PARHyS System: measurement tool for H2 concentration in soil – Industrial version

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Résumé

Natural hydrogen emanations depend on many factors and not be daily or regular. It is thus critical to be able to monitor them continuously over a sufficiently long period. ENGIE has developed, since 2017, a patented technology for continuous hydrogen measurement: The Permanent Analyses of Renewable Hydrogen with Sensors (PARHyS).
PARHyS enables to analyze gases pumped in the soil in real time over a long period with energy self-sufficiency. It is composed of 3 key elements: a soil gas sampling tube, a measurement chamber containing a miniature and selective hydrogen sensor, and a radio-frequency transmitter, sending acquired data to a LoRa concentrator. From there, data can be retrieved remotely via a satellite connection or LoRa operator.

Campaigns were conducted in 2019-2020 in the Sao Francisco basin (Brazil) with a network of 100 prototypes. Field test feedbacks led to the development of a new, higher-performance industrialized version. Improvements include :

- Durability and robustness to harsh environments with a lightweight and compact design
- A new design that allows easy assembly/disassembly for large-scale production and quick, easy maintenance
- Radio and electrical certifications for international marketing (CE and FCC).
- Strong improvement regarding measurement reliability and quality

To obtain such measurement improvements, two main concepts were rethought: the fluidic circuit, with its associated measurement cycle, and the sample tube with a new design allowing pump operation at atmospheric pressure. In more details, soil gas enters the sample tube by diffusion only. After a predefined time, the sample tube is then emptied using a pump maintained at atmospheric pressure, ensuring that the volume stored in it is identical to the volume measured using the H2 sensor, by converting the ppm measured into the exact volume of hydrogen recovered.
The laboratory tests indicate a clear improvement in the performance of PARHyS industrial version with concentration and volume accuracy and reproducibility of 0% to -14% and ±3% respectively. Optimized temperature compensation ensures the differentiation between

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cyclic emanations and cyclic daily temperature artifacts. Finally, first field feedback in winter conditions (soil saturation, negative temperatures, continuous rainfall) in different European areas indicate a very good endurance.

Mots-Clés: Geochemical monitoring, H2 sensor, Shallow soil, PARHyS