TECHNICAL NOTE

EXPLANATION OF FREE CHLORINE SENSOR pH DEPENDENCY

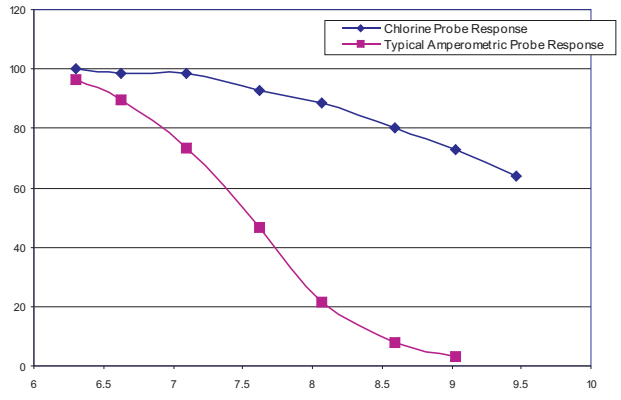
Like other amperometric devices used to measure free chlorine, Chemtrac's free chlorine sensor does exhibit some small pH dependency at pHs above 6.5 (although much less than most other amperometric devices). The reason a pH dependency exists is because amperometric free chlorine sensors measure all of the hypochlorous acid (HOCl) present but not all of the hypochlorite ion (OCl-). When chlorine dissolves into water, the pH of the water determines how much of the free chlorine is in the form of hypochlorous acid. Most of the free chlorine will be present as HOCl at a pH of 5. While at a pH of 9 most of the chlorine is present as OCl-. Thus, the measurement signal produced by amperometric sensors will be lower (measuring less of the free chlorine) as the pH increases. The red line in the below graph shows a typical amperometric sensor response to pH.

Because of the effect pH has on the formation of HOCl, there is a substantial impact to the measurement accuracy of traditional amperometric free chlorine sensors when a pH changes occur above a pH of 6.5. To help maintain the desired measurement accuracy, traditional amperometic free chlorine sensors will require the user to either fix the sample pH using an acid buffer, or they will require a pH meter to be used as an input to the analyzer to adjust the raw chlorine measurement signal.

Chemtrac's Free Chlorine Sensor (Model FCS1700) exhibits a significant reduction in pH dependency over other amperometric sensors as shown by the blue line in the graph below. This is accomplished through the unique design of the sensor. A membrane cap, which covers the sensor's electrodes, is filled with an acidic electrolyte solution. This low pH solution converts hypochlorite ions into hypochlorous acid as they permeate through the membrane thereby improving the free chlorine sensor's response at higher pH's. For most applications, this means pH buffers or pH correction is not required. If pH is stable within .5 pH units at a pH of 7, for example, the Chemtrac Free Chlorine sensor reading would vary by less than 5% (traditional amperometric sensors would drift by 10% to 20%).

In those situations where pH instability results in an unacceptable amount of error, the customer still has the option with the Chemtrac Free Chlorine sensor of using a pH buffer or a pH meter to improve measurement accuracy. And because the Chemtrac Free Chlorine sensor maintains a higher measurement signal at higher pH's than traditional amperometric sensors, the errors associated with a pH correction are much reduced. At a pH of 9, a traditional amperometric sensor sees less than 10% of free chlorine levels and as a result a larger correction factor would be needed to adjust the reading to match actual free chlorine levels. A higher correction factor is subject to greater error because it amplifies the inaccuracies in both the free chlorine and pH sensors. Chemtrac's Free Chlorine Sensor, on the other hand, still responds to 60% of free chlorine levels at a pH of 9. Because of the improved pH response of the FCS1700 sensor, a much smaller correction factor can be used and pH correction can be performed without significantly sacrificing accuracy.

Typical Probe Response to pH (Unbuffered)



Residual Chlorine

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eg. at pH 7

pH varies by +/- 0.1pH	pH varies by +/- 0.5pH	pH varies by +/- 1pH
0.5ppm would vary by +/- 0.02 ppm	0.5ppm would vary by +/- 0.02 ppm	0.5ppm would vary by +/- 0.05 ppm
1ppm +/- would vary by +/- 0.02 ppm	1ppm +/- would vary by +/- 0.04 ppm	1ppm +/- would vary by +/- 0.1 ppm
3ppm +/- would vary by +/- 0.06 ppm	3ppm +/- would vary by +/- 0.12 ppm	3ppm +/- would vary by +/- 0.3 ppm

eg. at pH 8

pH varies by +/- 0.1pH	pH varies by +/- 0.5pH	pH varies by +/- 1pH
0.5ppm would vary by +/- 0.02 ppm	0.5ppm would vary by +/- 0.05 ppm	0.5ppm would vary by +/- 0.08 ppm
1ppm +/- would vary by +/- 0.04 ppm	1ppm +/- would vary by +/- 0.1 ppm	1ppm +/- would vary by +/- 0.15 ppm
3ppm +/- would vary by +/- 0.12 ppm	3ppm +/- would vary by +/- 0.3 ppm	3ppm +/- would vary by +/- 0.45 ppm

eg. at pH 9

pH varies by +/- 0.1pH	pH varies by +/- 0.5pH	pH varies by +/- 1pH
0.5ppm would vary by +/- 0.03 ppm	0.5ppm would vary by +/- 0.07 ppm	0.5ppm would vary by +/- 0.16 ppm
1ppm +/- would vary by +/- 0.06 ppm	1ppm +/- would vary by +/- 0.14 ppm	1ppm +/- would vary by +/- 0.30 ppm
3ppm +/- would vary by +/- 0.18 ppm	3ppm +/- would vary by +/- 0.42 ppm	3ppm +/- would vary by +/- 0.90 ppm

NOTES

1. These figures are approximate and may vary from probe to probe
2. The effect on the sensor is predictable so that when the pH goes up the probe signal goes down and vice versa
3. When the pH is restored the probe will return to the original value
4. The normally accepted accuracy of a DPD test is + 0.05ppm
5. If the free chlorine sensor pH susceptibility is unacceptable on your process then there are Co2 and Acetic Acid buffers available. Please ask your sales representative for details

DONT FORGET! 98% of our customers dont use buffers and are very happy with the performance of their chlorine probes.