COURSE OVERVIEW LE0537-4D
Transformer Oil Analysis

Course Title
Transformer Oil Analysis

Course Reference
LE0537-4D

Course Duration/Credits
Four days/2.4 CEUs/24 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	June 10-13, 2024	Al Aziziya Hall, The Proud Hotel Al Khobar, Al Khobar, KSA
2	September 16-19, 2024	Club B Meeting Room, Ramada Plaza by Wyndham Istanbul City Center, Istanbul, Turkey
3	December 23-26, 2024	Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Description

This practical and highly-interactive course includes real-life case studies and exercises where participants will be engaged in a series of interactive small groups and class workshops.

The fault free operation of power transformers is a factor of major economic importance and safety in power supply utilities and industrial consumers of electricity. In the current economic climate, Industries/Supply Utilities tighten their control on capital spending and make cutbacks in maintenance, an increased awareness is placed on the reliability of the existing electric power supply. Down time is at a premium. Often, the loading is increase on present units, as this will defer purchasing additional plant capacity. Th us, the stress on the transformer increases. The net total effect of the thermal, electrical and mechanical stress brought on by increased service needs to be monitored to ensure reliability.

Regular sampling and testing of insulation oil taken from transformers is a valuable technique in a preventative maintenance program. If a proactive approach is adopted based on the condition of the transformer oil, the life of the transformer can be extended.

Transformer oil testing is a proven loss prevention technique that shall be a part of any condition based predictive maintenance program. Essentially, an early warning system, transformer oil testing allows management to identify maintenance priorities, plan work assignment schedules, and order necessary parts and materials.

In this course, you will start by refreshing the basic of transformers, transformer oil properties and specification and you will learn if your transformer oil is within specifications and the principle of the analysis method used for the transformer oil analysis and their relevant standard methods used.

This course will also cover the working principles of transformers including its applications, operation and performance parameters; the chemistry of transformer oil, characteristic properties and specification, physical properties, electrical properties, storage, handling and transport as well as compatibility and contaminants; the insulating of oils, fluids and gases; the principles of transformer oil testing instrumentation; the transformer oil testing; and the presentation of results.

Course Objectives

Upon the successful completion of this course, each participant will be able to: -

- Apply and gain an in-depth knowledge on transformer oil analysis
- Discuss the working principles of transformers including its applications, operation and performance parameters
- Describe the chemistry of transformer oil, characteristic properties and specification, physical properties and stability characteristics
- Identify the electrical properties and carryout proper storage, handling and transport
- Recognize the compatibility and contaminants and deterioration of insulating oil testing
- Carryout combustible gas analysis and insulating liquid sampling procedures
- Employ principles of transformer oil testing instrumentation covering UV/VIS spectrophotometers, spectrophotometer architecture, sources, filters and detectors
- Identify the design and performance criteria of instrumentation, fourier transform instruments and filter instrumentation
- Discuss atomic absorption spectroscopy, flame ASS, nebulizer/burner systems, atomization, interferences and graphite furnace ASS
- Determine gas chromatographs, selection of carrier gases and gas chromatography columns
- Explain column stationary phases, injectors and detectors and gas chromatography-mass spectrometry
- Illustrate electrochemical techniques, electrodeless (non-contact) measurement and pH probes, calibration, measurement and maintenance
- Employ transformer oil testing and results presentation

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides an overview of all significant aspects and considerations of transformer oil analysis for for engineers and other technical staff who need a sound understanding of transformer oil analysis.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

Al Khobar	**US$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Istanbul	**US$ 5,000** per Delegate + **VAT**. This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Abu Dhabi	**US$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations:-

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **2.4 CEUs** (Continuing Education Units) or **24 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. John Swinley is a **Senior Consultant** with over **50 years** of industrial experiences in **Chromatography and Spectroscopy**. His expertise widely covers in the areas of **Transformer Oil Gas** Analysis, **Transformer Oil Tests**, **Gas Analyzer**, **Insulating Oil**, **Vacuum** technology & **Vacuum** Pump Systems, **Gas Chromatography Techniques & Troubleshooting**, **Laboratory** Instrument Calibration, **Chromatography** Data System, Isotope Ratio Mass Spectrometry, Vacuum Technology, **Spectroscopic** Techniques, Capillary GC, **Gas Analysis**, **Analytical Laboratory Audit**, Natural & Refinery Gas Analysis, **Varian Gas Chromatography** Operation & Maintenance, **Agilent ChemStation** Operation, **GC Device Prevention & Maintenance**, **Process Analyzer**, Modern **Chemical Laboratory**, **Analytical Instrumentation**, Equipment Calibration, **GC Troubleshooting** & User Maintenance, **GC/MS Technology & Problem Solving**, Online **Gas Analyzer**, **GC/MS Mass Spectra** Interpretation, **Laboratory Equipment** Maintenance, Separation Technology, **Natural Gas Testing & Analysis** and **Natural & Refinery Testing**. He is currently involved in method development and optimization in nuclear energy, power generation and petrochemical industries wherein he troubleshoots instrument problems and introduce comprehensive GC applications for on-line analysis in petrochemistry.

During his career life, Mr. Swinley worked with several companies and institutions occupying numerous positions such as being the **Director**, **Product Manager**, **Product Specialist** and **Research Assistant** from the University Witwatersrand, G.D. Searle, SMM Instruments, Wirsam Scientific, Perkin Elmer SA, Scientific Group, Scientific Supply Services and Chromatography Consultants.

Mr. Swinley has a **Bachelor** degree in **Applied Mathematics and Physics** and a **Diploma** in **Industrial Electronics**. Further, he is a **Certified Instructor/Trainer** and has published a book "Practical Gas Analysis by Gas Chromatography" in 2019. He was awarded as the "Chromatographer of the year" by the ChromSA and has delivered numerous trainings, courses, workshops, seminars and conferences internationally.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Working Principles of Transformers*** *Applications of Transformer • Principles of Operation • Definition of a Few Basic Parameters of Transformer • Performance Parameters*

0930 – 0945	*Break*
0945 – 1100	***Insulating Oil*** *Chemistry of Transformer Oil • Characteristic Properties and Specification • Physical Properties • Stability Characteristics*
1100 – 1230	***Insulating Oil (cont'd)*** *Electrical Properties • Storage, Handling & Transport of Transformer Oil • Compatibility & Contaminants*
1230 - 1245	*Break*
1245 – 1330	***Insulating Oils, Fluids & Gases*** *Deterioration of Insulating Oil • Insulating Oil Testing • Combustible Gas Analysis of Insulating Oil • Less Flammable Insulating Fluids • Insulating Liquid Sampling Procedures*
1330 - 1420	***Principles of Transformer Oil Testing Instrumentation*** *UV/VIS Spectrophotometers • Spectrophotometer Architecture • Sources, Filters and Detectors • IR Instrumentation • Instrumentation: Design and Performance Criteria • Fourier Transform Instruments • Filter Instrumentation*
1420 - 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***Principles of Transformer Oil Testing Instrumentation (cont'd)*** *Atomic Absorption Spectroscopy • Introduction • Flame AAS • Nebulizer/Burner Systems • Atomisation and Interferences • Graphite Furnace AAS*
0930 – 0945	*Break*
0945 – 1100	***Principles of Transformer Oil Testing Instrumentation (cont'd)*** *ICP – OES :Inductively Coupled Plasma - Optical Emission Spectroscopy • Principals of Optical Emission Spectroscopy • Atomic Spectroscopy Sources • Techniques and Instruments • Analytical Performance • Applications of ICP-OES*
1100 – 1230	***Principles of Transformer Oil Testing Instrumentation (cont'd)*** *Gas Chromatographs • Selection of Carrier Gases • Gas Chromatography Columns • Column Stationary Phases • Injectors and Detectors • Gas Chromatography – Mass Spectrometry*
1230 - 1245	*Break*
1245 – 1330	***Principles of Transformer Oil Testing Instrumentation (cont'd)*** *Gas Chromatographs • Selection of Carrier Gases • Gas Chromatography Columns • Column Stationary Phases • Injectors and Detectors • Gas Chromatography – Mass Spectrometry*
1330 - 1420	***Principles of Transformer Oil Testing Instrumentation (cont'd)*** *Gas Chromatographs • Selection of Carrier Gases • Gas Chromatography Columns • Column Stationary Phases • Injectors and Detectors • Gas Chromatography – Mass Spectrometry*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0830	***Principles of Transformer Oil Testing Instrumentation (cont'd)*** *Electrochemical Techniques • Principals of Conductivity • Immersed Electrodes – 2 an 4 Electrode Cells • Electrodeless (Non-contact) Measurement • pH Probes – Theory, Calibration, Measurement and Maintenance*
0830 - 0930	***Transformer Oil Tests*** *Appearance • Color • Corrosive Sulphur • Density • Specific Gravity*

0930 – 0945	*Break*
0945 – 1100	***Transformer Oil Tests (cont'd)*** *Dielectric Breakdown Voltage • Dissolved Gas Analysis • Furfural and Related Compounds • Interfacial Tension*
1100 – 1230	***Transformer Oil Tests (cont'd)*** *Kinematic Viscosity • Oxidation Stability • Sediment, Sludge*
1230 - 1245	*Break*
1245 - 1420	***Transformer Oil Tests (cont'd)*** *Suspended Particles in Oil, Visual • Water Content*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

0730 – 0930	***Transformer Oil Tests (cont'd)*** *Trace Analysis • PCB's*
0930 – 0945	*Break*
0945 – 1100	***Results Presentation*** *Statistic Basics • Distributions of Data*
1100 – 1230	***Results Presentation (cont'd)*** *Significant Figures • Introduction to Measurement Uncertainty*
1230 - 1245	*Break*
1245 – 1345	***Results Presentation (cont'd)*** *Using Confidence Limits • Outlier Testing*
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions

This practical and highly-interactive course includes real-life case studies and exercises:-

Course Coordinator

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