● Industry Interaction E & TC Engineering

The department of E&TC has successfully conducted an Industrial visit.

The following are the details of the same.

Date:

14/02/2025

Time: 11:00

AM

Venue:-Seiler Garepa India Pvt. Ltd. At- Fanasu, Dapoli

The Industrial visit at Seiler Garepa India Pvt. Ltd. was highly engaging and intellectually stimulating event that took place on 14 Feb 2025 organized by EXTC Department. This Industrial visit aim to gain the practical insights into the operations and process of esteemed company and to better understand the manufacturing of helium leak test machines, helium recovery equipment and assembly lines.

Helium Leak Test Machines:

Helium leak test machines are used to detect and quantify leaks in various sealed components and systems. The process typically involves the following steps:

1. Preparation and Setup

- The test object (e.g., a sealed component, pipeline, or vacuum chamber) is placed in a test chamber or connected to the test setup.
- The system is evacuated to create a vacuum if required.
- Helium gas is used as a tracer gas because of its small atomic size and inert nature.

2. Testing Methods

Helium leak testing can be performed using different methods:

A. Vacuum (Sniffer) Method

- The test object is evacuated to create a vacuum inside.
- Helium gas is sprayed externally around potential leak points.

- A mass spectrometer-based helium detector inside the test object detects any helium that enters through leaks.

B. Pressure (Accumulation) Method

- The test object is pressurized with a helium-air mixture.
- A helium detector probes the external surface for escaping gas.
- This method is used when vacuum conditions are not feasible.

C. Helium Bombing Method (for Hermetically Sealed Parts)

- The sealed part is placed in a high-pressure helium atmosphere for a set duration.
- If there are micro-leaks, helium penetrates inside.
- The part is then placed in a vacuum chamber, and a helium detector measures the gas escaping from inside.

D. Integral (Vacuum Chamber) Method

- The test object is placed inside a vacuum chamber.
- The object is pressurized with helium internally.
- Any leaks cause helium to escape into the vacuum chamber, where a helium mass spectrometer detects it.

3. Leak Detection & Measurement

- The helium leak detector (typically a mass spectrometer) identifies the presence and concentration of helium.
- The leak rate is measured, usually in units of atm-cc/sec, mbar-L/sec, or ppm.
- Acceptable leakage thresholds depend on industry standards and application requirements.

4. Results & Interpretation

- The system determines if the component passes or fails based on predefined leak rate limits.
- Results are logged for quality assurance and traceability.

5. Post-Test Procedures

- If a leak is found, corrective actions such as sealing, re-welding, or component replacement may be taken.
- If the part passes, it proceeds to the next stage in production or deployment.

Helium Recovery Equipment:

Helium recovery equipment is used to collect, purify, and reuse helium gas, which helps reduce costs and prevent waste. When helium is used in processes like leak testing, cryogenics, or manufacturing, it is often lost into the air. A recovery system captures this helium, removes impurities, compresses it, and stores it for future use.

The system typically includes a collection unit that gathers the used helium, a compressor to pressurize it, a purification unit to filter out unwanted gases, and a storage tank to hold the clean helium. Once purified, the helium can be used again in the same process.

There are different types of helium recovery systems. Some only collect the gas but don't recycle it, while others fully clean and reuse it in a closed loop. Some systems mix recovered helium with fresh helium to maintain quality.

These systems are widely used in industries like aerospace, medical imaging (MRI machines), semiconductor manufacturing, and automotive testing. Using helium recovery not only saves money but also helps preserve this valuable gas for future needs.

Role of IoT in Helium Leak Test Machines

IoT (Internet of Things) enhances the functionality and efficiency of helium leak test machines by enabling real-time data collection, monitoring, and predictive maintenance.

Integration Points:

- **Remote Monitoring:** Sensors connected to the test machine relay real-time data about pressure, helium concentration, and leakage to a centralized cloud server.
- **Predictive Maintenance:** IoT systems analyze machine data and predict potential failures, minimizing downtime.

- **Data Analytics & Insights:** IoT platforms provide data visualization to help improve testing efficiency and process control.
- **Automated Alerts/Notifications:** Alerts are sent to operators if leakage exceeds permissible limits, ensuring prompt corrective actions.

Benefits:

- Increased efficiency and reliability.
- Reduced human intervention and error.
- Faster identification of leaks and real-time response.
- Enhanced traceability and compliance reporting.

Role of Embedded Systems in Helium Leak Test Machines

Embedded systems control and automate various functionalities of helium leak testing machines. These systems involve microcontrollers or microprocessors programmed to handle the core tasks of the test machine.

Key Functions:

- **Signal Acquisition & Processing:** Embedded systems read data from pressure sensors, helium detectors, and other test sensors.
- **Control Logic Implementation:** They execute test algorithms and control vacuum pumps, valves, and gas flow.
- **User Interface (UI):** Embedded systems provide intuitive interfaces via touch screens or display panels for operators to configure and monitor test parameters.
- **Communication Protocols:** Embedded systems enable communication between the leak test machine and IoT platforms via protocols such as MQTT, HTTP, or Mod bus.

Microcontroller/Processor Role:

- ADC/DAC for sensor data acquisition.
- Real-time operating systems (RTOS) for time-critical operations.
- Communication modules (Wi-Fi, Ethernet, Bluetooth) for IoT connectivity.

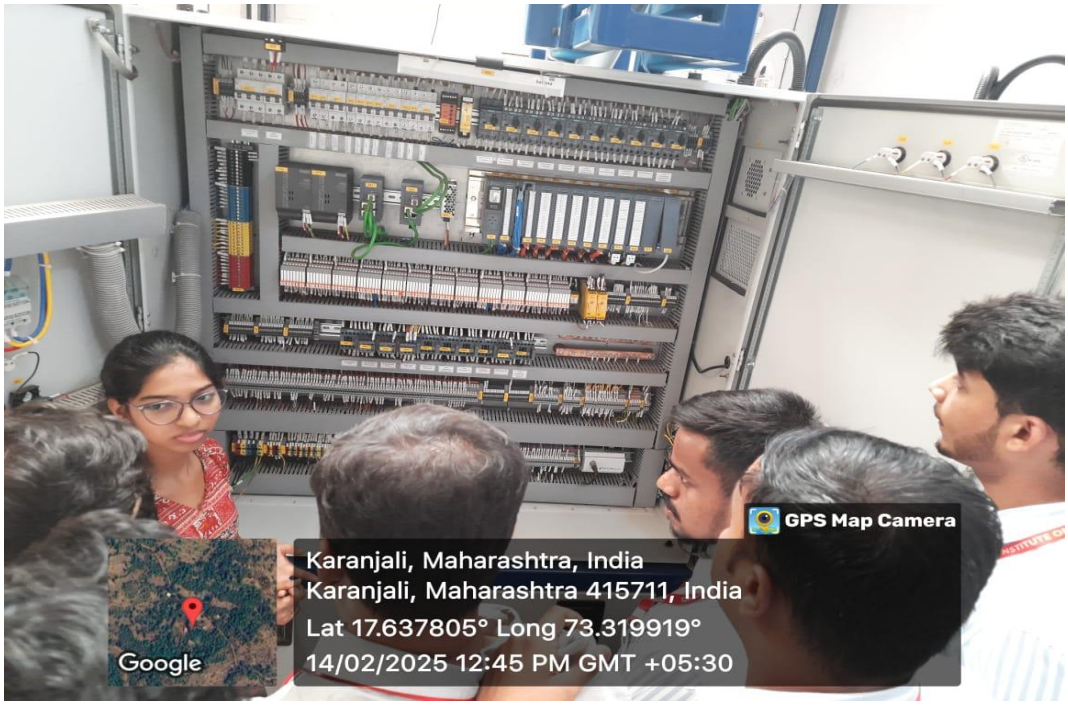
IoT and Embedded System Synergy in Helium Leak Testing

IoT and embedded systems work together to improve the performance of helium leak testing machines.

Data Flow:

- **Sensor Data Acquisition:** Embedded systems collect sensor data.
- **Local Processing & Control:** Embedded firmware controls the machine and performs initial analysis.
- **IoT Cloud Transmission:** Relevant data is transmitted to an IoT platform for advanced analysis and remote monitoring.
- **Action & Feedback Loop:** IoT platforms send control commands or alerts based on analyzed data, ensuring automated corrective measures.

Some photos of same are shown below,



The industrial visit to Seiler Garepa India Pvt. Ltd. was an enlightening experience, providing valuable insights into the manufacturing industry. We all were impressed by the company's commitment to quality, safety, and environmental responsibility.