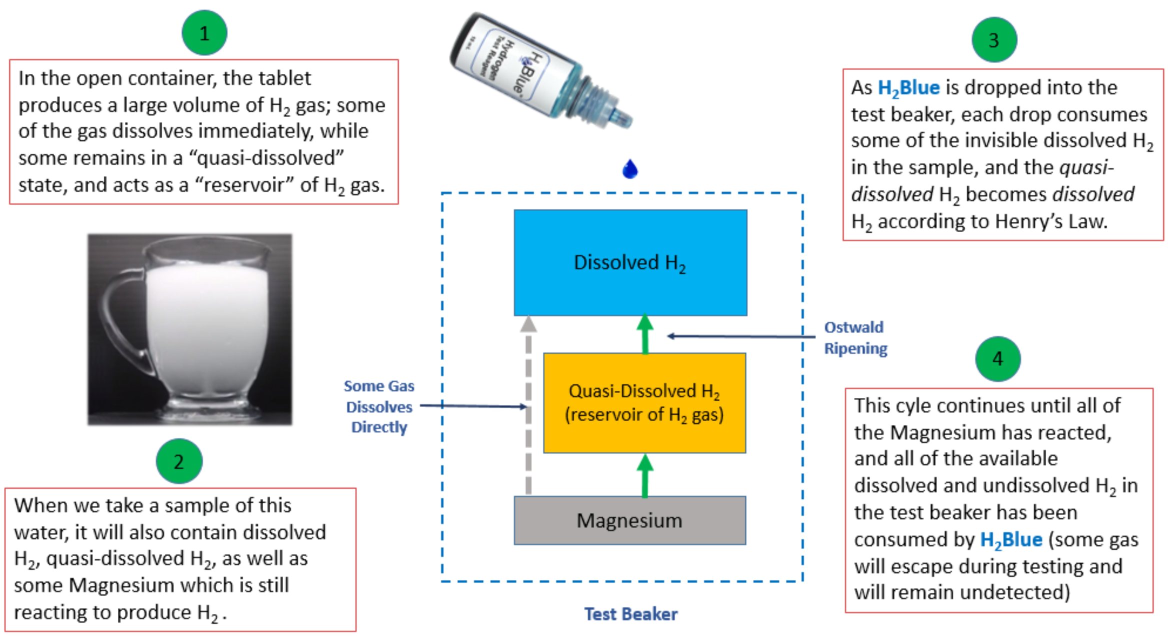
Measuring dissolved H_2 in water produced using "open glass" H_2 tablets:

Some H_2 tablet manufacturers & retailers recommend placing their tablets into an "open-glass" rather than a sealed container. These tablets produce H_2 water characterized by a dense "milky fog" that does not dissipate quickly, often lingering in the container for many minutes (see picture). When using H_2Blue to measure hydrogen-rich water produced by these types of magnesium tablets, a measurement taken from a sample (e.g. 500 mL) may require over 100 drops of the ethanol-based H_2Blue before reaching the titration endpoint. This suggests a dissolved H_2 level of 7.5 to 10mg/L (at 0.1mg/L per drop). This may seem impossible without accompanying pressure. However, due to the apparent micro and nanobubbles formed, there exists an internal pressure in the individual gas bubbles that can reach very high levels according to the Laplace equation. The concentration of dissolved H_2 gas is proportional to the gas pressure within the bubble according to Henry's Law. Small bubbles release gas into the solution, and large bubbles uptake gas from the solution and grow. This process is called "Ostwald ripening". Under these conditions, where the water becomes saturated with H_2, much of the remaining gas is in a "quasi-dissolved" state. As drops of H_2Blue are added to the sample, the dissolved H_2 gas is consumed by the reaction, making it possible for more H_2 to be released from the bubbles and dissolve into solution, where it will then react with more H_2Blue (notice also that, under the right conditions, gas being produced by the Magnesium may dissolve directly into the water without becoming "quasi-dissolved" first). This cycle of consumption and dissolving will continue until all of the available dissolved & "quasi-dissolved" H_2 gas in the sample has been consumed, and all of the magnesium has reacted (see diagram).



What can the total # of drops added tell us about the H_2 water being measured?

While counting the number of drops added does not tell us what the "peak" dissolved level of H_2 is, we can still use the total number of drops added to calculate the approximate amount of H_2 that will be ingested, which will include both the dissolved and the "quasi-dissolved" H_2. Because we can also calculate these same values in any other H_2 water, they can be used as an important tool for comparing ingested levels of H_2 across many different H_2 water technologies. There are some technologies that produce very cloudy/foggy water, but give very *low* readings with the H_2Blue. This simply means that the total amount of H_2 in this water is very low, since there is a direct relationship between dissolved and undissolved H_2 according to Henry's law. That is, H_2 gas is simultaneously dissolving into the water, and forming larger bubbles (coalescing) and escaping into the atmosphere. Indeed, if all the H_2 gas produced from these types of tablets was dissolved in solution, then the readings with H_2Blue would likely be even higher, since it would measure the gas before it escaped into the atmosphere.

Comparing the performance characteristics of the H_2Blue eco formula and ethanol-based H_2Blue:

The ethanol and eco formulations of H_2Blue perform identically for most types of hydrogen-infused water. However, when comparing the performance of the new H_2Blue eco formula to the ethanol formula for this specific type of H_2 water, lower levels of the reagent can be added before reaching the end point (perhaps as much as 50% less than the ethanol). This may be due to differences in the specific gravity, hydrophobicity, surface tension, ionic strength, etc. between the carrier solvents of the two formulations. These differences may affect the zeta-potential, bubble stability, rate and propensity for bubble coalescence, etc. The ethanol formula does not appear to have a negative impact the equilibrium between the "quasi-dissolved" and dissolved H_2. The eco formula, however, tends to destabilize these bubbles, which increases their growth and coalescence, resulting in most of the gas escaping into the atmosphere, thus resulting in a lower H_2 level. While the eco formula can still be used as a reliable "indicator" of the relatively high levels of H_2 gas *in this particular type of water*, if more accuracy is required, we recommend that you consider using the ethanol-based H_2Blue.

Contact Us for more information about purchasing the ethanol-based version of H_2Blue.

Hazmat Warning:
Because ethanol-based products are classified as "dangerous goods" by USDOT (49CFR), international IATA (DGR), and other regulatory agencies worldwide (class III flammable) , they are not permitted to be shipped via the US domestic/international postal service (USPS). Other carriers (UPS/Fedex/DHL) which do permit them to be shipped require special certification training of personnel, as well as specific packaging, labeling, handling and documentation before accepting dangerous goods for shipping. Therefore, the H_2Blue eco formula is the best choice under most circumstances.