AIC 2019

Colour and Landscape

Proceedings of the International Colour Association (AIC) Conference 2019

Buenos Aires, Argentina
14-17 October 2019
Universidad de Belgrano

Organized by
Grupo Argentino del Color (GAC)

Published by
International Colour Association (AIC)

Colour and Landscape

AIC 2019

Proceedings of the International Colour Association (AIC) Conference 2019

Buenos Aires, Argentina
14 – 17 October 2019
Universidad de Belgrano

Organized by: Grupo Argentino del Color (GAC)
Published by: International Colour Association (AIC)

grupo argentino del color
international colour association

This publication includes invited lectures, oral and poster papers presented in the International Colour Association (AIC) Midterm Meeting 2019. The theme of the conference was Colour and Landscape. The conference, organised by the Grupo Argentino del Color (GAC), was held in the Universidad de Belgrano, Buenos Aires, Argentina, on 14-17 October 2019.
The original website of the conference was http://aic2019.org.
The contents have been moved to a more permanent site: https://aic2019color.wordpress.com.

International Colour Association Incorporated
PO Box 764
Newtown, NSW 2042
Australia
www.aic-colour.org

DISCLAIMER

Matters of copyright for all images and text associated with the papers within the Proceedings of the International Colour Association (AIC) 2019 and Book of Abstracts are the responsibility of the authors. The AIC does not accept responsibility for any liabilities arising from the publication of any of the submissions.

COPYRIGHT

ISSN: 2617-2410
eISSN: 2617-2429
ISBN: 978-0-6484724-1-4

How to cite this book:

AIC (International Colour Association). 2019. *Proceedings of the International Colour Association (AIC) Conference 2019*. Newtown, NSW, Australia: AIC.

How to cite an article included in this book:

Author’s name. 2019. Title of the article. In: *Proceedings of the International Colour Association (AIC) Conference 2019*. Newtown, NSW, Australia: AIC, page numbers of the article.

Committees

AIC Executive Committee 2018-2019

President:	Tien-Rein Lee (Taiwan)
Past President:	Nick Harkness (Australia)
Vice President:	Vien Cheung (UK)
Secretary/Treasurer:	Leslie Harrington (USA)
Committee Members:	Maurizio Rossi (Italy)
	Paula Csillag (Brazil)
	Takahiko Horiuchi (Japan)
	Ralf Weber (Germany)

AIC 2019 Organizing Committee

Chair: María Paula Giglio (UN Mar del Plata)
Laura Quaintenne (Buenos Aires)
Gabriela Nirino (UBA)
María Luisa Musso (UBA)
Cristina Vadji (UBA)
María Inés Girelli (UN Córdoba)
María M. Mariconde (UN Córdoba)
Darío Suarez (UN Córdoba)
José Luis Caivano (UBA & Conicet)
Anahí López (LEMIT & UTN)
Hugo Salinas (Conicet)
Germán Díaz Colodrero (U. Belgrano)
Mabel A. López (U. Belgrano)
Diana Moreno (U. Belgrano)
Rosario Villalón Abad (U. Belgrano)
Logo design: Lucía Maillo (U. Belgrano)

AIC 2019 Publications Committee

Proceedings editor:	José Luis Caivano
Graphic design:	Lucía Maillo Puente (logos, colors), Diana Moreno (cover and layout)
AIC 2019 website:	María Paula Giglio, José Luis Caivano
Book of abstracts:	José Luis Caivano, Diana Moreno (cover and layout)
AIC 2019 program:	José Luis Caivano, María Paula Giglio, Diana Moreno

AIC 2019 Scientific Committee

Chair: José Luis Caivano
Kine Angelo (Norway)
Harald Arnkil (Finland)
Malvina Arrarte Grau (Peru)
Ulrich Bachmann (Switzerland)
Berit Bergström (Sweden)
Charles A. Booker (Norway)
Patrick Callet (France)
Vien Cheung (UK)
Elisa Cordero (Chile)
Paula Csillag (Brazil)
Maria João Durão (Portugal)
Brian Funt (Canada)
María Paula Giglio (Argentina)
Paul Green-Armytage (Australia)
Yulia A. Griber (Russia)
Robert Hirschler (Hungary)
Takahiko Horiuchi (Japan)
A. Kwiatkowska-Lubańska (Poland)
Jin-Sook Lee (Korea)
Anahí López (Argentina)
Ming Ronnier Luo (UK)
Maggie Maggio (USA)
Manuel Melgosa (Spain)
Galen Minah (USA)
María Luisa Musso (Argentina)
Dimitris Mylonas (UK)
Gabriela Nirino (Argentina)
Katsunori Okajima (Japan)
Galina Paramei (UK)
Javier Romero (Spain)
Maurizio Rossi (Italy)
Tetsuya Sato (Japan)
Verena M. Schindler (Switzerland)
Juan Serra-Lluch (Spain)
J. Tarajko-Kowalska (Poland)
Jinghong Wang (China)
Ralf Weber (Germany)

Organizing Institutions

On behalf of the International Colour Association (AIC),
the Grupo Argentino del Color (GAC) is responsible for the organization
of the AIC 2019 Midterm Meeting, at the Universidad de Belgrano (UB).

International Colour Association
Internationale Vereinigung für die Farbe
Association Internationale de la Couleur

The International Colour Association (AIC) is a learned society whose aims are to encourage research in all aspects of color, to disseminate the knowledge gained from this research, and to promote its application to the solution of problems in the fields of science, art, design and industry on an international basis. The AIC also aims for a close cooperation with other international organizations, regarding issues concerned with color. In 2009 the AIC agreed on the creation of an International Colour Day, which is celebrated in many countries around the world. Web: www.aic-color.org

Grupo Argentino del Color

The GAC is a non-profit civil association that was created in Buenos Aires in 1980. Its aims are to encourage studies and research on color, and disseminate the results. Besides, the GAC promotes exchanges with other color associations, holds a specialized documentation center, and integrates various fields of color study in different areas: science, technology, art, design, industry, etc. The GAC is a regular member of the International Colour Association, and is the organization that represents Argentina in the AIC.
Web: http://grupoargentinodelcolor.blogspot.com
Mail: gac@fadu.uba.ar

Universidad de Belgrano
Buenos Aires - Argentina

Founded in 1964, the Universidad de Belgrano (UB), is a center of higher education. The UB distributes its faculties in the headquarters of Belgrano neighborhood, Buenos Aires. Studies comprise Architecture & Urbanism, Agricultural Sciences, Health, Economics, Exact & Natural Sciences, Law & Social Sciences, Humanities, Engineering & Information Technology, Languages & Foreign Studies. PhD, master, and specializations are offered in most of these fields, as well as in Business and Psychology. The university operates a radio station and features sports activities, with teams competing at inter-university level and sports leagues. Web: www.ub.edu.ar

Universidad de Belgrano (UB)
Facultad de Arquitectura
y Urbanismo (FAU)

President: Dr. Avelino Porto
Vice-presidents: Prof. Aldo J. Pérez / Dr. Eustaquio Castro
Executive Directors: Dr. Marcela Porto / Lic. Ana Luisa Linares
Dean, Fac. Arquitectura y Urbanismo: Prof. Mónica Fernández
Director, Graphic Design career: Prof. Germán Díaz Colodrero

AIC Regular Members

Argentina
GRUPO ARGENTINO DEL COLOR

Australia
COLOUR SOCIETY OF AUSTRALIA

Belgium
INTERDISCIPLINARY COLOUR ASSOCIATION

Brazil
ASSOCIAÇÃO PRÓ-COR DO BRASIL

Bulgaria
COLOUR GROUP – BULGARIA

Canada
COLOUR RESEARCH SOCIETY OF CANADA

Chile
ASOCIACIÓN CHILENA DEL COLOR

China
COLOR ASSOCIATION OF CHINA

Croatia
HRVATSKA UDRUGA ZA BOJE

Finland
SUOMEN VÄRIYHDISTYS SVY RY

France
CENTRE FRANÇAIS DE LA COULEUR

Germany
DEUTSCHER VERBAND FARBE

Great Britain
THE COLOUR GROUP (GREAT BRITAIN)

Hungary
HUNGARIAN NATIONAL COLOUR COMMITTEE

Italy
GRUPPO DEL COLORE - ASSOC. ITALIANA COLORE

Japan
COLOR SCIENCE ASSOCIATION OF JAPAN

Korea
KOREAN SOCIETY OF COLOR STUDIES

Mexico
ASOC. MEXICANA DE INVESTIGADORES DEL COLOR

Norway
FORUM FARGE

Portugal
ASSOCIAÇÃO PORTUGUESA DA COR

Slovenia
SLOVENSKO ZDRUZENJE ZA BARVE

Spain
COMITÉ ESPAÑOL DEL COLOR

Sweden
STIFTELSEN SVENSKT FÄRGCENTRUM

Switzerland
PRO/COLORE

Taiwan
COLOR ASSOCIATION OF TAIWAN

Thailand
COLOR SOCIETY OF THAILAND

The Netherlands
STICHTING KLEURENVISIE

United States
INTER-SOCIETY COLOR COUNCIL

AIC Associate Members

NTERNATIONAL ASSOCIATION OF COLOR CONSULTANTS / DESIGNERS
North America

COLOR MARKETING GROUP
United States

AIC Study Groups

COLOR EDUCATION (CE)
Chair: Robert Hirschler (Hungary and Brazil)
Co-Chair: Maggie Maggio (USA)

COLOR VISION AND PSYCHOPHYSICS (CVP)
Chair: Katsunori Okajima (Japan)
Secretary: Manuel Melgosa (Spain)

ARTS AND DESIGN (AD)
Chair: Maria João Durão (Portugal)

ENVIRONMENTAL COLOR DESIGN (ECD)
Co-Chairs: Verena M. Schindler (Switzerland) and Yulia A. Griber (Russia)

THE LANGUAGE OF COLOR (LC)
Chair: Dimitris Mylonas (United Kingdom)
Co-Chair: Galina Paramei (United Kingdom)

Index of Contents

Color, Language and Culture 248

Urban Landscape 383

Color Education 480

Environmental Color Design 543

Color Vision and Psychophysics 574

Color Science and Technology

Appendix

Index of Authors

Prevention of the color changes in waterborne antimicrobial coatings with nano-functionalized siliceous filler

Leyanet Barberia-Roque[a]*, Erasmo Gámez Espinosa[a], Marisa Viera[ab], Natalia Bellotti[ac]

[a] Centro de Investigación y Desarrollo en Tecnología de Pinturas, CIDEPINT (CICPBA, CONICET, UNLP), Argentina
[b] Facultad de Ciencias Exactas, Universidad Nacional de la Plata, Argentina
[c] Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, Argentina
* l.barberia@ing.unlp.cidepint.edu.ar

ABSTRACT

Color fastness represents the capacity of a given paint to maintain its original color over the time when exposed to biotic and abiotic environmental factors. The aim of this work is to assess the color changes due to the addition of Ag nanoparticles in a natural siliceous based material in coatings. Analysis of the color data from 24 hours showed the effectiveness of the functionalized materials to decrease the color change. Paints with nanoparticles added directly presented color variation rated as very big, considering the colorimeter method by Teichmann, while with the addition of functionalized silica was barely evident. These results kept during the six months in which the study was conducted.

Keywords: *silver nanoparticles nano-functionalized, color change, antimicrobial waterborne paint*

INTRODUCTION

In the decorative paints field, color fastness represents the capacity of a given paint to maintain its original color over the time when exposed to environmental conditions such as chemical attack, UV radiation and the organisms activities (Hare 1992). The color of coatings is generated by addition of pigments, which can selectively absorb light in the visible spectrum. Waterborne coatings are colloidal systems composed of mineral and organic particles of distinctive sizes and shapes, dispersed at different volume concentrations into a polymeric resin. They also include small quantities of specific chemical species, additives whose function is to enhance the paint properties such as foam control, flow, leveling and rheology (Mahltig 2017).

In environmental engineering, biodeterioration is defined as any detrimental change made by an organism on a surface (Morton and Surman 1994). These changes can be caused by the mere presence of the organism as well as the result of its metabolic activity and can affect both the appearance and the structure of the materials, as well as potentially damaging to human health. The potential of metals to inhibit the growth of bacteria and fungi is well known, the mechanistic background of metallic antimicrobial effects is still under discussion and not yet fully understood (Mahltig 2017).

In recent years, the use of metal nanoparticles has been intensely studied as a antimicrobial component to be applied in functional material (Saratale et al. 2018). Despite all the advantages of adding metal compounds to paints, some of their properties are affected given the reactivity of metal ions (Arreche et al. 2015). For this reason, the addition of functionalized components with nanoparticles in coating formulations is an increasingly contemplated option (Barberia-Roque et al. 2019). However, some characteristics of the coating are affected by the nanoparticles, the color is one of the most recurrent (Zheng et al. 2018).

Silver nanoparticles have been used for the functionalization of other materials, transferring their antimicrobial activity to them and decreasing incidence on the color (Arreche et al. 2019). In the present research a natural siliceous based material-functionalized with silver nanoparticles has been used as an antimicrobial additive for a paint formulation. The color changes and antimicrobial performance during six months of natural aging were measured.

MATERIALS AND METHODS

Obtaining of nano-functionalized siliceous filler

A powdered siliceous material (SM), extract from Río Negro, Argentina; was first activated with an alkaline solution of NaOH 2.2 M (Fernández and Bellotti 2017). Then, two strategies were used: the direct addition of $AgNO_3$ 10^{-2}M solution (SMAg) and the addition of silver complexed with ammonium (SMAgC). Seven grams of activated SM was mixed with 100mL of the salt solution. The amount of adsorbed silver in the SM was determined from measurements of silver in the supernatant by a Mohr method variation.

Silver ions were reduced using the aqueous plant extract of *Senna occidentalis,* following a green synthesis method (Barberia-Roque et al. 2019).The green synthesis of free nanoparticles (AgNps) was carried out using the same silver nitrate solution and the plant extract as a reducing agent.

Paint preparation

The base paint composition was (% by mass): 48.6% of distilled water, 25.9% $CaCO_3$ (natural), 6.3% acrylic resin (1:1), 3.6% TiO_2, 2.0% $CaCO_3$ (precipitated) and 3.6% of additives (antifoaming, cellulosic thickener, dispersants and surfactants). The three products (AgNPS, SMAg and SMAgC) previously obtained were incorporated into the waterborne acrylic paint considering a silver concentration of 25 mg / 100 g of total paint.

Three different paintings were obtained AgNPsP, SMAgP and SMAgCP, respectively. In addition, two control paints without biocides were used: the base paint formulation (CP) and the base paint formulation with SM (SMP). The paints were applied on glass slides and cured for fifteen days. Some glasses were aged for six months exposed to natural light from behind a window, in laboratory conditions.

Color measurement

Color was measured by the CIELAB system with a colorimeter By K Gardner. CIELAB gloss and color parameters were evaluated on cured paints during their sunlight exposure. The change of color (ΔE) was calculated as: $\Delta E = [(a - a_0) 2 + (b - b_0) 2 + (L^* - L_0^*) 2]^{½}$, being: “a” the variation between magenta blue and green, “b” the variation between yellow and green and “L*”into black and white. The CIELAB parameters at t = 0 are referred as: a_0, b_0, and L_0^* while a, b and L*, correspond with the time elapsed. Visual appearance and ΔE were related with the rating as follow: < 0. 2 No visible, 0.2–0.5 Very slightly, 0.5–1.5 Slightly, 1.5–3.0 Evident, 3.0–6.0 Very evident, 6.0–12.0 Big, > 12.0 Very big (Arreche et al. 2019). An ANOVA parametric method was performed using the Tukey test for media comparison with 95% of confidence. SigmaPlot software was used in tabulation and graphing of all data.

Normalized antimicrobial assay

The antifungal efficiency of the prepared paints was evaluated by an in vitro procedure similar at the ASTM D5590 specification. The painted glasses, after two weeks and six months of aging, were cut in 2.5×2.5 cm and placed in minimum mineral media. The samples were inoculated with 50 µL of a spore suspension (10^5 spores/mL) of *Chaetomium globosum* KU 936228. The suspension was distributed homogeneously all over the painted surface. After four weeks of incubation at 28°C, fungal growth on the painted glasses was evaluated using a Leica magnifying glass at with an increase of 40 x.

RESULTS AND DISCUTION

Color change

The color assessment of the samples showed that, AgNPsP had the greatest change respect to the control whose initial values were used as a standard throughout the experiment like a_0, b_0 and L^*_0. Statistical analysis of the color data from 24 hours showed the effectiveness of the functionalized materials to decrease the color change, as it can be seen in Figure 1. However, in all paints containing nanoparticles, ΔE changes were statistically significant, which translates to naked eye detectable color changes. No significant differences were observed between ΔE_{30} and ΔE_{180} (subscripts represent aging time), in all the paints.

The color variation in the control paints was rated as slight. In the alternative paints with SMAg and AgNps it was big and very big. However, with the addition of SMAgC, the color change was barely evident. The color variation over time highlighted the effectiveness of the SMAgC to prevent the color change by approximately six months of weathering. These results allowed determining that the functionalization of SM with AgNPs is not enough the color change. However, we could conclude that complexing silver with ammonium helps to preserve more efficiently the properties of the paints.

The parameter L* had a higher incidence on the color change measured in each of the paintings. This phenomenon could be due to can be attributed to the composition initially and decomposition later of black compounds as those formed when silver reacts with sulfur compounds at the environmental pollution. Degradation of these compounds by the action of light or O_3 could explain that L* was the most affected color parameter during the natural aging process (Arreche et al. 2019). There were no significant changes in the brightness of the paints obtained with respect to the CP even after the aging process. The overall average brightness was 2 approximately.

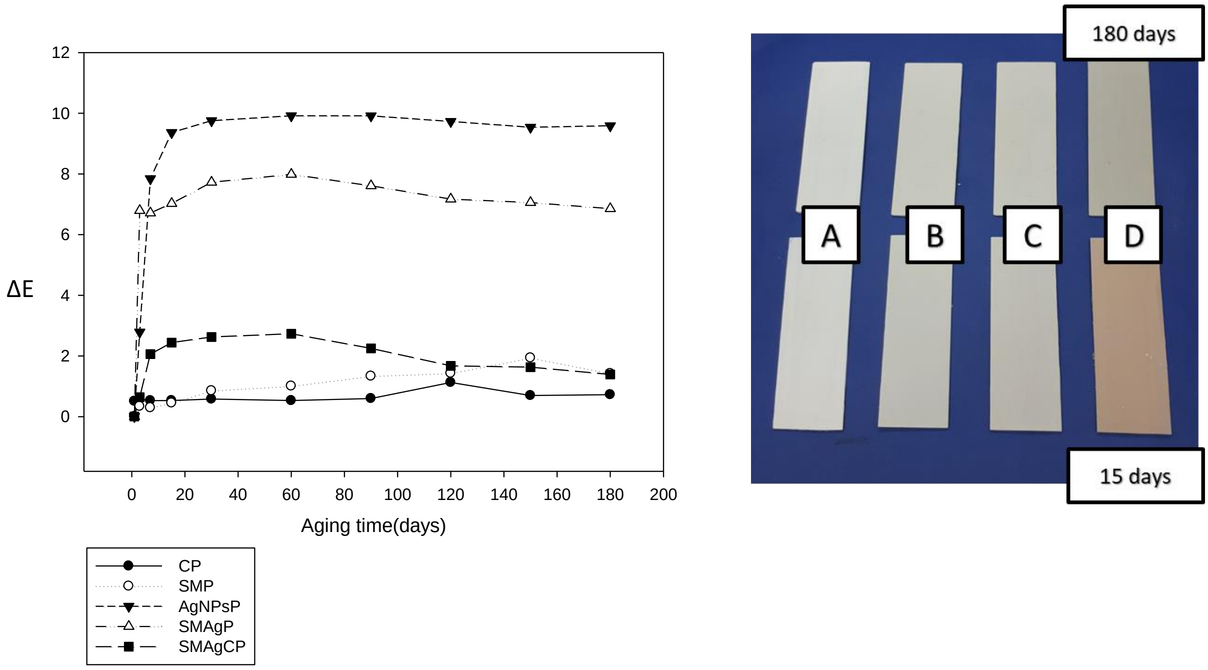

Figure 1: Graph of color change over time for six months (left).
Paintings after 15 and 120 days of curing (right) (A: CP; B: SMAgCP; C: SMAgP and D: AgNpsP).

Antifungal activity

All paints with AgNps showed a high degree of antifungal activity which can be seen in Figure 2. Control paint CP in Figure 2A, shows the development of the inoculated spores. In the rest of the samples (Figure 2B, C, D) can be observed how the inoculated spores were not even able to germinate. All the samples were rated as 0 according to the ASTM. However, samples with the functionalized fillers at t = 0 and those aged showed fungal growth around them while the paints without SM only presented fungal growth around the samples after six months, which could be related to loss of antifungal activity over time.

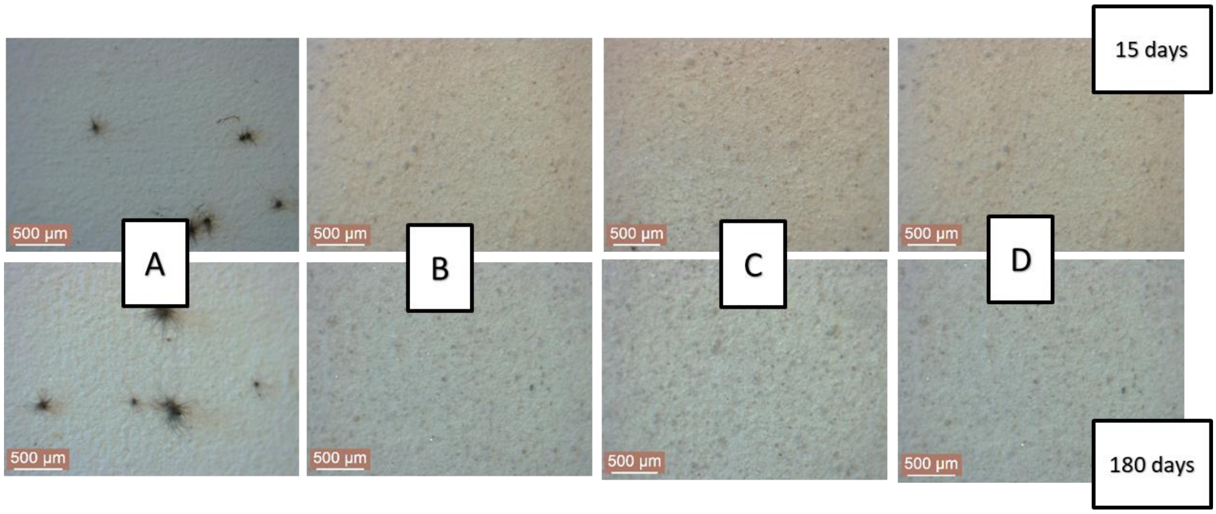

Figure 2: Antifungal assay against *C. globosum* (A: CP; B: SMAgCP; C: SMAgP and D: AgNpsP).

CONCLUSIONS

In the present work we have found that the functionalization of SM with silver nanoparticles impart their antimicrobial activity to the coatings, therefore, functionalized SM can be used as biocide in waterborne coating formulations. The addition of nanoparticles, associated to SM positively affects the maintenance of the color of the tested waterborne paint, allowing the color to remain without significant alterations over time.

ACKNOWLEDGEMENTS

The authors thank CICPBA, UNLP and CONICET for the financial support.

REFERENCES

Arreche, R., K. Igal, N. Bellotti, and P. Vázquez. 2015. Microbiological prevention using functionalized materials as ecological additives in hygienic paints. *Procedia Materials Science*. https://doi.org/10.1016/j.mspro.2015.05.040.

Arreche, R., K. Igal, N. Bellotti, C. Deyá, and P. Vázquez. 2019. Functionalized zirconia compounds as antifungal additives for hygienic waterborne coatings. *Progress in Organic Coatings*. https://doi.org/10.1016/j.porgcoat.2018.12.004.

Barberia-Roque, L., E. Gámez-Espinosa, M. Viera, and N. Bellotti. 2019. Assessment of three plant extracts to obtain silver nanoparticles as alternative additives to control biodeterioration of coatings. *International Biodeterioration and Biodegradation*. https://doi.org/10.1016/j.ibiod.2018.06.011.

Fernández, M. A., and N. Bellotti. 2017. Silica-based bioactive solids obtained from modified diatomaceous earth to be used as antimicrobial filler material. *Materials Letters*. https://doi.org/10.1016/j.matlet.2017.01.144.

Hare, C. H. 1992. The degradation of coatings by ultraviolet light and electromagnetic radiation. *Journal of Protective Coating & Linings*, May: 8029-8032.

Mahltig, B. 2017. Metal pigments as antimicrobial agent and coating additives. In: *Handbook of Antimicrobial Coatings*. Elsevier, 283-299. https://doi.org/10.1016/b978-0-12-811982-2.00014-7.

Morton, L. H. G., and S. B. Surman. 1994. Biofilms in biodeterioration - a review. *International Biodeterioration and Biodegradation*. https://doi.org/10.1016/0964-8305(94)90083-3.

Saratale, R. G., I. Karuppusamy, G. D. Saratale, A. Pugazhendhi, G. Kumar, Y. Park, G. S. Ghodake, R. N. Bharagava, J. R. Banu, H. S. Shin. 2018. A comprehensive review on green nanomaterials using biological systems: Recent perception and their future applications. *Colloids and Surfaces B: Biointerfaces*. https://doi.org/10.1016/j.colsurfb.2018.05.045.

Zheng, K., M. Setyawati, D. Leong, and J. Xie. 2018. Antimicrobial silver nanomaterials. *Coordination Chemistry Reviews*. https://doi.org/10.1016/j.ccr.2017.11.019.