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Detection of Blood Concealed Under Progressive Layers of Different Types of Automotive and Household Paint Using Luminol

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Abstract: Blood is critical evidence in crime scenes, and perpetrators often conceal it using multiple layers of paint. This study aims to detect blood hidden beneath various automotive and household paints available in the Indian market, specifically in Kerala, using Luminol, a reagent known for its chemiluminescent properties. The impact of the number of layers of paint on chemiluminescence and the detection of blood, comparing the effectiveness of automotive and household paints, and examining variations among different paint types within each category were also subjected to study.

Two surfaces were used for this study: a brick for household paint and a bumper for automotive paint, with a total of eight different paints (four from each category). Around 5 progressive layers of paint was used to conceal blood. Blood was spattered on the surfaces and was later concealed using progressive layers of paint. it was then detected using Luminol, which was then critically analysed and photographed. Results showed that concealed blood could be effectively detected through all layers of both paint types. Automotive paint provided better concealment than household paint, and variations in chemiluminescence were noted among different paints of the same category. It could be concluded that Luminol is effective in detecting concealed blood, with the type of paint and number of layers influencing detection outcomes.

Keywords: *Blood; Luminol; Concealed Bloodstains; Automotive Paint; Household Paint.*

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I. INTRODUCTION

Serological evidence becomes a crucial aspect in many crime scenes. Among them, blood is one of the most commonly encountered evidence especially in a violent crime. Perpetrators employ various methods to conceal blood. One such method of concealment is by repainting a surface with multiple layers of paint. luminol is one of the most effective reagents used to detect the presence of blood. This study aims to detect the blood concealed under progressive layers of various types of automotive and household paints that are commonly available in the Indian market, particularly in Kerala using Luminol reagent. Blood was concealed using progressive layers of household and automotive paint respectively. Around 8 different types of paint were subjected to study, consisting of four types automotive and four types of household paint. The concealed blood was later detected using Luminol. The impact of the number of layers on the chemiluminescence, comparison between the efficiency of automotive paint and household paint in concealing blood, the differences observed in the chemiluminescence are also subjected to study.

➢ *Objectives*

- To detect the blood concealed under progressive layers of both automotive and household paint
- To study the effect of the number of layers on the detection of blood using luminol.

➢ *Hypothesis*

- Blood concealed under progressive layers of automotive and household paint can be detected using luminol
- The number of progressive layers impact the chemiluminescence exhibited and the detection of blood.

II. MATERIALS AND METHODS

➢ *Materials*

- Brick
- A bumper
- Luminol reagent

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- Blood- animal blood (pig) was taken for the study
- Automotive paint – Nitrocellulose paint, Polyurethane paint, Alkyd paint and Putty
- Household paint – Whitewash, Emulsion paint, Acrylic epoxy paint, Texture paint
- UV torch as a light source
- Camera – iPhone 13 pro max

➢ *Method*

Two surfaces were selected. Each on which household paint and automotive paint are painted upon. A brick was selected to paint household paint and a bumper of a car was selected to paint automotive paint. A total of 4 different types of household paints and 4 different types of automotive paint was used with the number of layers increasing exponentially upto 5 layers, adding to a total sample size of 8 different paints with 5 layers each.

A total of 20 bricks were painted with a layer of whitewash as a base layer and allowed to air dry. Blood was spattered on the bricks using syringe and was allowed to airdry for around 2 hours.The paint was diluted using water as the household paints were mostly water based paints.

Blood was then concealed using multiple layers of paint with the number of layers increasing exponentially. Upto 5 layers of 4 different types of commonly used household paints were used to conceal the blood and was left to airdry overnight for around 6 hours.

A bumper was taken and was cut into 20 pieces and cleaned. It was then coated with a layer of primer followed by a layer of automotive paint. Blood was spattered on the surface using a syringe and was left to air dry for around 2 hours. Blood was then concealed using 4 different types of commonly used automotive paint with the number of layers increasing exponentially. Up to 5 layers of automotive paint was used to conceal blood which was left to airdry overnight for around 6 hours.

Luminol solution was prepared. 2 grams of luminol and 15 g of Potassium Hydroxide was dissolved in 250 mL of distilled water. 10 ml of the above prepared solution was added to 10 mL of Hydrogen Peroxide. Which was then transferred to a clean spray bottle. In a dark room, the surfaces with blood concealed using both automotive and household paint was sprayed with luminol solution in the presence of UV light using a UV torch as the light source. The chemiluminescence produced was visually observed and photographed. The photographs were manually compared to check the effectiveness of luminol and the impact of multiple layers of paint on the chemiluminescence produced

III. RESULT

➢ *Automotive Paint*

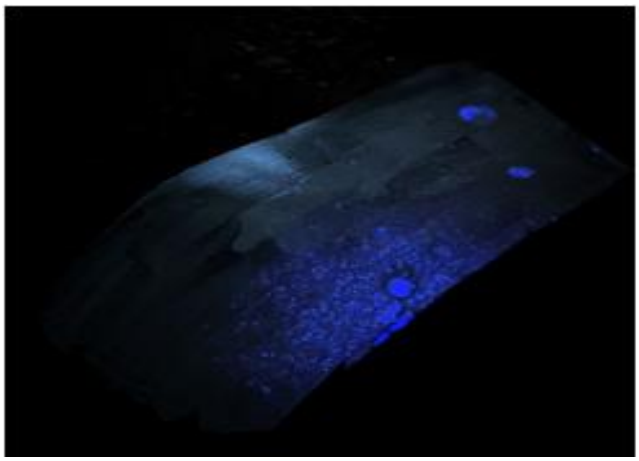

Fig 1 Chemiluminescence Observed in Layer 1 of Nitrocellulose Paint.

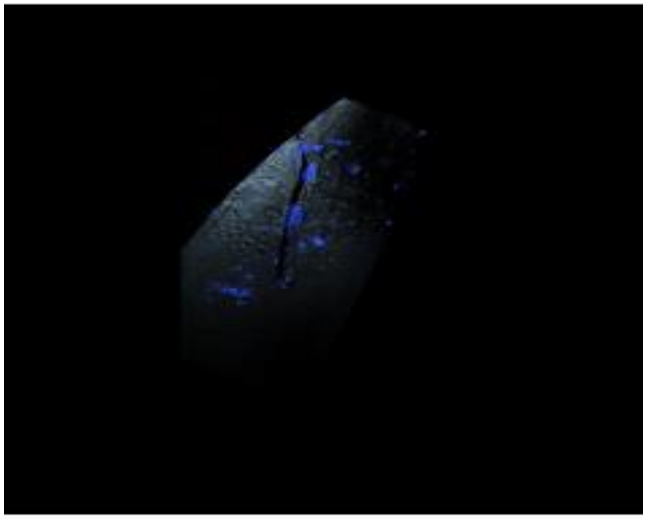

Fig 2 Chemiluminescence Observed in Layer 5 of Nitrocellulose Paint.

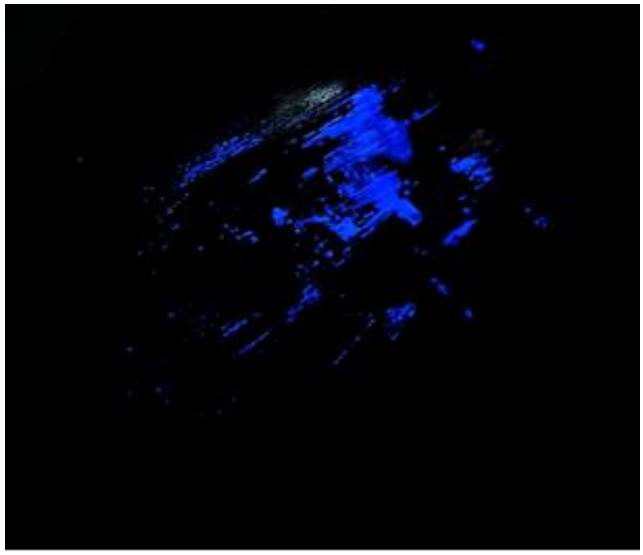

Fig 3 Chemiluminescence Observed In Layer 1 of Polyurethane Paint

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Fig 4 Chemiluminescence Observed In Layer 5 of Polyurethane Paint.

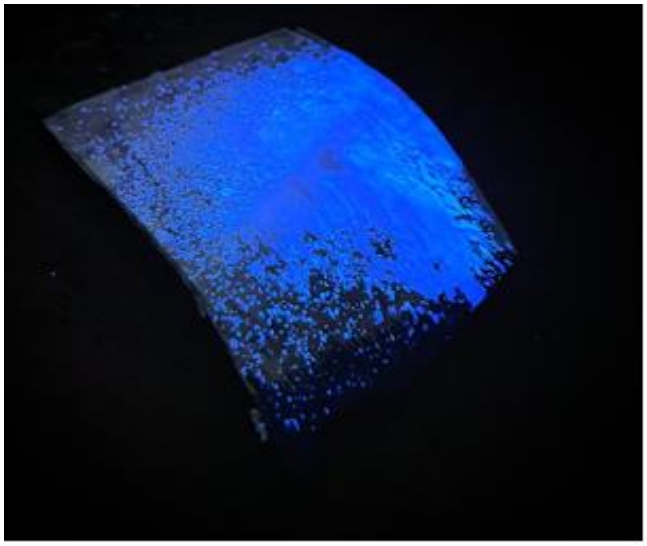

Fig 5 Chemiluminescence Observed In Layer 1 of Putty

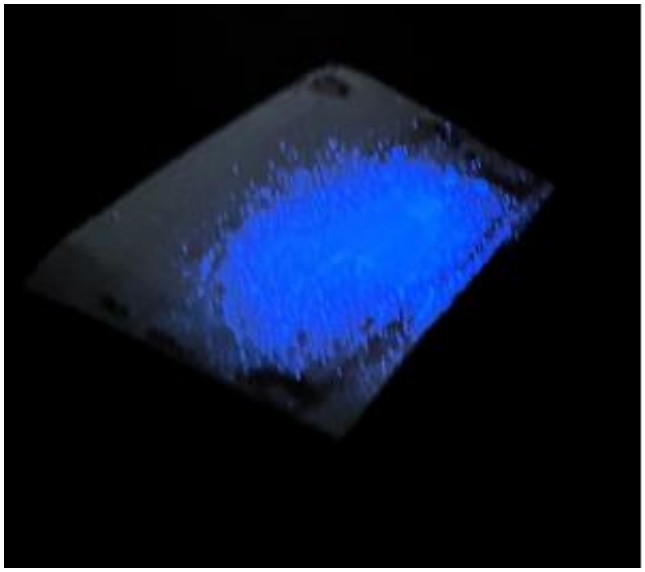

Fig 6 Chemiluminescence Observed In Layer 5 of Putty

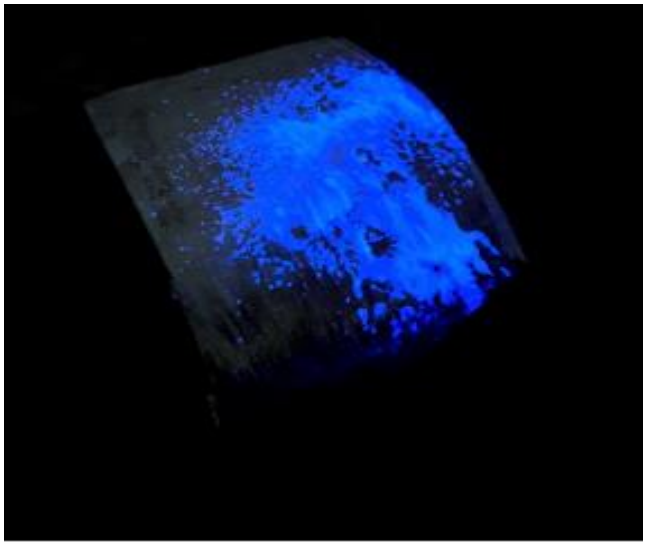

Fig 7 Chemiluminescence Observed In Layer 1 of Alkyd Paint.

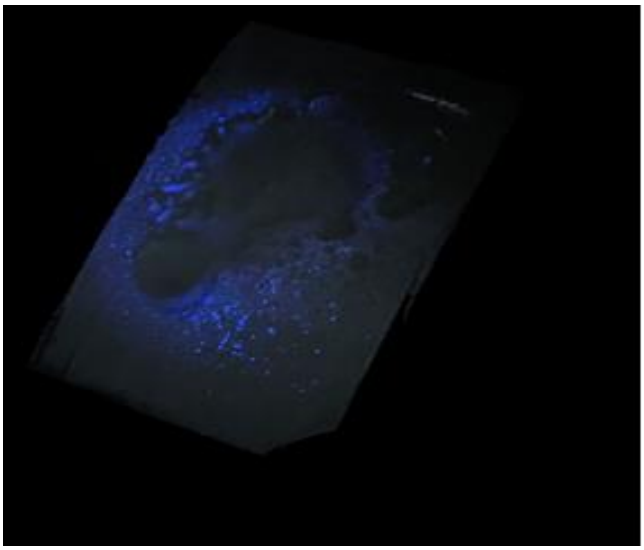

Fig 8 Chemiluminescence Observed In Layer 5 of Alkyd Paint.

- *Household Paint*

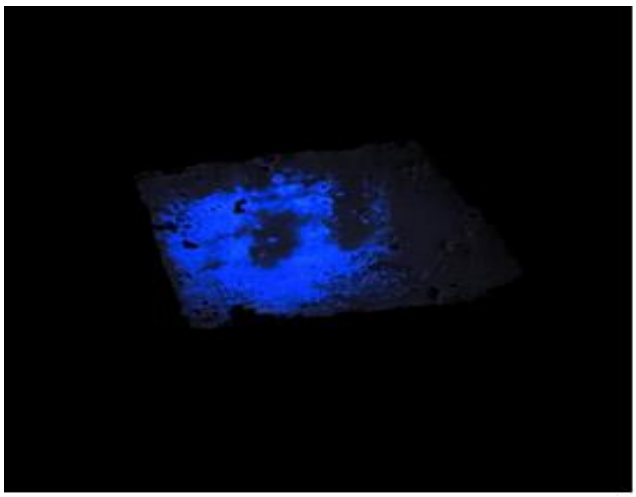

Fig 9 Chemiluminescence Observed In Layer 1 of Whitewash

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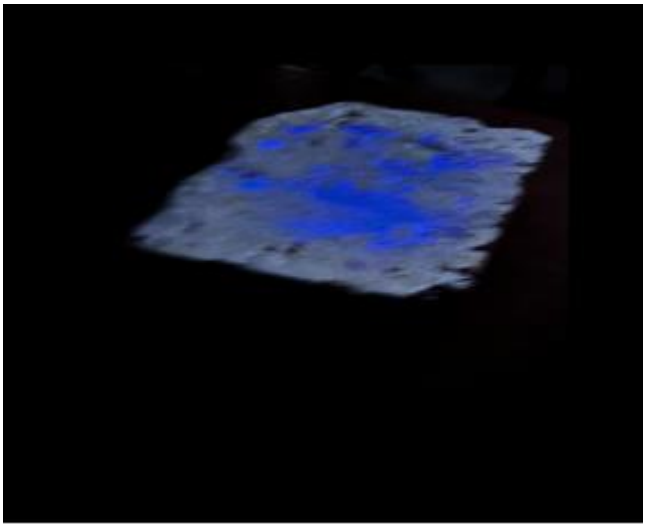

Fig 10 Chemiluminescence Observed In Layer 5 of Whitewash

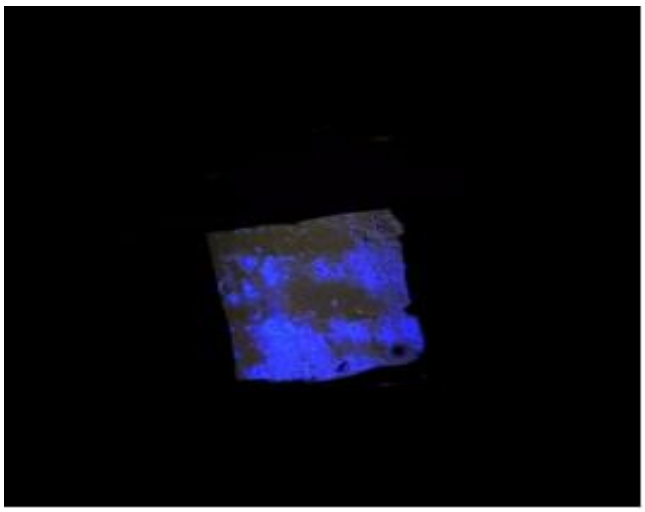

Fig 11 Chemiluminescence Observed In Layer 1 of Texture Paint

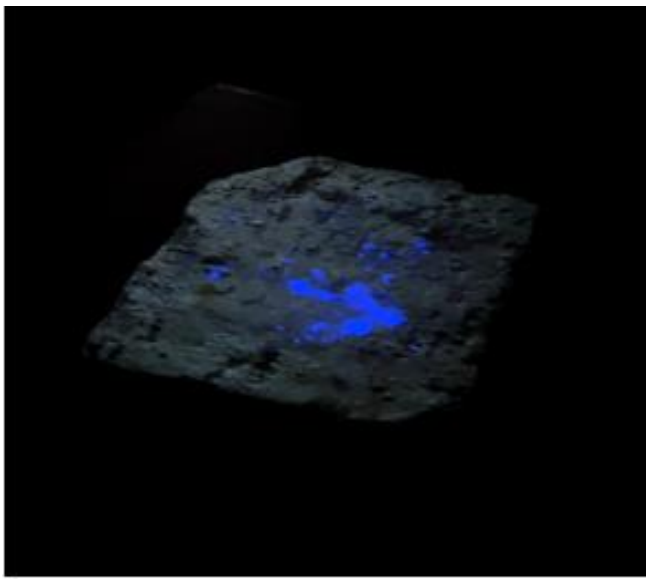

Fig 12 Chemiluminescence Observed In Layer 5 of Texture Paint

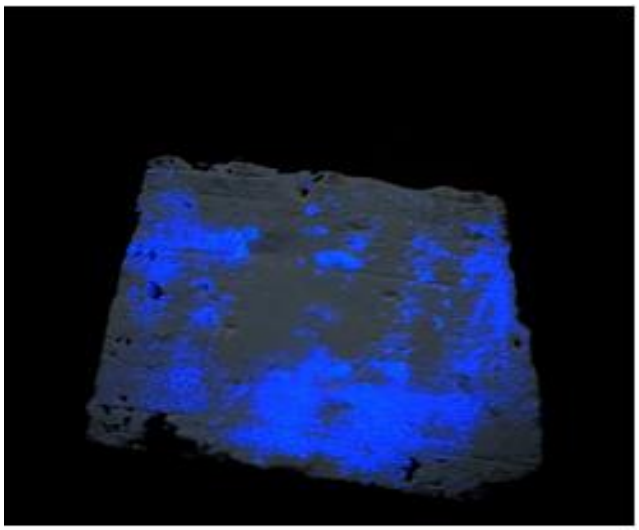

Fig 13 Chemiluminescence Observed In Layer 1 of Emulsion Paint

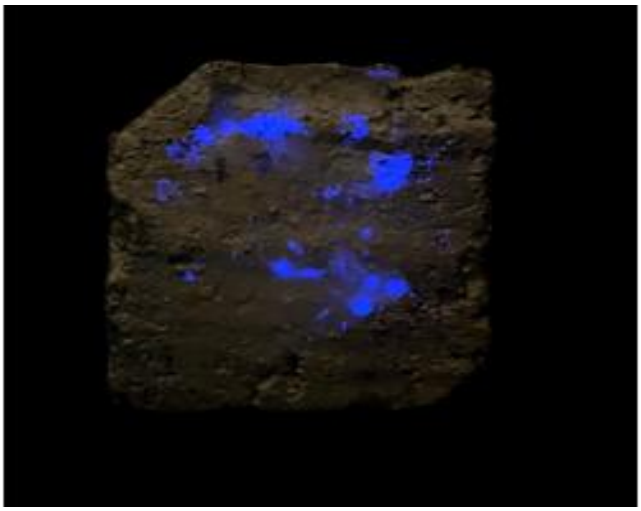

Fig 14 Chemiluminescence Observed In Layer 5 of Emulsion Paint

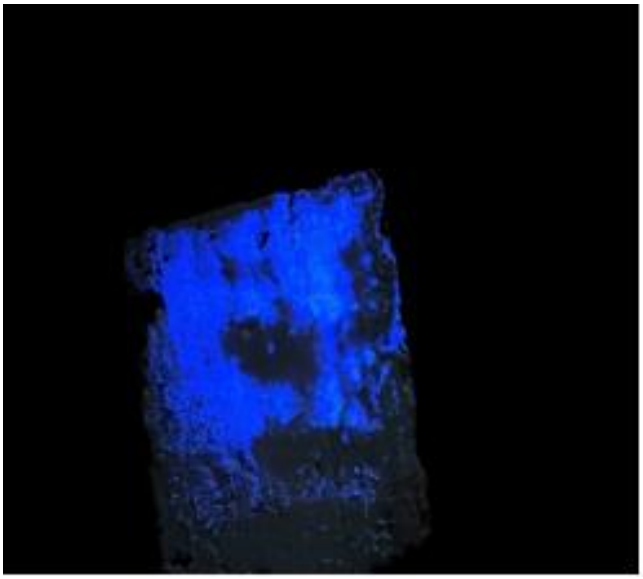

Fig 15 Chemiluminescence Observed In Layer 1 Of Acrylic Epoxy Paint.

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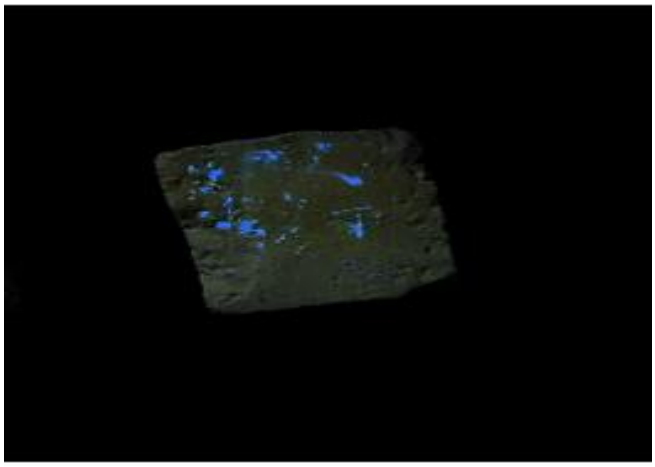

Fig 16 Chemiluminescence Observed In Layer 5 of Acrylic Epoxy Paint

IV. DISCUSSION AND CONCLUSION

➢ *Major Findings*

- Blood concealed under multiple layers of automotive and household paint could be effectively detected using Luminol. Luminol can penetrate through multiple layers of paint, thus proving to be an effective reagent in the detection of concealed blood stains.
- The number of layers of paint significantly impact the detection of blood. With an increase in the number of layers, the chemiluminescence became significantly weaker.
- Compared to the household paint, automotive paint showed better concealment of blood. The chemiluminescence was also weaker when compared to household paint.

➢ *Household Paint*

- In blood concealed using household paint, the chemiluminescence was consistent till the 3rd layer of concealment. Towards the fifth layer, noticeable reduction in the chemiluminescence could be observed in comparison with the first layers.
- However, when in comparison to the other paints, whitewash exhibited no distinct changes even towards the 5th layer of concealment.
- In the case of acrylic epoxy paint, when compared to the other paints, the chemiluminescence was weaker, especially from the third layer of concealment.
- In both texture paint and emulsion paint, chemiluminescence was consistent till the third layer of concealment. In the third layer, differentiable difference could be observed in the chemiluminescence than the other two layers. To the fifth layer, chemiluminescence became noticeably weaker.

➢ *Automotive Paint*

- In automotive paint, the chemiluminescence weakened from the second layer of concealment. Towards the 5th layer of concealment, the chemiluminescence became very weak.
- However, in the case of putty, the chemiluminescence became weaker only from the 3rd layer of concealment. Towards the 5th layer of concealment, eventhough the chemiluminescence became weaker, it didn't show much variations when compared to the same layer of other paints.
- In all other paints: nitrocellulose paint, polyurethane paint and alkyd paint, the chemiluminescence was weak from the 2nd layer of concealment and towards the 5th layer, it became significantly weaker when compared to the first two layers of concealment.

➢ *Discussions Related To Hypothesis*

- The blood concealed using progressive layers of household and automotive paint on two different surfaces was effectively detected using Luminol. The changes have been carefully observed and compared.
- With respect to the first hypothesis, the study proved that Luminol reagent could effectively detect concealed blood in both automotive and household paints, thereby proving the hypothesis.
- With respect to the second hypothesis, the study showed that although Luminol could effectively detect the concealed blood stains, the chemiluminescence exhibited varied with the increasing number of layers. In household paint, the chemiluminescence observed was weaker from the third layer of concealment and showed significant changes towards the last layers. In the case of blood concealed using automotive paints the chemiluminescence observed was significantly weaker from the second layer of concealment to the fifth layer. It can be concluded that the number of layers significantly impact the chemiluminescence produced by Luminol.

➢ *Limitations*

- The persistence of luminol lasted for about 60 seconds, which made it difficult to properly document.
- The number of surfaces used in this study is two, which can be increased in the further studies.
- The type of paint and the number of layers subjected to study can be increased

➢ *Conclusion*

The findings of the present study shows that luminol reagent can effectively detect the blood concealed under progressive layers of household and automotive paint. However, the number of layers have a significant impact on the chemiluminescence exhibited. The study shows that luminol can penetrate through multiple layers of paint. However, the intensity of the chemiluminescent reaction decreases as the number of layers increase. Automotive paint shows better levels of concealment of blood when compared to household paint. There are variations in the chemiluminescence observed among the different types of paint within the same category which shows that the type of paint used can impact the chemiluminescence.

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