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AN ANALYTICAL STUDY OF PATINA RECIPES WITH REFERENCE TO BRASS METAL SCULPTURES

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ABSTRACT

This paper attempts to explore the new patina recipes for brass metal sculptures. It is based on experiments on new patina recipes with the help of the required percentage of chemical compositions and exploring the new way of surface treatment of brass metal sculptures in the form of texture and polish through a chemical process. This research delves into the development and characterization of innovative brass patina recipes aimed at achieving both enhanced aesthetics and improved durability. Brass, an alloy of copper and zinc, has a long history of artistic and practical applications due to its malleability, color, and corrosion resistance. The patina, a surface layer formed over time, adds distinct visual appeal and protective qualities to brass objects. Traditional patina recipes often rely on the interaction of copper with atmospheric elements, leading to variable and unpredictable results. In this study, a systematic approach was undertaken to formulate new brass patina recipes using controlled chemical reactions. By experimenting with various compounds, solutions, and application techniques, a range of patina colors and textures were achieved. Corrosion resistance testing was conducted to comprehensively characterize the developed patinas in terms of their composition, microstructure, and protective properties. The results of this research highlight the potential for customizing brass patina recipes to cater to specific artistic and functional requirements. The newly developed recipes offer consistent and controllable outcomes, reducing the reliance on unpredictable natural processes. The improved understanding of the patina's chemical composition i.e. Ferric oxide, Tin oxide, sulphate compounds etc. and structural attributes contribute to the preservation and maintenance of brass objects over time. This research not only advances the field of material science by presenting novel approaches to brass patination but also provides artisans, conservators, and manufacturers with valuable insights into creating visually appealing brass objects with enhanced durability in coastal/marine environments. The findings open avenues for further investigation into the broader applications of controlled patina formation on other metal alloys and contribute to the sustainable use and appreciation of brass Sculptures.

Keywords: Patination, Surface Treatment, Chemical Compositions, Protective Covering, Coastal/Marine Environments, Brass Alloy, Copper and Zinc, Ferric Oxide, Tin Oxide, Sulphate Compounds

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1. INTRODUCTION

The composition of brass, generally prepared with 66% copper and 34% zinc are used during experimentation while preparing new patina recipes for brass metal the effort is made to explore the combination of two chemicals in each recipe. The brass material is used to get a number of patina colour options. The researcher did experiments with

patina on brass metal. It gives an antique look to art objects and metals by non-repeating application on metal surfaces. The oxidation process of many years makes the patina more and more aesthetically rich/graceful. The researcher added chemicals and acids i.e. Ammonium, Cupric Nitrate, Ferric Chloride, Lead Acetate, Nitric Acid, Copper Acetate, Pot. Dichromate, Silver Nitrate, Sodium Chloride, Ammonia Solution, Ferric Oxide Red, Tin Oxide, Acetic Acid, Sulphur were used in the cold methods of Patina. A patina layer takes many years to develop under sculpture compounds. Sculptures in damp coastal/marine environments will develop patina layers faster than ones in dry inland areas.

The purpose of the study is to investigate safety precautions while doing experiments on patina and brass metal. The Students learned to apply chemicals on different -2 metals and prepare patina recipes. There are two types of patina recipes hot and cold method implementation on metal sheets.

Such patina recipes gave us new dimensions and more options for metalwork. The cold patina method of applying on the surface of the sculptures is easier than the hot patina method. The researcher mostly concentrated on the cold patina process. The result shown in the Paper is based on 1:2 combinations of chemicals for patina recipes. The intention of the researcher in this paper is to provide patina recipes to visual artists by using local standards of materials and chemicals. In short, artists have very little reference to such recipes of locally available chemical and metal compositions. Mostly Sculptors depend on Western references for metal sculpture Patina. All available recipe references are based on Western quality standards of chemicals, materials and Climates. The references taken by artists from available printed materials/Books etc. Using the same reference of recipes with locally available chemicals to prepare such patina recipes, the result is not found up to the mark or as required. Researchers have received UGC grants for 'Metal Patina recipes and metal surface treatments' from Research and Consultancy Cells, The Maharaja Sayajirao University of Baroda, Vadodara, 2015.

2. SIGNIFICANCE OF PATINA RECIPES

It is developing the process and composition of patina recipes and new surface treatments on brass medium. Researcher's studies are giving the new composition of coloured patina recipes and new technique of surface treatment on brass and improve the Indian standard of patination as an international standard. The major significance of the research study is exploring the new composition of patina recipes, experimenting with different -2 chemicals and adopting the new and creative method of patination. It will be a great contribution and addition to the surface of metal sculpture in the form of a colored patina. Artists deliberately add patinas as a part of the original design and decoration of art or to simulate antiquity in newly made objects.

"A wide range of chemicals, both household and commercial, can give a variety of patinas. They are often used by artists as surface embellishments either for color, texture, or both. Patination composition varies with the reacted elements and these will determine the color of the patina. For copper alloys, such as bronze, exposure to chlorides leads to green, while sulfur compounds (such as "liver of sulfur") tend to brown. The basic palette for patinas on copper alloys includes chemicals like ammonium sulfide (blue-black), liver of sulfur (brown-black), cupric nitrate (blue-green) and ferric nitrate (yellow-brown). For artworks, patination is often deliberately accelerated by applying chemicals with heat. Colors range from matte sandstone yellow to deep blues, greens, whites, reds and various blacks. Some patina colors are achieved by the mixing of colors from the reaction with the metal surface with pigments added to the chemicals. Sometimes the surface is enhanced by waxing, oiling, or other types of lacquers or clear coats. More simply, the French sculptor Auguste Rodin used to instruct assistants at his studio to urinate over bronzes stored in the outside yard. A patina can be produced on copper by the application of vinegar (acetic acid). This patina is water-soluble and will not last on the outside of a building like a "true" patina. It is usually used as a pigment.

Patina is also found on slip rings and commutators. This type of patina is formed by corrosion, what elements the air might hold, residue from the wear of the carbon brush and moisture; thus, the patina needs special conditions to work as intended", (Richard Hughes and Michael Rowe, 1991).

3. REVIEW OF LITERATURE

Reviewing the literature on brass metal patina reveals a range of studies that explore various aspects of this subject. The brass, an alloy of copper and zinc, develops a patina over time due to exposure to air, moisture, and other environmental factors. Brass metal is an alloy made of copper and zinc. The composition of brass is Cu=60% - 70%–80%, Zn=20% - 30%–40%. Copper and Zinc present in Brass with the hydrogen sulphide, it leads to the formation of Copper

sulphide and Zinc Sulphide. Brass also reacts with the oxygen present in the air that leads to corrosion of brass. Many studies focus on the chemical processes and mechanisms involved in the formation of patina on brass. They examine the interaction between brass and its surrounding environment, including atmospheric pollutants, moisture, and temperature. These investigations help in understanding the composition, structure, and thickness of the patina layer. The preservation and conservation of brass objects with patina are key concerns in the literature. Researchers discuss strategies and techniques for protecting brass artifacts and preventing further deterioration. They examine methods for stabilizing patina layers, mitigating corrosion, and minimizing the impact of environmental factors on brass objects. Literature on brass patina often involves analytical techniques for characterizing its composition and properties. Researchers employ methods such as mixing ingredients in to particular proportion to analyze the chemical and physical characteristics of the patina. Several studies investigate the role of environmental factors in brass corrosion and patina formation. They explore the impact of air pollutants, humidity, temperature, and exposure conditions on the rate and nature of patina development. These investigations contribute to understanding the deterioration processes of brass sculptures. The visual appearance and aesthetic qualities of brass patina has been the subject of exploration in several articles. Researchers investigate the color, texture, patterns, and changes in the patina's appearance over time. They examine factors such as patina aging, corrosion, and the effects of cleaning and maintenance on the visual characteristics of brass. "A Patina is a thin layer of corrosion, usually brown or green, that appears on copper or copper alloys as a result of natural or artificial oxidation. The purpose of coloring metal is to produce a change in its appearance in a short time. This could take place naturally but would take much longer and would require controlled conditions. The natural discoloration of metal surfaces after exposure to air, moisture, and gases is actually a combination of corrosion and oxidation which alters the composition of the metal's surface. Coloring is the final process, after all soldering and polishing have been completed. Coloring will not conceal any surface defects. In some cases, the defects will actually be more exposed. Good ventilation is important for any chemical coloring process. The coloring should be done near an exhaust fan, or even outside. Many of the solutions and chemicals used for patinas are extremely toxic and corrosive and are difficult to dispose of after they are used. Some of the chemicals are difficult to find and the solutions have complicated procedures. In this paper I researched simple, fairly non-toxic solutions for use on copper, brass, and sterling silver. Each piece of metal has been slightly formed with a hammered texture, a high polish, and sandblasted finish to show the different effects that a patina can have on various surfaces. I have chosen procedures that are for the most part environmentally friendly and economical for metal smiths. I have provided samples and formulas that use common chemicals. The same chemical can produce varying results. Most of the chemicals are made with household products and ingredients found in your kitchen. The most toxic is the liver of sulfur, or potassium sulphide, which requires proper ventilation when used. It is essential to have proper ventilation because when the liver of sulfur is heated it emits toxic fumes. It is a good idea to use proper ventilation with any chemical colouring. Colouring can be done by various methods. There are certain factors in the colouring of metals that make it less than an exact science, and this should be noted. The composition of the metal is one factor. The reaction of the metals to the chemical agents will vary depending on the alloy composition. The temperature of the chemical, the time allowed for the change, whether the metal is sheet or cast, and the purity of the chemicals are all factors that can influence the results. For these reasons, it is important to do test pieces of the various solutions and applications". (Julie Jerman-Melka 1996). Brass sculptures with patina often hold cultural and historical significance. Some studies focus on the contextual and symbolic meanings associated with brass artifacts and their patina. They explore the cultural heritage and traditions related to brass objects in different societies and regions. It is important to note that the literature on brass metal patina is diverse, encompassing materials science, conservation, art history, and cultural studies. Accessing specific articles and publications would require exploring academic databases, libraries, and online resources that specialize in these areas.

4. OBJECTIVES OF THE STUDY

- To exploring new approaches of treatment of brass patina through chemicals.
- To develop new patina recipes on brass metal.
- To investigate new surface treatment on brass metal.
- To examine multiple colours options on surface of brass metal.
- To examine oxidation effects on brass metal of patina under Baroda weather condition. (summer and winter)

5. STATEMENT OF THE PROBLEM

In the history of the Indian tradition of making patina, the process of metal sculpture has a major role in it. We have found very rich varieties of patina and surface treatments on Indian metal sculptures. But it is mostly available on bronze sculptures. For brass sculpture, we have very few patina recipes and surface treatments. Very little experimental work was done due to a lack of research work on the patina process and understanding of the technical process of patina and surface treatment on brass metal. According to the last 10 years records of BVA and MVA courses at the faculty of fine arts, Baroda, very few recipes of patina or surface treatment on the brass medium were used hence, there is a need to explore and create awareness through research work about the process of new patina recipes and new techniques of surface treatment on brass metal. Many patina recipes involve the use of potentially hazardous chemicals, such as acids and fumes, which can pose health risks if not handled properly. Researchers need to be aware of safety precautions and proper ventilation. Some patina recipes involve the use of chemicals that can have negative environmental effects if not properly disposed of or managed. There is a lack of standardized guidelines for brass patina recipes, leading to a wide variety of approaches and outcomes. This can make it difficult for researchers to find reliable and repeatable methods. Achieving a successful patina often requires thorough cleaning and surface preparation. Failure to adequately clean and degrease the brass can result in uneven or incomplete patina formation.

6. METHODOLOGY

1) Experiment on patina are conducted with (50%, 50%) between 10% to 20% of chemical compositions of Patina to create Particular colours for protecting/covering outer surface of metal sculpture.
2) Prepared new chemical composition of cold patina through (96) experimentations and with application methods like brushing, spraying, wiping and dipping method.
3) Prepared (96) samples of metal sheets and casted brass metal compositions to get better and new result of metal patina.
4) All (96) brass metal sheets and brass metal were washed with 20% nitric acid to obtain better results.
5) Three Visits to chemical factories to find out new methods of patination.
6) 96 Patina and metal samples collected and prepared year wise list (2016-2017) of successful patina recipes along with detail of compositions of the chemicals.
7) Experimenting with surface treatment directly on sample of brass metal sculptures and metal sheets done in studio, Department of Sculpture, The M. S. University of Baroda.

7. THE SCOPE AND LIMITATIONS OF THE STUDY

The present study is applicable to examine Patina recipes on Brass Metal sculptures in MSU Baroda University lab/studio between 2016-2017. The experiments are subject to the quality and quantity of chemicals available in and around Baroda City to conduct an experiment on Patina is a broad area of research and processes are endless, thus the study is carried out under given conditions and resources. Patina recipes provide a way to customize the color and texture of the patina, allowing for a range of artistic possibilities. Different recipes can yield colors such as green, blue, brown, and even black. Patina formation is influenced by various factors such as temperature, humidity, and the composition of the metal. As a result, achieving consistent and predictable results can be challenging, especially for beginners some patinas may not be very durable and can degrade over time, potentially affecting the appearance and integrity of the brass surface. All brass alloys and compositions may not react well to certain patina recipes. It's important to test the recipe on a small, inconspicuous area before applying it to a larger surface.

8. PATINA RECIPES AND BRASS METAL SCULPTURES

1) At the time of patina recipe preparation following immediate reactions were observed:
2) Ferric Chloride + Ammonium Sulphide = **Hot** (Reaction)
3) Nitric Acid + Ammonium Sulphide = **Smoke and Cold** (Reaction)

4) Acetic Acid + Ammonium Sulphide = **Smoke and Hot** (Reaction)
5) Nitric Acid + Ammonia solution = **Very hot and Smoke**(Reaction)
6) Nitric Acid + Ferric oxide = **Hot** (Reaction)
7) Tin Oxide + Nitric acid = **Smoke and Hot** (Reaction)

Table No. 1; List of cold patina Experiments on Brass Metal (Two Chemicals Recipes)

E/No.	Composition	Quantity	Metal	Effect React.	Colour	Cold Patina	Remarks
BI	Ferric nitrate Ammonium Water	1 table Spoon 2 table Spoon 200 ml	Brass	Yes	Transparent Metallic Blue	Yes	
B2	Ferric nitrate Sulphur Water	15 gm 15 gm 300 ml	Brass	Yes	Pink Purple	Yes	
B3	Ferric nitrate Cupric Nitrate Water	15 gm 15 gm 300 ml	Brass	Yes	Light Purple	Yes	
B4	Ferric nitrate Ferric Chloride Water	15 gm 15 gm 300 ml	Brass	Yes	Light Pink Brown	Yes	
B5	Ferric nitrate Lead Acetate Water	15 gm 15 gm 300 ml	Brass	Yes	Dark Purple	Yes	
B6	Ferric nitrate Nitric Acid Water	15 gm 10 ml 2 cups	Brass	Yes	Transparent Purple Border	Yes	
B7	Ferric nitrate Copper Acetate Water	15 gm 15 gm 400 ml	Brass	Yes	Terracotta Light Brown	Yes	
B8	Ferric nitrate Pot. Dichromate Water	15 gm 15 gm 300 ml	Brass	Yes	Light Brown	Yes	
B9	Ferric nitrate Silver Nitrate Water	15 gm 05 gm 200 ml	Brass	Yes	Light Yellow	Yes	
B10	Ferric nitrate Ammonia Solution Water	1 table Spoon 10 ml 300 ml	Brass	Yes	Metallic Black	Yes	
B11	Ferric nitrate Ferric Oxide Red Water	1 table Spoon 1 table Spoon 2 cups	Brass	Yes	Soft Pink	Yes	

B12	Ferric nitrate Tin Oxide Water	1 table Spoon 05 gm 200 ml	Brass	Yes	Purple Boarder	Yes	
B13	Ferric nitrate Acetic Acid Water	1 table Spoon 10 ml 200 ml	Brass	Yes	Brown Purple	Yes	
B14	Ammonium Sulphur Water	10 ml 1 table Spoon 200 ml	Brass	Yes	Black spot and Light yellow	Yes	
B15	Ammonium Cupric Nitrate Water	10 ml 15 gm 200 ml	Brass	Yes	Army Green	Yes	
B16	Ammonium Ferric Chloride Water	10 ml 15 gm 200 ml	Brass	Yes	Light Brown Yellow	Yes	Hot
B17	Ammonium Lead Acetate Water	10 ml 15 gm 200 ml	Brass	Yes	Brown	Yes	
B18	Ammonium Nitric Acid Water	10 ml 10 ml 200 ml	Brass	Yes	Light White Green	Yes	Smoke and Cold
B19	Ammonium Copper Acetate Water	10 ml 15 gm 200 ml	Brass	Yes	Army green with Blue Boarder	Yes	
B20	Ammonium Pot. Dichromate Water	10 ml 15 gm 200 ml	Brass	Yes	Yellow Brown	Yes	
B21	Ammonium Silver Nitrate Water	10 ml 05 gm 100 ml	Brass	Yes	Black with Multi Colours	Yes	
B22	Ammonium Sodium Chloride Water	10 ml 15 gm 200 ml	Brass	Yes	Dark Brown	Yes	
B23	Ammonium Ammonia Solution Water	10 ml 10 ml 100 ml	Brass	Yes	Light Brown	Yes	
B24	Ammonium Ferric Oxide Red Water	10 ml 15 gm 200 ml	Brass	Yes	Red Black	Yes	

B25	Ammonium Tin Oxide Water	10 ml 05 gm 100 ml	Brass	Yes	Black	Yes	
B26	Ammonium Acetic Acid Water	10 ml 10 ml 100 ml	Brass	Yes	Rusty Black	Yes	Smoke and Hot
B27	Sulphur Cupric Nitrate Water	15 gm 15 gm 300 ml	Brass	Yes	Transparent Metallic	Yes	
B28	Sulphur Ferric Chloride Water	15 gm 15 gm 300 ml	Brass	Yes	Light Pink	Yes	
B30	Sulphur Nitric Acid Water	15 gm 10 ml 200 ml	Brass	Yes	Red	Yes	
B33	Sulphur Silver Nitrate Water	15 gm 05 gm 200 ml	Brass	Yes	Black Green	Yes	
B35	Sulphur Ammonia Solution Water	15 gm 10 ml 300 ml	Brass	Yes	Light Brown	Yes	
B36	Sulphur Ferric Oxide Red Water	15 gm 1 Table Spoon 300 ml	Brass	Yes	Light Brown	Yes	
B38	Sulphur Acetic Acid Water	15 gm 10 ml 100 ml	Brass	Yes	Yellow	Yes	
B39	Cupric Nitrate Ferric Chloride Water	15 gm 15 gm 300 ml	Brass	Yes	Light pink with Brown	Yes	
B40	Cupric Nitrate Lead Acetate Water	15 gm 15 gm 300 ml	Brass	Yes	Green brown	Yes	
B41	Cupric Nitrate Nitric Acid Water	15 gm 10 ml 200 ml	Brass	Yes	Red	Yes	
B42	Cupric Nitrate Copper Acetate Water	15 gm 15 gm 300 ml	Brass	Yes	Light Green	Yes	
B44	Cupric Nitrate Silver Nitrate Water	15 gm 05 gm 200 ml	Brass	Yes	Dark Brown	Yes	

B45	Cupric Nitrate Sodium Chloride Water	15 gm 15 gm 300 ml	Brass	Yes	Light Pink	Yes	
B46	Cupric Nitrate Ammonia Solution Water	15 gm 10 ml 200 ml	Brass	Yes	Dark Brown	Yes	
B47	Cupric Nitrate Ferric Oxide Red Water	15 gm 1 Table Spoon 200 ml	Brass	Yes	Metallic Brown	Yes	
B48	Cupric Nitrate Tin Oxide Water	10 ml 05 gm 100 ml	Brass	Yes	Metallic Brown	Yes	
B49	Cupric Nitrate Acetic Acid Water	15 gm 10 ml 200ml	Brass	Yes	Brown	Yes	
B50	Ferric Chloride Lead Acetate Water	15gm 15gm 300ml	Brass	Yes	Light Pink	Yes	
B51	Ferric Chloride Nitric Acid Water	15gm 10 ml 200 ml	Brass	Yes	Light Pink	Yes	
B52	Ferric Chloride Copper Acetate Water	15gm 15gm 300 ml	Brass	Yes	Dark Pink	Yes	
B53	Ferric Chloride Pot. Dichromate Water	15 gm 15 gm 300 ml	Brass	Yes	Light Yellow	Yes	
B54	Ferric Chloride Silver Nitrate Water	15 gm 05 gm 200 ml	Brass	Yes	Light Pink	Yes	
B55	Ferric Chloride Sodium Chloride Water	15 gm 15 gm 300 ml	Brass	Yes	Soft Pink	Yes	
B56	Ferric Chloride Ammonia Solution	15 gm 10 ml 200 ml	Brass	Yes	Pink Brown	Yes	

	Water						
B57	Ferric Chloride Ferric Oxide Red Water	15 gm 1 Table Spoon 300 ml	Brass	Yes	Light Pink	Yes	
B58	Ferric Chloride Tin Oxide Water	15 gm 05 gm 200 ml	Brass	Yes	Light Pink	Yes	
B59	Ferric Chloride Acetic Acid Water	15 gm 10 ml 200 ml	Brass	Yes	Light Pink	Yes	
B60	Lead Acetate Nitric Acid Water	15 gm 10 ml 200 gm	Brass	Yes	Pink	Yes	
B61	Lead Acetate Copper Acetate Water	15 gm 15 gm 300 ml	Brass	Yes	Metallic Brown	Yes	
B62	Lead Acetate Pot. Dichromate Water	15 gm 15 gm 300 ml	Brass	Yes	Dark Brown	Yes	
B67	Lead Acetate Tin Oxide Water	15 gm 05 gm 100 ml	Brass	Yes	Brown	Yes	
B69	Nitric Acid Copper Acetate Water	10 ml 15gm 200 ml	Brass	Yes	Brown Red	Yes	
B70	Nitric Acid Pot. Dichromate Water	10 ml 15gm 200 ml	Brass	Yes	Brown	Yes	
B71	Nitric Acid Silver Nitrate Water	10 ml 05gm 100 ml	Brass	Yes	Yellow with Dark Purple	Yes	
B72	Nitric Acid Sodium Chloride Water	10ml 15gm 200ml	Brass	Yes	Light Pink	Yes	
B73	Nitric Acid Ammonia Solution Water	10ml 10 ml 100ml	Brass	Yes	Light Blue	Yes	Very hot and Smoke
B74	Nitric Acid	10 ml	Brass	Yes	Dark Red and White	Yes	Hot

	Ferric Oxide Red Water	1table spoon 100ml					
B75	Nitric Acid Tin Oxide Water	10 ml 05 gm 100 ml	Brass	Yes	Dark Purple	Yes	Smoke and Hot
B76	Nitric Acid Acetic Acid Water	10 ml 10 ml 100 ml	Brass	Yes	Brown	Yes	
B78	Copper Acetate Silver Nitrate Water	15 gm 05 gm 200 ml	Brass	Yes	Light Grey	Yes	
B79	Copper Acetate Sodium Chloride Water	15 gm 05 gm 200 ml	Brass	Yes	Light Pink	Yes	
B80	Copper Acetate Ammonia Solution Water	15 gm 10 ml 200 ml	Brass	Yes	Dark Green	Yes	
B81	Copper Acetate Ferric Oxide Red Water	15 gm 1 Table spoon 300 ml	Brass	Yes	Brown	Yes	
B94	Ammonia Solution Ferric Oxide Red Water	10 ml 1 Table Spoon 200 ml	Brass	Yes	Dark Brown	Yes	
B95	Ammonia Solution Tin Oxide Water	10 ml 05 gm 100 ml	Brass	Yes	Metallic Brown	Yes	

Source: Experiments in Studio/open air at the Department of Sculpture, The M.S. University of Baroda, source of materials from the chemical store at Baroda.

From above table no. 1, it is evident that Around 72, different patina colours were observed out of 96 recipes on Brass metal respectively. In the field of Sculpture, metal sculptures have very great contributions to outdoor sculptures. Patina is one of the major parts of it. It turns rich with age due to oxidation of weather effects. It is found that more than 60 patina colours are extremely good and it is open for sharing with all the artists/Sculptors community in India for their benefit. The study intends to introduce it as a class assignment to the students as well. They can benefit from it. It is one kind of achievement and contribution to visual art by adding the more satisfactory result of patination and enhancing the scope of outdoor brass metal sculpture surface treatment along with a variety of aesthetically rich colors.

To conduct experiments and reach the desired objectives of the study, the investigators have used the following chemicals and acidic materials Ammonium sulfide, Liver of sulfur, Cupric nitrate, Ferric nitrate, Potassium sulfide, Lead acetate, Nitric acid, Copper acetate, potassium dichromate, Silver nitrate, Sodium chloride, Ammonia,

Vinegar, Ammonium chloride, Ferric chloride, Red ferric oxide, Tin oxide and acidic vegetables, fruits and similar household materials.

Further, to achieve the set objective the researcher will use materials like Stainless Steel sheets, Metal and Metal Sheets, Gas masks, Gloves, Sample materials, Wax, Brushes, Fire Bricks, Spray Guns, Blow Torch, Buffing Materials, Containers, Wax polish, Lint-free cloth, Nitric acid for surface cleaning and other acidic materials on Patinas and Surface treatments.

During experimentation on patina recipes researcher observed that the expected colours of the patina may vary with the effects of weather conditions such as season, day and night temperature and even inside and open-air weather conditions can also create an effect on colour. Water used in the patina recipes can also change the colour effects due to variations of minerals percentage available in the locally available water from two or more two sites/sources.

9. FINDINGS

1) It is practically found that it is a useful source for sculptors, practicing artists and sculpture students.
2) It will benefit the artists in the form of the addition of new patina recipes in the field of metal sculpture.
3) The study will be a source of new possibilities for coloured patina and covering layers on outdoor and indoor metal sculpture.
4) Around 72, different patina colours were observed out of 96 recipes on Brass respectively. In the field of Sculpture, metal sculptures have very great contributions to outdoor sculptures. Patina is one of the major parts of it. It turns more and richer with age due to oxidation of weather effects.

10. CONCLUSION

There are unlimited scopes of new patina recipes and it will help to increase the possibilities of patina multiple colours for outdoor and indoor brass metal sculptures. The study in this field with locally available chemical and materials fulfill the need of practicing artists, art students and sculptors to reach the sufficient or required patina colours result with the simplified application of chemical of cold patina recipes.

The literature on brass metal patina provides a comprehensive understanding of its formation, composition, visual characteristics, preservation, and cultural significance. Through scientific investigations, researchers have explored the chemical processes involved in the development of patina on brass, shedding light on its composition, structure, and changes over time. The visual and aesthetic aspects of brass patina have also been examined, with studies focusing on its color, texture, patterns, and the impact of aging and environmental factors. Preservation and conservation techniques have been explored to protect brass objects with patina, aiming to stabilize the patina layer, mitigate corrosion, and ensure the long-term preservation of these artifacts. Researchers have utilized various analytical techniques to characterize the composition and properties of brass patina, allowing for a deeper understanding of its chemical and physical characteristics. Environmental factors and corrosion have been investigated to better comprehend the impact of air pollutants, humidity, and exposure conditions on the formation and deterioration of patina on brass. The literature also encompasses restoration and cleaning techniques, providing insights into safe methods for removing dirt and contaminants from brass patina while preserving the underlying metal. It serves as a valuable resource for researchers, conservators, and individuals interested in understanding the science, aesthetics, and preservation of brass objects with patina.

The name of patina colours (1:2) are achieved on brass metal; Metallic Blue, Pink Purple, Light Purple, Light Pink Brown, Dark Purple, Transparent with Purple Border, Terracotta Light Brown, Light Brown, Light Yellow, Metallic Black, Soft Pink, Purple Boarder, Brown Purple, Black spot and Light yellow, Army Green, Light Brown Yellow, Brown, Light White Green, Army green with Blue Boarder, Yellow Brown, Black with Multi Colours, Dark Brown, Light Brown, Red Black, Black, Rusty Black, Light Pink, Red, Black Green, Light Brown, Yellow, Light pink with Brown, Green brown, Light Green, Metallic Brown, Dark Pink, Light Yellow, Yellow with Dark Purple, Light Blue, Dark Red and White and Light Grey.

CONFLICT OF INTERESTS

None.

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