

## PERASAN® vs. Chlorine Equivalency

Q: What ppm 15% PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is) is equivalent to 1 ppm gas Cl<sub>2</sub>?

The following explanation is a simple exercise in counting electrons to determine how much PERASAN® 15% PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is) is equivalent to gas Cl<sub>2</sub>.

The calculations below are theoretical, and do not take into account less well-defined variables such as relative reaction kinetics differences or relative efficacy differences.

As an illustrative example of where this calculation might be applied, we will address a typical question that a customer has asked: “How much PERASAN® 15% PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is) does it take to oxidize iron and manganese in the well water used as make-up in my cooling water system?”

### Calculation

First we calculate the number of moles of oxidizing agent in 100 g of PERASAN® 15% PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is) and compare this to the number of moles of oxidizing agent in 100 g gas Cl<sub>2</sub>.

100g PERASAN® 15% PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is) contains  $15/76 + 22/34$  g of oxidizing agent.

This becomes  $0.197 + 0.647 = 0.84$  moles oxidizing agent.

100g gas Cl<sub>2</sub> contains  $100/71$  g of oxidizing agent.

This becomes 1.41 moles oxidizing agent.

Therefore, 100g of gas Cl<sub>2</sub> is equivalent to  $(100 \times 1.41/0.84) = 167$ g PERASAN® 15%PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is), or

<b>1 ppm Cl<sub>2</sub> is equivalent to 1.67 ppm of PERASAN® 15%PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is)</b>
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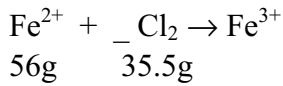
To convert this value to activity, multiply the 1.67 x the activity (0.15). Thus, the above result =  $1.67 \times 0.15 = 0.25$  ppm equivalency.

However, remember that upon dilution, only half the chlorine is available as hypochlorous acid, and the other half of the chlorine becomes HCL, which is not an oxidizing species. In practice, the net result is that 2 ppm Cl<sub>2</sub> is equivalent to 0.25 ppm active PERASAN®.

### Customer Question

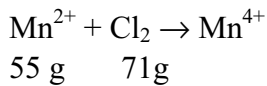
“How much PERASAN® 15% PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is) does it take to oxidize iron and manganese in the well water used as make-up in my cooling water system?”

First we calculate how much gas Cl<sub>2</sub> is required to effect the oxidation reaction:



**i.e. 1 ppm Fe<sup>2+</sup> requires (35.5/56) = 0.63 ppm Cl<sub>2</sub>, or (0.63 x 1.67) = 1.05 ppm PERASAN® 15% PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is)**

Next we calculate how much gas Cl<sub>2</sub> is required to effect the oxidation reaction:



**i.e. 1 ppm Mn<sup>2+</sup> requires (71/55) = 1.29 ppm Cl<sub>2</sub>, or (1.29 x 1.67) = 2.16 ppm PERASAN® 15% PAA, 22% H<sub>2</sub>O<sub>2</sub> (product-as-is)**