

***Design and Construction of a Smart and Portable Multi-Sensor Measuring Instrument for Measuring the Purity and Energy Potential of Hydrogen Gas***

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***ABSTRACT***

*This research aims to design and build a microcontroller-based multi-sensor measurement instrument to determine the purity and energy potential of hydrogen gas in real-time. The system integrates MQ-8 (H<sub>2</sub>), MQ-135 (CO<sub>2</sub>), DS18B20 (temperature), and HX710B (pressure) sensors controlled by Arduino Uno. The test results show the system operates at a temperature of 29.75–34.75°C and a stable pressure of around 104.92 kPa. The hydrogen concentration is detected in the range of 12–40 ppm (0.000012–0.000040%), producing a hydrogen mass of 0.00104–0.00333 g and an energy potential of 150.19–399.85 J based on the low calorific value (LHV) 120 MJ/Kg. The concentration of CO<sub>2</sub> as an impurity gas is in the range of 335–1108 ppm. Test variations showed that the 0.2 M condition without a magnet resulted in the highest H<sub>2</sub> concentration (±24 ppm), while the use of a magnet at high concentrations reduced H<sub>2</sub> to ±8–10 ppm and increased CO<sub>2</sub> to nearly 300 ppm in dynamic testing. Overall, the system was capable of performing real-time measurements with stable and consistent data, although further calibration is still required to improve accuracy.*

***Key words:*** *hydrogen gas, portable measuring instruments, hydrogen content, energy potential, multi-sensor system*