DOI: https://doi.org./10.24163/ijart/2017/6(5):28-34

INTERNATIONAL JOURNAL OF APPLIED RESEARCH AND TECHNOLOGY
ISSN 2519-5115
RESEARCH ARTICLE

# Evaluation of the Relative Resistance of Emulsion Paints in the Container against Microorganisms.

[1]Senthil Kumar. P
[2]Ismail M. Ali

[1]M.Sc in Microbiology
Karpagam University
[2]M.Sc in Microbiology
Ramnarain Ruia College

Corresponding author:
senthi.2605p@gmail.com

Received: October 14, 2021
Revised: October 23, 2021
Published: October 30, 2021

## ABSTRACT

Paints have been used since ancient times and there several paints of varying chemical composition have been in use for domestic and industrial purposes. The effectiveness of the preservative used in the paint samples which is easily available in the market was evaluated against different microorganisms as the consequences of microbial deterioration have serious economic implications on the paint industry. The aim of this study was, therefore, to investigate the microbial quality of paints with a view to improving the shelf life of paint and paint products.

This study was carried to evaluate the resistance of emulsion paints in the container against microorganisms such as *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Aspergillus niger* and *Candida albicans*.

It can be observed from this study that the concentration of preservative component in the emulsion paint is directly proportional to the inhibition of the bacterial growth irrespective of its pathogenicity.

**Keywords-** Paint, Antimicrobial activity, Emulsion paint Contaminants, Deterioration.

DOI: https://doi.org./10.24163/ijart/2017/6(5):28-34

## INTRODUCTION

Paint and paint products are one of the oldest synthetic substances known to mankind. In ancient times, clay and chalks were mixed with animal fats and were used as paints to depict hunts on the cave walls. [11, 13]

Paints are uniformly dispersed mixtures having a viscosity ranging from a thin liquid to a semi-solid paste, consisting of a pigment suspended in a liquid vehicle such as oil or water. With a brush or roller or spray gun, paint is applied in a thin coat to various surfaces such as wood, metal, or stone. [1, 2, 12] However, contemporary household paints consist of different chemicals such as binder's, pigments, and solvents alongside with polyamides, epoxy resins, chlorides, organic solvents, and water which constituents as carbon source for most of the microorganisms. Although paints are meant to protect the surfaces from biodeterioration, corrosion, oxidation, environmental weathering or other types of deterioration, the presence of microorganisms tend to defeat this aim.

Paints and coatings are susceptible to bacterial and fungal growth when in the liquid state but prone to colonization, after application; components such as residual thickening agents are the most abundant carbon source. Interior painted surfaces are most frequently colonized by moulds, with yeasts growing in areas with excessive moisture.

The effects of such growth are initially disfigurement of the surface followed by breakdown of the coating and decay or corrosion of the underlying substrate.[5]

The microorganism's bio-deteriorate the paint constituents and reduces its economic value, durability adhesive and decorative finish. [3, 12]

The genus Aspergillus is one of the most frequently isolated fungi from bio-deteriorated painted walls. Other research reported that fungi associated with deterioration of paints include *Rhizopus arrhizus*, *Aspergillus niger*, *Aspergillus alternata*. [4, 6, 7, 14] The bacterial species commonly isolated were *Bacillus* species, *Pseudomonas* species, Enterobacter species, *Proteus* species, *Escherichia coli*, *Micrococcus* species, *Serratia* species, *Aeromonas* species. [9]

*ustus*, *Aspergillus flavus*, *Penicillium citrinum*, *Alternaria alternata*, *Chaetomium globosum*, *Alternaria*

The consequences of this microbial deterioration such as foul smell, viscosity loss, discoloration and visible surface growth have serious economic implications on the paint industry. The aim of this study was, therefore, to investigate the microbial quality of paints with a view to improving the shelf life of paint and paint products. In this study the resistance of emulsion paints in the container was evaluated against *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Aspergillus niger* and *Candida albicans* microorganisms by a test study based on ASTM D 2574.

## EXPERIMENTAL METHODS

### 2.1. Selection of Paint:

A matt emulsion pain which was an acrylic copolymer based; washable and used for exterior and interior decorative finish was used for the analysis. The paint was white in color, which had the physical-chemical characteristics as mentioned in Table 1.

Table 1-Physical-chemical characteristics of paint sample.

| Parameter | Result |
|---|---|
| Specific gravity | 1.40 ± 0.1 |
| Theoretical spreading | 11-9 $m^2$/L |
| Flash point | Water base |
| Dry film thickness | 40-50 µ/coat |
| Wet film thickness | 90-110 µ/coat |
| Volume of solids | 43±3% |
| Full dry | 24 hours |

DOI: https://doi.org./10.24163/ijart/2017/6(5):28-34

### 2.2 Bacterial Cultures

Cell culture pellets were revived in nutrient broth. The bacterial and fungal strains were then sub cultured in the nutrient broth. The cell cultures were incubated for 24 hours prior to use. The cultures used in the experiment were *Escherichia coli* ATCC 10536, *Pseudomonas aeruginosa* ATCC 10145, *Staphylococcus aureus* ATCC 6538, *Aspergillus niger* ATCC 6275 and *Candida albicans* ATCC 10231.

### 2.3 Evaluation of the Resistance of the Emulsion Paint in the Container against Microorganisms

A known volume and concentration of 24 hours incubated cultures were added to individually to the paint to obtain a final concentration of $10^6$ CFU/ml. The inoculated paint was then incubated at 30$^o$C for one week. The container and the paint sample were examined for any visual or organoleptic deterioration and the paint was evaluated for its resistance evaluating the recovery of the inoculated cultures at Day 1, 3, 5 and 7.

The recovery of the inoculated cultures in the paint was performed by using spreading the inoculated paint on tryptic soya agar plates. These plates were incubated at 30$^o$C for 24 hours.

## RESULTS

### 3.1 Results for selected bacterial cultures

A 24-hour old sub-cultured strain of *Escherichia coli* ATCC 10536, *Pseudomonas aeruginosa* ATCC 10145, *Staphylococcus aureus* ATCC 6538, *Aspergillus niger* ATCC 6275 and *Candida albicans* ATCC 10231.

The cell concentration of the microorganism's (observed in table 2) was determined before inoculating in the paint sample.

Table 2-Concentration of Microorganisms

| Name of the Microorganism | CFU/ml |
|---|---|
| *Escherichia coli* | 5.2 X $10^8$ |
| *Pseudomonas aeruginosa* | 5.1 X $10^8$ |
| *Staphylococcus aureus* | 5.3 X $10^8$ |
| *Aspergillus niger* | 5.0 X $10^8$ |
| *Candida albicans* | 5.2 X $10^8$ |

### 3.2 Results for the evaluation of the resistance of the emulsion paint in the container against microorganisms.

A 24-hour old sub-cultured strain of *Escherichia coli* ATCC 10536, *Pseudomonas aeruginosa* ATCC 10145, *Staphylococcus aureus* ATCC 6538, *Aspergillus niger* ATCC 6275 and *Candida albicans* ATCC 10231 were used. The inoculated paint sample was incubated and evaluated on the following days 1, 3, 5, 7, 10 and 14. The results are observed in the table's 3, 4, 5, 6 and 7.

DOI: https://doi.org./10.24163/ijart/2017/6(5):28-34

**Table 3-Results for *Escherichia coli* ATCC 10536.**

| | Day 1 | Day 3 | Day 5 | Day 7 | Day 10 | Day 14 |
|---|---|---|---|---|---|---|
| Swelling of container or Lid | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed |
| Visual and organoleptic deterioration of paint | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed |
| Loss of viscosity | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed |
| Recovery | 0% | 0% | 0% | 0% | 0% | 0% |

**Table 4-Results for *Pseudomonas aeruginosa* ATCC 10145.**

| | Day 1 | Day 3 | Day 5 | Day 7 | Day 10 | Day 14 |
|---|---|---|---|---|---|---|
| Swelling of container or Lid | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed |
| Visual and organoleptic deterioration of paint | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed |
| Loss of viscosity | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed |
| Recovery | 0% | 0% | 0% | 0% | 0% | 0% |

**Table 5-Results for *Staphylococcus aureus* ATCC 6538.**

| | Day 1 | Day 3 | Day 5 | Day 7 | Day 10 | Day 14 |
|---|---|---|---|---|---|---|
| Swelling of container or Lid | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed |
| Visual and organoleptic deterioration of paint | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed |
| Loss of viscosity | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed |
| Recovery | 0% | 0% | 0% | 0% | 0% | 0% |

DOI: https://doi.org./10.24163/ijart/2017/6(5):28-34

**Table 6- *Aspergillus niger* ATCC 6275.**

| | Day 1 | Day 3 | Day 5 | Day 7 | Day 10 | Day 14 |
|---|---|---|---|---|---|---|
| Swelling of container or Lid | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed |
| Visual and organoleptic deterioration of paint | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed |
| Loss of viscosity | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed |
| Recovery | 0% | 0% | 0% | 0% | 0% | 0% |

**Table 7-Results for *Candida albicans* ATCC 10231.**

| | Day 1 | Day 3 | Day 5 | Day 7 | Day 10 | Day 14 |
|---|---|---|---|---|---|---|
| Swelling of container or Lid | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed | No swelling observed |
| Visual and organoleptic deterioration of paint | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed | No deterioration observed |
| Loss of viscosity | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed | No loss of viscosity observed |
| Recovery | 0% | 0% | 0% | 0% | 0% | 0% |

DOI: https://doi.org./10.24163/ijart/2017/6(5):28-34

## DISCUSSION

In the present study, five different microorganism which were known through past studies, for causing deterioration in paints and painted surfaces were analyzed to evaluate the resistance of emulsion paints in container against microorganisms. Due to the presence of different types of chemical solvents and chemical compounds the paints depict antimicrobial activity.

In this study the microorganism was inoculated inside the container to evaluate the resistance of the paint when exposed to microorganisms inside the paint container to check the level of deterioration of the paint over a duration of fourteen days; as observed in the tables 3, 4, 5, 6 and 7.

There has been ongoing research and studies where the paints contain $TiO_2$ nanoparticles which acts as an anti-microbial agent.

As this study was carried out on emulsion paint which is commonly used in the middle east region for commercial and industrial purpose; the results cannot be extrapolated to all the different categories of paints. Thus, this study should also be performed on different paints with different chemical composition and characteristics to understand the better resistance of the ingredients in the paint composition in preventing growth of microorganism.

## CONCLUSION

In the present we have observed that the emulsion paint sample has demonstrated a marked antimicrobial activity against test organisms in vitro and have displayed satisfactory results. This study also revealed that paint samples in the containers are resistant against the attack of microorganisms.

Also, further studies are required to know the role of different chemical solvents and their concentrations which act as anti-microbial agents in the paint samples.

## REFERENCES

Adeleye, I.A. and O.A. Adeleye. (1999): Isolation and identification of microbes associated with paints and weathered painted walls. J. Sci. Res. Dev; (4): 71-76.

Briggs, M.A. (1980): Emulsion paint preservation: factory practice and hygiene. Paint Research Association Technical Report; TR/878.

Da Silva, V. Q. (2003): Microbial deterioration of paints, diversity and community structure in natural environments. Critical. Review. (26): 37-57.

Elumalai, P., Elumalai, E. K., and David, E. (2014): Fungi associated with deteriorations of painted wall surfaces: Isolation and identification. European Journal of Academic Essays.

Gaylarde, C. and P.M. Gaylarde (2005): A comparative study of the major microbial biomass of biofilms on exterior of buildings in Europe and Latin America. Int. Biodeterior. Biodegrad; (55): 131-139.

Gillatt, A. C, (1992): Bacterial and fungal spoilage of water-borne formulations. Additives; (10): 387-393.

Imperi, F., Caneva, G., Cancellieri, L., Ricci, M. A., Sodo, A. and Visca, P. (2007): The bacterial aetiology of rosy

DOI: https://doi.org./10.24163/ijart/2017/6(5):28-34

discolouration of ancient wall paintings. J. Environ. Microbiol. 11, 146-292.

Jakabowski, J. A., Gyuris, J. and Simpson, S. L. (1983): Microbiology of modern coating system. J. Coatings. Technol; (58): 49-57.

Opperman, A. A., and Gull, M. (1984): Presence and effects of anaerobic bacteria in water-based paints. J. Coatings Technol; (56): 51-57.

Ositadinma Chonyere Ugbogu.; Ibrahim Awache.; Dawn Ify Agwaranze.; Alloysius Chibuike Ogodo.; Andefiki Ubandoma. and Michael Nosano Yakubu. (2008): Microbial Deterioration of Painted Wall Surfaces in Wukari, Taraba State, Nigeria. Journal of Environmental Biology; 30(5): 835-840.

Prescott, L.M., J.P. Harley and D.A. Klein. (2002): The influence of environmental factors on microbial growth. In Microbiology. 6th edition. Mc Graw-Hill publication: 118-125.

Ravikumar, H. R., Shwetha S. R., and Karigar C. S. (2012): Biodegradation of paints: a current status. Indian Journal of Science and Technology; 5 (1): 1977-1987.

Saad, R. R., (1992): Fungi of biodeteriorated paint films and their cellulolytic activity. Zentralbl Mikrobiol. (147): 427-430.