OC1_01_01

Title : **The reduction of toxic solvent and ink in the whiteboard marker**

Field : Chemistry

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Abstract :

Whiteboard marker has been recently used instead of traditional chalk in order to avoid the dangerous from the wasting dust. However, the chemicals solvents used to make the whiteboard marker ink can also be dangerous. The aim of this project is to investigate if it is possible to use some other less toxic chemicals and some natural materials to produce whiteboard marker ink that can be safer to use in class room. The experiment has 3 steps 1.)Finding some natural materials that can be used as the ink 2.) Investigating the most suitable solvents and 3.) Modifying the smell of the ink.

From the study, we found that the extracted solution from Butterfly pea is one of the most suitable source of the blue color because the intense red color can be easily turn to blue by changing the pH of the solution same as Ceylon spinach color, source of violet. Isopropanol is the most suitable solvent due to its polarity match to that of our color substance. In addition, we found that glycerin can be added to increase the ability to stick of the color on the white board. The experiment showed that the ratio of ink (Butterfly pea and Ceylon spinach): solvent: glycerin of 1: 0.125 : 0.125 is the best ratio that made the best quality ink. To change the color of the ink, the ratio of the Butterfly pea solution: acid of 1 : 0.6 results in the optimum red color. Finally, the home-made synthetic ester was added to gain the favorable fragrance.

Keywords : Butterfly pea, Ceylon spinach, fragrance, glycerin, isopropanol

Introduction :

At present, whiteboard marker is usually used because the traditional chalk produce unavoidable dust which could be dangerous to our health. Nevertheless, the dangerous of the chemical whiteboard marker is also should be concerned. Ministry of Public Health of Thailand reported the extremely dangerous of whiteboard marker specially when it is used in the bad ventilation classroom. This is because that xylene, bad smell volatile and high toxic chemical, is used as a solvent. The long time intake could be bad for respiratory system, irritate our skin. It is possible that the intense imposture of the chemical ink could resist the production of red blood cells and also resist the production of white blood cells that create Anemia and Leukemia from bone marrow.

The ventilation in classroom can be adjusted to help eliminate the chemicals. Another possible way is to change the components in whiteboard marker ink. In this research, we changed the chemical ink to natural extracted ink. The lest toxic solvent was also used. The smell of the ink was also change using our synthetic ester compounds.

Methodology :

Finding the natural color to be used as ink

The ink were prepared by boiling 1 g fresh Butterfly pea, dry Butterfly pea and burned coconut husk with 50 ml water in 3 beakers for 90 minutes. After that, the solution was separated from the plant materials using paper filter. HCl was added into the solution (1-10 ml) to investigate the changing of color from blue to red of the Butterfly pea extract solution. Furthermore, we squeezed 200 g Ceylon spinach fresh fruits in zip-lock bags.

Finding the most suitable solvent

Put 5 ml ethanol, isoamyl alcohol and isopropanol in 3 different test tubes. Dropped the plant extract 5 drops into each of the test tubes, stirred and compared the results. Next, mixed Butterfly pea color with solvent in different ratio (solution : ink) from 1 : 5, 1 : 2.5, 1 : 1, 1 : 0.5 to 1 : 0.125 and Ceylon spinach color with solvent in different ratio (solution : ink) from 1 : 0.5, 1 : 0.25, 1 : 0.125 to 1 : 0.0625 to compare the color.

For the blue whiteboard marker, we compared 2 ratios of ink (Butterfly pea): solvent: glycerin, 1 : 0.125 : 0.125 and 1 : 0.125 : 1. For the red whiteboard marker, compared 3 ratios of ink (Butterfly pea and HCl) : solvent : glycerin , 1 : 0.125 : 0.25, 1 : 0.125 : 0.125 and 1 : 0.125 : 0.0625. Moreover, the violet whiteboard marker, we compared 2 ratios of ink (Ceylon spinach): solvent: glycerin, 1 : 0.125 : 0.125 and 1 : 0.125 : 1. Finally, filled them in felt-tip pens to test the real use.

Adding the fragrance to the whiteboard marker.

To synthesize a banana fragrance, a volatile ester, mixed acetic acid and isoamyl alcohol. Then, dropped 5, 8 and 10 drops of the fragrance into the best ratio invenstigated from previous step. Contrasted their smell.

Results and Discussion:

Finding the natural color to be ink in the whiteboard marker

Fig.1 shows the filtered solutions from each plant materials. It can be seen that color from burned coconut husk was clear brown color whilst both fresh Butterfly pea and dry Butterfly pea gave us same thing, a deep blue color. Thus, we used dry Butterfly pea to be our ink because it is easier to find and keep than fresh Butterfly pea. Fig. 2 shows the color of our solution, Butterfly pea when 1 – 10 ml HCl was added. We found out that 6 ml of HCl was the smallest volume of HCl that changed the Butterfly pea color with the intensest red color. Fig.3 shows the squeezed Ceylon spinach giving us violet liquid. Therefore, we used it as our ink too.

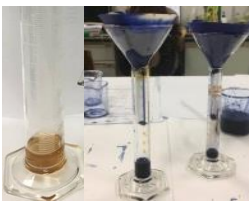

Fig.1 Filtered solution: burned coconut husk (left), fresh Butterfly pea (middle) and dry Butterfly pea (right).

Fig.2 The color of Butterfly pea different concentrations of HCl.

Fig.3 The bag, used for squeezing Ceylon spinach.

Finding the most suitable solvent

Fig.4 shows that Butterfly pea and Ceylon spinach solution could not be dissolved in isoamyl alcohol. But they could dissolve better in isopropanol and ethanol. However, the clearer solution could be obtained when isopropanol was used. Therefore, we used isopropanol as the solvent. Moreover, we found that when the ratio of Butterfly pea ink: solvent was 1: 0.125, the deeper color was obtained (shown in Fig.5). Same with Butterfly pea, the ration of Ceylon spinach ink : solvent was 1: 0.125, the deeper color was obtained and dried faster than the 1 : 0.0625 (shown in Fig.6).

We studied the increase ability of the stickiness to the whiteboard by adding glycerin to decrease its polarity. We also found that the best ratio of ink (Butterfly pea): solvent: glycerin in blue whiteboard marker was 1: 0.125: 0.125 since this gave the more intense blue color than that using 1 : 0.125 : 1 ratio (shown in Fig.7). Similar to blue white board marker results, the best ratio of ink (Butterfly pea): solvent: glycerin in the red one was 1: 0.125: 0.125 forasmuch it gave deeper color than that of 1 : 0.125 : 0.0625 and not too fluid as 1: 0.125: 0.25 (shown in Fig.8). Like blue white board marker results, the best ratio of ink (Ceylon spinach): solvent: glycerin in the violet one was 1: 0.125: 0.125 due to it gave darker color than that of 1 : 0.125 : 1 (shown in Fig.9)

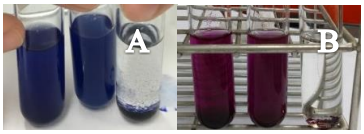

Fig.4 The ability of Butterfly pea (A) and Ceylon spinach (B) dissolution in ethanol (left) isopropanol (middle) and isoamyl alcohol (right).

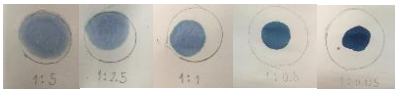

Fig.5 The blue color results using the ratio of ink (Butterfly pea solution) : solvent of 1 : 5, 1 : 2.5, 1 : 1, 1 : 0.5 and 1 : 0.125 from left to right.

Fig.6 The violet color results using the ratio of ink (Ceylon spinach solution) : solvent of 1 : 0.5, 1 : 0.25, 1 : 0.125 and 1 : 0.0625 from left to right.

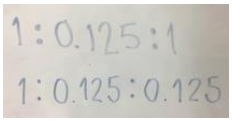

Fig.7 The blue color results using the ratio of ink (Butterfly pea): solvent: glycerin, 1: 0.125: 1 (upper) and 1: 0.125: 0.125 (lower).

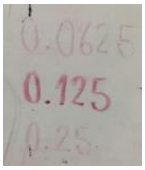

Fig.8 The red color results using the ratio of ink (Butterfly pea and HCl): solvent: glycerin of 1 : 0.125 : 0.0625 (upper)1 : 0.125 : 0.125 (middle) and 1: 0.125: 0.25 (lower).

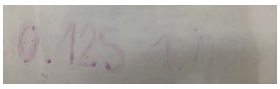

Fig.9 The violet color results using the ratio of ink (Ceylon spinach) : solvent : glycerin , 1 : 0.125 : 0.125 (left) and 1 : 0.125 : 1 (right).

Adding the fragrance to the whiteboard marker.

From the experiment, we found that 10 drops of fragrance gave the most fragrant smell. Also, the rotten smell of Butterfly pea was reduced.

Conclusion :

This study thus contributes to the best ratio of ink (Butterfly pea) : solvent : glycerin was 1 : 0.125 : 0.125 which made the best quality ink both in blue and red whiteboard marker. The changing color from blue to be red of the ink can be done by adding diluted acid (HCl) where the ratio of Butterfly pea solution: acid is 1: 0.6. Besides that, to made the best quality ink in violet whiteboard marker, the best ratio of ink (Ceylon spinach): solvent: glycerin was 1: 0.125: 0.125 same in blue and red (shown in Fig.10). Finally, adding the fragrance to the whiteboard marker through esterification to make ester. The experiment indicated that 10 drops per 5 mL is the proper quantity. This project is satisfiable although we cannot make the color as deep as the general whiteboard marker and the Butterfly pea and Ceylon spinach solution may be rotten.Even if the developed whiteboard marker can use similar to the general whiteboard marker and safer.

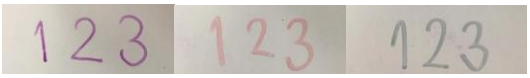

Fig.10 the result of the best ratio of ink (every color): solvent: glycerin when we use on the whiteboard.

Acknowledgements :

This project was a part of Science Classrooms in University-Affiliated School supported by Ministry of Science and Technology.

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