How Different Oxidizers React With One Another

Oxidizing Agent (Oxidizer) Definition: A substance that can acquire or accept electrons from another substance. In general, "***Oxidizing agents acquire electrons and become reduced, while reducing agents lose electrons and become oxidized.***"

A chemical reaction where one substance is oxidized and another substance is reduced is called an oxidation-reduction reaction, abbreviated as a "Redox" reaction. If a substance is oxidized, then another substance **MUST** have been reduced in the process.

Two common oxidizers that are used in the sanitation process are sodium hypochlorite (chlorine bleach) and hydrogen peroxide. A major component of peracetic acid sanitizer is hydrogen peroxide. Different oxidizers have different redox potentials – see the chart below:

TABLE 18.1 Standard Reduction Potentials at 25°C

	Reduction Half-Reaction		E° (V)
Stronger oxidizing agent ↑	$F_2(g) + 2\,e^-$	$\longrightarrow 2\,F^-(aq)$	2.87
	$H_2O_2(aq) + 2\,H^+(aq) + 2\,e^-$	$\longrightarrow 2\,H_2O(l)$	1.78
	$MnO_4^-(aq) + 8\,H^+(aq) + 5\,e^-$	$\longrightarrow Mn^{2+}(aq) + 4\,H_2O(l)$	1.51
	$Cl_2(g) + 2\,e^-$	$\longrightarrow 2\,Cl^-(aq)$	1.36
	$Cr_2O_7^{2-}(aq) + 14\,H^+(aq) + 6\,e^-$	$\longrightarrow 2\,Cr^{3+}(aq) + 7\,H_2O(l)$	1.33
	$O_2(g) + 4\,H^+(aq) + 4\,e^-$	$\longrightarrow 2\,H_2O(l)$	1.23
	$Br_2(l) + 2\,e^-$	$\longrightarrow 2\,Br^-(aq)$	1.09
	$Ag^+(aq) + e^-$	$\longrightarrow Ag(s)$	0.80
	$Fe^{3+}(aq) + e^-$	$\longrightarrow Fe^{2+}(aq)$	0.77
	$O_2(g) + 2\,H^+(aq) + 2\,e^-$	$\longrightarrow H_2O_2(aq)$	0.70
	$I_2(s) + 2\,e^-$	$\longrightarrow 2\,I^-(aq)$	0.54
	$O_2(g) + 2\,H_2O(l) + 4\,e^-$	$\longrightarrow 4\,OH^-(aq)$	0.40
	$Cu^{2+}(aq) + 2\,e^-$	$\longrightarrow Cu(s)$	0.34
	$Sn^{4+}(aq) + 2\,e^-$	$\longrightarrow Sn^{2+}(aq)$	0.15
	$2\,H^+(aq) + 2\,e^-$	$\longrightarrow H_2(g)$	0

As the chart depicts, hydrogen peroxide is a stronger oxidizer than chlorine. Therefore, if chlorine and hydrogen peroxide are present in the same aqueous solution, the hydrogen peroxide remains an oxidizer (pulls electrons from chlorine) and the chlorine becomes a reducing agent (gives up electrons to the peroxide). Essentially, both compounds neutralize one another according to the equation:

NaOCl(aq) + H2O2(aq) ----------> O2(g) + NaCl + H2O

Sodium Hypochlorite Hydrogen Peroxide Oxygen Salt Water

The takeaway from all of this is that allowing chlorine bleach and peroxides to mix together does not produce a solution with more oxidizing strength – it will actually have less! If you are sanitizing with peracetic acid, it is a good idea to check your make-up water for excessive free chlorine.

Reach out to the RITE team for more information on using oxidizers.