# ABSTRACT

Alkaline Water Electrolysis (AWE) has shown to be an effective method of producing hydrogen from renewable sources of energy. However this process accounts for only 4-5% of the global hydrogen production. Challenges abound for water electrolysis technologies that presents the traditional methods as comparably favourable.

This research focuses on investigating the relevant performance influencing parameters for alkaline water electrolysers, their contribution to compromising or enhancing cell performance and the various interdependencies that exist between variables. Hydrox Holdings Ltd., in partnership with Demcotech Engineering, provided permission to analyse the performance of a membraneless alkaline water electrolysis pilot plant.

Using pure nickel for the anode and cathode electrodes yielded current densities of 51.9 $mA.cm^{-2}$ (at 1.8VDC, 82% HHV efficiency) and 242.9$mA.cm^{-2}$ (at 2 VDC, 73% HHV efficiency) at an electrode gap of 2.5mm, temperature of 70°C and a flow velocity of 0.075$m.s^{-1}$. At these same experimental conditions, employing Ir-$RuO_2$ on a Ti substrate for the anode and Pt on a Ti substrate for the hydrogen evolution reaction, current densities of 220 $mA.cm^{-2}$ (at 1.765VDC) and 474 $mA.cm^{-2}$ (at 2 VDC) was achieved.

Marini et al., (2012), notes that performance for conventional alkaline water electrolysers should be in the order of > 100 $mA.cm^{-2}$ when operating at a cell potential of 2 VDC. The performance of the membraneless technology has therefore exceeded this benchmark by more than 2 times with the use of basic nickel electrodes and being more than 4 times with the use of PGM catalytic materials, and hence could be described to very comparable as advanced methods of alkaline water electrolysis. The ability to obtain high current density thresholds implies that the membraneless technology has potential for a substantial reduction in scale and hence, in the total capital cost of the technology.