



RESEARCH ARTICLE

NEW METHOD DEVELOPMENT FOR RESTORATION OF OBLITERATED PAINTED REGISTRATION NUMBER ON VEHICLE REGISTRATION NUMBER PLATE

¹Sandeep Kumar Pathak, ¹Munish Kumar Mishra, ³Rashmi Sharma, ²Rajeev Kumar and ^{1,*}Lav Kesharwani

¹Department of Forensic Science, SHIATS, Allahabad, UP, India 211007

²Department of Forensic Science, Galgotias University, Noida, India

³Central Forensic Science Laboratory, Chandigarh, India

ARTICLE INFO

Article History:

Received 27th September, 2016
Received in revised form
22nd October, 2016
Accepted 09th November, 2016
Published online 30th December, 2016

Key words:

Registration Number Plate,
Chemical Etching Reagent,
Vehicle Registration Number.

ABSTRACT

Vehicle Registration Numbers are used as a unique identification number of any motorized vehicle, but these can be obliterated by painting during the use of vehicle in criminal activity such as murder, hit and run cases, dacoity, thefts, so that the ownership cannot be traced. Nowadays only very few methods are available for restoration of obliterated painted registration numbers on the metal plate surface. Chemical etching remains the most common and successful method for restoration of obliterated painted registration number on metal registration plate. In this study three different methods have been proposed along with 10 different etching reagents used for restoration of obliterated numbers by using a gentle and careful squeezing of the surface uniformly with a small, handy and densely rolled ball of dry cotton. Here the best results were archived with the use of method third with etching reagent R10 (composition: Carbon tetrachloride-30ml, dioxin-50ml and Ethyl acetate-20ml). The proposed third method can be best utilized along with reagent no. R10 for restoration of obliterated painted number on the vehicle registration number plate.

Copyright©2016, Sandeep Kumar Pathak et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Sandeep Kumar Pathak, Munish Kumar Mishra, Rashmi Sharma, Rajeev Kumar and Lav Kesharwani. 2016. "New method development for restoration of obliterated painted registration number on vehicle registration number plate", *International Journal of Current Research*, 8, (12), 43196-43203.

INTRODUCTION

The theft of two wheeler and four wheeler vehicles are very common in India as well as in rest of the world. The persons who are involved in the theft generally change the identification marks of the vehicle. Criminals used many methods for removal of identifying numbers such as filing or grinding, peeling and drilling, Katterwe (2006). But in case of vehicle registration number plate they generally paint the new number on the same registration plate using paint of different make and batch or some time they replace the registration number plate with other plate which was earlier removed from some other vehicle. In Forensic practice few experimental techniques are available Hogan *et al.* (2006) which was used successfully to restore the obliterated serial number on the metal surfaces. But in case of vehicle registration number plate no such experimental technique are available for restoration of obliterated vehicle registration number plate Nickolls (1956), Katterwe (2006).

Earlier few workers have tried to restore the obliterated painted number using Methyl IOS Butyl Ketone (MIBK) Thirunavukkarasu *at al.* (2002) but the method is not very much useful because it also destroys the under layer destroying the number in examination also. Certain solvents such as actone, chloroform ether and other similar solvents are also being suggested for use but all above showed non valuable result. Therefore this work was formulated to develop a method for restoration of obliterated painted number on vehicle number registration plate with an objective to develop a method for restoration of obliterated painted number on vehicle number registration plate. Here three different method have been proposed for restoration using different physical examination techniques (U.V-Light, I.R-Light, Oblique-Light, Heat treatment etc) along with chemical technique using 10 different solvents for restoration. In case of obliterated painted registration number plates if top layers of paint swelled or softened then top layers can be removed by gently and careful squeezing of the surface uniformly with a small, handy and densely rolled ball of dry cotton. The cotton should be dipped regularly in fresh etchant and applied until the desired contrast is obtained. When the top paint layer was thus removed, the original identification number hidden underneath appears at the top layer of paint on metal plate Klees(2009), Massiah

*Corresponding author: Lav Kesharwani,

Department of Forensic Science, SHIATS, Allahabad, UP, India 211007.

(1976). Chemical etching method are used at normal room temperature either by swabbing the sample or immersing and gently agitating it Crowe and Smith (2005).

MATERIALS AND METHODS

An attempt has been made for the restoration of obliterated painted registration numbers on number plates by applying three different methods and different reagents. The procedure applied in this practical work is similar to the method prescribed in first, second and third. The methods applied are as follows. In first method the obliterated plates were first visually observed for examination of any mark visible to normal eye, then oblique light examination of obliterated number on metal plate will be carried out followed by U.V and I.R light examination and finally all 10 prepared reagents were tried to restore the mark along with examination of recovered marks. In second method of restoration of obliterated registration number plates, first visually examination of plates were carried out followed by oblique light, U.V, I.R, heat treatment and treatment with prepared reagents finally result will be interpreted on the basis of observation made during experiments. Third method of examination will be carried out by visual examination, oblique light examination of obliterated number plates followed by heat treatment and treatment with chemical reagents prepared earlier.

Collection and photography of the samples

Vehicle registration numbered metal plates were collected from the market. Photography of all plates were done and all the plates were numbered as S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32, S33, S34, S35, S36, S37, S38, S39 and S40. The registrations plates are then painted with different registration number using different coloured paint of a specific company. Now the photography of all registration plates containing registration number were carried out so that comparison with the numbers that will comes after restoration by three suggested methods can be carried out.

Obliteration of marks by painting and then photographed of samples

All the samples having registration numbers were obliterated by white colour paint of same batch number. All the obliterated samples were again photographed by the use of digital camera.

Renumbered on obliterated samples and photographed

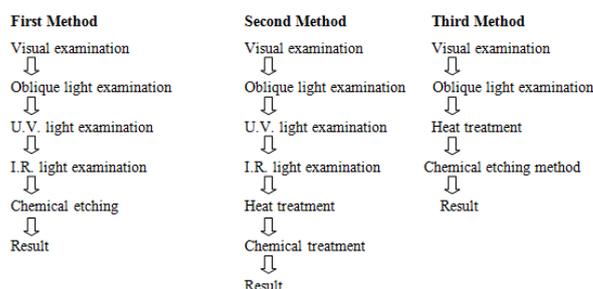
All the obliterated samples were then renumbered with different registration number over the plates by various colour of paint of same company. All the renumbered plates were then photographed with the help of digital camera.

Surface preparation

All obliterated samples were then cleaned by distilled water for removing all dust. Photography of the every cleaned sample has been carried out for recording the details of the clean surface by close-up photography using digital camera.

Methods proposed for restoration of numbers

Three methods have been proposed for restoration of obliterated painted registration numbers on registration number plates which are as follows



Chemical etching reagents and its composition

Ten different chemical etching reagents were prepared and tested over the number surface of the samples. The chemical etching reagent and their composition are given in table 1.

Table 1. Composition of etching reagent prepared for restoration of obliterated painted registration number on vehicle registration number plate

S.No.	Etching reagent	Reagent composition
1.	Reagent R1	Acetone
2.	Reagent R2	Chloroform
3.	Reagent R3	Chloroform 50 ml and 1,4Dioxan 50 ml
4.	Reagent R4	1,4Dioxan 40 ml and Ethyl Acetate 60 ml
5.	Reagent R5	Acetone 50 ml and chloroform 50 ml
6.	Reagent R6	Acetone-40ml, Chloroform-40ml, 1,4Dioxan-60ml and Ethyl Acetate-40ml
7.	Reagent R7	1,4Dioxan
8.	Reagent R8	Chloroform-30ml, 1,4Dioxan -50ml and Ethyl Acetate-20ml
9.	Reagent R9	Acetone-50ml and 1,4Dioxan -50ml
10.	Reagent R10	Carbon Tetrachloride-30ml, 1,4Dioxan-50ml and Ethyl Acetate - 20ml

Visible examination of obliterated plates – The examination were performed over these obliterated samples under normal light. After examination it was found that all sample were showed slight elevation marks below the upper layer (Figure 1).

Oblique light examination- Oblique light examination of all obliterated sample plates were carried out using oblique light arrangement. In dark room after examination of plate under oblique light it was found that examination showed restoration of numbers beneath under layer to some extent but not enough for full examination. All plates showed quite less visible deciphered restoration numbers below the upper layer (Figure 2).

U.V. light examination – The obliterated plates were examined under transmitted U.V. light to restore the numbers below layers using transmitted light box instrument. All 40 plates were examined for restoration of marks under layer. After examination it was found that no restorations of obliterated numbers were found at any extent (Figure 3).

I.R. light examination – All the obliterated plates were examined under I.R. light for restoration of numbers under layers. I.R. light illumination examination did not restore any marks over the plates (Figure 4).



Figure1. Visible light examination of plates



Figure 2. Oblique light examination of plates



Figure 3. U.V. light examination of plates

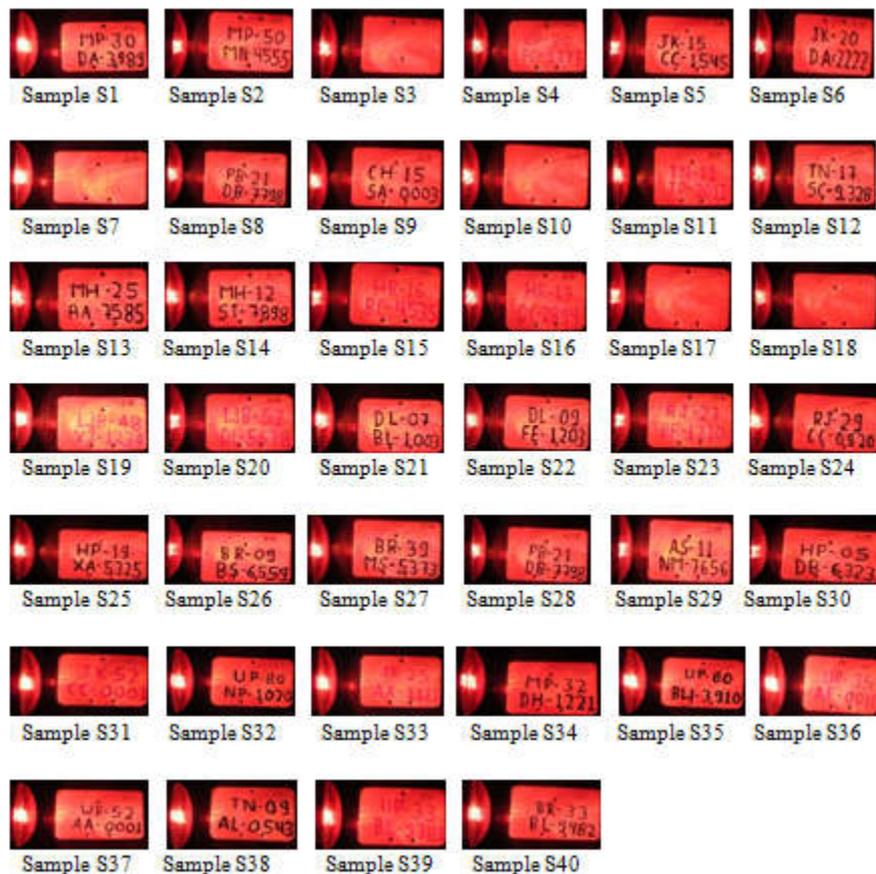


Figure No.4. I.R. light examination of plates

Table 2. Etching reagents and their application method in restoration of obliterated painted registration number

S. No.	Etching reagent	Composition	Application method(6)
1.	R1	Acetone	Treat the plate with reagent using cotton swab, until the top layer just swelled or softened. Then top layer was removed by gentle and careful squeezing of the surface uniformly with a small, handy and densely rolled ball of dry cotton.
2.	R2	Chloroform	Treat the plate with reagent using cotton swab, until the top layer removed exposing the inner layers.
3.	R3	Chloroform-50ml and 1,4Dioxan-50ml	Reagent R3 was applied using cotton swab, until the top layer just swelled or softened. Then top layer was removed by gentle and careful squeezing of the surface uniformly with a small, handy and densely rolled ball of dry cotton.
4.	R4	Dioxan-40ml and Ethyl Acetate-60ml	Reagent R4 was applied over the plate by cotton swab, until the top layer just swelled or softened. Then top layer was removed by gentle and careful squeezing of the surface uniformly with a small, handy and densely rolled ball of dry cotton.
5.	R5	Acetone-50ml and Chloroform-50ml	Plate was treated with the reagent with the help of cotton ball dipped in reagent
6.	R6	Acetone-40ml, Chloroform-40ml, 1,4Dioxan-60ml and Ethyl Acetate-40ml	Treat the plate with reagent using cotton swab, until the top layer just swelled or softened. Then top layer was removed by gentle and careful squeezing of the surface uniformly with a small, handy and densely rolled ball of dry cotton.
7.	R7	1,4Dioxan	This reagent was applied with help of cotton ball wrapped over a glass rod
8.	R8	Chloroform-30ml, 1,4Dioxan-50ml and Ethyl Acetate-20ml	Treat the plate with reagent using cotton swab, until the top layer just swelled or softened. And then removed showing inner layer.
9.	R9	Acetone-50ml and 1,4Dioxan-50ml	Treat the plate with reagent using cotton swab, until the top layer just swelled or softened. Then top layer was removed by gentle and careful squeezing of the surface uniformly with a small, handy and densely rolled ball of dry cotton.
10.	R10	Carbon Tetrachloride-30ml, 1,4Dioxan-50ml and Ethyl Acetate-20ml	Treat the plate with reagent using cotton swab, until the top layer removed exposing the inner layers.

Table 3. Comparison of number restored by etching reagent R10

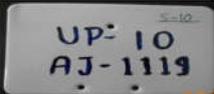
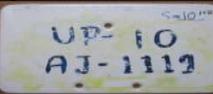
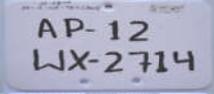
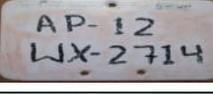
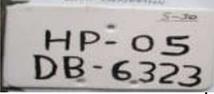
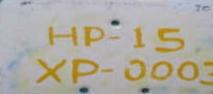
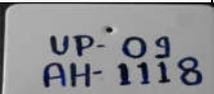
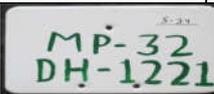
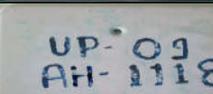
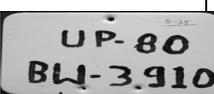
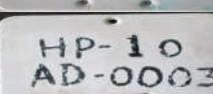
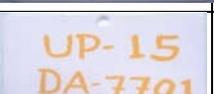
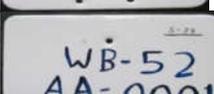
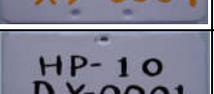
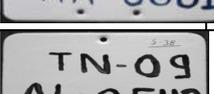
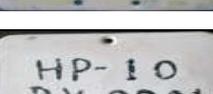
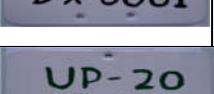
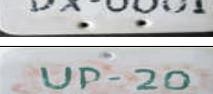
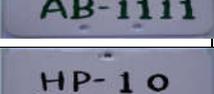
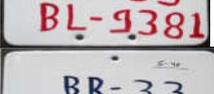
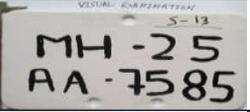
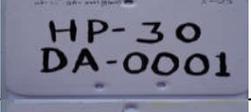
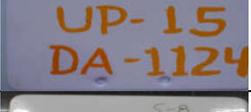
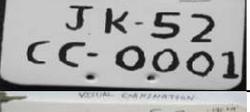
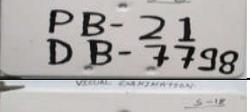
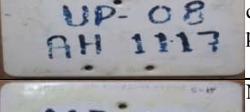
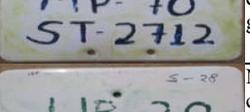
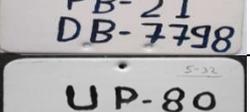
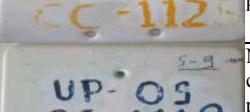
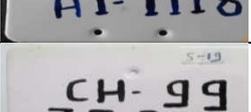
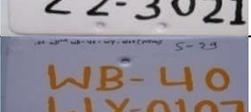
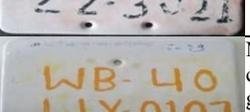
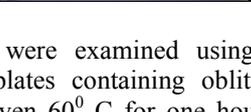
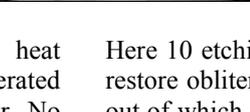
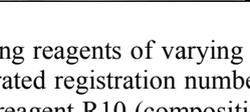
S. No	Sample No.	Original Number	Renumber	Number restored after experiment	Results
1.	S10				Numbers appeared in good contrast and reproducibility was good
2.	S20				Numbers appeared in good contrast and reproducibility was good
3.	S30				Numbers appeared in good contrast and reproducibility was fair
4.	S34				Numbers appeared in good contrast and reproducibility was good
5.	S35				Numbers appeared in good contrast and reproducibility was good
6.	S36				Numbers appeared in good contrast and reproducibility was fair
7.	S37				Numbers appeared in good contrast and reproducibility was fair
8.	S38				Numbers appeared in good contrast and reproducibility was good
9.	S39				Numbers appeared in good contrast and reproducibility was fair
10.	S40				Numbers appeared in good contrast and reproducibility was good

Table 4. Comparison of number restored by etching reagent R3, R8 and R9.

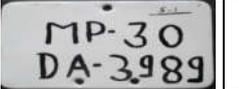
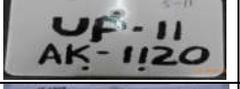
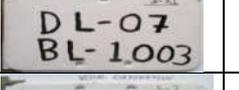
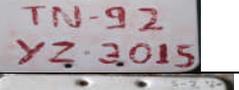
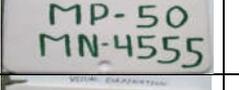
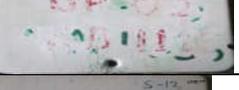
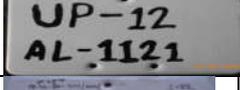
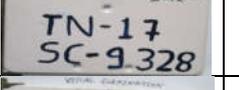
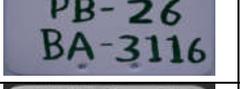
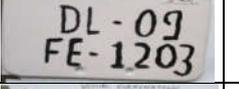
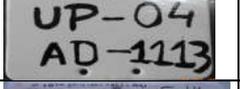
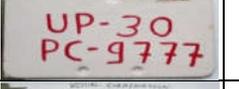
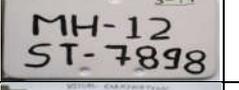
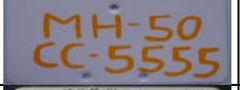
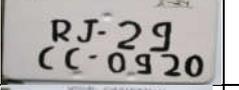
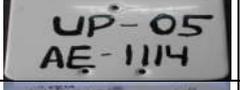
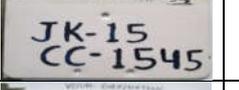
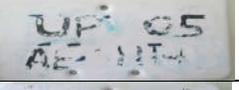
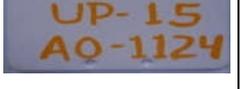
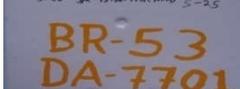
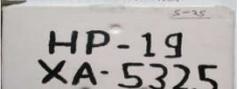
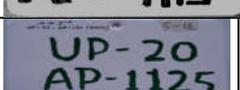
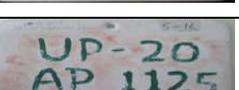
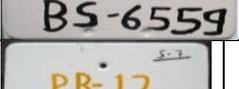
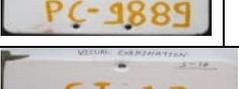
S. No	Etching reagent	Sample No.	Original Number	Renumber	Number restored after experiment	Results
1.	R3	S3				Numbers appeared in partial contrast. Reproducibility was poor.
2.	R3	S13				Numbers appeared in good contrast. Reproducibility was fair.
3.	R3	S23				Numbers appeared in good contrast. Reproducibility was fair.
4.	R3	S31				Numbers appeared in good contrast. Reproducibility was fair.
5.	R8	S8				Numbers appeared in partial contrast. Reproducibility was poor.
6.	R8	S18				Numbers appeared in good contrast. Reproducibility was good.
7.	R8	S28				Numbers appeared in partial contrast. Reproducibility was poor.
8.	R8	S32				Numbers appeared in partial contrast. Reproducibility was poor.
9.	R9	S9				Numbers appeared in partial contrast. Reproducibility was poor.
10.	R9	S19				Numbers appeared in partial contrast. Reproducibility was poor.
11.	R9	S29				Numbers appeared in good contrast. Reproducibility was good.
12.	R9	S33				Numbers appeared in good contrast. Reproducibility was good.

Heat treatment- Some plates were examined using heat treatment technique, here the plates containing obliterated number are placed inside the oven 60°C for one hour. No restoration of marks were found. The plates were again treated at 80°C for one hour slight destruction of marks were occurred. At 100°C for one hour the plates were completely destroyed, all layers mixed together leaving no marks. But plates which are treated at 60°C for one hour showed better result of restoration with chemical reagent.

Chemical treatment of plates- Obliterated numbers plates from serial number S1- S40 were again treated with different reagents from number R1- R10 with different composition. Some plates were first treated with heat then the reagents were applied. Few plates were earlier treated with these reagents without heat treatment showed less valuable result in comparison to plates treated at 60°C in an oven for one hour.

Here 10 etching reagents of varying composition were used to restore obliterated registration number on the samples S1- S40 out of which reagent R10 (composition; Carbon Tetrachloride-30ml, 1,4 Dioxan-50ml and Ethyl Acetate-20ml) produced the best result, while other three reagents i.e. reagent R3 (composition; Chloroform-50ml and 1,4 Dioxan-50ml), reagent R8 (composition; Chloroform-30ml, 1,4 Dioxan-50ml and Ethyl Acetate-20ml) and reagent R9 (composition; Acetone-50ml and 1,4 Dioxan-50ml) gave less valuable restoration results in comparison to reagent R10. Other six reagents R1, R2, R4, R5, R6 and R7 did not produced either good contrast or any effect on the plate and they were found to be quite ineffective in the restoration. The composition of reagent R10 was Carbon Tetrachloride, Ethyl Acetate and 1,4 Dioxane is in ratio of 3:2:5. Carbon tetra chloride remain toxic in nature, Ethyl Acetate is highly flammable and irritant and 1,4 Dioxane is also harmful and highly flammable so it must be used carefully.

Table 5. Comparison of number restored by etching reagent R1, R2, R4, R5, R6 and R7

S. No	Etching reagent	Sample No.	Original Number	Renumber	Number restored after experiment	results
1.	R1	S1				Number not appeared.
2.	R1	S11				Number not appeared.
3.	R1	S21				Number appeared in partial contrast. Reproducibility was poor.
4.	R2	S2				Number not appeared.
5.	R2	S12				Number not appeared.
6.	R2	S22				Number appeared in partial contrast. Reproducibility was poor.
7.	R4	S4				Number not appears.
8.	R4	S14				Number appears in poor contrast. Reproducibility was poor.
9.	R4	S24				Number appears in poor contrast. Reproducibility was poor.
10.	R5	S5				Number not appeared.
11.	R5	S15				Number appears in good contrast. Reproducibility was fair.
12.	R5	S25				Number appears in partial contrast. Reproducibility was poor.
13.	R6	S6				Number not appeared.
14.	R6	S16				Number appears in partial contrast. Reproducibility was poor.
15.	R6	S26				Number appears in good contrast. Reproducibility was good.
16.	R7	S7				Number not appeared.
17.	R7	S17				Number appears in poor contrast. Reproducibility was poor.
18.	R7	S27				Number appears in poor contrast. Reproducibility was poor.

This reagent utilises less time in compare to other reagents. Excess amount of this reagent was resulted in destruction of under layer marks.

DISCUSSION

Work on restoration of vehicle registration number plate have been done by using 10 different etching reagents of varying composition by applying three proposed methods and after experiment it was found that the etching reagent R10 produced best result which was more better than the result produced by Thirunavukkarasu *et al.* (2002) Who worked on restoration of obliterated painted registration number on metal plate surfaces using reagent Methyl Iso Butyl Ketone (MIBK), a common paint solvent. Experimental observations have recommended the use of swabbing method on the obliterated surfaces for obtaining the desired results after heat treating the plate. Therefore third method of restoration using reagent R10 was found most suitable for restoration of obliterated painted registration numbers on vehicle registration number plates.

Conclusion

Three methods were used for restoration purpose and around ten different reagents were prepared by using different combination of reagents and it was applied over forty plates for this restoration purpose. After observation, it have been found that out of three method, method third was the best method for restoration of numbers and out of ten different reagents one reagent i.e. reagent R10 (composition; Carbon Tetrachloride, 1,4Dioxan and Ethyl Acetate) produced the best results while three other reagents i.e. etching reagent R3, etching reagent R8 and etching reagent R9 gave partial result of restoration and other six reagents R1, R2, R4, R5, R6 and R7 did not produced

either good contrast or any effect on the number plate and found to be quite ineffective for the restoration of numbers over plate.

Therefore on the basis of this study it have been shown that method third with etching reagent R10 can be used as reagent of choice for restoration of obliterated painted registration number on vehicle registration number plate.

REFERENCES

- Crowe G. and Smith R.M. 2005. Restoration of a jeweller's marks in gold jewellery, *AFTE Journal*, 37(4) 379-381.
- Hogan B.E. Smith D.R. and Hall B.R. MAPP Gas 2006. An Alternative to Oxyacetylene, *Journal of Forensic Identification*, 56 232-241.
- Katterwe H. 2006. Restoration of serial numbers in Forensic investigation of stolen-recovered and other crime-related vehicles, Academic Press, 177-205.
- Klees G.S. 2009. The restoration of detection of obliterated laser-etched firearm marking by scanning electron microscopy and x-ray mapping, *AFTE Journal*, 41(2)184-187.
- Massiah E. 1976. A compilation of techniques and chemical formulae used in the restoration of obliterated markings, *AFTE Journal*, 8(2) 26-62.
- Nickolls L.C. 1956. The scientific investigation of crime, Butterworth & Co. Ltd., London.
- Thirunavukkarasu G., Hemalatha M. and Kuppaswamy R. 2002. Restoration of obliterated painted registration number on vehicle, *Journal of Forensic Science*, 47(2) 374-376.
