Maryknoll Convent School (Secondary Section)

The *Vanish* solution

Introduction

Using "experiments" is one of the strategies in advertising commercial products. However, are those "experiments" reliable? We came across a series of exaggerated experiments in the commercial of a stain removal product called "*Vanish*".

This motivates us investigating *Vanish*. Our first question is - Is *Vanish* really the best solution to stain removal?

Objective

- To analyse the chemical composition of *Vanish*
- To compare the stain removing ability of *Vanish* with other commercial stain removers
- To investigate the possible damage of various stain removers on fabrics
- To investigate the stability of *Vanish*

Theory

Mechanism of bleaching

The active ingredient of *Vanish* is sodium percarbonate. It dissolves in water to give Na_2CO_3 and H_2O_2. (equation 1)

(1) $2Na_2CO_3 \cdot 3H_2O_2 \xrightarrow{aq} 2Na_2CO_3 + 3H_2O_2$

Hydrolysis of CO_3^{2-} (equation 2) provides a favorable alkaline medium for the acid dissociation of H_2O_2 (equation 3), giving out the active bleaching agent, OOH^-.

(2) $CO_3^{2-} + H_2O \rightleftharpoons HCO_3^- + OH^-$

(3) $H_2O_2 \rightleftharpoons H^+ + OOH^-$

Colors of stains are caused by chromophores that are often conjugated pi systems. The perhydroxyl anions attack these systems, ruining the chromophores thus cause decolorization.

Experiments

Part 1. Qualitative analysis of Vanish

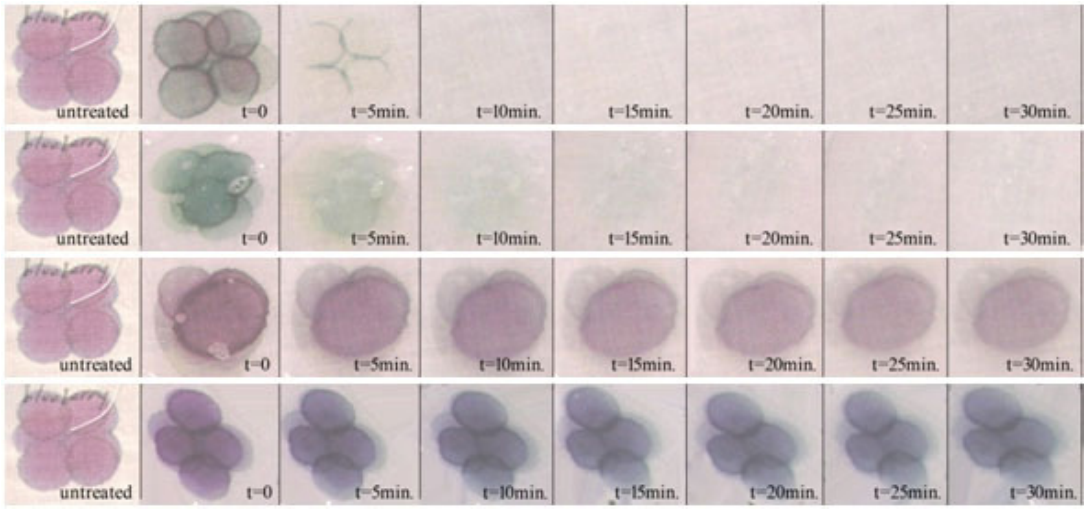
The chemical composition of *Vanish* was confirmed with qualitative tests. Results show that Na^+, CO_3^{2-}, and H_2O_2 were present in a solution of *Vanish*.

Part 2. Stain removal ability of Vanish

The bleaching power of *Vanish* was compared with chlorine bleach and a color-safe liquid bleach(with H_2O_2 as active ingredient) on different stains in various soaking tests, water was used as a control.

We carried out a 30-minute soaking test on milder stains (as found in a preliminary soaking test) including blueberry extract and soy sauce, as well as a 3-hour test on more stubborn stain including chilli oil, ketchup and curry.

The following are the results of 30-minute soak on blueberry stains:



(From top to bottom: chlorine bleach, *Vanish*, colour-safe liquid bleach, water)

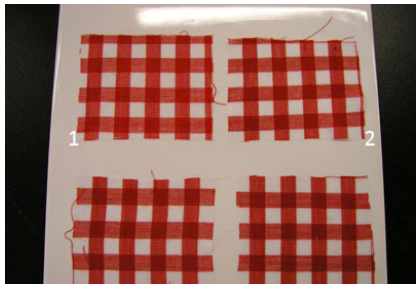
In another experiment we studied the effect of temperature on bleaching power. In general, a higher temperature speeds up the bleaching.

In all the mentioned tests, the same order of bleaching power was obtained: *Vanish* seconded to chlorine bleach, with color-safe liquid bleach being the weakest. It was also verified that high pH enhanced the bleaching power of *Vanish*.

Part 3 Possible damage of various stain removers on fabrics

The bleaches, as demonstrated, have strong powers. The possible damages caused were investigated, including fabric colour and mechanical strength.

In investigating the effect on fabric colour, a 3-hour soak was carried out. The cloth treated with chlorine bleach has its colour faded, but not the others. This shows that oxygen bleaches are colour-safe.



1=Cl bleach 2=coloursafe liquid bleach
3=*Vanish* 4=water

The change in mechanical strength was measured by means of the tensile strength of the fabrics. In the first part of the investigation, tensile strength tests were carried out on several materials. The standard deviations of four trials were compared, the best material, wool, was chosen for testing. Tensile strength tests of wool threads were then carried out after treated with various bleach solutions for 1 day. However, there was no significant drop in tensile strength in various solutions, even with chlorine bleach which is known to be damaging to wool, only yellowing of wool was observed. Tensile strength might not be a good indication on the mechanical damage of fabrics.

Part 4 stability of Vanish

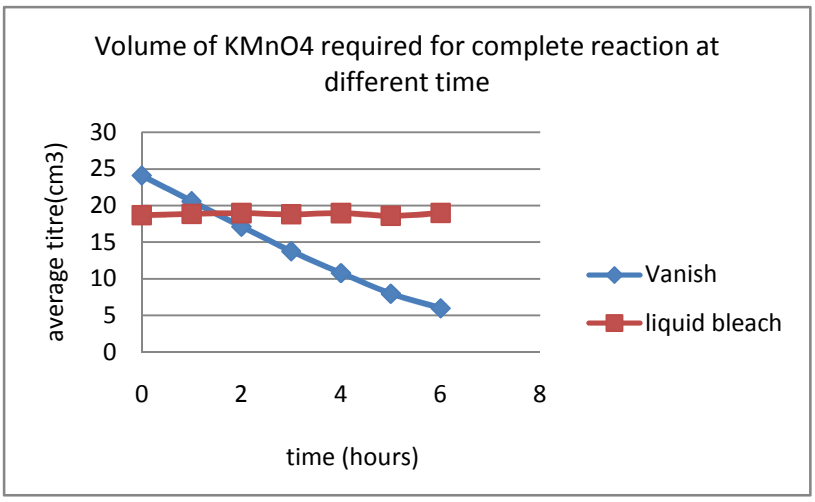
An interesting phenomenon was observed during our preparation of bleach solutions. Bubbles were formed continuously in the *Vanish* solution, but not colour-safe liquid bleach which also got H_2O_2 as active ingredient. We suspected the bubbles were oxygen formed from the decomposition of H_2O_2 according to the following equation:

$2\ H_2O_2 \rightarrow 2H_2O + O_2$

As concentration H_2O_2 affects bleaching power, would that be desirable for us to soak clothes for a long time if $[H_2O_2]$ drops with time? $[H_2O_2]$ of *Vanish* and colour-safe liquid bleach was studied over a period of 6 hours. It was found by titrating acidified bleach solution against $KMnO_4$ solution according to the equation:

$2MnO_4^- + 5\ H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O$

When *Vanish* dissolved in water, its active ingredient, H_2O_2 *"vanished"* (decomposed) rapidly.

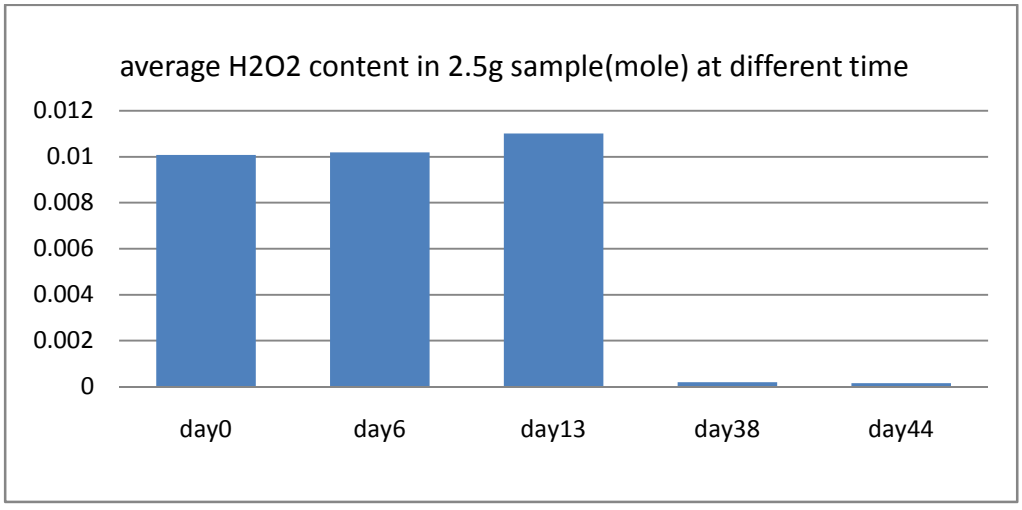


Its content dropped by 75.1 % in 6 hours, but that of colour-safe liquid bleach remained constant. Hence, long term soaking with *Vanish* would not remove stains better.

The above experiment showed that *Vanish* was indeed incompatible with moisture. Theoretically moisture in air could also cause decomposition. The effect of humidity on hydrogen peroxide content of *Vanish* powder was studied.

A humid environment was created by placing a beaker of water in a jell jar. Multiple samples were put into the system. Analysis of hydrogen peroxide content were carried out at day 0, day 6, day 13, day 38 and day 44.

The relation of H_2O_2 content and time was shown below:



The H_2O_2 content remained constant at the beginning stage of the investigation, however, deliquescence was observed after day 38, and the H_2O_2 content dropped significantly.

Conclusion

Vanish is the strongest among color-safe bleaches. It is disadvantageous when compared with colour-safe liquid bleach as it is incompatible with moisture. It seems not to have damaged the fabric as acute as we feared. It is also more environmental friendly than chlorine bleaches as its effluent contains less harmful substances. To conclude, *Vanish* is a commercial product that is worth buying.

Our recommendations when using *Vanish*:

- Store it away from moisture
- Prepare the solution right before use
- The recommended soaking period is 3-5 hours