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Environmental Preservation Through The Use Of Less Toxic Reagents To Treat Hazardous Solid Chemical Waste From Undergraduate Chemistry Laboratories

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ABSTRACT

Azo dye compounds are derivatives of diazine, in which both hydrogens are substituted with hydrocarbyl groups.The disposal of these compounds are difficult and also they are hazardous. Apart from Azo dye, Osazone is another compound which is prepared by undergraduate students as a part of their academics.When it comes to Osazone it contains chemicals like phenylhydrazine which show toxic effects on blood cells and they induce Anemia decrease in RBCs, Haemoglobin and Haematocrit. The present studies focus on decolourisation and reduction of hazardous nature of Azo dye and Osazone. In order to carry out this project expired Hydrogen Peroxide (H_2O_2) (from Chemistry labs), Lemon juice and Vinegar are used as they have high bleaching properties and they are easily available, cost effective. According to the findings, hydrogen peroxide had the strongest bleaching property of the three.

Keywords : Azo dye, Osazone, Hydrogen Peroxide, bleaching property.

INTRODUCTION

Chemical waste management is the process of collecting, separating, recycling, and disposing of chemical waste in a safe and environmentally responsible manner. Chemical waste can include products from manufacturing, research, and testing, as well as household cleaning supplies. Proper waste management ensures that toxins are not released into the environment and that the materials are disposed of properly to avoid contaminating water supplies.Colors are the first pollutants to be recognized in waste water and must be removed before discharged into the watercourses.

Even the presence of very small amounts of dye in water affects visual quality of water. In comparison to colorless organic compounds, removal of color is more important that burdens a larger portion of biochemical oxygen demand.Azo compounds are widely used in the dyeing of every type of fibers, natural, artificial and synthetic in order to color a variety of things; textiles and plastics to cosmetics and food. The time for Azo dyes to be common in our clothing has passed, we need to make a change in order to get rid of this harmful production.

Osazone is the derivative of carbohydrates that are formed by the reaction of carbohydrates with phenylhydrazine. Osazone contains chemicals like phenylhydrazine which show toxic effects on blood cells and they induce Anemia decrease in RBCs, Haemoglobin and Haematocrit.

Azo dye and Osazone preparation are required and are covered in the undergraduate curriculum. In order to reduce the harmful impacts of dissolving dye and osazone into water and the environment. For bleaching property expired H2O2 which is no longer used for experiments as it has lost its strength, Vinegar, and Lemon juice are used both in concentrated form as well as in combination of dilutions,since they have been found to have a high bleaching action. H_2O_2 and Vinegar that we used are expired, and lemon extract , a natural bleach, is affordable. To determine which is more effective, both individual and comparative studies were conducted.

MATERIAL REQUIRED : Test tubes, test tube stand, cuvette, graduated pipette, boiling tube, funnel,, beaker, water bath, tripod stand, filter paper, spatula, weighing machine , colorimeter, lemon, vinegar, conical flask.

CHEMICALS REQUIRED : Aniline, 1:1 HCl, Sodium Nitrite, β-naphthol, 10%NaOH , H_2O_2, Distilled water, Methyl acetate, Phenyl hydrazine hydrochloride, Sodium acetate, Acetic acid, Ethanol .

METHODOLOGY

PREPARATION OF AZO DYE

Dissolve 2 ml of aniline in 12 ml of 1:1 HCl in a boiling tube. Cool it in an ice bath. Dissolve 2 ml of $NaNO_2$ in 10 ml of water. Cool it in an ice bath. Dissolve 3 gm of β-naphthol in 20 ml of 10%NaOH in a conical flask. Cool it in an ice bath. Diazotized aniline slowly by adding $NaNO_2$ dropwise with constant stirring. Add the mixture to the β-naphthol solution with constant stirring. Red coloured crystals of dye separated out. Filter the dye and keep it aside to dry.

PREPARATION OF OSAZONE

Dissolve 1 gm of dextrose in 5 ml of water in a boiling tube. Add 2 gms of Phenyl hydrazine hydrochloride, 0.5 gms of sodium acetate and 2-3 ml of acetic acid. Stir it well. Warm it in a hot water bath for about 15 minutes. Cool it. Lemon yellow crystals of Osazone are formed. Filter the crystals and keep it aside to dry.

PREPARATION OF LEMON EXTRACT

Lemon extract is obtained by filtering the lemon juice and centrifuges to reduce its turbidity.

PREPARATION OF DYE SOLUTION

Dissolve 1 gm of azo dye in 10 ml of methyl acetate.

PREPARATION OF OSAZONE SOLUTION

Dissolve 1 gram of Osazone in 10 ml of ethanol.

OBSERVATIONS

Optical density of azo dye solution at different filters to know highest absorbance of the solution.

Table : 1

Serial no	Filter	Optical Density
1	550 nm	1.69
2	580 nm	0.96
3	610 nm	0.39
4	700 nm	0.12

Colorimeter is used to know the range of decolourisation of azo dye when mixed with Lemon juice and hydrogen peroxide. Here are some dilutions along with the optical density of the solutions :

TABLE 2 :

Dilutions of Azo dye solution with H_2O_2 and Lemon extract with their OD values.

S. no.	Azo Dye Solution (ml)	H_2O_2(ml)	Lemon extract (ml)	OD
1	1	-	6	1.78
2	1	1	5	1.78
3	1	2	4	1.78
4	1	3	3	1.47
5	1	4	2	0.93
6	1	5	1	0.5
7	1	6	-	0.11

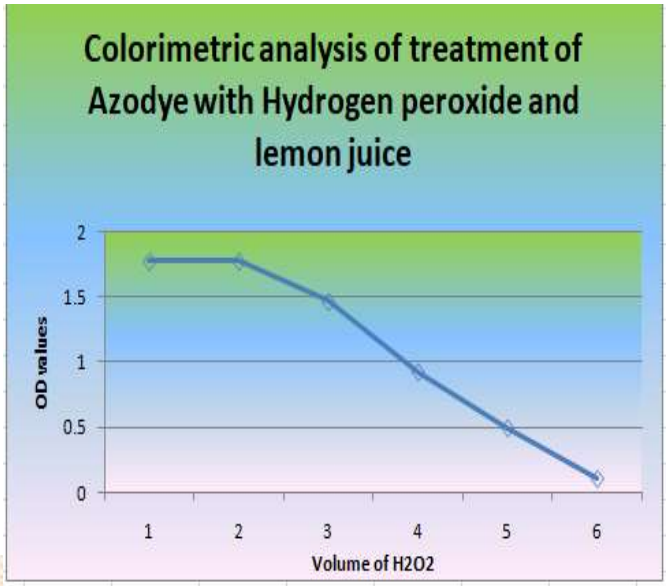


Figure 3

TABLE 3 :

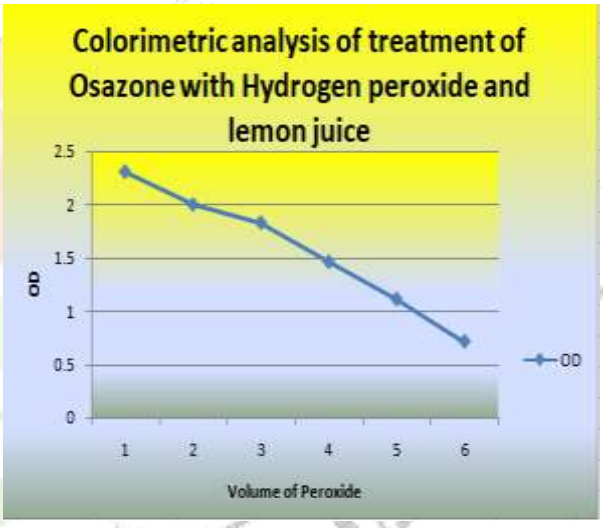
Optical density of Osazone solution at different filters to know highest absorbance of the solution.

Serial no.	Filter (nm)	Optical Density
1	430	0.77
2	470	1.22
3	490	0.88
4	520	0.8
5	580	0.74
6	610	0.49
7	700	0.55

TABLE 4 :

Dilutions of Osazone solution with H_2O_2 and Lemon extract with their OD values.

Serial no	Osazone solution (ml)	H_2O_2	Lemon juice (ml)	OD
1	1	-	6	2.31
2	1	1	5	2.31
3	1	2	4	2
4	1	3	3	1.83
5	1	4	2	1.46
6	1	5	1	1.11
7	1	6	-	0.71



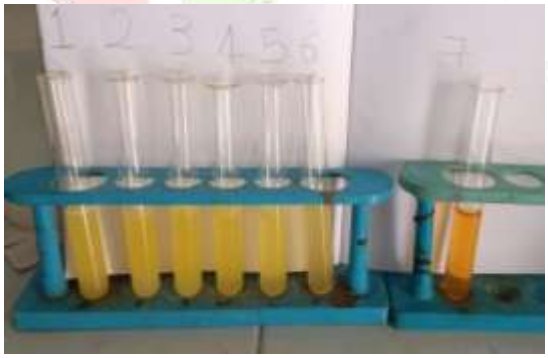


Figure : 4

TABLE 5 :

Dilutions of Azo dye solution with Vinegar and H_2O with their OD values .

S.NO	Azodye solution(ml)	Vinegar (ml)	H_2O (ml)	O.D
1	1	6	-	0.15
2	1	5	1	0.14
3	1	4	2	0.13
4	1	3	3	0.12
5	1	2	4	0.12
6	1	1	5	0.11
7	1	-	6	0.11

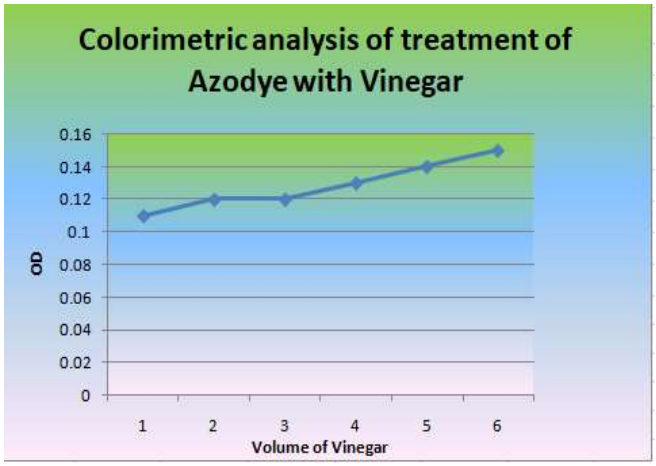


Figure : 5

TABLE 6 :

Dilutions of Osazone with lemon extract and H_2O with their OD values

SERIAL NO.	OSAZONE SOLUTION	LEMON EXTRACT (ml)	WATER	OPTICAL DENSITY (OD VALUES)
1	1	5	1	1.31
2	1	4	2	1.0
3	1	3	3	0.83
4	1	2	4	0.61
5	1	1	5	0.4

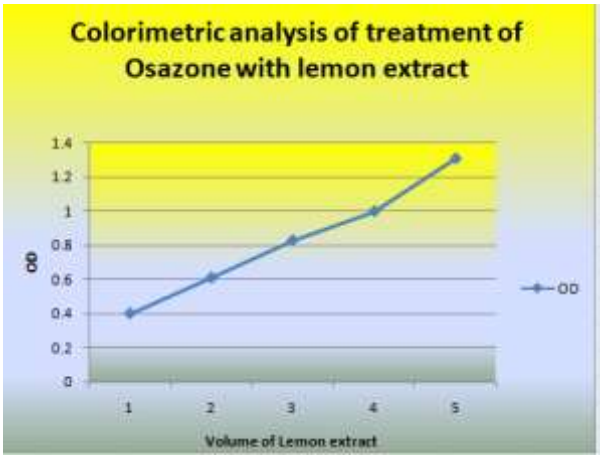


Figure : 6

TABLE 7 :

Dilutions of Osazone solution with Vinegar and H_2O with their OD values.

Serial no.	Osazone Solution (ml)	Vinegar (ml)	Water (ml)	OD
1	1	6	-	0.11
2	1	5	1	0.14
3	1	4	2	0.18
4	1	3	3	0.20
5	1	2	4	0.22
6	1	1	5	0.24
7	1	-	6	0.36

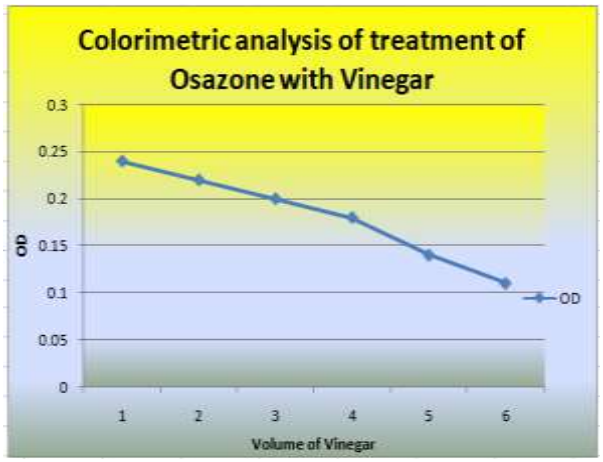


Figure : 7

TABLE 8 :

Dilutions of Azo dye solution with lemon extract and H_2O with their OD values.

S.No	AZO DYE Solution(ml)	Lemon Extract (ml)	Water (ml)	O.D
1	1	5	1	0.78
2	1	4	2	0.78
3	1	3	3	0.78
4	1	2	4	0.78
5	1	1	5	0.3

Figure : 8

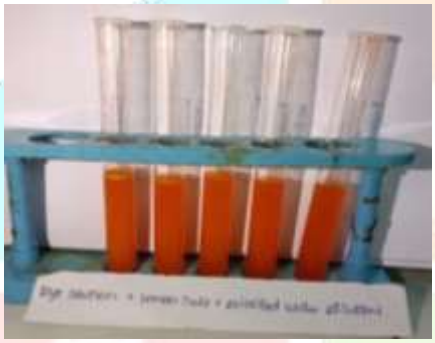


TABLE 9 :

Comparative OD values of the Dye solution with pure concentration of the reagents.

Serial no	Reagents	OD
1	H_2O_2	0.11
2	Vinegar	0.15
3	Lemon extract	0.78

TABLE 10 :

Comparative OD values of the Osazone solution with pure concentration of the reagents.

Serial no	Reagents	OD
1	H_2O_2	0.4
2	Vinegar	0.11
3	Lemon extract	0.3

DISCUSSION

According to the OD values in the table, 550 nm has the maximum absorbance and 610 nm has the lowest absorbance(Table :1)

H_2O_2 and vinegar is found to be more effective in decolourisation of Azo dye solution as the OD values are decreased drastically from 1.60 to 0.11. On the basis of colorimetric measurement, dilutions of azo dye solution with increasing H_2O_2 and decreased concentration of lemon extracts result in a decrease in OD values, proving that pure concentrations of H_2O_2 are more efficient at decolorizing azo dye solution (Table 2) ; dilutions of azo dye solution with decreasing volume of vinegar or increasing dilution with water OD values are found to increasing, indicating that more concentration of vinegar is suitable for effective treatment of Azo dye (Table 5) ; dilutions of Azo dye solution with pure lemon extract with water combination , increase in the concentration of the lemon extract or decrease in the volume of water indicates no action in decolourisation as OD values were constant (Table : 9) where as dilutions of azo dye with combination of H_2O_2 and lemon extract shows the bleaching effect as lemon extract together with hydrogen peroxide enhances the bleaching effect of the lemon extract (Table : 2) .

Vinegar is found to be more effective in decolourising as O.D values are decreased dramatically from 1.22 to 0.11. H_2O_2 and lemon extract are also effective almost equally. On colorimetric analysis it is found that dilution of vinegar resulted in fluctuations of O.D values (Table : 10)

On decreasing volumes of vinegar or increasing dilutions with water with Osazone, O.D values are found to increase, indicating that more concentrated vinegar is suitable for effective treatment (Table : 7) Treatment of Osazone solution with pure lemon extract O.D values are increased. This can be explained on the basis of the turbid nature of lemon extract. On dilution with water, lemon extract and water combination is found to be not much effective for decolourisation, so the O.D values decreased with decreasing volumes of lemon. At high concentrations of H_2O_2 and vinegar the O.D values are low, indicating that they are effective in decolourising osazone to a maximum extent (Table : 6)

CONCLUSION

The aim of the study is to reduce the harmful impacts of dissolving Azo dye and Osazone into water and the environment. OD values are used to determine and comprehend the effects of expired H_2O_2, vinegar, and lemon juice on azo dye and osazone both separately and in combination.

OD values typically vary depending on the concentration of the solution, That makes sense given that OD values drop as the decolourisation is more. H_2O_2, Vinegar and lemon juice are known to have high bleaching actions. The outcomes of the combination dilutions, such as Azo dye with H_2O_2 and lemon juice, Azo dye with vinegar, and Osazone with H_2O_2 and lemon juice, are graphically displayed to clearly demonstrate the decolorization impact. We can conclude from all of these investigations that pure dilutions, such as H_2O_2 with

Azo dye solution and H_2O_2 with Osazone solution completely decolorize the sample, Vinegar with Azo dye solution and Osazone solution exhibit the similar decolorization. Lemon juice shows no action as it is not effective. comparatively H_2O_2 shows better result than Vinegar. The structures and toxicity of the compounds following treatment with these reagents must be studied further.

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