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Study of Characteristic Burn Patterns Formed by Three Different Accelerants on Plastered Wall

Tulika Banerjee[1], Lav Kesharwani[2], Vimal Rarh[3]

Author Affiliation: [1]Research Scholar, UGC-SRF, [2]Assistant Professor, Department of Forensic Science, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh 211007, India. [3]Senior Assistant Professor, Department of Chemistry, Sri Guru Tegh Bahadur Khalsa College, University of Delhi, Delhi 110007, India.

Corresponding Author: Lav Kesharwani, Assistant Professor, Department of Forensic Science, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh 211007, India.

E-mail: lav_2222@yahoo.com

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Abstract

One of the important aspect of arson investigation is to study the burn patterns or characteristics resulting from various accelerants. In India, the basic accelerants which are used to set fire to a scene include petrol, diesel and kerosene. This research article is based on the different types of burn patterns on plastered wall resulting from the use of three different accelerants which are being commonly used to set fire to a scene. Fire was initiated by spilling the accelerant on the plastered wall to simulate the scene of arson. An equal amount of each accelerant was taken for experimental purposes. The burn patterns provided by the three accelerants namely petrol, diesel and kerosene on the plastered wall shows some varying characteristics which help in differentiating the patterns caused by these accelerants. It is expected that results provided by this research will help the arson investigators in the investigation process.

Keywords: Arson; Fire; Accelerant; Burn pattern.

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Introduction

The word **"arson"** is often employed to specify that a crime has taken place whereas the word **"incendiary"** is used to denote that a fire was deliberately or intentionally set. Though it is probable for incendiary fires to be the consequence of imprudent but not criminal acts, there is generally a large connexion between incendiary and arson fires. In general, fires due to arson are not hard to identify. Arsonists normally set fire to a scene by the use of an ignitable liquid, which is identifiable once the fire has completely burnt out. Lentini (2006) stated that in few cases where the author was asked to investigate and check the claims that a specific fire was deliberately set, most of the determinations were carried out by evaluating the burn patterns or the existence of definite artefacts, how ever were not based on the presence of residues from ignitable liquid in the fire debris as all the samples tested negative [1]. The examination of fire scene should be investigated by an arson investigator for signs of arson immediately after the fire has subsided. Most of the arson cases are initiated with the usage of petroleum or petroleum based products for example, kerosene or gasoline. Hence, existence of containers with the possibility of holding accelerants or ignitable liquids rouse

suspicions of arson [2]. Today, few researches have been carried out to study the specific burn patterns created by the use of gasoline or petrol on various flooring materials [3, 4-8]. Liang and Liu (2010) carried out a study based on the impact of amount and spilling style of gasoline or petrol on the burnt traces found on different types of flooring materials [4, 7-8]. Moreover, when a fire starts, number of factors affect the burn characteristics after the sustained fire has subsided either naturally or by manual means. In order to help investigator apart from collection of evidences from the scene of crime and also in identification of the presence of possible accelerant at the scene of crime, it is required to study the pattern formed very precisely so as to pin point the type of accelerant used.

In this paper, three accelerants have been considered for the purpose of study – petrol, diesel and kerosene because of their usage in wide number of arson cases in India and to study the burn pattern characteristics, plastered wall has been considered. Patterns were characterised and studied by simulating the scene of fire. Fire was let to subside naturally and no mechanical means was used to douse the fire.

Materials and Methods

Accelerant samples

50 mL of each of the three accelerant samples viz. petrol, diesel and kerosene have been considered for the study of pattern characteristics.

Volume of the accelerant samples taken, were kept constant for each set of study.

To study the differences and carry out comparative studies, a set of three observations was taken with each accelerant sample.

Surface/ area

A well ventilated space was chosen for the simulation of scene of arson.

The surface considered for study of characteristics of burn patterns was carried out on a plastered wall.

Way of ignition

The method of ignition with the use of accelerant was chosen to be the method of spillage. This way of ignition was selected purporting to the established fact that an arsonist will use the common technique of pouring or spillage to set the scene on fire and destroy the evidences or for that matter the scene.

Photography

A DSLR camera was used to clearly record the burn patterns created after the complete ignition had subsided naturally.

Results and Discussions

Patterns were studied on plastered wall by three accelerants viz. petrol, diesel and kerosene. The burn patterns were studied after the fire subsided naturally and without the use of any mechanical means to douse the fire. The inferences thereby obtained for each type of accelerant has been summarised systematically.

a) Patterns formed by petrol

The burn patterns obtained by petrol on plastered wall has been shown in Figure 1, Figure 2, and Figure 3. Set of three observations were obtained on three different areas of the same wall using the same volume of accelerant (petrol) i.e. 50 mL by spillage method. The observations thereby obtained has been summarised in Table 3a.

a) Patterns formed by petrol

Fig. 1: First pattern formed on the vertical wall after petrol was spilled and then burned.

Fig. 2: Second pattern formed on the vertical wall after petrol was spilled and then burned.

Fig. 3: Third pattern formed on the vertical wall after petrol was spilled and then burned.

b) Patterns formed by diesel

The burn patterns obtained by diesel on plastered wall has been shown in Figure 4, Figure 5, and Figure 6. Set of three observations were obtained on three different areas of the same wall using the same volume of accelerant (diesel) i.e. 50 mL by spillage method. The observations thereby obtained has been summarised in Table 3b.

c) Patterns formed by kerosene

The burn patterns obtained by kerosene on plastered wall has been shown in Figure 7, Figure 8, and Figure 9. Set of three observations were obtained on three different areas of the same wall using the same volume of accelerant (kerosene) i.e. 50 mL by spillage method. The observations thereby obtained has been summarised in Table 3c.

Table 3a: Observations obtained from burn pattern formed by petrol on plastered wall

Accelerant used	Method of extinguishment	Observations (for three set of readings)
Petrol	Naturally	• Soot formation was observed being dense and concentrated near the origin of fire and as the fire moved in upward direction concentration of soot formation and accumulation goes on decreasing. • No complete or partial charring of wall or plaster was observed in all the subsequent experiments carried out. • Plaster was intact in all the three subsequent experiments carried out in three phases. • No additional features or characteristics found.

b) Patterns formed by diesel

Fig. 4: First pattern formed on the vertical wall after diesel was spilled and then burned.

Fig. 5: Second pattern formed on the vertical wall after diesel was spilled and then burned.

Fig. 6: Third pattern formed on the vertical wall after diesel was spilled and then burned.

Table 3b: Observations obtained from burn pattern formed by diesel on plastered wall

Accelerant used	Method of extinguishment	Observations (for three set of readings)
Diesel	Naturally	• Dense soot formation was found at places where the fire moved in upward direction and grey colored soot formation resulted near the origin of fire indicating that soot concentrated mostly all over the fire travel. • Marked distinction between the two regions i.e. grey to black colored soot formation can be seen in Figure 2 thereby leading to discoloration of plastered wall ranging from dark black to ash grey. • Figure 2 and 3 shows plaster being swollen at some parts. This characteristic was not observed while studying burn characteristics by petrol. • No additional features or characteristics found.

c) Patterns formed by kerosene

Fig. 7: First pattern formed on the vertical wall after kerosene was spilled and then burned.

Fig. 8: Second pattern formed on the vertical wall after kerosene was spilled and then burned.

Fig. 9: Third pattern formed on the vertical wall after kerosene was spilled and then burned.

Table 3c: Observations obtained from burn pattern formed by kerosene on plastered wall

Accelerant used	Method of extinguishment	Observations (for three set of readings)
Kerosene	Naturally	• Formation of dense soot near the origin of fire and all over the fire travel in upward direction. • No complete or partial charring of plastering noticed. • Discoloration of the plastering is found ranging from dark black to ash grey. • Figure 8 and 9 shows characteristic swelling at some parts of the plastered wall. • The swollen plastered parts made cracking noise during the process of burning. • More profound effects (swelling of plaster) are seen near the origin of fire. • No additional features or characteristics found.

Conclusion

The burn patterns presented by different accelerants on plastered wall shows few characteristics which easily differentiates them apart. Few of the characteristics mention in the observation tables of patterns produced by petrol, diesel and kerosene are quite similar for example the formation of soot and absence of any characteristic charring of the plastered wall. No spallation of plastering was seen in this experimental case. Moreover, the burn patterns are dependent upon the volume of accelerant or ignitable liquid used, direction of wind, method of ignition, etc. The differentiating characteristics found in case of kerosene is that the characteristic swelling of plaster at some points and becoming more profound near the origin of fire. Also, these swelled up plaster broke down with characteristic noise during the process of burning. The cracking noise was absent in case of burn patterns formed by diesel and swell up of plaster was not so profound. Both these characteristics have been found to be absent in case of burn pattern caused by petrol.

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