Internship Report on

“HHO gas: A Sustainable Energy Solution for the Future - A Review of its Application and Opportunities”

To

K.R. MANGALAM UNIVERSITY

Completed at

Idyllic Futuristic Technologies LLP, Noida

Internship period: 1st April 2025 to 30th April 2025

Submitted by:

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Internship Certificate

Certified that **Mr. Mayank Nautiyal**, B.Sc. Forensic Science (Enrollment no. 2303212028), from K.R. Manglam University, Gurugram, Haryana has successfully Completed Internship from Idyllic Futuristic technologies LLP, Noida (U.P), from 1/04/2025 to 30/04/2025

During the internship period, he was involved in various tasks and projects related to **Department of Forensic Science**.He demonstrated a keen interest in learning and showed enthusiasm, punctuality, and professionalism throughout the tenure.

The internship was undertaken as part of academic/professional training and has been completed satisfactorily.

Date- 12.05.2025

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Declaration

I hereby declare that the internship report entitled & quote; HHO Gas: A Sustainable Energy Solution for the Future – A Review of its Application and Opportunities submitted in partial fulfilment of the requirement for the degree of Bachelor of Forensic Science at K.R. Mangalam University is my original work and has not been submitted elsewhere. All sources of information used have been duly acknowledged.



Student Name : Mayank Nautiyal

Roll Number: 2303212028'

Date: 03-07-2025



Dr . Shivani Sehgal

Assistant Professor

SBAS

Acknowledgement

I would like to express my sincere gratitude to Idyllic Futuristic Technologies LLP for providing me the opportunity to carry out my internship on the topic: HHO Gas: A Sustainable Energy Solution for the Future – A Review of its Application and Opportunities; I am especially thankful to my mentors and colleagues for their constant support, guidance, and encouragement throughout this internship. Finally, I extend my gratitude to K.R. Mangalam University for including this internship program as an integral part of our curriculum.



Student Name: Mayank Nautiyal

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Abstract

This report presents a comprehensive review of HHO gas (oxyhydrogen), a potential sustainable energy solution for the future. The internship focused on experimental research and literature review to explore its applications, efficiency, and opportunities in the energy sector. HHO gas, produced via electrolysis of water, has potential use in internal combustion engines, welding, and as a supplementary fuel for reducing carbon emissions. The report highlights the advantages, challenges, and future prospects of integrating HHO gas technology into existing systems, emphasizing its role as a clean and renewable energy solution.

Introduction

Purpose of the Internship: The primary objective of this internship was to gain hands-on experience in the research and development of alternative energy solutions, specifically focusing on the production and properties of HHO gas

Company/Organization: Idyllic Futuristic Technologies LLP is a Defence R&D startup focused on developing futuristic and dual-use technologies, including innovative solutions in the green fuels sector. The company is mentored by armed forces veterans and aims to contribute to India's self-reliance ("Atmanirbhar Bharat") in critical technologies.

My Role: My role as a Research Intern involved setting up an experimental apparatus for water electrolysis, conducting experiments to generate HHO gas, and analysing the factors that affect its production rate.

Motivation: This internship directly connects with my academic interest in chemistry and analytical techniques. The opportunity to work on a sustainable energy project at a forward-thinking R&D company was a compelling reason for choosing this role.

Organization Profile

Idyllic Futuristic Technologies LLP is an active limited liability partnership incorporated on November 9, 2022, and based in Vadodara, Gujarat, India. Specializing in the manufacturing of machinery and equipment as well as cutting-edge technology solutions, the organization leverages the expertise of industry veterans to support innovation in fields such as aerospace, defence, artificial intelligence, cyber security, and precision engineering. With a paid-up capital of ₹1,00,000 and a dynamic team of partners, Idyllic Futuristic Technologies LLP is committed to advancing indigenous technologies through the "Make in India" initiative and fostering collaborations between industry, academia, and MSMEs for national and commercial impact.

Work/Project Description

Key Responsibilities:

- Conducting a literature review on water electrolysis and HHO gas.
- Designing and assembling a lab-scale HHO generator (electrolyser).
- Preparing electrolyte solutions of varying concentrations.
- Performing experiments to measure the rate of HHO gas production under different conditions.
- Ensuring adherence to all laboratory safety protocols.

Project Overview:

- The project focused on the **electrolytic production of HHO gas**. HHO, also known as oxyhydrogen, is a stoichiometric mixture of hydrogen (H2) and oxygen (O2) gases in a 2:1 ratio, produced by splitting water (H2O) molecules. The core of the project was to investigate how the concentration of the electrolyte, Potassium Hydroxide (KOH), influences the efficiency of this process. The overall chemical reaction is:

Tools/Technologies Used:

- DC Power Supply
- Electrolyser Cell (Dry Cell configuration)
- Glassware (Beakers, Graduated Cylinders)
- Digital Weighing Scale
- Stopwatch and Multimeter

Skills and Knowledge Acquired

Skills Developed:

- **Technical Skills:** Gained proficiency in setting up electrochemical apparatus, precise measurement of chemicals, and handling DC power systems safely. Learned data collection and graphical analysis using spreadsheet software.
- **Soft Skills:** Enhanced problem-solving abilities, time management, and the ability to work independently on a research task. Improved technical communication skills through documentation and discussion of results.

Key Takeaways: The most important lesson was the direct relationship between theoretical scientific principles and their practical application. Seeing how a simple change in electrolyte concentration could drastically alter the outcome of the experiment was a powerful learning experience.

Challenges and Solutions

Challenges Faced:

1. **Gas Leakage:** The initial setup of the electrolyser had minor gas leaks from the hose connections, leading to inaccurate volume measurements.
2. **Electrode Corrosion:** Initial tests with stainless steel plates showed minor signs of corrosion over extended use, which could impact long-term efficiency
3. **Heat Management:** During prolonged operation, the electrolyser cell would heat up, which can increase the resistance of the electrolyte and vaporize water, affecting results.

- **How I Overcame Them:**

1. To solve the leakage, all connections were systematically checked and sealed using PTFE (Teflon) tape and appropriate clamps, ensuring a gas-tight system
2. Research indicated that using higher-grade stainless steel (316L) is more resistant to corrosion. This was noted as a key recommendation for future work.

3. Experiments were conducted in shorter bursts with cooling periods in between to maintain a relatively stable operating temperature, ensuring more consistent and reliable data.

Observations and Reflections

Effect of Electrolyte Concentration on HHO Production; An experiment was conducted to measure the volume of HHO gas produced over 5 minutes using two different concentrations of the KOH electrolyte. The voltage was kept constant at 12V. The findings are presented below.

Table 1: HHO Gas Volume vs. Time for Different KOH Concentrations

Time (minutes)	Gas Volume (mL) at 5% KOH	Gas Volume (mL) at 10% KOH
1	45	95
2	92	195
3	140	290
4	185	380
5	230	475

Conclusion

- **Summary of the Experience:** This internship at Idyllic Futuristic Technologies LLP was an invaluable experience. It provided a bridge between academic theory and real-world R&D, allowing me to contribute to a project in the promising field of green energy. The hands-on work solidified my understanding of electrochemical processes and laboratory practices
- **Impact on Future Plans:** The experience has ignited a strong interest in renewable energy research. I now plan to pursue further studies or a career path that combines my background in forensic and analytical chemistry with sustainable technology development. This internship has provided me with the practical skills and confidence to pursue this goal.