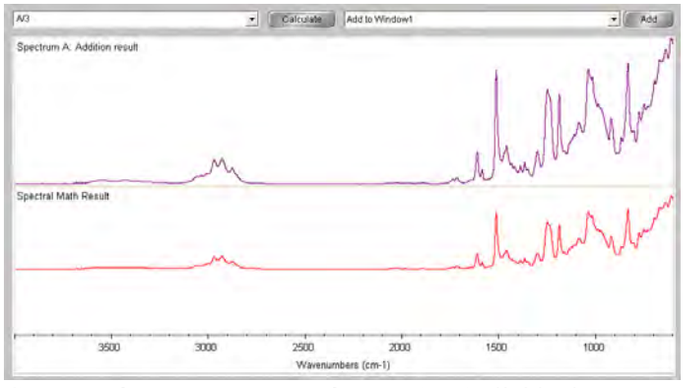
Step 2 Transmittance mode: **Epoxy1_B1** after automatic baseline correction



Step 3 Absorbance mode**: Epoxy1_B1** after automatic baseline correction



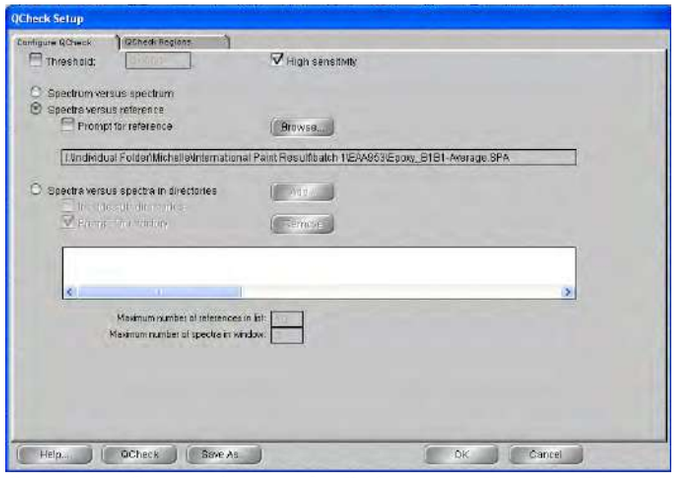
Step 4 Reference spectrum of **Epoxy1_B1:** Add' Epoxy1_B1B1-1, Epoxy1_B1M1-1 and Epoxy1_B1T1-1



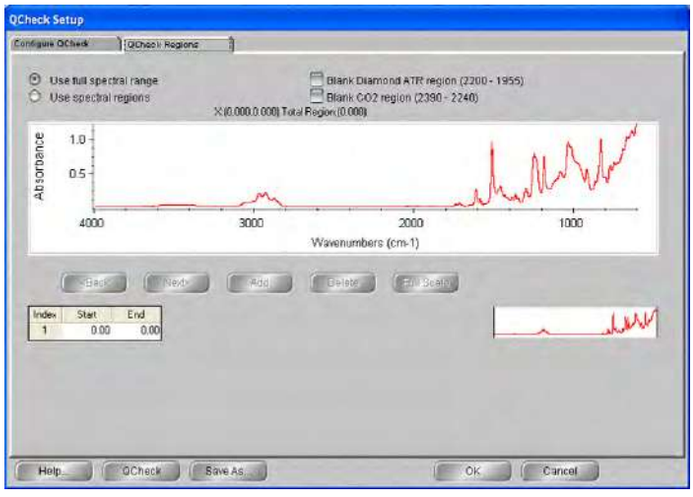
Step 5 Reference spectrum of **Epoxy1_B1:** divide the addition spectrum by 3

Appendix C

A step-by step guide for estimation of degree of similarity (r) for Reference Epoxy1_B1 to Epoxy1_B1T(or M or B) for 1st FTIR scanning



Step 1 Comparison of **Reference Epoxy1_B1** to Epoxy1_B1**T**(or **M** or **B**) by estimation of correlation (*r*) by using *high sensitivity feature* of *QCheck* setup



Step 2 Comparison of **Reference Epoxy1_B1** to Epoxy1_B1**T**(or **M** or **B**) (full range of FTIR region) (similar procedure can be adopted for other fingerprinting regions)

Plant Visit to PPG Performance Coatings Sdn Bhd

Reported by Nor Azrie Abu Samah, Materials Technology Education
Edited by Ir. Max Ong Chong Hup and Assoc. Prof. Dr. Melissa Chan Chin Han, Editors of Materials Mind

Date: 27th June 2014, Friday
Time: 10 am to 12 noon
Venue: PPG Performance Coatings Sdn Bhd, Lot 9 & 11, Jalan Tukang 16/4, 40702 Shah Alam, Selangor, Malaysia

Members of the Polymer Committee and Task Force on Coatings Fingerprinting of Institute of Materials, Malaysia (IMM) visited the paint factory of PPG Performance Coatings Sdn Bhd located in Shah Alam, Selangor on 27th Jun 2014. One of the prime objectives of this plant visit is to expose the IMM members of the Polymer Committee and Task Force on Coatings Fingerprinting on the paint manufacturing process as well as the in-house quality control and quality assurance (QA & QC) processes for protective coatings.

Mr. Terrence Wee, Technical Operations Support Manager – AP Business & Tech Support – Asia Pacific, an active member of the IMM Task Force on Coatings Fingerprinting, welcomed all the guests during the plant visit. Briefing by Mr. Anurag Sahai (Business Director - Malaysia, Thailand, India & Export Countries) on the PPG business was followed afterwards. PPG was established in 1883 with its headquarters located in Pittsburgh, USA. In 2012, PPG was ranked as the 3rd most admired company by Fortune Magazine.

He mentioned that PPG has the world's broadest coatings portfolio which includes aerospace, architectural, automotive OEM, automotive refinish, industrial coatings, packaging coatings and protective and marine coatings and is now ranked the biggest paint company in the world after their recent acquisition of Akzo-Nobel's Decorative Coatings business in Canada. IMM members were briefed with an overview of the manufacturing plant, manufacturing processes, research & development for protective coatings; and lastly on QA & QC processes. The tour began with the visit to the storage compartments of the raw materials and the intermediate materials of the paints. Then, members were guided to visit the mixing tanks of the intermediate materials of the paints. Lastly, various QA and QC tests were shared with the members at their in-house laboratory.

At the end of the plant visit, IMM members and the staffs of PPG mutually agreed that Fourier-transform infrared (FTIR) structural analysis of epoxy paints on steel structure for coating fingerprinting certificate is practical to be carried out at the in-house laboratory of the company. As presented during the Final Forum on "Towards Fingerprinting of Polymeric Coatings" III on 20th Jun 2014, the complete Coating Fingerprint Certificate for polymeric coatings consist of two parts, *i.e.* **(1)** physical analyses (e.g. viscosity, density, color code, non-volatile matter (by mass) weight solid (Zn metal/total Zn) (which are the routine in-house analyses for QA & QC purposes) and **(2)** structural analysis by FTIR (which will be carried out immediately after each batch of the production in the paint factory).

IMM thank PPG for hosting this plant visit.

Figure 1 *Front row from left to right:* Mr. M Shahril Atiqi B M Sharip (PETRONAS), Ms. Elizah Samat (Shell), Dr. Tan Winie (UiTM), Assoc. Prof. Dr. Melissa Chan Chin Han (UiTM), Ir. Max Ong Chong Hup (Norimax Sdn Bhd) and Mr. Lim Chuan Gee (SIRIM).
Second row from left to right: PPG's staff members, plus Mr. Anurag Sahai (second right) and Mr. Terrence Wee (far right)

Figure 2 Mr. Terrence Wee was welcoming all the guests during the plant visit

Technical article 2

ATR-FTIR: A Simple and Rapid Tool For Coating Fingerprinting

WAY Chiang Poh[1], **TAN** Winie[2*] and **CHAN** Chin Han[2]
[1]PerkinElmer (M) Sdn. Bhd., #2.01, Level 2, Wisma Academy, Lot 4A, Jalan 19/1, 46300, Petaling Jaya, Selangor, Malaysia
Email: Kenneth.way@perkinelmer.com
[2]Universiti Teknologi MARA, Faculty of Applied Sciences, 40450 Shah Alam, Selangor, Malaysia
E-mail: tanwinie@salam.uitm.edu.my and tan_winie@yahoo.com (* corresponding author)
cchan@salam.uitm.edu.my and cchan_25@yahoo.com.sg

Abstract

ATR-FTIR is a simple and rapid tool for coating fingerprinting. Reference FTIR spectra for resin and hardener can be easily generated. The degree of similarity, which is termed as *correlation* (*r*), of a spectrum can be easily generated by comparing the spectra of the samples to that of the reference spectrum. *Correlation* (*r*) = 1 denotes perfect match between the sample and reference spectra. The greater deviation of *correlation* (*r*) value from unity suggests a more significant difference between the sample and reference spectra. FTIR results showed homogeneity of resin and hardener at top, middle and bottom of the mixing tank and good batch-to-batch reproducibility. By referring to the FTIR results, different types of resin and hardener could be deduced.

Introduction

In the oil and gas industry, industry players have invested billions in polymeric coatings in order to protect the steel material used for offshore petroleum transportation. However, the companies in Malaysia are facing a quality issue with polymeric coatings. It was observed that the quality of certified material eroded more rapidly although the certificate of analysis which emphasized only in physical tests complies with the customer required parameters. This can be due to potential problems of reformulated polymeric coatings or adulterations being practiced. The polymeric coatings quality problems have led to enormous monetary losses, which have hit the investors severely. In addition, it has caused serious environmental impact [1].

For paint manufacturers in their quality control processes, it encompasses physical assays for their raw materials (resin & hardener) and finished goods. The test parameters cover solid content, viscosity, specific gravity, adhesive test, pH, color and so on and are practiced routinely. Unique test such as salt-fogging test, chemical resistance test were done upon client request. Until to-date, there is no relevant scientific approach such as FTIR spectroscopic technique being applied. It is because local paint suppliers have concerns of its paint formulation secrets being review [3]. In addition to huge investment and maintenance costs, professionals with strong technical competence in analytical instruments are essential to better quality assurance.

Infrared (IR) spectroscopy is a useful scientific tool in characterizing organic functional groups based on the compound molecular vibrational patterns. Radiation in the IR region resulted in both stretching and bending vibrations of the covalent bonds of the organic compounds. In principle, IR technique can be used to characterize specific polymers by either transmission or reflectance measurements. The resulting spectrum shows the molecular absorption and transmission, creating a molecular fingerprint of the compound especially at the wavenumbers of 1500-400cm^{-1}. In short, each sample has its own distinctive IR spectrum.

ASTM D7588-11 requires the use of attenuated total reflectance (ATR) accessory, coupling with FTIR to rapidly analyse the paint samples without any sample preparation. The FTIR analysis requires minimal operation time and operator skill. The possibility of using the ATR accessory approach appears to be very promising [2].

The objectives of this work are 1) to generate reference FTIR spectra for resin and hardener samples, 2) to check the homogeneity of resins and hardeners at the Top (T), Middle (M) and Bottom (B) of the mixing tanks and batch-to-batch reproducibility by estimation of *correlation* (*r*) using COMPARE algorithm featured by Perkin Elmer at fingerprinting regions, 3) to discriminate different types of resin and hardener.

Experimental

FTIR sample collection

The resins and hardeners were supplied by a local paint manufacturer. 2 batches of resin and hardener collected at interval of 1 day were received for FTIR analysis within a week after sample collection. Each batch consists of 4 types of resin and hardener. Sampling of samples was done from the Top (T), Middle (M) and Bottom (B) of the mixing tanks as shown in Figure 1. Sample coding Resin_*x*-*yz* and Hardener_*x*-*yz* denote resin or hardener of *x* type for *y* batch at the location *z* (T, M or B).

Figure 1 Sampling of samples was done from the Top (T), Middle (M) and Bottom (B) of the mixing tanks

Attenuated total reflection (ATR)-FTIR spectroscopic studies were carried out using a diamond coated ZnSe crystal on a PerkinElmer Frontier FTIR spectrophotometer (USA). FTIR spectra were recorded in the transmittance mode in the frequency range from 600 to 4000 cm^{-1} by averaging 32 scans at a resolution of 4 cm^{-1}. The obtained FTIR spectra were then analyzed by COMPARE algorithm featured by Perkin Elmer at fingerprinting regions. The fingerprinting regions selected are 1000 – 1300 cm^{-1} (C-O-C) and 700 – 900 cm^{-1} (C-O-C) for resin and 1000 – 1400 cm^{-1} (C-N) for hardener.

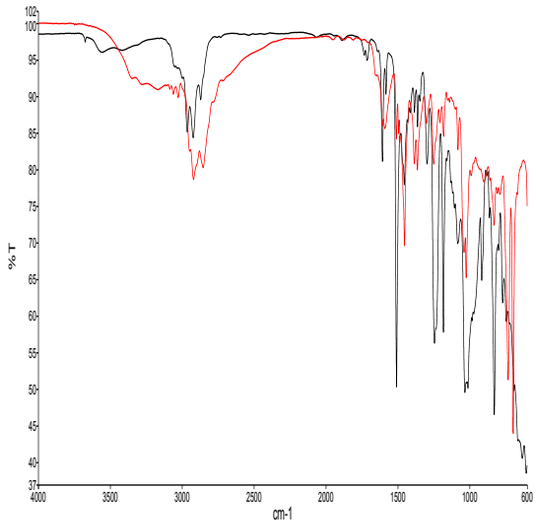


Figure 2 Reference FTIR spectra for resin (Resin_A95-1M) and hardener (Hardener_A96-1M) in the region between 600 and 4000 cm^{-1}

The FTIR spectrum of resin type A95, from batch 1 and obtained from the middle of the mixing tank (sample coding Resin_A95-1M) was selected as the reference spectrum. The reference spectrum for hardener was Hardener_A96-1M (i.e hardener type A96, from batch 1 and middle of the mixing tank) (see Objective 1). Figure 2 presents the reference FTIR spectra for resin and hardener. The degree of similarity, which is termed as *correlation* (*r*), of a spectrum was generated by comparing the spectra of the samples to that of the reference spectrum in the defined fingerprinting regions. *Correlation* (*r*) = 1 denotes perfect match between the sample and reference spectra. The greater deviation of *correlation* (*r*) value from unity suggests a more significant difference between the sample and reference spectra.

Results and discussion

Figure 3 presents the FTIR spectra of Resin_A95-1T, Resin_A95-1M and Resin_A95-1B in the region between 600 and 1800 cm^{-1}. The 1000 – 1300 cm^{-1} (C-O-C) and 700 – 900 cm^{-1} (C-O-C) are the fingerprinting regions for resin. Table 1 presents the *correlation* (*r*) for reference Resin_A95-1M to Resin_A95-1T (or B). *Correlation* (*r*) > 0.90 suggests homogeneity of resins at top, middle and bottom of the mixing tank.

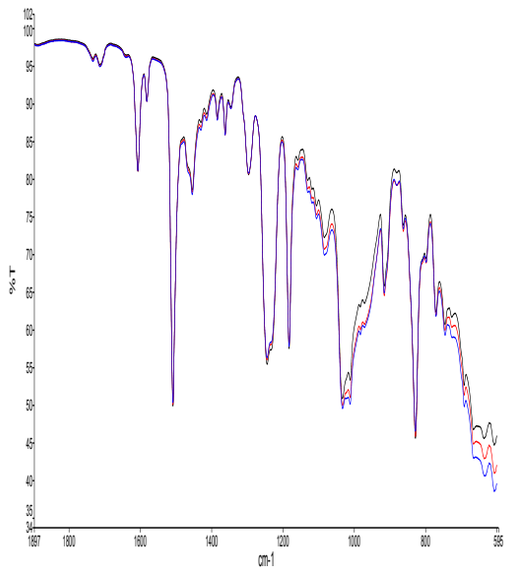


Figure 3 FTIR spectra of Resin_A95-1T, Resin_A95-1M and Resin_A95-1B in the region between 600 and 1800 cm^{-1}.

Figure 4 presents the FTIR spectra of Hardener_A96-1T, Hardener_A96-1M and Hardener_A96-1B in the region between 800 and 1700 cm^{-1}. The fingerprinting region for hardener is 1000 – 1400 cm^{-1} (C-N). Table 2 presents the *correlation* (*r*) for reference Hardener_A96-1M to Hardener_A96-1T (or B). *Correlation* (*r*) > 0.90 suggests homogeneity of hardener at top, middle and bottom of the mixing tank.

Table 3 presents the *correlation* (*r*) for reference Resin_A95-1M to Resin_A95-2M (T or B) while Table 4 presents the *correlation* (*r*) for reference Hardener_A96-1M to Hardener_A96-2M (T or B). Results from Tables 3 and 4 show *correlation* (*r*) > 0.90 suggests batch-to-batch reproducibility.

Table 1 *Correlation* (*r*) for reference Resin_A95-1M to Resin_A95-1T (or B)

Sample Code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1300 cm^{-1} (C-O-C)	*r* 700 – 900 cm^{-1} (C-O-C)	Reference Spectrum
Resin_A95-1T	0.9992	0.9992	0.9992	Resin_A9 - 1M
Resin_A95-1B	0.9998	0.9998	0.9999	

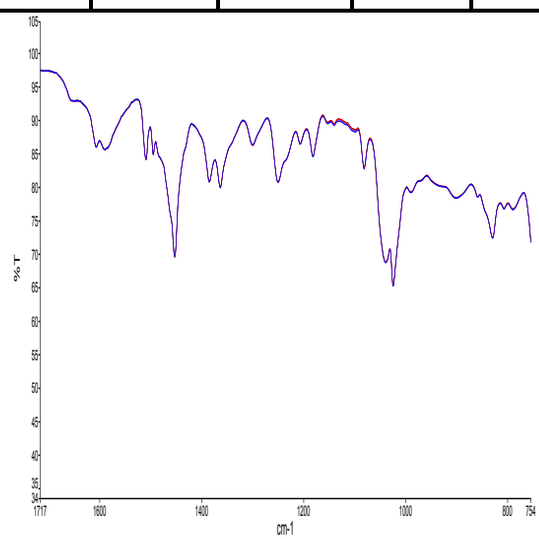


Figure 4 FTIR spectra of Hardener_A96-1T, Hardener_A96-1M and Hardener_A96-1B in

Table 2 *Correlation* (*r*) for reference Hardener_A96-1M to Hardener_A96-1T (or B)

Sample Code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1400 cm^{-1} (C-N)	Reference Spectrum
Hardener_A96-1T	0.9999	0.9999	Hardener_A96-1M
Hardener_A96-1B	0.9999	0.9999	

Table 3 *Correlation* (*r*) for reference Resin_A95-1M to Resin_A95-2M (T or B)

Sample Code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1300 cm^{-1} (C-O-C)	*r* 700 – 900 cm^{-1} (C-O-C)	Reference Spectrum
Resin_A95-2T	0.9974	0.9967	0.9967	Resin_A95-1M
Resin_A95-2M	0.9995	0.9995	0.9995	
Resin_A95-2B	0.9996	0.9996	0.9996	

Table 4 *Correlation* (*r*) for reference Hardener_A96-1M to Hardener_A96-2M (T or B)

Sample Code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1400 cm^{-1} (C-N)	Reference Spectrum
Hardener_A96-2T	0.9997	0.9997	Hardener_A96-1M
Hardener_A96-2M	0.9996	0.9998	
Hardener_A96-2B	0.9996	0.9997	

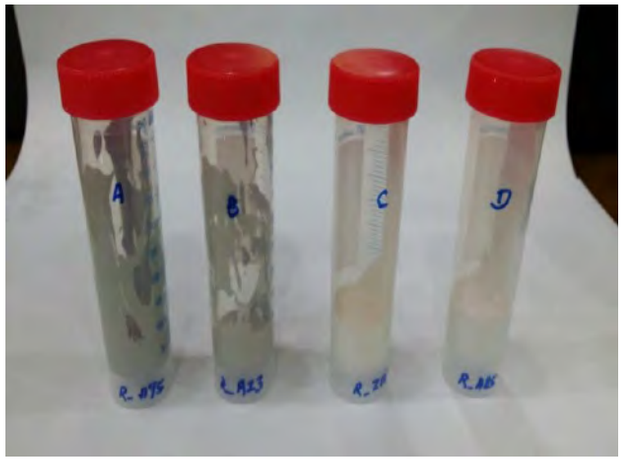


Figure 5 Physical appearances of A) Resin_A95, B) Resin_A23, C) Resin_Z00 and D) Resin_A85

Figures 5 and 6 present the physical appearance of different types of resins and hardeners, respectively. Resins and hardeners may smell and appear physical alike. ATR-FTIR can be used to differentiate different types of resins and hardeners. Table 5 presents the *correlation* (*r*) for reference Resin_A95-1M to Resin_A23-1M, Resin_Z00-1M and Resin_A85-1M. Based on the extremely low value of *correlation* (*r*), Resin_Z00 reviewed its significant variation of chemical composition compared to the other 3 types of resin. An online IR library search showed that sample labeled, as Resin_Z00 was polyurethane resin. On the other hand, library search results showed that Resin_A95, Resin_A23 and Resin_A85 were epoxy-type resin. Different types of hardener could also be detected using ATR-FTIR tool (see Table 6).

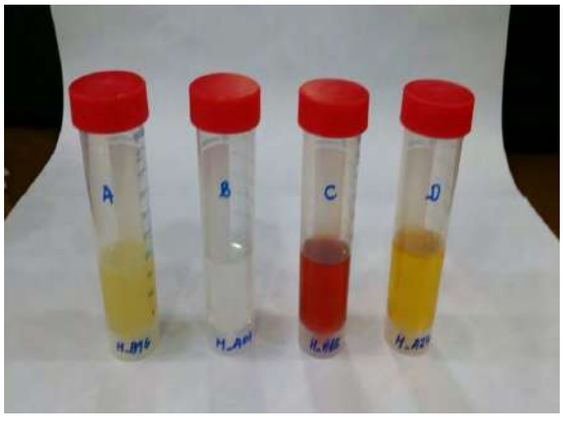


Figure 6 Physical appearances of A) Hardener_A96, B) Hardener_A04, C) Hardener_A85 and D) Hardener_A24

Table 5 *Correlation* (*r*) for reference Resin_A95 to Resin_A23, Resin_Z00 and Resin_A85

Sample Code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1300 cm^{-1} (C-O-C)	*r* 700 – 900 cm^{-1} (C-O-C)	Reference Spectrum
Resin_A23-1M	0.9770	0.9850	0.8927	Resin_A95-1M
Resin_Z00-1M	0.1573	0.1817	0.0630	
Resin_A85-1M	0.8599	0.9557	0.9090	

Table 6 *Correlation* (*r*) for reference Hardener_A96 to Hardener_A04, Hardener_A85 and Hardener_A24

Sample Code	*r* 600 – 4000 cm^{-1}	*r* 1000 – 1400 cm^{-1} (C-N)	Reference Spectrum
Hardener_A04-1M	0.1237	0.0349	Hardener_A96-1M
Hardener_A85-1M	0.5006	0.3875	
Hardener_A24-1M	0.5145	0.1669	

Conclusion

Reference FTIR spectra for resin and hardener can be easily generated. FTIR results showed homogeneity of resin and hardener at top, middle and bottom of the mixing tank and good batch-to-batch reproducibility. Different types of resin and hardener could be detected by FTIR.

Acknowledgement

IMM Coating Fingerprinting Task Force committees would like to thank the paint manufacturer for supplying the samples. Acknowledgement to application chemists, Mr Lim Bon Tong & Ms Ling Jia Yi from Perkin Elmer (M) Sdn Bhd for the technical support provided. Besides, the authors gratefully acknowledge the research funding by Knowledge Transfer Programme Grants [100-CAN(ICAN/AIC.37/2/14) provided by Ministry of Education for parts of the experimental works.

References

1. Byrd, J., *Coatings and cathodic protection for pipeline: An introduction*. Journal of Protective Coatings and Linings, 2002. **19**(3): p. 50-56.
2. Hartshorn, J.H. *Compositional assurance testing – A system approach to chemical quality*. In SPIE 1145, *Proceedings of the 7th International Conference on Fourier Transform Spectroscopy*. 1989. Bellongham, WA: The International Society for Optical Engineering.
3. Chew, K.C. and Lim, C.H., *FT-IR fingerprinting of organic coatings: Possibilities and practicalities in industry, in Materials Mind*. 2013, Institute of Materials, Malaysia: Selangor, Malaysia. p. 19-21, 26.

Biodata

Kenneth WAY obtained his Bachelor and Master degree of Science from Universiti Putra Malaysia (UPM) in both Biochemistry and Molecular Biology & Genetic Engineering respectively. He worked in Sigma-Aldrich as the sales & application specialist in Research

Biotechnology segment, taking care of molecular biology, cell biology, signaling molecules and diagnostic divisions for 3 years before continued his post-graduate research, which was research project collaboration between Sigma-Aldrich and a prestigious research institute in gene silencing therapy used in cancer treatment. He has published a few technical papers in established journals. Meanwhile, he is also the member for the professional body of Malaysia Society for Biochemistry and Molecular Biology (MSBMB) and MENSA since 2004 & 1994 respectively. Currently, he is the product manager for spectroscopy such as UV-VIS-NIR, Fluorescence, FTIR, Thermal analyzers (TGA, DSC, TMA, DMA) and Hyphenation Techniques (TG-IR, TG-MS, TG-GCMS, TG-IR -GCMS, DSC-UV, DSC-NIR)

TAN Winie is a senior lecturer at School of Physics and Material Science, Universiti Teknologi MARA, Malaysia. Solid State Ionics are her main research areas. She is an Associate Fellow of the Malaysian Scientific Association (2012–present), Council Member of Institute of Materials, Malaysia (2014-2016) and member of Malaysian Solid State Science and Technology Society (2009-present). She is appointed as one of the editors in International Journal of Institute of Materials, Malaysia (IJIMM), Science Letters, Materials Research Innovation (2009) and American Institute of Physics (2009). Her contribution is also in the form of written chapter in books and over 40 International journal publications. Her research outcomes won her several medals and awards in international and national events.

CHAN Chin Han is an associate professor at Universiti Teknologi MARA, Malaysia. Her research interest is devoted to physical properties of macromolecules. She was appointed as Visiting Scientist at China University of Petroleum, Beijing, China (2011-2012), as Chair Professor on Advances in Hybrid Materials at Mahatma Gandhi University, Kottayam, India (2014), National Representative (Malaysia) of International Union of Pure and Applkied Chemistry (IUPAC) for Polymer Division (2014-2015) etc. She has been one of the editors of Malysian Journal of Chemistry, Berita IKM – Chemistry in Malaysia, Deputy Editor of Materials Mind of Institute of Materials, Malaysia and books published by Royal Society of Chemistry (2013) and Apple Academic Press (2014) (distributed by CRC

JOIN IMM FOR FREE

The IMM continues to encourage members of other professional societies and associations to join as Ordinary Members with no annual subscriptions. Materials Science & Technology is essential to everyone and IMM welcomes the sharing of knowledge & experience amongst professionals from all disciplines (medical, dental, nursing, architectural, engineering, science, arts, physics, biology, chemistry, banking, finance, accounting, legal, insurance, marine, oil & gas, petrochemical, geology, etc).

The IMM also offers free "Company Membership" to Companies who are company members of other Trade Associations such as MOGSC (Malaysian Oil & Gas Services Council), MOCA (Malaysian Offshore Contractors Association), MOGEC (Malaysian Oil & Gas Engineering Council), FMM (Federation of Malaysian Manufacturers) and others, free-of-annual subscriptions. IMM aims to bring greater awareness of Materials Science & Engineering to all sectors of industry and academia and encourages everyone to join and share their knowledge, experience and expertise for the benefit of the nation.

Just log-on *to www.iomm.org.my* and download the application from for Free Ordinary or Company Membership or call +603-58823574/84.

Advertisement Rates in Materials Mind

Standard full page (odd numbered page)
Rate: RM 1500
Size:A4 210 (w) x 297 (h) mm

Standard full page (even numbered page)
Rate: RM 1000
Size:A4 210 (w) x 297 (h) mm

Inside Front Cover
Rate: RM 2000*
Size:A4 210 (w) x 297 (h) mm

Inside Back Cover
Rate: RM 2500*
Size:A4 210 (w) x 297 (h) mm

Half Page
Product/Services article without advertisement with one photograph
RM 800

Quarter Page
Product/Services article without advertisement with one photograph
RM 500

Name card size
Classified Ads
RM 200

Note* : Advertisers enjoy free half page article

Technical Requirement

- JPG / Ai / PDF / PSD Format
- Ai / Illustrator - Text must be outlined and saved together with high resolution picture embedded.
- All format must be at least - 300 dpi pictures and / or embedded pictures in Ai.
- Films are not acceptable.
- Artwork prepared by the advertiser.

Payment

50% upon confirmation of booking advertisement space and full amount once artwork done or Full payment upon collecting the CD if visual prepared by advertiser.

Cancellation

10 day notice before the publication otherwise deposit will be forfeited.

For more information please contact:

Suhaila Suhaimi
suhaila@mte.com.my

Tel: +603-58823574
Fax: +603-58823524

CORROSION MANAGEMENT | SACRIFICIAL ANODES | FAILURE ANALYSIS | FCC BOLTS & NUTS | THERMAL SPRAY COATINGS
CATHODIC PROTECTION | PASSIVE FIRE PROTECTION | MATERIALS TESTING | COATINGS CONSULTANTS

MATERIALS INTEGRITY ENGINEERING & SERVICES

Why Materials Fail?

- > STRUCTURAL INTEGRITY
- > PIPELINE INTEGRITY
- > WELL INTEGRITY

Norimax NORIMAX SDN BHD (489913-K)

KLR 0500421

Tel : +603-8060 2334 | Fax : +603-8062 2334 | Website : www.norimax.com.my | Email : sales@norimax.com.my

No. 2, Jalan TPP 5/17, Taman Perindustrian Puchong, Seksyen 5, 47160 Puchong, Selangor Darul Ehsan, Malaysia.

IMM FORUM

MATERIALS INTEGRITY & QUALITY ASSURANCE

THURSDAY | 11 SEPTEMBER 2014 | 2PM - 6PM

IMPIANA KLCC HOTEL

Impiana Banquet Hall 2

The Oil & Gas, Power & Marine industries are plagued with Materials Integrity issues. Very often we hear of catastrophes such as a gas pipeline rupture & explosion or collapse of a key structural component and many near misses. Sometimes, these events lead to fatalities.

This Forum will discuss the possible root causes and possible solutions to reduce such occurrences or even prevent them from ever occurring. Focus will be on Inspection, Coatings, and Welding with emphasis on the implementation of the Common Welder Certification Scheme to enhance welding quality & facility safety through better monitoring of welder performance.

The format of this Forum will be short presentations by representatives from the Oil & Gas industry who will share their experiences and offer possible solutions followed by open Q&A and interactive discussions between the panel of speakers and the audience.

Program

2.00pm	Registration (Tea/Coffee served)
2.30pm	Welcoming Speech - Prof. Dr. Mohd. Kamal Bin Harun (President, IMM)
2.35pm	Opening Remarks 1) Prof. Dr. Khudzir Hj. Ismail (Dean of Faculty of Applied Sciences, UiTM) 2) Representative from PETRONAS
2.45pm	**Overview of Integrity Issue in the Oil & Gas Industry** - En. Azmi Md Noor (Head of Asset Integrity, Upstream HSE)
3.05pm	Q & A
3.15pm	**Coatings Fingerprinting Initiative-Phase 1 Success** - Puan Nurul Asni (Principal Engineer - Corrosion, PETRONAS GTS)
3.35pm	Q & A
3.45pm	Tea-Break
4.00pm	**Common Welder Certification Scheme** - Mr. Ang Chee Pheng (Sec. Gen - AWF; VP - IIW)
4.20pm	PANEL FORUM Q&A
4.50pm	Closing Remarks - En. Azmi Md Noor (Head of Asset Integrity, Upstream HSE)
5.00pm	Refreshment & Networking
6.00pm	Adjourn

Prior Registration required
Free-of-Charge for IMM Members and their Guests

- Non members : RM40.00
- Walk-in Participants : RM60.00

Please register with the IMM secretariat at azrie@mte.com.my by 4th Sept 2014

Institute Of Materials, Malaysia
No 10-1, Jalan Bandar 3,
Pusat Bandar Puchong,
47160 Puchong,
Selangor Darul Ehsan, Malaysia.
Tel : +603 - 5882 3574 Fax : +603-5882 3524
Website : www.iomm.org.my
Email : admin@iomm.org.my

Joint Organisers :
- IMM Materials & Asset Integrity Committee
- IMM Welding Committee
- IMM Polymer Committee

UNIVERSITI TEKNOLOGI MARA

Co-organiser :
Faculty of Applied Sciences, Universiti Teknologi MARA