

## Question # 82651

Are the concentrations of old and new hydrogen peroxide different? Given what you know about the stability of hydrogen peroxide do you expect them to be?

Answer:

Hydrogen peroxide is thermodynamically unstable and decomposes to form water and oxygen with a  $\Delta H^0$  of  $-98.2$  kJ/mol and a  $\Delta S$  of  $70.5$  J/(mol·K). As hydrogen peroxide is unstable and slowly decomposes in the presence of light. Because of its instability, hydrogen peroxide is typically stored with a stabilizer in a weakly acidic solution. Decomposition is catalysed by various compounds, including most transition metals and their compounds (e.g. manganese dioxide, silver, and platinum). Certain metal ions, such as  $\text{Fe}^{2+}$  or  $\text{Ti}^{3+}$ , can cause the decomposition to take a different path, with free radicals such as  $(\text{HO}\cdot)$  and  $(\text{HOO}\cdot)$  being formed. Non-metallic catalysts include potassium iodide, which reacts particularly rapidly and forms the basis of the elephant toothpaste experiment. Hydrogen peroxide can also be decomposed biologically by the enzyme catalase. The decomposition of hydrogen peroxide liberates oxygen and heat; this can be dangerous, as spilling high-concentration hydrogen peroxide on a flammable substance can cause an immediate fire [1].

So, hydrogen peroxide can be decomposed by the heat, light, and catalysts. To reduce this effect, the stabilizer is added to hydrogen peroxide solution. But according to my personal experience, this stabilizer is useful only in case of hermetically sealed containers for 2-3 years. In other cases, the decomposition of hydrogen peroxide is inevitable. It does not mean that all hydrogen peroxide will decompose; it means just that the concentration of hydrogen peroxide will decrease. You can observe this when you use the old solution of hydrogen peroxide for the wound: the disinfection reaction is more passive than with new hydrogen peroxide. I suppose that the stabilizer is stable in hydrogen peroxide solution just for 2 years (expiration date of 3% hydrogen peroxide solutions). If you are interested in more concentrated solutions, the expiration date for them is near 0.5-1.0 year.

Reference:

[1] [https://en.wikipedia.org/wiki/Hydrogen\\_peroxide](https://en.wikipedia.org/wiki/Hydrogen_peroxide)