

# *AquaSciences LLC*

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## **Objective**

Quantitative chemical analysis of pH, oxidation-reduction potential (ORP) and molecular hydrogen gas concentration were performed on the Leveluk SD501 from Enagic. Results are shown in table 1.

## **Methods and Conditions**

The pH of source water was  $\approx 7.50$ , ORP  $\approx 265$  mV, temperature  $\approx 19$  °C and pressure 0.83 atm. The machine was given a minimum of 30 minutes of “non-use”, before tests were conducted in order to verify complete cooling. However, this precaution did not appear to make any significant difference.

Hydrogen gas concentration was measured immediately after obtaining aliquots in order to minimize hydrogen exsolution from samples. Molecular hydrogen detection limit was 0.05 ppm. Saturation of hydrogen is 1.6 ppm (0.8 mM) at STP. Hydrogen gas was determined via a novel redox titration method using methylene blue as reagent and colloidal-platinum particles as catalyst. This method has previously been demonstrated effective and accurate with great precision compared to the standard electrochemical method (Seo, Tomoki, et al. Med Gas Res. 2, (2012)).

The values reported represent the averages that were obtained following appropriate analytical procedure. These averages also show the ranges (low to high) that were observed during this work. The values that do not have a corresponding range are the results of only one test; nevertheless, this is merely due to confidence in the values reported. Indeed, they correlate well with the known data and coincide with basic scientific knowledge.

## Results

**Table1.** Results for the Enagic Leveluk SD501

Type	pH	ORP (mV)	[H <sub>2</sub> ] ppm	% saturation
With saline solution, "increase flow" (5 mL/s)	11.60 (11.51-11.71)	-875 (-865 to -885)	1.48 (1.0-2.0)	92.5% (62.5-125.0)
No saline solution, 9.5 setting, "increase flow" (5 mL/s)	10.75 (10.6-11.0)	-838 (-835 to -840)	1.2 (0.9-1.3)	68.8 % (56.3-81.3)
No saline solution, 9.5 setting, "normal flow" (30 mL/s)	9.50 (9.31-9.61)	-650 (-480 to -732)	0.35 (0.3-0.5)	21.9 % (18.8-31.0)
After 10 liter 9.5 setting, "normal flow" (30 mL/s)	9.5	-720	0.35	18.8%
10 liters produced at 9.5 setting, "normal flow" (30 mL/S)	9.5	-720	0.35	18.8 %

At a low flow rate (5 mL/sec), with the saline solution, the SD501 was able to produce a supersaturated hydrogen gas solution (2.0 ppm) with extremely low redox potential; however, other times only half of that concentration was achieved.

Notably, when on normal flow, the machine produced a consistent hydrogen gas concentration ( $\approx 0.35$  ppm) even after 10 liters, fluctuating between 0.3 and 0.45 ppm.

## Discussion

The “normal flow” rate used in this work was more than twice as slow as recommended by the manufacture (0.5 gallons per minute vs. 1-2 gallons per minute). This flow rate (8+ seconds/cup) was used in order to obtain a pH  $\approx$  9.5 thus also assuring a greater hydrogen gas concentration. Indeed, at the faster flow rate (63 mL/s or 1 gallon/min) the SD501 only produced a hydrogen gas concentration of  $\approx$  0.1 ppm (data not shown).

The pH of source water is a critical factor in performing these types of analysis. A low pH, by definition, has a greater hydrogen ion concentration, which facilitates the redox reaction  $[2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2 (\text{g})]$  at the cathode. Furthermore, if the pH of the source water is relatively high ( $\approx$  pH 8.5), then running water at the same flow rate used in this work would produce a pH closer to 10.5—which is considered unpalatable.