COURSE OVERVIEW TE0070
Multistage-Flash (MSF) Unit Startup & Shutdown

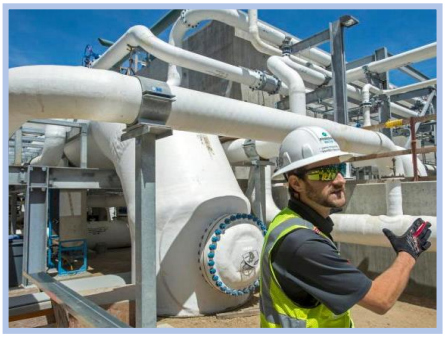
Course Title
Multistage-Flash (MSF) Unit Startup & Shutdown

Course Date/Venue
Session 1: August 26-30, 2024/Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
Session 2: November 25-29, 2024/Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Reference
TE0070

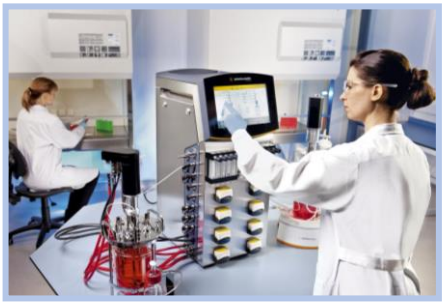
Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description



This practical and highly-interactive course includes practical sessions and exercises where participants will visit an MSF desalination plant. Practical sessions will be performed in order to apply the theory learnt in the class.

The Multi-Stage Flash (MSF) plants are the majority of desalination plants in the Middle East. MSF plants in the Middle East are currently producing over 70% of the total world capacity of land-based desalting.



The MSF process is used in large-scale distillers to produce potable water from seawater. In essence, the process involves heating seawater to a high temperature then passing it through a series of chambers (or stages) where the pressure and temperature are reduced progressively. This process causes the sea water to boil at each successive stage. The vapor thus released is condensed and collected as distilled water. The process of boiling by pressure reduction is known as "flashing".

In the MSF process, the seawater is invariably heated by low-pressure steam from an associated power plant. A technique known as "brine recirculation" improves the distiller efficiency so that it is possible to produce between 8 and 10 times as much distilled water as the steam consumption of the brine heater.

This quantity is defined as the performance ratio of the unit. The success and popularity of the MSF process is due to its simplicity, inherent robustness and vast amount of acquired experience which resulted in reducing material and operating costs and increasing reliability.

The basic technology of modern large-scale MSF is similar to the early units. However, improvements were implemented during the years such as the development of On-Line Ball Cleaning System, Scale Control Techniques, Corrosion Resistant Materials and increase of unit capacity. Distillers of up to 16.7 migd (million gallons per day) capacity have been built and units of 20 migd are planned. A typical power and desalination plant would have several distillation units with a combined output of up to 120 migd.

This course is designed to provide a comprehensive and up-to-date overview of the MSF distillation technology. The course will focus on practical engineering rather than academic considerations. It is suitable for engineers of all disciplines and water utility employees being trained to purchase, operate and maintain MSF distillers. The course will cover operation, maintenance, Heat Balance, performance, optimization and plant management. It will give clear step-by-step instructions for starting a large MSF plant and for subsequent troubleshooting. Further, the course is suitable for personnel in other types of distillation plant as well as for corrosion engineers and chemists. It deals with those aspects of desalination which significantly affect plant life and costs and includes theory as well as detailed information specific to the MSF process. In general, the course is useful for engineers and operators in both desalination and power plants, and will interest technical personnel in the process industries.

The course will describe also the common interface of MSF desalination with associated power plants in various configurations. Desalination Power Generation matching criteria including hybrid system configuration will be illustrated. The theoretical aspects of the course will be complemented by classroom exercises which will cover typical heat and mass balances, heat transfer calculations, typical calculation of MSF stage heat transfer areas, process streams overall power and desalination plant mass balance. A short session on material selection in MSF desalination and balance of plant including structural aspects is included.

Course Objectives

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

- Apply an in-depth knowledge in the operation, heat balance, performance, optimization, start-up and troubleshooting of MSF desalination plants
- Determine the principles and processes of thermal desalination technology emphasizing the classification, historical development & market status, MSF flashing stage, basic heat & mass flows, performance ratio, fouling and scaling
- Illustrate the basic process of Multi-Stage Flash (MSF) technology
- Identify the different types of MSF plants and determine the criteria for classification
- Sketch the schematic configurations of MSF desalination plant
- Determine the MSF process description including flow sheets and main process parameters profiles

- Implement the Stage Stimulation Model used in MSF technology
- Apply the concept of combined power and MSF plant including auxiliary equipment, power-desalination plant combinations and pass out steam turbine
- Determine power and desalination matching optimization applied in MSF plants
- Carryout proper maintenance procedures of MSF plants such as tube cleaning, chemical cleaning of metals and sponge balls
- Select and use maintenance tools & techniques for MSF desalination technology
- Employ the concept of material selection and lifetime expectancy as applied in MSF plant
- Identify the types of alloys in MSF plant and recognize their features, functions and importance
- Implement the concepts of limestone water treatment including its process

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, sample video clips of the instructor's actual lectures & practical sessions during the course conveniently saved in a **Tablet PC**.*

Who Should Attend

This course covers systematic techniques and methodologies on the operation, heat balance, performance, optimization, start-up and troubleshooting of MSF desalination plants for engineers of all disciplines and water utility employees being trained to purchase, operate and maintain MSF distillers. Further, the course is suitable for personnel in other types of distillation plant as well as for corrosion engineers and chemists. In general, the course is useful for engineers and other technical staff in both desalination and power plants, and will interest technical personnel in the process industries.

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

US$ 5,500 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 **3.0 CEUs** (Continuing Education Units) or **30 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. Paul Patsi, MSc, BSc, is a **Senior Analytical Chemist** and an **International Expert** in **Water & Waste Water Treatment Technology** with over **25 years** of extensive experience in **Analytical Laboratory** and **Water & Wastewater Treatment Engineering**. His expertise covers **Laboratory Assessment**, **Microbiological Quality Assurance**, **Analytical Chemistry**, **Statistical Analysis**, **Laboratory Safety**, **Equipment & Infrastructure Management**, **Budgeting & Planning of Laboratory Consumables**, **Business Administration**, **Personnel Management**, **Laboratory Management**, **Chemical Analysis**, **Laboratory Auditing**, **Risk Assessment**, **Microbiological Analysis of Water & Waste Water**, **Waste Water Treatment Analysis**, **Water Chemistry**, **HACCP**, **ISO 22000**, **ISO 17025**, **ISO 9001**, Good Manufacturing Practice (**GMP**), Good Hygiene Practice (**GHP**) and Good Laboratory Practice (**GLP**). He is also an expert in microbiological indoor air quality, water biology, food sampling and calibration. He is currently the **Head of Industrial Analytical Laboratory** of PINDOS wherein he is in-charge of the budgeting, auditing, consumables, suppliers, personnel management, equipment and infrastructure management along with waste water treatment and water/environmental legislation.

During his career life, Mr. Paul has held key positions such as the **Head of Microbiology & Chemical Laboratory**, **Head of Quality Control**, **Technical Consultant**, **Research Projects Specialist**, **Scientific Consultant**, **Biologist-Scientific Expert** and **Biologist** for multi-billion companies like the **European Union**, **Help LTD**, **Lake Pamvotis Municipality Company**, **Hellenic Centre for Marine Research**, **Cargill** and **Nestle** just to name a few.

Mr. Paul has a **Master's** degree in **Food Science and Food Technology** from the **University of Ioannina** (**Greece**) and a **Bachelor's** degree in **Biology** from the **Aristotle University of Thessaloniki** (**Greece**). He is a **Certified Instructor/Trainer** and a **Member** of the **Society for Applied Microbiology**, **Society of Biological Scientist** and the **Global Coalition for Sustained Excellence in Food & Health Protection**.

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	***Thermal Desalination Technology*** *Water Resources, Composition and Measuring Scales ● Classification, Historical Development and Market Status ● Flash Desalination Processes ● MSF Flashing Stage ● Basic Heat and Mass Flows for Thermal Plants ● Performance Ratio Definitions and Examples (MSF)*

0930 – 0945	*Break*
0945 – 1045	***Thermal Desalination Technology (cont'd)*** *Thermal Desalination Process and Energy Input ● Single Effect Evaporation ● Single Effect Mechanical Vapor Compression ● Multiple Effect Evaporation*
1045 – 1230	***Thermal Desalination Technology (cont'd)*** *Multiple Effect Evaporation with Vapor Compression ● Energy ● Fouling and Scaling*
1230 – 1245	*Break*
1245 – 1420	***Multi-Stage Flash (MSF) Technology*** *Basics of the Process and the Technology ● Different Types of MSF Plants ● Criteria for Classification*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0900	***Multi-Stage Flash (MSF) Technology (cont'd)*** *Schematic Configurations ● MSF Process Description*
0900 – 0915	*Break*
0915 – 1045	***Multi-Stage Flash (MSF) Technology (cont'd)*** *Flow Sheets ● Main Process Parameters Profiles*
1045 – 1230	***Multi-Stage Flash (MSF) Technology (cont'd)*** *MSF Process Thermodynamics ● Stage Simulation Model*
1230 – 1245	*Break*
1245 – 1420	***Multi-Stage Flash (MSF) Technology (cont'd)*** *Concepts of Heat Transfer ● Auxiliary Equipment*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0900	***Combined Power and MSF Plant*** *MSF Plant Interfaces with the Rest of the Yard ● Auxiliary Equipment ● Main Process Interface Interconnection ● Typical Layouts ●Power–Desalination Plant Combinations ●Pass Out Steam Turbine ● CCGT ● Others*
0900 – 0915	*Break*
0915 – 1045	***Power and Desalination Matching Optimization*** *Link to the Power Plant Optimization Criteria ● Hybrid Plants*
1045 – 1230	***Maintenance of MSF Plant*** *Tube Cleaning ● Mechanical Tube Cleaning ● Chemical Cleaning of Metals*
1230 – 1245	*Break*
1245 – 1420	***Maintenance of MSF Plant (cont'd)*** *Sponge Balls*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

0730 – 0900	***"Site Visit to Modern MSF Plant in the UAE"***
0900 – 0915	*Break*
0915 – 1045	***"Site Visit to Modern MSF Plant in the UAE" (cont'd)***
1045 – 1230	***"Site Visit to Modern MSF Plant in the UAE" (cont'd)***
1230 – 1245	*Break*
1245 – 1420	***"Site Visit to Modern MSF Plant in the UAE" (cont'd)***
1420 - 1430	***Recap***
1430	*Lunch & End of Day Four*

Day 5

0730 – 0930	***Material Selection and Lifetime Expectancy*** *Basics of the Corrosion Process in Desalination ● Criteria for Material Selection ● Evaporator (Internal External Components) ● Balance of Plant (Pumps Etc.) ● Life Expectancy ● Rehabilitation and Upgrading ● Up-Rating*
0930 – 0945	*Break*
0945 – 1100	***Alloys in MSF Plant*** *Copper Alloys in Natural Seawater ● Copper Alloys in Deaerated Seawater and Brine ● Copper Alloys in Incondensable Gases ● Tubeplates ● Waterboxes ● Evaporator Shells and Flash Chamber Linings ● Piping Systems ● Problems in Cooling Water Circuits ● Monitor – Channeling ● Condenser Monitoring System CMS ● Ball Effectiveness and Cleaning Frequency*
1100 – 1215	***Limestone Water Treatment*** *Limestone Post Treatment Procedures ● Limestone Water Treatment Plant*
1215 – 1230	*Break*
1230 – 1345	***MSF Plant Maintenance Case Studies*** *High-Performance Condenser Tube Cleaning System Featuring Advanced Ball Collecting Technology ● MSF Maintenance System*
1345 - 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions/Site Visit

Site visit will be organized during the course for delegates to practice the theory learnt:-




Course Coordinator

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