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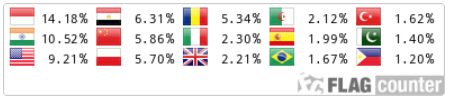

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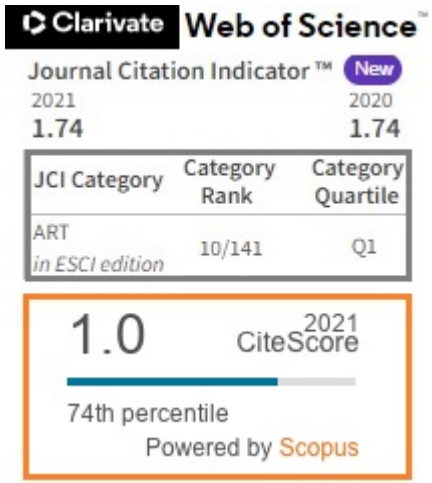

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Research articles

P. Jin, F. Ruan, X. Yang, K. Liu, H. Zou, L. Ye, L. Gu

Assessment of Cleaning the Corrosion Layer of Plated Bronzes with a Complex Gel of Polyvinyl Alcohol and Carbomer

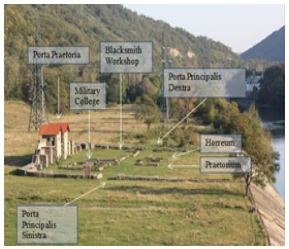
[Abstract] [Full Article - PDF] pp. 3-14

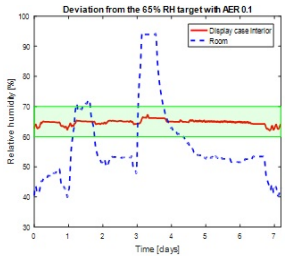
When unearthed from soil, many plated bronzes were covered with a thick layer of patina that hid their original shiny lustre. A sandwich structure is observed in their cross-section including superficial patina, plated layer and inner patina. In this paper, a hydrogel cleaner, composed of polyvinyl alcohol (PVA) and Carbomer, and added by formic acid and cysteine, is introduced as de-rusting agent which can not only remove the patina from the surface of plated bronzes successfully, but also keep their original lustre.

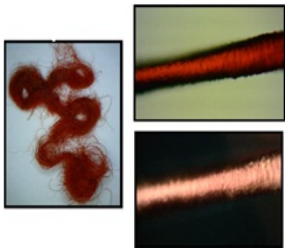
Keywords: Plated bronze; Patina; De-rusting; Gel cleaning; PVA; Carbomer.

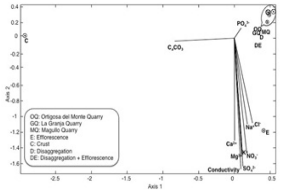
WA. Mohamed, N.M. Mohamed

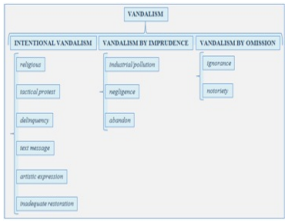
Testing Coatings for Enameled Metal Artifacts

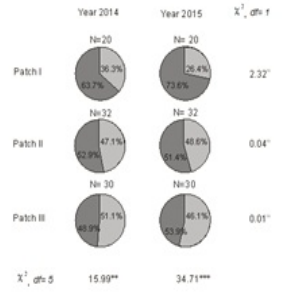


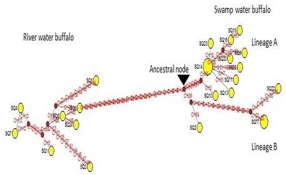












State of the art of close-range photogrammetry reveals new methods for creation of 3D models for heritage and archaeological objects and sites. Effective and competent methodologies have been developed for surveying and modeling archaeological sites and thus provide high quality and accurate realistic textured models for better research, preservation, education and monitoring projects. A specific methodology was applied to produce a scale 3D model of "Arutela (Căciulata) Roman Castrum" in a digital environment. A complex product is created, with complemental geometry and texture. The accurate geometry and appearance details (size, shape, position and texture) can be used for a proper documentation, preservation and restauration applications.

Keywords: Close-range photogrammetry; Digital photographs; 3D modeling; Archaeological site; Heritage conservation.

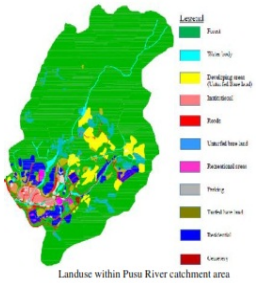
G. Goli, L. Cocchi, M. Togni, M. Fioravanti

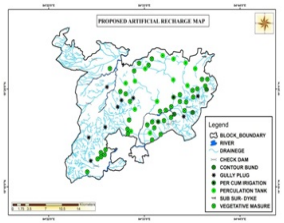
Test of a Device for the Active Control of Environmental Humidity in Museum Display Cases

[Abstract] [Full Article - PDF] pp. 43-50

A series of laboratory tests were conducted on a commercial device for active relative humidity control of display cases to assess the ability of the machine to control a medium format (3.45 m3) museum display case. An extreme museum environment with large relative humidity and temperature fluctuations was simulated and different air leakage rates were produced (0.1 - 0.5 - 6 AER/day) on a purposely-made display case. The machine was shown to work very effectively for both in humidify and dehumidifying for conditions corresponding to very well sealed (AER 0.1) to medium sealed (AER 0.5). On a very poorly sealed enclosure (AER 6), the external environmental fluctuation resulted in internal fluctuations but the machine very effectively mitigated these effects. The use of the machine in positive pressure mode and (optional) recirculating mode was shown to be irrelevant to the ability of the machine to control the relative humidity. Positive pressure mode provides a constant flow to remove VOC's from the showcase (which could contribute to artefact degradation.), and to prevent ingress of ambient pollutants.

Keywords: Showcase; Climate; Active conditioning; Microclimate; Relative humidity





E.M. Osman, Y.E. Zidan, N.K. Fahim

The Determination of Conservation State of Archaeological Moroccan Kilim by Physical Analytical Methods

[Abstract] [Full Article - PDF] pp. 51-58

This paper present the strategies for identification the raw material and dyes used in old textile and deterioration and degradation statement of archaeological dyed samples by using physical techniques such as light microscopy, scanning electron microscope and X-ray diffraction. Samples were taken from morocco kilim which was suffering from several types of damage, as a result of natural ageing appearing in brittle fibres, fading in dyes in many parts of it and missing in a lot of parts in many places. Light microscope and SEM were used to identify the kind of fibres, their condition and surface morphology. XRD was used to identify mordant, impurities and dust. Various dyed samples were taken from different eight sites selected from the worst places in statement of damage in the kilim, and examined by optical microscope, XRD and Scanning electron microscope. Main results revealed that the raw material was wool with its significant morphology appearance. XRD analysis revealed that iron sulphate, Alum, copper sulphate, tin was the main mordant existed in. On one hand, these mordants were considered the most common mordants used in archaeological textiles, on the other hand it should be one of the deterioration and degradation factors for old samples. SEM showed the weakness, brittleness and friction existed in dyed wool samples, the reasons of deterioration/degradation was discussed. Finally, the previous analysis provided a suitable plan for treatment the archaeological dyed textile, as it could be helpful for conservator to have a good decision of the procedure and material should be used in the conservation process based on the previously obtained data analysis.

Keywords: Deterioration and degradation; Physical techniques; Dyed wool;
Archaeological textile; Mordant

A.C. Inigo, J. García-Talegon, S. Vicente-Tavera, S. Casado-Marín, S. Martin-Gonzalez

Multivariate Analyses of Soluble Salts Responsible for Pathologies in Granites of the Roman Aqueduct of Segovia, Spain

[Abstract] [Full Article - PDF] pp. 59-66

The aim of this work is to characterize the main pathologies caused by salt crystallization in granitic monuments (crusts, salt efflorescence, disaggregation and disaggregation with salt efflorescence). Water soluble ions were determined quantitatively. Using the Canonical Biplot multivariate method it was determined that: a) there is a relationship between the content of water soluble salts and the different identified pathologies; b) sulphate and NO3-, Cl-, Ca2+, Mg2+, K+ and Na+ ions are the major components of salt efflorescence; c) carbonate is a major component of the crust; and d) the disaggregated granites, with or without salt efflorescence, have a low proportion of soluble salts but no predominant ion composition.

Keywords: Granite; Pathologies; Salt crystallization; Crust; Efflorescence; Disaggregation; Canonical Biplot

N. Buisson, C. Laffont, A. Pequignot, C. Badoual, P. Faulcon, C. Nich

New Insights into the Heart of Voltaire Using a Multidisciplinary Approach

[Abstract] [Full Article - PDF] pp. 67-80

A rare occasion to investigate the conservation mode of the heart of the philosopher Voltaire (1694–1778) presented itself following an incident with his statue at the National Library of France which enclosed the organ. A multidisciplinary study was carried out to propose and implement an improved reconditioning method for the organ. The study generated a better knowledge of the fabrication technique of funeral metallic boxes as well as a better understanding of the degradation process of both the organ and the box. The heart and its conditioning, as well as the volatile products (VOCs) released by the heart were analysed with nondestructive methods. X-ray fluorescence spectroscopy (XRF) and scanning electron microscopy associated with X-ray microanalysis (SEM-EDX) were used for the identification of the metal, the preparation and the gilding of the metal box. The heart-shaped metal box is made of lead with tin welds. The box received a double layer white lead preparation. The binding of the preparation is probably of proteinic nature. Gold leaf had been

deposited on a gilding bole made of a mixture of red ochre and minium, enhancing the preciousness of this particular artefact. Identification of VOCs released from the heart done by SPME fibres followed by gas chromatography-mass spectrometry (GC-MS) analysis confirmed the origin of the strong smell, essentially acetic acid. From the inside of the heart-shaped metal box, emission of VOCs suggest that the organ may have been embalmed in a liquid containing alcohol (spirit of wine), resins, natural extracts or essences from cedar or lavender. Histological analysis of tissue samples showed the presence of striated muscle fibres. These results helped to determine the optimal reconditioning of the heart. It has been decided to keep the organ inside its metal box in a stabilized environment with static anoxia, in order to preserve the heart for future generations while protecting the tissues against oxygen degradation for further investigations.

Keywords: Heart of Voltaire; Gilding; Metal analysis; SEM-EDX; XRF; VOCs; CT scanner; Histology

P. Spiridon, I. Sandu, L. Stratulat

The Conscious Deterioration and Degradation of the Cultural Heritage

[Abstract] [Full Article - PDF] pp. 81-88

The present paper aims to present the different forms of vandalism resulted from the human activities and manifestations that harm the environment and/or put in danger the cultural heritage assets. For this purpose, we selected a number of relevant cases in the field in order to identify the real reasons behind these actions that have often mutilated the artifacts. The results revealed that anthropic factors are just as dangerous as the natural factors for the cultural heritage, and that there are many different manifestations, controllable or uncontrollable, based on intention, imprudence or omission.

Keywords: cultural heritage; conservation; vandalism; destruction; graffiti; demolition

K. Kostrakiewicz-Gieralt

The Impact of Habitat Conditions on the Performance of Generative Ramet Clusters of High Medicinal Value, Rare Species Betonica Officinalis l.

[Abstract] [Full Article - PDF] pp. 89-104

Observations were carried out in the years 2014-2015 in moor grass meadows, old fields, willow thickets and macroforbs. In the successive study sites, the height of the standing vegetation and soil moisture gradually increased, whilst the light availability decreased. Stable in consecutive seasons, the total number of ramets per generative ramet cluster achieved the lowest values in willow thickets due to mechanical suppression of vegetative growth by the robust underground organs of neighbouring plants. Constant during the study period, the share of generative stems decreased in successive study sites, while the percentage of leaf rosettes showed an inverted tendency. The increase of height of generative stems and number of flowers per inflorescence in consecutive Patches, as well as the augmentation of length of flowers in time and space, might trigger an improvement of generative reproduction in a crowded environment. The increase of the number of nodes and dimensions of cauline leaf blades in successive Patches and the augmentation of the number and dimensions of rosette leaves in the time and space might contribute to greater efficacy of light capture in growing shading. Summarizing the plasticity of traits might assure the spread of generative ramet clusters in open habitats, as well as their persistence in crowded sites.

Keywords: Cauline leaves; Flowers; Generative stem; Rosette; Spatial and temporal variability

N. Sarataphan, W. Narongwanichgarn, S. Maneerat

Phylogenetic Analysis of a Thai Wild Water Buffalo (bubalus arnee) Through Mitochondrial Control Region

[Abstract] [Full Article - PDF] pp. 105-112

Asiatic wild water buffaloes (Bubalus arnee) are categorized as endangered species on the IUCN Red List, and distribute only in Nepal, India, Sri Lanka, Myanmar, Bhutan, Cambodia and Thailand. The objective of this study was to verify the relationship between the maternal lineages of a Thai wild water buffalo in Huai Kha Khaeng Wildlife Sanctuary and other domesticated water buffaloes. Mitochondrial control region sequence were analysed in comparison with published sequences of domestic water buffaloes. The DNA fragment size of 396 bp indicated 55 polymorphic nucleotide sites with 50 transitions and 5 transversions. The maximum likelihood tree revealed that the Thai wild water buffalo

located in lineage A of one major swamp water buffalo clade. The Thai wild water buffalo genetic material has more similarities with that of the swamp water buffalo from lineage A, than that from lineage B. Median-joining phylogenetic network and mutation position showed that the evolution of the Thai wild water buffalo happened prior to domesticate swamp water buffaloes. Analysis of mitochondrial control region sequence of the wild water buffalo showed independent maternal origin, separating from other domesticated swamp water buffaloes.

Keywords: Thai wild water buffalo; control region; mitochondrial DNA

D.R. Shah, D.J. Gavali

Floral Diversity in Vadodara Gardens, Gujarat, India

[Abstract] [Full Article - PDF] pp. 113-120

Garden biodiversity is an integral part of the urban ecosystem and play an important role in improving green infrastructure and aid in climate change adaptations. Little research is available on the floral diversity of the parks and gardens. The present study is an attempt to document the floral diversity of 77 gardens in Vadodara city and elucidate trends based on the size of the gardens. Study indicated presence of 217 species belonging to 72 families from the gardens of Vadodara city. The floristic data revealed that around 53% of the species represented indigenous species and 47% belonged to exotic species. Paper concluded that diversity is more in the small gardens as compared to large sized garden, where plantation of few species in undertaken. Species suitable to the semi-arid climate with low water requirement dominated the gardens indicative of better management practices and adapt to climate change.

Keywords: Garden; Urban ecosystem; Exotic species; Plant Diversity, Gujarat;

M. Nuruzzaman, A. Al-Mamun, M.N. Salleh

Challenges in the Rehabilitation of the Pusu River

[Abstract] [Full Article - PDF] pp. 121-130

River rehabilitation efforts in the world are increasing to conserve the ecosystem. These efforts, generally, face challenges from various sources. Major constraints which can turn such a program into a failed project have been discussed explicitly in the first portion of this paper. In the latter portion of the paper, focus has been given on the problems of rehabilitation of the Pusu Rive at Gombak District in Malaysia. Water sampling from the river and its catchment has been done in different periods and events. Pollution loadings into the river have been calculated for different parameters. Based on analysis, sand mining activities, point source pollution and catchment landuse have been identified as the major impediments of Pusu River rehabilitation. These problems must be addressed before the rehabilitation of the river to ensure the rehabilitation of the river is successful.

Keywords: River rehabilitation; Pollution; Targets; Impediments; Failure reasons.

M.Z. Haque, M.I.H. Reza

Salinity Intrusion Affecting the Ecological Integrity of Sundarbans Mangrove Forests, Bangladesh

[Abstract] [Full Article - PDF] pp. 131-144

The raising of the sea causes salinity intrusion into fresh water zones such as river, lake, floodplain and other lowlands. Salinity intrusion in the Mangrove forest is a continuous process. However, due to the increasing salinity ecological integrity of the Sundarbans have been largely affected. The compositional and functional aspects of flora and fauna have been changing at a great deal. The objective of this study is to delineate the changes of the structure and composition of the Sundarbans Mangrove Forest due to excess salinity intrusion and how salinity affect its biodiversity, wildlife habitat and other ecosystem components. This study reviewed related literature gathered through an extensive survey of various websites and the secondary data obtained from various departments with necessary modifications. The land use maps collected from the Bangladesh Forest Department were interpreted to achieve an elaborate classification of forest type and its gradual change with increasing salinity. Observations at the periphery of Sundarbans explore the effect of salinity on the population, livestock, aquatic species and the paddy fields. We used ArcGIS 9.3 to visualize the salinity prone zones, the boundary of administrative zones and the forest type to identify

the causes and intensity of the issues, and to suggest the appropriate mitigating measures. The study states that the salinity intrusion causes the reduction of fresh water availability in Sundarbans. As a result, fresh water loving species are replaced by the species of the saline zone. Most of the areas are found with the small and bushy typed species that reduce biomass in comparison with their standard volume. The study reveals the effects of salinity intrusion in the Sundarbans Mangrove Forest which may affect its compositional, structural and functional integrity. Long-term and short-term policies are recommended to resolve the issues.

Keywords: Salinity intrusion; Ecological integrity; Mangrove ecosystem; Biodiversity; Wildlife habitat; Structure and composition of mangrove species

P.C. Sahu

Groundwater Resource Conservation and Augmentation in Hard Rock Terrain: An Integrated Geological and Geo-Spatial Approach

[Abstract] [Full Article - PDF] pp. 145-156

Digapahandi block of Ganjam district is a chronically drought prone and economically backward area of Odisha. The agricultural lands which are mostly rain fed bear the adverse effects of drought resulting in loss of crops. Surface water irrigation is very limited and not dependable due to vagaries of monsoon rainfall. Drinking water problem is very acute during summer as most of the wells go dry. Keeping this fact in view the research was aimed at locating site specific artificial recharge structures for groundwater resource conservation and augmentation in hard rock terrain. Satellite IRS- IC LISS III data have been used to prepare various thematic maps. The study reveals that the major litho units are granitic gneisses, khondalite and charnockite suite of rocks. The geomorphic units are pediplain, flood plain, denudational and structural hills .Four sets of lineaments have been identified. The trends of lineaments are broadly NE-SW, NNE-SSW, NW-SE and N-S. The interpreted data is cross-checked and confirmed during field visits. Based on the hydro-geological set-up, suitable site-specific artificial recharge structures such as percolation tank, check dam, contour bund, gully plug and vegetative measures have been suggested to maintain the balance between the recharge and draft.

Keywords: Conservation; Artificial recharge; Hydro-geomorphology; Lineament; Drought prone

M. Asyari, Udiansyah, Bagyoyanuwiadi, M.L. Rayes

Management Policy Formulation of Teluk Kelumpang Natural Reserve Related with Mangrove Forest Degradation at South Borneo, Indonesia

[Abstract] [Full Article - PDF] pp. 157-164

Indonesia is an archipelago that has the largest mangrove forest in the world. Strategic role of forest resources encourages the need for sustainable management of mangrove forests. This study aims to formulate strategies for management of mangrove forests related with degradation of land use in Teluk Kelumpang Natural Reserve area at Kotabaru Regency, using Analysis Hierarchy Process (AHP) approachment. The results of study explained that the hierarchical structure I which consists of the supporting factors for socio-ecological, sosio-cultural and sosio-economic aspects got score 1,809; 1,682 and 0,239 respectively. It shows that the supporting factor which based on socio-ecological aspects, believe to be the most dominant factor for sustainable and sustainability Teluk Kelumpang Natural Reserve mangrove forest management policy formulation. Based on the hierarchical structure II, conclude that the socio-economic indicators, ie: utilization based to the absence of access to land ownership, capitalization of the business and source of livelihood got score 1,717; 0,781 and 0,874 respectively. On the socio-ecological indicators can be concluded that the understanding of mangrove forest conservation got score 1,027, environmental services is 0,753 and the ecological functions of mangrove forest is 0,735. Socio-cultural indicators which become the foundation supporting the utilization of sustainable and sustainability Teluk Kelumpang Natural Reserve mangrove forest, namely: the utilization for cultural function / local wisdom / pond got score 1,035. The utilization for entertainment functions / recreation / beach tourism got a score 0,941 and the utilization for educational function got score 0,734.

Keywords: Mangrove forests; Analysis Hierarchy Process; Teluk Kelumpang.

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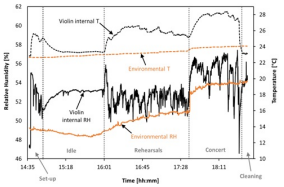
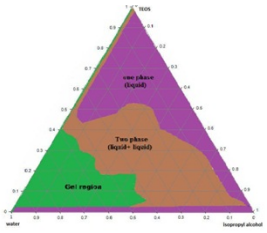




Research articles

L. Bianco

Limestone Replacement in Restoration: The Case of the Church of Santa Maria (Birkirkara, Malta)

[Abstract] [Full Article - PDF] pp. 167-176

The Church of Santa Maria is one of the finest examples of seventeenth century heritage monuments in the Maltese archipelago. The provenance of limestone used in the restoration works is different from the original heritage fabric. It is obtained from a quarry located 5.2 km south of the church whilst the original source of the limestone, according to tradition, is from an area 2.2 km north of the monument. This petrological study concludes that although both extracted from the same geological formation, there are physical, textural, geochemical and mineralogical differences even over a distance of 7.4 km. The limestone used in replacement is more resistance in terms of compressive strength and is less porous. Although having same principal non-carbonate oxides, the quantitative variations in the geochemistry and the mineralogy are indicative of qualitative differences between the two lithotypes; they are diagnostic indicators of the provenance of the limestone.

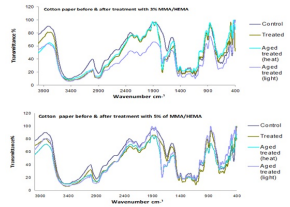
Keywords: Limestone; Globigerina Limestone; Restoration; Compatibility, Evaluation, Baroque; Malta; Birkirkara.

G. Goli, B. Marcon, L. Busoni, B. Carlson, A. Cavalli, A. Giordano, P. Mazzanti, P. Montanari, M. Togni, M. Fioravanti

Antique Violins: Effect of the Player on the Moisture Content

[Abstract] [Full Article - PDF] pp. 177-186

In this research the inside and outside relative humidity and temperature of the violin Guarneri "del Gesù" violin (1743) known as the "Cannone", were monitored during nine concerts. The environmental variations during concerts were analysed showing how the internal relative humidity tends to an average value between the conservation conditions and the external conditions. The violin internal temperature is highly influenced by the contact



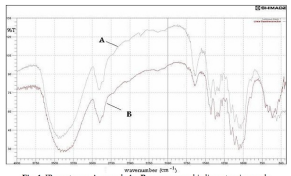
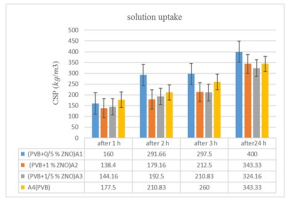


Fig. 1. IR spectrums: A - sample 1a; B - new prepared indigo – tannin sample



between the player and the violin resulting in a typical saw-tooth graph during a concert because of the discontinuous contact with the player's body. The violin internal relative humidity presents a typical drop when the player stops playing. The mass variations consequent to the concerts were also recorded and analysed. This analysis has shown how the difference between the conservation average relative humidity and the violin external average relative humidity during a concert are good predictors of the mass variation. Relative humidity and Equilibrium Moisture Content have shown the same ability to predict the mass loss showing how the temperature (for the variation measured in this research) is not an important factor. The analysis suggests that the presence of the violinist does not play a relevant role on the violin mass transfer during a concert.

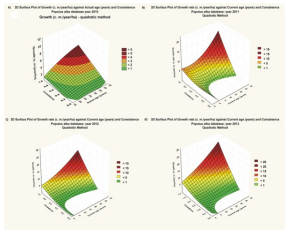
Keywords: Violinist; Moisture content; Concert; Mass; Guarneri; Violin; Hygrothermal transfers.

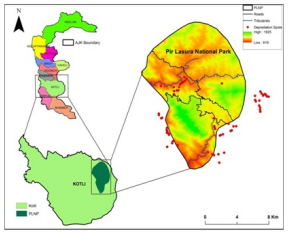
A. Al-Bawab, R. Abd-Allah, H. Al-Hamati, F. Odeh, A. Bozeya

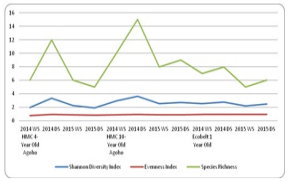
Consolidation of Archaeological Basalt Stone: A new Experimental Protocol by using Different Dispersions Formulation

[Abstract] [Full Article - PDF] pp. 187-198

In this study, a new protocol of consolidation for basaltic stone artifacts was investigated. A considerable series of samples of deteriorated basaltic artifacts were collected from the Rujm el-kursi archaeological site in Jordan. Colloidal dispersion was prepared to act as a consolidant solution for the selected basalt artifacts. The phase behavior for a system composed of Water /Calcium hydroxide/ Isopropyl alcohol/ Tetraethyl orthosilicate (TEOS)/ Paraloid B72 was investigated. The resulting ternary phase diagram was used to prepare the optimum formulation for consolidant dispersion. A series of laboratory experiments were conducted to evaluate the efficiency of the prepared dispersion. Experiments included capillarity water absorption, penetration of water, water drop absorption, salts movement and accelerated artificial aging test. Treated samples were investigated using scanning electron microscope (SEM), X-ray diffraction (XRD), X-ray fluorescent (XRF) and polarizing microscope (PM). The results of laboratory experiments showed that the prepared colloidal dispersion expressed acceptable efficient in strengthening the internal structure of stone. Obvious changes in the mineralogical







composition of treated samples were not recorded. The treated basalt stone appeared to be water repellent; can decrease the penetration of water, which in turn led to the decrease of salts crystallization process inside basalt stone pores. The prepared dispersion appeared to be stable against accelerated aging factors and effective in decreasing the basalt stone decaying process.

Keywords: Basalt stone; Consolidant dispersion; Ternary phase diagram; Paraloid B72; SEM; XRF.

G. Abeer

The Use of Mineralogical Data in Interpretation of Brass Alloy Brittleness Through a Metallic Object from Museum of Faculty of Applied Arts in Cairo

[Abstract] [Full Article - PDF] pp. 199-206

Metallic objects undergo physical-chemical transformations involving complex mechanisms, which change both their surface and their metallic core. This paper presents the study of a Brass head of a princess from the museum of Faculty of Applied Arts in Cairo, in which we used Optical microscopy (OM), Metallographic microscope, Scanning electron microscopy, coupled with energy dispersive X- ray spectroscopy (SEM-EDX), and X- ray diffraction. The results revealed the excess of the chloride ion in corrosion products, transforming the bulk in stratified sponge structure. Compounds of primary and secondary patina were found as color stains on the surface. The alloy components (Cu, Sn, Zn) and contamination components, allowed us to prove the influence of environmental factors in the alteration processes of Brass alloy artifacts causing brittleness in the mineralogical composition. Finally, the results obtained helps in choosing the best methods of treatment and conservation.

Keywords: Corrosion mechanism; Brass alloys Brittleness; OM; SEM-EDX; XRD.

J. Abbasi, K. Samanian, M. Afsharpor

Evaluation of Polyvinyl Butyral and Zinc Oxide Nano-Composite for Consolidation of Historical Woods

[Abstract] [Full Article - PDF] pp. 207-214

Consolidation of degraded wooden artifacts by natural and synthetic polymers in a solution is an important step in the treatment process of wooden heritage. This treatment is basically depended on the penetration, distribution and retention of the consolidate in the wood structure. One of the most frequently used consolidate for wooden material is polyvinyl butyral (PVB). Present research aims to evaluate polyvinyl butyral and zinc oxide as consolidate of old dried wooden material and investigate the efficiency of zinc oxide as a supplement on the distribution, penetration and retention of the consolidate in the "patanus orientalts-L" wood samples. Samples used for this research all belong to Qajar period. They were obtained from the same artifact and had the same, relatively sound condition. Cross sections were cut and obtained in a chamber with controlled temperature and relative humidity and weighted afterwards. Zinc oxide was used in 0.5, 1 and 1.5 concentrations in the polyvinyl butyral matrix of 10 % concentration. Efficiency of consolidate was evaluated by weighting, distribution and penetration in the wood and were examined by Fe-SEM and EDX. Concentrations 0.5 and 1 % of Nano- zinc oxide increased the penetration of consolidate and all three concentrations of zinc oxide increased the retention. Penetration of Nano- zinc oxide in the lumen as well as uniform distribution of it in the wood structure was also observed by microscopic observation.

Keywords: Wood; Consolidate; Nano-composite; Polyvinyl butyral; Zinc oxide

M. Paryad, M. Janpourtaher, M. Barkeshli

Technology, Pathology and Scientific Analysis of a Piece of Safavid Curtain in the Moghadam Museum

[Abstract] [Full Article - PDF] pp. 215-226

The curtain under study with the inventory number 3421 is one of the exquisite brocade fabrics belonging to Iran's Safavid period (dated 16th century) housed in Moghadam museum. This research aims to identify the stitching techniques, texture, pigments and deterioration factors, and to examine the different causes of damages through historical and artistic review. Data and information is collected through library and field studies, laboratory tests, instrument approaches, analysis, survey and direct observation of the object. Fibers and pigments were detected using polarizing light microscopy, chemical tests and

affordable analysis devices. Results showed the fibers as silk, and Indigo and Madder were identified as main colorants used in dying the fibers. Also according to the SEM results, metal thread was identified as pure silver, which is covered with a layer of black sulfur. According to postural warp and weft and braid string, weaving technique was a combination method with split-woven technique. A series of internal and external destructive factors as well as improper past repairs caused several damages to the fabric. Based on the current condition of the object and the damages it contains, this research aims to identify the deterioration factors and assess them.

Keywords: Technology; Pathology; Safavid textile; Brocade fabric; Moghadam Museum

J.F. Bejarano Bella, A. Torres Rodríguez

50 Years of Preservation in Doñana (Spain). Public Involvement as the Present Challenge and Management Strategy to Face Future Challenges (Case Study)

[Abstract] [Full Article - PDF] pp. 227-236

In social sciences, scientific approaches to nature preservation in Protected Natural Areas (PNA) are scarce, and those aimed at assessing the involvement of local communities with PNA are particularly deficient. In this paper, we show how management strategies of Protected Areas (PA) have created a lack of trust since the beginning on those social agents who are more directly affected by them. Even if sustainable development policies have tried to diminish the rift between local populations and PNA, they must be reinvented in order to face present preservation challenges and generate or increase citizens' commitment to PNA. Regarding the Natural Area of Doñana (Spain), some of the main challenges are conflicts due to water scarcity, the impact of agroindustry proliferation and the loss of traditional environmental knowledge. Social research provides us with critical elements to create management strategies capable of minimizing negative social and environmental consequences of the persistent and deceitful preservation/development dichotomy. Our main conclusion is that new responsibilities in ecological heritage management must be the result of public involvement, due to its ability to produce civic education and governability. This means that whether public involvement in the management of nature

preservation in PNA succeeds or fails will determine the success or failure of preservation itself.

Keywords: Conservation; Civil society; Doñana; Protected Areas; Governability.

R.R.A. Hassan, W.S. Mohamed

Effect of Methyl Methacrylate/Hydroxyethyl Methacrylate Copolymer on Optical and Mechanical Properties and Long-Term Durability of Paper under Accelerated Ageing

[Abstract] [Full Article - PDF] pp. 237-250

The main goal of this study was to study and evaluate the effect of MMA/HEMA copolymer on the mechanical properties and chemical composition of wood pulp and cotton linter cellulose fibers samples under accelerated ageing .The change of the physical and chemical properties of the untreated and treated paper after ageing was assessed by different methods. The results revealed that copolymer improves the mechanical properties of the paper sheets with reduction in the ΔE, but after heat ageing the value increased, which is a point to consider. From the micrographs, it is clear that the treated fibers are more bundled to each other than the untreated fibers where this fiber bundles increased by increasing the copolymer concentration.

Keywords: Wood pulp; Ageing; Scanning Electron Microscope; Mechanical properties; Copolymer

N. Al-Sharairi, Z. Al-Saad, I. Sandu

Identification of Dyes Applied to Ottoman Textiles

[Abstract] [Full Article - PDF] pp. 251-258

Representative samples of textiles taken from Ottoman costumes were chemically analyzed for dyes identification purpose. The collection dates from the 19th century and belongs to the Museum of Jordanian Heritage. The chemical analyses were carried out using HPLC, FT-IR and two samples with EDX. Indigo, Madder, Prussian blue, Scheele's green, synthetic alizarin and tannin additives were successfully identified. Relative production dates have been approximately determined. Such information is very helpful for future conservation. It also enriches our knowledge about these costumes in specific and costumes of the late Ottoman period in general.

Keywords: Dyes, Ottoman textiles, Jordanian Heritage, HPLC, FTIR, EDX.

S. Mahapatra, J. Rout, G. Sahoo, J. Sethy

Dietary Preference of Euphlyctis Cyanophlyctis Tadpoles in Different Habitats in and Around Similipal Biosphere Reserve, Odisha, India

[Abstract] [Full Article - PDF] pp. 259-268

Amphibian tadpoles are the key consumers and play an important role in the food chain of aquatic ecosystems. Understanding the natural diet of tadpoles can help in developing management strategies for them. We characterized the diet of 170 Euphlyctis cyanophlyctis tadpoles collected from 34 sites during rainy seasons (July to October) of 2014 and 2015 in different temporary habitats in and around Similipal Biosphere Reserve, India. After morphometric measurements (total length, body length and body width), the complete intestine of each tadpole was analyzed for food items and quantified based on the numeric frequency (NF %) and frequency of occurrence (FO %). The food spectrum of tadpoles included mostly detritus followed by phytoplanktons (represented by 6 classes and 55 genera). The food items ingested were similar in all the habitats, suggesting that they are non-selective predators that lack an apparent dietary preference, and their diet is mostly dependent on the availability of food items. Knowledge of food habits and feeding behaviour of the tadpoles is essential, since the early part of the life history of amphibians is dependent on the availability of the food items in the natural habitat.

Keywords: Similipal Biosphere Reserve; Euphlyctis cyanophlyctis; Tadpole; Diet; Phytoplankton.

C.K. Rohini, T. Aravindan, K.S. Anoop Das, P.A. Vinayan

Peoples' Attitude Towards Wildlife Conservation In Kerala Part of the Western Ghats, India

[Abstract] [Full Article - PDF] pp. 269-280

High population densities around conservation areas demand strategies for balancing conservation goals and livelihood needs. Management of conservation issues and conflicting interests

among stakeholders in such areas can be achieved by exploring the attitude of residents towards wildlife and its conservation. Although a substantial body of research analyses local resident's attitude towards conservation challenges around protected areas, very scanty information is available on the attitude towards areas with less categories of protection status. Hence, an attempt was made to understand people's attitude towards conservation issues, in the fringe villages of North and South Forest Divisions of Nilambur, Kerala, India. A questionnaire survey was administered to 158 residents in five villages during the year 2014 to 2015. Responses were differentiated under different categories of gender, literacy status, age, occupation, and landholding size. The majority of respondents supported wildlife conservation, provided that there is no associated cost. The attitude towards forest protection staffs were largely positive. An improved system of participatory level conservation programs will probably reduce antagonistic ambience between forest protection staffs and villagers to a great extent thereby enhance people's tolerance towards conflict-causing wildlife, and thus facilitate conservation. Socioeconomic characteristics of residents provided some sort of explanation for the distribution of conservation attitude. These differences should be taken into consideration while designing and implementing any policies. People will support conservation of wildlife and natural systems if their problems are effectively addressed.

Keywords: Attitude; Conservation; Conflict; Nilambur; Kerala; Western Ghats; Wildlife; Management

U.H. Goursi, M. Kabir, A. Mehmood

Occurrence of Russell's Chain Viper Daboia Russelii Russelii in Deva Vatala National Park, Azad Jammu and Kashmir

[Abstract] [Full Article - PDF] pp. 281-288

The Russell's chain viper is being reported for the first time from Deva Vatala National Park, Azad Jammu and Kashmir (AJ&K) during surveys conducted from August 2011 to March 2012. The study area falls under dry sub-tropical region. The species is distributed in all the four selected sites of National Park over an area of about 7.2 km2. Distribution was determined through direct observations as also used indirect evidences (crawling signs, molted skin, burrow surveys etc.) in its habitat using sign survey. Occurrence and terrain examined which revealed that Vipers'

prefers gradual slopes (70%), as compared to steep slopes (12%) and flat areas (18%). The data on morphometric measurements were also recorded from two collected live specimens of Russell's chain viper along with photographs. There is a ruthless killing of this snake by local people mainly out of fear (39%) which is the major threat to its population as compared to others i.e, illegal trade for their fine skin (10%), venom collection for medicinal purposes (5%), roadside killings (11%), habitat degradation including encroachment, developments and segmentation (22%) and lack of awareness (13%). The present study during 2011-2012 not only confirms the presence of Russell's chain viper presence in Deva Vatala National Park but also highlighted the threats to study species.

Keywords: Distribution; Threats; Fauna of DVNP; Reptiles; Russell's chain viper; Dry sub-tropical region

S. Utami, S. Anggoro, T.R. Soeprobowati

The Diversity and Regeneration of Mangrove on Panjang Island Jepara Central Java

[Abstract] [Full Article - PDF] pp. 289-294

Panjang Island is a small island under the administrative territory Jepara Regency, Central Java Indonesia. Small islands, such as Panjang, have been vulnerable to changes and environmental pressures. Because of their natural resources and fragile nature, the existence of small islands is necessary to be protected and ensured. Mangrove is a vegetation with a function to protect the coastal ecosystem. Its regeneration status will determine the sustainability of the ecosystem. This study aimed to assess mangrove species diversity and mangrove regeneration on Panjang Island. The site research was determined by purposive sampling. Research sites were four stations located in the southern, eastern, northern, and western part of the island. Each station occupied with three plots measuring 20 × 20 meters for tree stage, 5 × 5 m for sapling and 1 × 1 m for the seedling stage. Data was calculated according to important value index (IVI), diversity index (H') and the evenness index E . In Panjang Island, 7 true mangrove and 7 mangrove associated species have been found. The dominant true mangrove was Pemphis acidula, whereas the dominant mangrove associate was Thespesia populnea. The diversity index mangrove species (H') is between 1.28 – 1.82. The mangrove regeneration in Panjang Island did not take place

appropriately, as indicated by the number of individual saplings (57 individuals/Ha) < number of individual seedlings (191 individual/Ha) < number of individual trees (274 individuals/Ha). There were two important tree species in Panjang island, Pemphis acidula (Stigi) with Least Concern status according IUCN, and Excoecaria agallocha. Both species require protection. The study recommended a mangrove reforestation with local species in order to obtain the sustainability of coastal ecosystem in Panjang Island.

Keywords: Small island; Diversity; Sustainability; Regeneration; Important Value Index (IVI).

M. Kabir, M. Waseem, S. Ahmad, U. Hafeez, M.N. Awan

Livestock Depredation by Leopard. An Alarming Intimidation for its Conservation in Pir Lasoora National Park Nakial, Azad Jammu And Kashmir

[Abstract] [Full Article - PDF] pp. 295-302

The threat posed by leopards to livestock and human lives makes their coexistence difficult. Mitigation measure should be based on an unequivocal understanding of the conflict patterns. Household surveys were conducted with an intention to quantify livestock losses and its effects on leopard conservation in the Pir Lasoora National Park. The questionnaire survey revealed a total of 72 livestock killed, equated to an annual loss of 4324.50 US$. Among the domestic animals, goats were killed significantly ($p<0.05$) in higher number. Young and female stocks were more vulnerable to leopard attacks. Forests were the preferred killing sites, and night time killing was more frequent than during other periods of the day. Seasonal killing and attacks were also observed, both attacks and killing in June showed significant ($p<0.05$) difference from other months of year. Results revealed the massive economic loss, which inevitably resulted in retaliation against 17 leopards since 2000 in the region. Habitat degradation and depletion of natural prey are more striking factors driving leopard populations to local extinction form the study area. Our results iterate the need of an awareness program, the implementation of collaborative insurance schemes, and the involvement of the local community in order to modify the negative perception towards the conservation of the leopard.

Keywords: Panthera pardus; Livestock depredation; Conservation; PLNP; AJ & K.

G. Murariu, V. Hahuie, A.G. Murariu, L. Georgescu, M.A. Calin, D. Buruiana, I. Soare, M. Onica, G.B. Carp

Growth Rate Modeling for White Poplar in the South Eastern part of Romania: An Important issue of Forrest Conservation

[Abstract] [Full Article - PDF] pp. 303-316

Nowadays, the process of monitoring forested areas is a national requirement. The importance of forests in mitigating climate change is well known. On the other hand, the economic aspects of forest management are important too. From this point of view, inventorying and assessing the growth and yield rate of wooded areas is extremely important. Estimating growth rate per hectare unit and production level of forested areas in order to obtain and accurate inventory is important in determining the supply of wood. The present paper is based on the evaluation after 6 growing seasons. The sectors monitored are located along areas of relatively low elevation (280–450 m). The climatic gradient can also be neglected because of the character of the studied areas. The research was carried out in the southeastern part of Romania. The entire complex comprises 375 forested tracts. Only for white poplar we have included a set of 36 carefully selected forest sectors. The study's timespan was between 2010 and 2015, and data from the field have been used. The case study presented is white poplar, and the methods used are shown in a comparative way. Technological factors like consistence, density, etc. were carefully evaluated on the basis of direct observations and measurements. The recorded data were subsequently validated. The computer analysis, used on different optimization methods, was selected from the most employed series in the dedicated literature. Our results indicated that: (1) the evaluations of the estimated growth rate of production can be vary significantly when employing different statistical analysis and numerical methods; (2) by using numerical optimization models, the computer simulations can provide accurate estimates of the growth rate and, hence, the efficiency for a given forest inventory; (3) common numerical interpolation methods or neural network uses that do not always give consistent results. The specific numerical methods are preferable for a better assessment of the growth rate and existing inventory; and (4) investments in computer simulation methods and software should be encouraged in order to successfully reach a permanent inventory, to improve the efficiency of the logging operations, and to support environmental protection.

Keywords: Growth rate; Numerical approach; Statistical analysis; Interpolation method.

N.C. Pandey, D. Bhatt, D. Arya, B.M. Upreti, N. Chopra, G.C. Joshi, L.M. Tewari

Patterns of Agro-Diversity with its Socio-Economic Uses at Gagas Valley, Almora, Kumaun Himalaya

[Abstract] [Full Article - PDF] pp. 317-324

A large population (70%) of the Kumaun Himalayan region is largely depended on agriculture for its livelihood. In this community, various conventional crops and their associated cropping methods have prevailed for ages. The resulting agro-biodiversity systems are responsible for maintaining soil fertility, as well as a series of varied socio-cultural and religious rituals. But less emphasis, poor scientific understanding, and related socioeconomic issues, have gravely encumbered the recognition of solutions for a sustainable agricultural development in the Himalayan region. Currently, the policies have taken into consideration the importance of appropriate technologies, which can play a key role in coping with the uncertainties prevailing in the Himalaya and therefore have stressed the need for on-site training and capacity building of user groups in rural areas of the region. There is a vital need to fetch viable changes in the agricultural policy, research, land use and breeding approaches in reference to mountainous regions. The present paper describes patterns of agro-diversity with its socio-economic uses in the Gagas Valley, Kumaun Himalaya with some policy dimensions, and strategies for management of the agroecosystems.

Keywords: Agro-diversity; Mixed cropping; Conservation; Indigenous knowledge

R.P. Varela, G.A.A. Garcia

Arthropod Recolonization in Rehabilitated Mined-Out Nickel Mines in Surigao Province, Philippines

[Abstract] [Full Article - PDF] pp. 325-332

Arthropods inhabiting the soil and litter are eliminated during mine extraction particularly in nickel mining. In this operation, the topsoil and the associated vegetation are stripped off. Planting of

Mangium (Acacia mangium) and Agoho (Casuarina equisetifolia) is generally done to rehabilitate the mined-out areas in Caraga Region, Philippines. To monitor the ecosystem restoration in rehabilitated sites, the recolonization of arthropods was assessed. Sampling was conducted in sites where C. equisetifolia and A. mangium are planted and in the newly introduced ecobelt. In the 4-year old and 10-year old C. equisetifolia planting at Hinatuan Mining Corporation, arthropods have started to assemble in the soil and litter. In these sites, species of ground beetles, true bugs and ants are present, with the red ants predominating. In 1-year old C. equisetifolia, none was sampled yet since the litter fall is still very thin and the soil is not yet favorable to harbor soil-inhabiting arthropods. In the ecobelt where 1-year old mixed planting of tree and flowering plant species at Hinatuan Mining Corporation, 7 species of arthropods were collected. In Taganito Mining Corporation, soil-dwelling beetles, true bugs, flies and springtails have been collected from the rehabilitated sites. In the 1-year old ecobelt at Taganito Mining Corporation, only species of red ants and staphylinid beetles were collected. The copious growth of the nurse trees in areas rehabilitated for 4 years and older and in the ecobelt provided partial shading that possibly modified the microclimate that attracted the arthropods.

Keywords: Recolonization; Arthropods; Mine rehabilitation; Nickel mining; Ecobelt

R.S. Sai Murali, G. Nageswara Rao, R. Basavaraju

Looking Through the Lens of a Conservation Biologist: Life of Medicinal Plants in the Eastern Ghats of Andhra Pradesh, India

[Abstract] [Full Article - PDF] pp. 333-347

Plants have been used by people to fulfil their spiritual, cultural, emotional and materialistic needs. In quest of using plants, man has forgotten the implications of overexploitation of these resources. Hence the question of restoring the balance has long been intriguing the conservation biologists. In this review we focus on the struggle of medicinal plants in the Eastern Ghats (EGs) of Andhra Pradesh (AP) in the changing scenario of overexploitation and destruction of natural habitats. Here we concentrate on a sum total of 267 medicinal plant taxa from these regions with due emphasis on their utility as leading herbal medicines. Endemic flora and the threat status of medicinal plants from this area are highlighted in this paper. Andhra Pradesh, so far, has been

successful in having one biosphere reserve, six national parks and twenty one wildlife sanctuaries with over 13,000 sq km of forest cover, but there have been no proper scientific studies undertaken till date to evaluate the working and maintenance of these protected areas. As EGs of AP have received less attention from the Government and NGOs, the analysis of past research reports in this review gives a clariant call for a much awaited coordinated effort for conservation and management of plants in these areas. Furthermore, we stress on having a formal system to monitor the local pockets of these hilly ranges for a better coordinated conservation mechanism. This review is a humble attempt to give a wakeup call to all the policy makers, managers and other government officials working with protected areas and forest departments. The diversity of medicinal flora, uses and conservation priorities of Eastern Ghats of Andhra Pradesh form the subject matter for this review.

Keywords: Medicinal Plants; Threat Status; Conservation; Ethnomedicine; Aboriginals; Eastern Ghats

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GO UP

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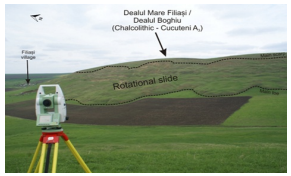
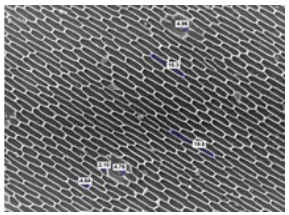
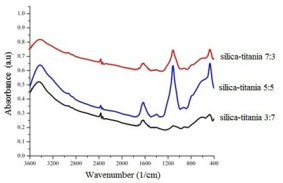
Issue Cover

Research articles

Salt crystallisation is a major cause of deterioration of porous building materials, strongly related to the fluctuation of the environmental parameters. This paper explores the application of different methodologies to assess the potential damage caused by soluble salts to a series of sixteenth century frescoes with the thermo-hygrometric variations. The method of counting the transition cycles for six crystalline systems, the thermodynamic model ECOS for mixed salt solutions and a combination of both







methodologies were used, in order to evaluate and compare these different approaches and to determine the risk of salt decay for this particularly sensitive case study. To this end, the temperature and relative humidity in the churches housing the wall paintings were monitored during a year and the salt content of the frescoes analysed. The seasonality of the salt crystallisation was studied and the range of relative humidity at which the transitions occurred determined. All methods identified a significant risk of salt decay, mainly related to the crystallisation of chlorides and nitrates, which corresponds well with the observations in situ. Finally, the advantages and inconveniences of each method were discussed, along with the results obtained in other published works, and the combined method was suggested as the most efficient

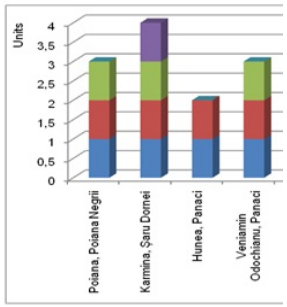
Keywords: Salt weathering; Risk assessment; Environmental monitoring; Wall paintings; ECOS; Transition cycles count

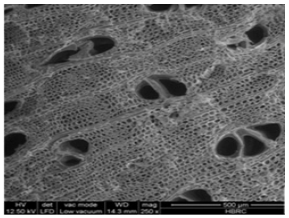
F. Gao, Y. Qi, W. Zhou, S. Liu

Evaluation and Formation Mechanism of Surface Contaminants and Stratification on the Rock Paintings of Huashan Mountain (Guangxi, China)

[Abstract] [Full Article - PDF] pp. 365-374

The Rock Paintings of Huashan Mountain dated back from ~1620 to ~4800 years ago provide clear and definite information on the history of ancient Luoyue people. Investigation shows that a great amount of water drops attached to the rock surface combining with dusts resulted in the formation of mud wrapping layers covering the rock paintings. Yellow thick and dense calcium based stratification on the limestone due to the karst water seepage are very commonly observed as well. Both are main factors that are ascribed to the spallation of the rock painting from the limestones. Combining with on-site and laboratory measurements using SEM with EDS, X-ray diffraction, portable XPS, and stereoscopic microscopy, this work aims to characterize the mud wrappings and dense calcium based stratification on the surface of the rock painting and clarify the underlying mechanisms that cause a large scale of spallation on the rock paintings, a phenomenon that has to be resolved or retarded urgently. This work allows the execution of specifically directed conservation strategies and chooses the most appropriate cleaning technique. Especially, it has provided a





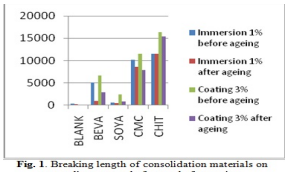
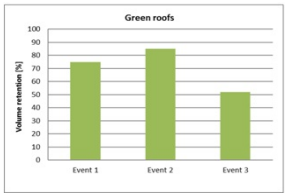
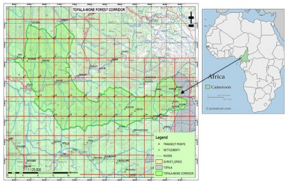
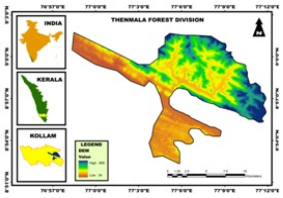


Fig. 1. Breaking length of consolidation materials on cotton linter paper before and after ageing.







solid technological support to the restoration project conducted from 2010 to 2013.

Keywords: Cultural heritage; Limestone monuments; Rock paintings; Surface stratifications

I.C. Nicu

Natural Hazards – A Threat for Immovable Cultural Heritage. A Review

[Abstract] [Full Article - PDF] pp. 375-388

This study presents a review of how natural hazards can impact on immovable cultural heritage (ICH). In the last few decades, the global impact of natural hazards on cultural heritage appears to be growing, which in part, may be a response to the changes in the intensity and frequency of geomorphological processes in the light of climate and environmental change. Research undertaken at present by geographers, geologists, archaeologists, conservationists, and other specialists, shows significant interest in the protection, assessment, and mitigation of natural risk phenomena on ICH. However, attempts of evaluating the present state, and to predict the future degradation of cultural heritage is a real challenge. A review of the published literature indicates that the emergence of studies focused on the degradation of ICH by natural hazards started approximately 40 years ago, with an increasing trend starting from early in the 21st century; Europe is the most studied area globally. These studies demonstrate that conservation measures need to be implemented to protect and prevent further degradation of the world's cultural heritage, to preserve a legacy for future generations.

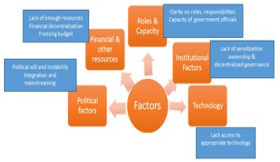
Keywords: Immovable cultural heritage, Natural hazards, Mitigation, Conservation.

M.R. Singh, S.V. Kumar

Multi – Analytical Characterization of XVII Century Mughal Glaze Tiles from Northern India

[Abstract] [Full Article - PDF] pp. 389-400

Glazed tile art work is a technique that has been employed for decoration in most of the Mughal monuments during 16 – 17th Century in India. Dakhni Sarai is one of the finest and best



preserved specimens of Mughal caravan sarais from India. Glaze tile samples of Dakhni Sarai were analyzed for glaze segments and colours that were used during the Mughal era. The samples were studied using stereomicroscopic analysis, EMPA – WDS, SEM - EDX and by thermal analysis using DTA/TGA. The EMPA-WDS results indicated the usage of lead colorants – tin for yellow glazes, copper - cobalt for blue glazes, and a mixture of two for green glaze tiles. The thickness and slip fusion of the tiles with the inner have also been studied. The result showed that oxides of copper/cobalt/lead used as colorant in varied proportion have imparted color to the glaze under different firing environment and temperature. The presence of copper/cobalt could be either due to its deliberate addition as part of the manufacturing process or as traces in raw material. The results proved that the manufacturing techniques of 16th century Mughal galze tile art work show resemblance to contemporary Persian tile works.

Keywords: Glazed tile; Colorant; Vitrification; Quartzite; Sillimanite; Firing environment; EPMA.

M. Afif, Mahirta

The Effectiveness of Sansevieria Trifasciata Cuticle Isolation to Protect Cultural Heritage Objects against Weathering caused by Rainwater

[Abstract] [Full Article - PDF] pp. 401-410

This research discusses the use of Sansevieria trifasciata as a natural water repellent for andesite and brick materials. Most of the outdoor cultural heritage objects are made of andesite and brick materials and are subject to disaggregation caused by rainwater. The decision to choose to isolate the cuticle of Sansevieria trifasciata based on knowledge that cuticle on plant can become water repellent on the plant and its availability is abundant in Indonesia. The authors isolated the cuticle of Sansevieria trifasciata for coating surface of andesite and brick materials and created an alternative solution by using natural substance against weathering of cultural heritage objects. The result shows that the cuticle isolation can effectively prevent the absorption of water on andesite but it cannot prevent absorption of the brick material. Although it's effective to reduce water absorption for andesite, cuticle isolation has changed the surface colour of andesite and brick materials. Referring to the principles of cultural heritage management, cuticle isolation has changed the

authenticity of the material. Therefore, in the future, more research is needed to achieve the transparent color of cuticle isolation before being applied to cultural heritage objects.

Keywords: Andesite; Brick; Coated; Cuticle; Rainwater; Sansevieria trifasciata, Weathering

A.A. Widati, A. Abdulloh, M. Khasanah, R. Kusumawati, N. Cahyandaru

Fabrication of Silica-Titania as Consolidant and Self Cleaning for the Conservation of Andesite Stone

[Abstract] [Full Article - PDF] pp. 411-418

The composites of silica-titania that have consolidant and self-cleaning property have been synthesized by mixing titania and colloidal silica. The coating of stone using silica-titania could improve the mechanical properties of andesite stone. In addition, the coating created the superhydrophilic properties and similar visual appearance with untreated andesite. The self-cleaning performance of treated andesite could remove the 92% of congo red and 67% of methylene blue as staining agents through photocatalysis process.

Keywords: Colloidal silica; Titania; Consolidant; Self-cleaning; Andesite

C.R. Vintu, I.N. Alecu, A. Chiran, E. Leonte, A.F. Jitareanu, M. Stefan

Researches on the Agrotouristic Offer of Guest Houses in Dornelor Bassin (Case Study)

[Abstract] [Full Article - PDF] pp. 419-430

Sustainability in the rural area of the Romanian economy is closely linked to the possibility of meeting the consumption needs of the population through a growing, permanent, diversified and high-quality offer, in line with current and potential consumer needs. The agrotourism offer targets a certain segment of the population (tourists), being represented by both material elements (food, non-food goods), but above all, by agrotouristic services, which comprise a wide range of activities. Agrotourism is a form of rural tourism, being closely related to the agrotouristic household, which is based on the existing resources in rural areas (agricultural, touristic, human, economic). Agrotourism includes both basic tourist activities (accommodation, tourist hiking, basic

tourist services such as catering and accommodation) and additional services, plus a series of agricultural activities (plant cultivation, livestock breeding), as well as the processing of agricultural raw materials within the households (agrotourist guest houses) and the capitalization of finished products, both to the tourists accommodated in the guest house and to the markets and fairs in the area. The research was carried out in Dorna Basin and covered 35 touristic and agrotouristic guest houses, of which 11 which own agricultural land (arable, natural pastures, natural meadows) and animals (cattle, pigs, poultry) were selected. The research had an applicative character and was based on a questionnaire, which was administered to a panel of 11 boarders of agro-touristic guest houses located in the Dornelor Basin. The work has an original character, being the result of own research by the authors.

Keywords: Agrotourism; Tourism offer; Sustainability; Service quality; Dorna Basin; Romania

M.E. Osman, A.A. El-Shaphy, M.M. Ayid

Evaluation of the Inhibitory Effect of Dimethyl Sulfoxide on Fungal Degradated Archaeological Wood

[Abstract] [Full Article - PDF] pp. 431-440

Fungi play a very important role in deterioration of ancient wood antiques and therefore must not be neglected due to the increasing aesthetic value of art objects as well as the impact on health of conservators. A number of chemicals have been used for the treatment of museum artefacts. Biocides are the most effective at eradicating spores and mature organisms. Dimethyl sulfoxide (DMSO) is frequently used as a solvent for anti-fungal drugs. This study was carried out to evaluate in vitro and in vivo antifungal efficacy of DMSO against Aspergillus parasiticus. In vitro, fifty percent of DMSO gave complete inhibition of the growth. Also, 25% of DMSO inhibition growth by 60%. On the other hand low concentrations of DMSO were less effective. In vivo studies, treatment with DMSO on biodeteriorated sycamore wood resulted in inhibition of fungal growth. Furthermore, the application of DMSO had no effect on the colour, structure and chemical characteristic of the wood as well as, DMSO removed extraneous wood components that easily dissolve in DMSO.

Keywords: Biodeterioration; Wood treatment; Biocides; DMSO; Aspergillus parasiticus.

A.M. Rushdy, W.N. Wahba, M.S. Abd-Aziz, M. El Samahy, S. Kamel

A Comparative Study of Consolidation Materials for Paper Conservation

[Abstract] [Full Article - PDF] pp. 431-452

Historical paper is an essential part in cultural and economic progress of humanity.So, this study is to improve the physical-mechanical properties and stability of the brightness of historical paper by evaluating some consolidation materials, carboxymethyl cellulose, chitosan, BEVA 371, and soya bean flour, and to show the changes in paper properties, resulting from thermal accelerated ageing. Analytical techniques used for the evaluation process were pH measurements, tensile strength, burst strength,color change, and scanning electron microscopy (SEM). Also AgNP is deposited by the in situ reduction of silver nitrate on the treated paper sheets in the presence of citrate molecules as stabilizing agent. Antimicrobial activities of the paper sheets were also investigated against Gram positive bacterium Staphylococcus aureus, Gram negative bacterium Pseudomonas aeruginosa, yeast Candida albicans, and fungal Aspergillus niger which are model microorganisms for testing bactericidal properties. The result pointed out that chitosan and carboxymethyl cellulose lead to a significant improvement of the paper mechanical properties and AgNP containing papers gave an improvement as antimicrobial for all the consolidation materials.

Keywords: Paper conservation; Consolidation; Chitosan; Carboxymethyl cellulose; BEVA 371; Soya beans flour; Thermal ageing; Silver Nano-particles; Antimicrobial.

S. Sanchez-Sabau, M. Sabau, L. Montero, J. Gonzalez-Coneo, A. Abellan, C. Osorio

A Look to the Sustainable Draining Systems: Criteria of Sustainability and Successful Cases

[Abstract] [Full Article - PDF] pp. 453-464

There have been many studies and research that address sustainable drainage urban systems (SUDS), where factors like costs or the zone where a SUDS is to be installed are determinant, so multicriteria studies are important in decision-making. The development of a multidisciplinary approach could in the future

serve as a helping tool to support decision, whose purpose would be to guide users in their choice of the most appropriate solution for managing the collection of rainwater. Another key point is to make use of other strategies to accurately define the most appropriate SUDS for a particular location. Modelling for example, considers different factors to simulate real-time rainfall events and evaluate the performance of rainwater collection systems among other low impact development systems. Based on what has been stated above, some successful cases currently performed all over the world were studied, where it is evident that green roofs can retain between 70% and 100% when rainfall is not high and peak reduction on these may reach 83.3%. Concrete and porous asphalt mixtures differ in their behaviour, but even so, they can maintain over time an average permeability between 0.41 cm/s and 0.22 cm/s, and similar values in the reduction of the infiltration capacity of 79.43% and 82.04% respectively.

Keywords: SUDS; Urban drainage; Low impact development; Rainwater; Green roofs; Permeable pavements.

N.B. Che, M.F. Nkemny, E.T. Atem, R. Giliba

The Correlation between Bushmeat Harvesting and Wildlife Abundance in the Tofala-Mone Forest Corridor, Cameroon

[Abstract] [Full Article - PDF] pp. 465-474

The use of sophisticated tools and unconventional methods in wildlife exploitation is a threat to wildlife conservation. This study analysed the influence of bushmeat harvesting on wildlife abundance in the Tofala-Mone Forest Corridor (TMFC), Cameroon. Data were collected across 8 villages using semi-structured questionnaires, in-depth interviews and transect survey. Descriptive and inferential statistical analyses were used for quantitative data while content analyses were used for qualitative data. The key finding revealed that the main reason for bushmeat harvesting was for income generation. Agriculture, large family sizes and motivation were some of the factors influencing harvesting. An average of 16.0 ± 2.0 animals was harvested weekly per harvester, giving an annual average of 272.8901tons per harvester. Annual bushmeat harvested stood at 2,665,156 Francs CFA (5,330 US Dollar) per harvester. Most harvesters (97.3 %) reported a decrease in wildlife abundance. Hunting time per catch was reported to be about 3.48 hours compared to lesser time in the past. A negative correlation was obtained between

harvested wildlife species and scarce wildlife species. This suggested that bushmeat exploitation was a major threat to wildlife abundance in the study areas.

Keywords: Bushmeat harvesting; Wildlife abundance; Biodiversity conservation; Wildlife management; Household income; Cameroon.

H.S. Veena, R.S. Ajin, A.M. Loghin, R. Sipai, P. Adarsh, A. Viswam, P.G. Vinod, M.K. Jacob, M. Jayaprakash

Wildfire Risk Zonation in a Tropical Forest Division in Kerala, India: A Study using Geospatial Techniques

[Abstract] [Full Article - PDF] pp. 475-484

The forests of the Western Ghats in India are often affected by wildfires. Such forest fires are potential hazards seriously damaging the environment. Wildfire occurrence in an area is influenced by environment, terrain, and climatic conditions, alongside with human activities. The records on previous forest fire data show that the present study area is also prone to fires. The present study aims to delineate and map wildfire risk zones in Thenmala forest division, a part of the Western Ghats, using Remote Sensing (RS) and Geographic Information System (GIS) techniques. Factors such as land use/land cover (LU/LC) type, slope, aspect, distance from settlement, distance from road, and elevation are selected for this study. All these factors have direct or indirect influence on fire occurrence. A Modified Fire Risk Index method has been used to prepare the fire risk zone map. The prepared fire risk zone map of Thenmala forest division has classified the area into five zones viz., very low, low, moderate, high, and very high. Finally, the risk zone map is validated with the fire incidence points, which shows that 75% of the fires have occurred in the high and very high risk zones. This shows the effectiveness of the present methodology and can be used for entire Western Ghats region. The study shows that the majority of fires are induced by humans. The officials of the forest departments can use this risk zone map to easily locate areas under high and very high fire risks and take effective preventive and mitigation measures. This can reduce loss of life and precious forest wealth.

Keywords: Wildfire; Modified Fire Risk Index; Incidence points; Western Ghats

S.K. Maharjan, K.L. Maharjan

State of Climate Policies, Plans/Strategies and Factors Affecting its Implementation in Nepal

[Abstract] [Full Article - PDF] pp. 485-496

Climate change is a complex and cross-cutting issue in Nepal that needs joint initiatives and efforts from all sectors at all levels to minimize its impacts. The government has developed climate policies, plans and frameworks – NAPA, National Climate Change Policy, LAPA and now in the process of developing National Adaptation Plans (NAPs). This paper has explored the views and experiences of climate experts in Nepal on state of climate policies, its inter-linkages, roles and responsibilities of ministries and departments, important factors to be considered and subjective indicators for effective implementation of policies. Altogether 30 experts responded the questionnaire sent via the email, LinkedIn and Skype Interview. The experiences of the experts' ranges from 2 to 30 years in the field representing government and non-government sectors including media and independent experts. The policies in Nepal are progressing in more strategic direction with national and local priorities. LAPA is the framework to address the local climatic issues originated in Nepal. However, lack of clarity on roles and responsibilities and coordination among the ministries, departments and clear mechanisms for implementation of these policies, lack of sensitization and decentralization and delegation of finance and technologies and capacity of the stakeholders are the major challenges.

Keywords: Climate policy; Nepal; NAPA; LAPA; Climate experts

M.N. Tamalene, M.H..I. Almudhar

Local Knowledge of Management System of Forest Ecosystem by Togutil Ethnic Group on Halmahera Island, Indonesia: Traditional Utilization and Conservation

[Abstract] [Full Article - PDF] pp. 497-508

Logging and industrial mining have brought rapid change to the functions of forests. This also occurred on Halmahera Island,

Indonesia. The Togutil ethnic group who lived in the Halmahera forest, especially in Buli village, had lost their local practical knowledge related to traditional forest conservation. This was due to the existence of nickel mining in their indigenous forest area. The study location was an area far from mining activity; therefore, local knowledge-based forest conservation practice could still be found. Research results show that the Togutil ethnic group on Halmahera Island, especially in the Akelamo and Oba, Tidore Kepulauan areas, had local knowledge of traditional forest ecosystem management through the classification of forest areas where there existed zones of food and medicinal plants, hunting, plantation and settlements, bird habitats, taboo, and watersheds. The classification of forest areas through a zone system was a conservative practice of biodiversity by maintaining local tradition.

Keywords: Local knowledge; Forest ecosystem management; Biodiversity; Togutil

O.S. Dairo, O.J. Soyelu

Consequences of Prolonged Agronomic Practices: Faunal Composition and Abundance in Cultivated and Fallowed Soils

[Abstract] [Full Article - PDF] pp. 509-518

Composition and abundance of soil fauna were compared between continuously cultivated and fallowed soils with a view to determining the impact of prolonged agronomic activities on biodiversity. The cultivated soils had been under continuous use for over a decade for arable crop production whereas the fallowed soils had been undisturbed for about twenty years. Soil samples were collected from selected plots using a soil auger and standard methods were applied in the laboratory to extract different types of soil fauna. Pitfall traps were also set up in the plots to collect surface-dwelling arthropods. Members of three phyla were identified in the study, namely, Annelida, Arthropoda (Class Arachnida, Chilopoda, Diplopoda, Entognatha, Insecta, Malacostraca, Pauropoda) and Nematoda (Class Adenophorea, Enoplea, Secernentea, Tylenchoidea). Nematodes were the most abundant fauna (50.7%) in sampled soils followed by Collembola (Entognatha) (15.2%) and Acari (Arachnida) (12.3%) while Pseudoscorpionida (Arachnida) (0.1%) was the least abundant. Generally, fallowed soils were significantly richer in soil fauna compared to cultivated ones. It was concluded that agronomic practices, especially on a continuously-cropped soil, would have a

negative impact on faunal biodiversity. Environment-friendly farming systems that entail minimum tillage of the soil, adoption of non-chemical pest control strategies and regular soil tests were suggested as viable ways of conserving faunal biodiversity.

Keywords: Biodiversity; Minimum tillage; Non-chemical pesticides; Soil fauna; Species abundance.

N. Mohammed, K.S. Goudar, G. Getachew, H. Ibrahim

Human - Wildlife Conflict: Intensity of Domestic Damage Caused by Wild Animals Around Yegof National Forest Priority Area, South Wollo, Amhara Region, Ethiopia

[Abstract] [Full Article - PDF] pp. 519-528

Damage manifestations in terms of crop damage and livestock depredation are common in Ethiopia and reporting of such domestic damage in the vicinity of Yegof National Forest Priority Area was achieved by collecting information using the pretested semi-structured questionnaire from November 2013 to May 2014. The anubis baboon (Papio anubis) and grivet monkey (Chlorocebus aethiops) were identified as major crop pests and maize crop was more vulnerable than other crops. Increase in population of crop raiders was perceived reason for crop damage. Guarding was the best believed mitigation strategy. Though the informants lack remedial measures, some alternative was suggested to minimize primates through displacing them to other areas and remove them completely. Leopard (Panthera pardus) and striped hyaena (Hyaena hyaena) were reported as major predators of livestock and both accounts for a loss of 1,993 domestic animals, hitherto. Despite this loss, most of the informants had positive attitude. In conclusion, the study area demands for sustainable and culturally acceptable conservation solutions to mitigate domestic damage.

Keywords: Attitude; Crop damage; Human-wildlife conflict; Livestock predation; Local community; Yegof national forest priority area.

B. Subbaiyan, M. Visveshwari, V. Thangapandian

An Efficient Indirect Regeneration and Multiple Shoots Formation from Nodal Explant of Ceropegia Juncea Roxb.

[Abstract] [Full Article - PDF] pp.529-536

An effective protocol has been developed for indirect shoots regeneration from nodal explant of C. juncea. Explants were cultured on MS medium inclusion with alone 2,4-dichlorophenoxyacetic acid (2, 4-D), Thidiazuron (TDZ) or in combined with concentrations of 6-benzylaminopurine (BA) and Kinetin (KN) for callus induction. The best response (73.5%) was observed from nodal explants on MS medium 0.5mg/L 2,4-D in combination with 0.05mg/L BA.Thecalli derived from nodal explants were subcultured on MS medium supplemented with BA in combination with NAA or IAA for shoot induction. The more number of shoots (5.37) and shoot length (6.13cm) was observed on MS medium supplemented with 1.0 mg/L BA with 0.10mg/L NAA of shoot regeneration in nodal derived callus. Nodal callus derived microshoots gave the highest rooting percentage (77.9%), root numbers (9.75) and length of roots (5.32 cm) were observed on half strength MS basal medium Inclusion of 0.5 mg/L IBA. Regenerated plantlets with well-developed shoots and roots successfully transferred to soil. This protocol could be useful for conservation and cultivation of C. juncea.

Keywords: Ceropegia; Node; Callus initiation; 2,4-dichlorophenoxyacetic acid.

N.H. Nik Raikhan, A.R. Khairul Izwan

Novel Treatment of Heavily Oiled Wastewater using Pseudomonas Aeruginosa Nr.22 Producing Usable Free Fatty Acids (FFA)

[Abstract] [Full Article - PDF] pp. 537-544

Heavily oiled wastewater treatment has been great challenge to engineers to accomplish. Since there are too many water bodies are polluted with oil, chemical treatment could still give lots of negative side effects. We are recommending discharging the oil using our novel microbial approach. The strain Pseudomonas aeruginosa NR.22 (Ps.NR.22); an extracellular lipase producer isolated from a polluted lake in Malaysia has been proved to remove different oils from heavily oiled-wastewater with 59.0g/L oil concentration to about 70% lower in lesser than 48 hours with the addition of local source, mix grade 9.1g/L nitrogen compose. We measured the excess of oil using the standard Gravimetric method. Study of the factors affecting the percentage of oil removal have resulted 45°C as the best temperature, 200rpm shaking rate and 11% (v/v) 24 hours inoculum with

5.0x105cells/mL. Lipase activity were significantly high and go all along with the values of oil removed. Oil removal was recorded excellently high using combination of the best parameters; valued of 92.8±0.01% removed oil with lipase activity about 29.8±0.08U/mL and a very positive sign of growth through biomass of 6.0±0.1g/mL. FTIR was used to study the oil characterization in the wastewater before and after the treatment and the finding supported the lipase-oil removal Gravimetric report where oil was cut to simpler C-C bonds to 6 different types of free fatty acids (FFA), confirmed using GC-MS as lauric acid (C12:0), myristic acid (C14:0), palmitic acid (C16:0), linoleic acid (C18:2), oleic acid (C18:1) and caprylic acid (C8:0). All of the listed FFA has great potential for biodiesel production.

Keywords: Pseudomonas aeruginosa NR.22; Oil; Wastewater; Lipase; Free fatty acid (FFA)

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GO UP

Volume 8, Issue 4, December 2017

Issue Cover

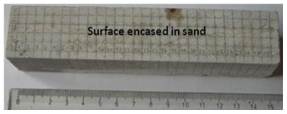
Research articles

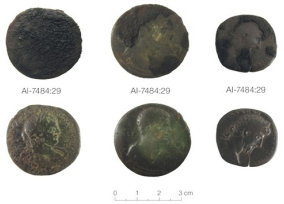
F.C. Izzo, C. Zanin, H. Van Keulen, C. Da Roit

From Pigments to Paints: Studying Original Materials from the Atelier of the Artist Mariano Fortuny Y Madrazo

[Abstract] [Full Article - PDF] pp. 547-564

We present the first study related to the painting materials used by Mariano Fortuny y Madrazo (Granada 1871 - Venice 1949). This eclectic artist, whose activities ranged from photography to painting, produced his own tempera colours Tempere Fortuny. His atelier in Palazzo Pesaro degli Orfei in Venice still conserves several kinds of painting materials employed in different stages of paint manufacture: from raw colourant materials (e.g. pigments and dyes) to a ready-to-use paint tube containing a complex mixture of pigment, binder ad additives. Micro samples collected from 29 "raw" materials and 2 handcrafted coloured paint mixtures were characterised by XRF, FT-IR and PyGCMS analysis. Through this multi-analytical approach, both inorganic and organic fractions





were detected. According to the obtained results, Mariano Fortuny used both traditional and innovative materials- commercial products which were available at his time and sold for artistic practice and paint manufacture. This study allowed to understand the procedures followed by Fortuny in the production of his own colours, in particular highlighting the technical expedients the artist used in binding medium processing. These pieces of information prove Fortuny's deep proficiency in paint manufacture and explain why his own Tempere were appreciated by his contemporaries.

Keywords: Mariano Fortuny y Madrazo; XX century tempera; Paint manufacture; FT-IR; PyGCMS; Rapeseed oil; Lead soaps

E. Martinho, A. Dionísio, M. Mendes

Simulation of a Portuguese Limestone Masonry Structure Submitted to Fire: 3D Ultrasonic Tomography Approach

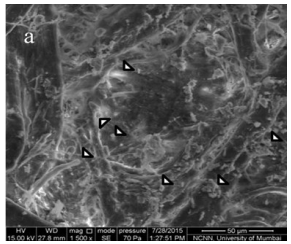
[Abstract] [Full Article - PDF] pp. 565-580

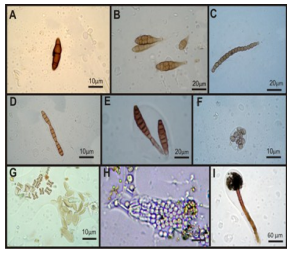
A multianalytical approach combining 3D ultrasonic tomography, FESEM, capillary absorption coefficient, open porosity and elastic constants (σ, E, μ and K) has been applied to characterize the extent and severity of Lioz limestone decay processes induced by fire, as well as the performance of two consolidants (ethyl silicate and nanolime). Samples (15 cm × 3 cm × 3 cm) were partially buried in fine sand (to mimic the real situation of stone blocks in masonry structures) and a section of 15 cm × 3 cm × 0.5 cm was exposed to direct heat (600ºC). The region directly exposed to heat exhibited lower P-wave velocity and more intense fissuration whereas the areas more protected showed thermal etch pits structures. Ethyl silicate showed better performance than nanolime and 3D ultrasonic tomography allowed estimating the depth reached by this consolidant.

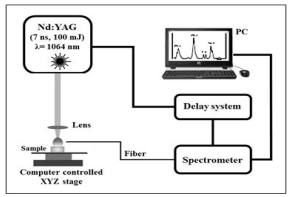
Keywords: Fire decay; Lioz limestone; Consolidation; 3D ultrasonic tomography; FESEM

P.M. Barone, C. Ferrara

The Past Beneath the Present: GPR as a Scientific Investigation for Archaeology and Cultural Heritage Preservation







[Abstract] [Full Article - PDF] pp. 581-588

The presence of modern structures and infrastructures is relevant if you want to plan an archaeological or cultural heritage project in a populated area (e.g., cities and countryside). Both natural and manmade objects "hidden" in the subsurface (like tree roots, electrical cables, pipelines, tunnels, etc.) can interfere in preservation of buried heritage. The main advantage of a conservation approach is the application of different non-destructive techniques (NDTs) to obtain the best result, in terms of both resolution and accuracy, without digging. One of these NDTs, i.e., the Ground Penetrating Radar (GPR) method, is used in this paper. The examples shown here demonstrate not only that the use of the GPR technique, as a scientific investigation, represents an effective and non-destructive methodology for discovering, recovering, and understanding archeological data but also it can be applied to better understand the evolution of the ancient Past through the development of the Present.

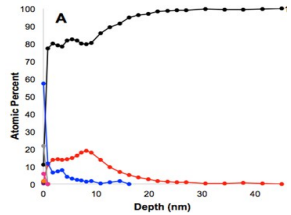
Keywords: GPR; NDT; Archaeology; Cultural Heritage; Management; Conservation

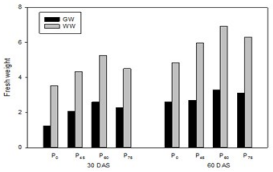
W. Hamma, A.I. Petrisor

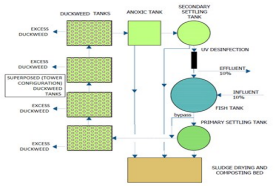
Assessing the Restoration of Sidi El Benna Mosque in Tlemcen (Algeria)

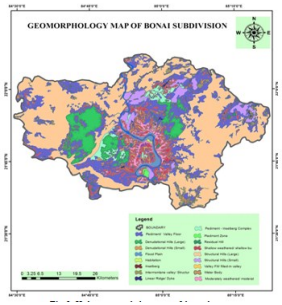
[Abstract] [Full Article - PDF] pp. 589-598

The restoration of historical monuments in Tlemcen was conceived as a fast process meant to prepare the city for hosting the events dedicated to the designation of the city as cultural capital of Islam in 2011. During two years, numerous monuments were disfigured; for this reason, Sidi El Benna mosque, dating from the 14th century, was chosen as a case study in order to understand the reasons beyond the interventions failure. The evaluation was performed in two steps; the first consisted in checking the scientific consistency of the approach, and the second, in checking whether the national and international rules and criteria were observed. The evaluation shows that the approach lacked scientific soundness and a multi-disciplinary character, and certain study or implementation phases were not properly carried out. Moreover, the restoration principles (minimal intervention, reversibility, compatibility, distinctiveness, authenticity and maintenance) were not considered. In addition, original architectural elements were replaced by new ones, new elements were added without any









reasons, the color of other elements was changed, and some elements were detached.

Keywords: Conservation; Heritage; Project management; Islamic monument; Urban regeneration; Qualification.

A. Viljus, M. Viljus

Coin Hoard from Varudi – Vanaküla. Questions and Answers in Conservation

[Abstract] [Full Article - PDF] pp. 599-606

The article discusses the conservation issues of Roman coins on the example of a specific find, gives an overview of the conservation process and material studies. It analyses corrosion products and the historic patina survived on the coin surface. The author endeavors to establish connections between the composition of the coin metal and corrosion.

Keywords: Roman coins; Conservation, Composition of metal; Corrosion; Patina.

S.M. Jacob, J. Raseetha, V. Kelkar-Mane

Physico-Chemical Assessment of Biodeteriorated and Biodegradated Archival Paper

[Abstract] [Full Article - PDF] pp. 607-618

Archival preservation has always been important for mankind to transfer knowledge to the posterity. Their degradation/deterioration and preservation has been studied with a view to aid in their restoration and conservation. The present work employs analytical and microbial methods to understand the physico-chemical deterioration and degradation of 19th century colored map and a 20th century photozincographed map. Irrespective of the era, analysis revealed that all the three samples were acidic in nature with rosins as sizing agent, were high in organic matter primarily cellulose with high moisture levels. The degradated/deteriorated regions of the paper were subjected to Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) to further elucidate the type of effect. The estimates of microbial count efficiently co-related with the physico-chemical changes observed in the archival documents. It can thus be concluded that irrespective of the era biodeterioration

and biodegradation of archival documents follow a similar pattern.

Keywords: Archival documents; Biodeterioration and biodegradation; Cellulose support; FTIR; SEM

A.C. Mallo, D.S. Nitiu, L.A. Elíades , M.C.N. Saparrat

Fungal Degradation of Cellulosic Materials used as Support for Cultural Heritage

[Abstract] [Full Article - PDF] pp. 619-632

A great part of the cultural heritage of humanity available in museums and libraries is stored in paper. However, this main support used from early civilization times is a biomaterial susceptible to deterioration by fungal transformation. Two fungal phenomena, cellulose degradation and synthesis of secondary metabolites, are responsible for paper deterioration. Thus, the understanding of fungal deterioration pathways is key to improve the durability of the cultural heritage in paper and develop new and adequate sustainable strategies of restoration. This review gives an approach about the current knowledge of cellulose transformation by fungi associated with paper and the mechanisms involved. Since several metabolites derived from fungi growing on paper, such as pigments, can deteriorate invaluable cultural heritage, knowledge on these metabolites is also fundamental to improve conservation strategies of historical documents.

Keywords: Biodegradation; Cellulolysis; Fungi; Pigments; Dyestuff; Cellulosic support; Preservation.

C. Pellerito, M. Sebastianelli, M. Orlando, M. Vitella, B. Pignataro, R. Lucido, F. Palla

The San Vito Wooden Pulpit from Museo Diocesano Of Palermo, Italy: Multidisciplinary Approach and Analytical Techniques for Dating and Restoration

[Abstract] [Full Article - PDF] pp. 633-640

The aim of the present research is to investigate the constitutive materials and the execution techniques of San Vito wooden pulpit from Museo Diocesano of Palermo (Italy) and to provide helpful information to dating it in addition to technical, historical and artistic evaluations. The pulpit, attributed to unknown artist,

belongs to the decorative arts and the most relevant feature is its double dating, in addition to the singular painting technique: it has a linear structure typical of 19th century and three polychrome and gilded panels probably dated to the end of 17th century. This paper describes the application of analytical techniques (imaging diagnostics techniques, Scanning Electron Microscopy coupled with X-ray Energy Dispersive Spectroscopy and Fourier Transform Infrared Spectroscopy) to better understand and characterize the pulpit, both support and decoration, useful to plan and perform the correct restoration. They revealed a proteinaceous pittoric layer for the linear structure, without a preparation. The panels are entirely covered by gold leaf applied on a preparation composed by a first white layer with gypsum and animal glue and a second one with bole. The traditional pigments, red and green lacquers using oil as binding medium are applied on gold leaf by thin and transparent brushstrokes.

Keywords: Wooden pulpit; Decorative arts; Tempera and oil on wood; Water gilding; SEM-EDS; FT-IR Spectroscopy; Conservative restoration; Museo Diocesano of Palermo

G. Leucci, G. Scardozzi, L. De Giorgi, G. Di Giacomo, L. Calcagnile, G. Quarta

GPR Investigations at the Basilica of Copertino (Lecce, Southern Italy)

[Abstract] [Full Article - PDF] pp. 641-650

GPR survey was undertaken inside and outside the Basilica of Our Lady of the Snows in Copertino, a village located a few kilometres Southwest of Lecce (Italy). The church was built in 1088 CE by the will of the Norman Count Goffredo of Conversano and was originally entitled to the Virgin. In 1255 Manfredi, Prince of Taranto and Count of Copertino elevated it to basilica entitling it to the Virgin of the Snows. It is the mother church of Copertino, already directed basilica and in 2011 elevated to the rank of minor basilica. The purpose of the survey was to obtain information about the existence of ancient structures beneath and outside the church. No document or writing exists to confirm the presence of structures under the church. However, there are several oral testimonies handed down over the centuries that suggest the presence of these ancient structures. Survey was carried out using a IDS Hi Mod georadar system, incorporating the dual band 200-600MHz centre frequency antennae. The GPR time slices were

constructed from closely spaced parallel profiles. The time slices, computed from averaging radar reflections over vertical time windows several nanoseconds thick, are used to map subsoil features associated with the structures, probably of anthropogenic origin. To facilitate the interpretation of the results, a three-dimensional image was constructed using closely spaced parallel profiles, which are linearly interpolated.

Keywords: GPR; Cultural Heritage; 3D visualization; Anomalies.

A. Del Mondo, G. Pinto, A. De Natale, A. Pollio

In Vitro Colonization Experiments for the Assessment of Mycelial Growth on a Tuff Substratum by a Fusarium Solani Strain Isolated from the Oplontis (Naples, Italy) Archaeological Site

[Abstract] [Full Article - PDF] pp. 651-662

In order to investigate the mycelial structure of rock-inhabiting fungi, an in vitro colonization test has been set with a low carbon source supply. A surface overlay documentation of the spreading colonies and their hyphal branching was observed both by metallurgical microscopy and fluorescence microscopy with the use of a fluorescent chitin and cellulose binding dye, calcofluor, during the whole experiment. The thickness of the fungal mat was also measured in central, medial and distal areas of the colony for each tuff tile, using a metallurgical microscope. Finally, after 20 days the tiles were also observed with CLS-microscope and all the photographic documentation was used for a segmentation image analysis on Fiji software to calculate the overlay and the volume of the mycelium. Our findings confirm that in vitro experiments coupled with microscopic observations are useful tools to evaluate and quantify fungal biomass on a stone substratum, especially in the early steps of fungal colonization.

Keywords: Fusarium solani; Colonization of hyphae; Primary bioreceptivity; Image analysis; CLSM confocal microscopy

M.M. Morita, G.M. Bilmes

Photonic Methods Applied to Heritage Conservation in Argentina

[Abstract] [Full Article - PDF] pp. 663-674

As part of an ongoing program performed in collaboration with museums and institutions of Argentina, we present results on the application of laser based techniques and 3D imaging methods for material characterization, cleaning and documentation of cultural heritage objects, particularly the collections of public museums located in different regions of the country. In this work, we present results on the application of Laser Induced Breakdown Spectroscopy (LIBS) for material characterization of objects found in the ex-detention, torture and extermination center called Club Atletico (Instituto Espacio Memoria) of Buenos Aires. We also show laser cleaning applications to archaeological objects found in Patagonia and in the city of Buenos Aires. Finally, we present a 3D system developed for recording and documentation of artworks. It is based on digital photogrammetry and uses low cost devices and free software for data processing. This 3D system has measurement tools and the possibility of creating deterioration maps in the virtual model. We present examples of the applications of this 3D system to artworks from argentine museums.

Keywords: LIBS; laser cleaning; 3D documentation; digital photogrammetry; Structure from Motion; Photonic techniques in conservation

M.S. Kozachuk, T.K. Sham, R.R. Martin, M. Robinson, A.J. Nelson, M.C. Biesinger

X-Ray Photoelectron Spectroscopy In The Study Of The Chemistry Of A Daguerreotype Surface

[Abstract] [Full Article - PDF] pp. 675-684

Laboratory and synchrotron-based X-ray Photoelectron Spectroscopy (XPS) were used to study the element distribution and chemistry of a specially prepared daguerreotype plate. The goal of this work was to achieve a greater understanding of how the chemistry of the daguerreian plate changes from surface to subsurface. A silver-gold alloy was expected to vary between highlight and shadow regions. Depth analysis showed that residual halogens and mercury were present on the surface as well as the formation of a silver-gold alloy that varied with depth. Valence band examination indicates minimal alloying between silver, gold, and mercury.

Keywords: Daguerreotypes; X-ray photoelectron spectroscopy; Scanning electron microscopy; Depth profiling; Synchrotron

N.H. Nik Raikhan, O. Nur Hidayati, Z. Mohd

Non-Mediator Supported Novel Natural Oxidative Biodegradation of Bisphenol A (BPA) in Contaminated Industrial Wastewater By Pseudomonas Aeruginosa Nr.22

[Abstract] [Full Article - PDF] pp. 685-694

The strain Pseudomonas aeruginosa NR.22 (Ps.NR.22); an extracellular laccase enzyme producer isolated from a lake in Malaysia has been proved to grow very well in more than 50 ppm BPA in the industrial wastewater collected from Bukit Minyak Industrial Park, Pulau Pinang, Malaysia. The 50 ppm BPA degradation was catalyzed by 1.0 U/ml of extracellular crude laccase without addition of types any mediator and was completely removed within 24 hours. Components of β-hydroxybutyric acid (C4H8O3), pyroglutamic acid (C5H7NO3), hydrocinnamic acid (C9H10O2) and tartaric acid (C4H6O6) were detected as direct oxidative degradation products from the BPA; identified by the GC-MS. The GC-MS didn't detect a formation of any intermediate compound, which was believed to be caused by the high laccase activity in the product interchange; therefore the intermediate compound has appeared in a very short time and was hardly detectable by GC-MS. Correlation between laccase activities with the BPA concentration was studied in the kinetic of BPA as a substrate for laccase. At 1000 ppm BPA concentration, the rate of BPA used was recorded as 0.94 gL-1h-1 or 940 ppm. The ability to degrade 94% BPA has been catalyzed by 27.42 ± 0.01 U/ml laccasein 18 hours. In conclusion, laccase Ps.NR.22 has played a critical role in BPA biodegradation and catalyzed a cross-coupling reaction with four major acid group compounds as the products which has been listed above. This strain is highly potential for industrial application in maintaining water quality and land conservation from BPA contamination.

Keywords: Bacterial growth; kinetic model; substrate utilization; Pseudomonas aeruginosa NR.22; BPA.

S. Samreen, A. Inam, A.A. Khan

Fresh Water Conservation Prospective: Cultivation of Chili (capsicum annuum l. Var. Pusa jwala) using Waste Water in

Presence of Phosphorus Fertilizer

[Abstract] [Full Article - PDF] pp. 695-702

The experiment was conducted to study the comparative effect of wastewater on the physico-morphological characteristics of chili. The crop was supplemented with four basal doses of phosphorus with the rates of 0, 45, 60 and 75 kgha-1P with uniform basal dose of nitrogen and potassium with the rates of 60 kgha-1N and 50 kgha-1K respectively. Data was recorded at 30 and 60 day after sowing (DAS). Wastewater irrigation resulted significant increase in plant shoot length, root length, fresh weight and dry weight, leaf area, leaf number plant-1, chlorophyll content, nitrate reductase activity and carbonic anhydrase activity. Among phosphorus doses P60 along with wastewater proved best for growth and physiology of the plant. Thus it may be concluded that WW reduce the demand of fertilizers and it may be used profitably for the cultivation of chili.

Keywords: Carbonic anhydrase; Chili; Nitrate reductase; Phosphorus; Wastewater.

G. Murariu, V. Hahuie, A. Murariu, L. Georgescu, C. Iticescu, M. Calin, C. Preda, D.L. Buruiana, G.B. Carp

Forest Monitoring Method using Combinations of Satellite and UAV Aerial Images. Case Study - Balabanesti Forest

[Abstract] [Full Article - PDF] pp. 703-714

The increasing use of satellite faraway sensing for civilian use has proved to be the most cost effective means of mapping and monitoring environmental changes. From this point of view, these new tools are now essential in monitoring operations for vegetation and non-renewable resources, especially in developing countries. In today's literature a series of 262 spectral indices are defined to evaluate the vegetation health for a specific area. For the vast majority of these infrared spectral index values are included. Infrared recording devices are quite expensive. In this respect, the possibility of using only the visible domain should be experienced in order to reduce the operational costs. The main hypothesis comes from the fact that any changes in vegetation status cannot be reduced and described only by the infrared domain changes. This study presents the results of a general aim: to design, to investigate and to confirm a specific analysis method that uses only the visible RGB spectra by using historical

recordings. With this main objective of getting a method with a minimal operational cost, in this regard a combination of two classical techniques was tested - satellite image monitor analysis and UAV high resolution images use. The further exposed method in this paper suggests the joining of the two monitoring methods in successive phases: in the first step resolution suitable satellite images were used in order to succeed in building a forest model. The model confirmation and the validation process is done in the second stage by using specific UAV flights for high resolution images acquiring over a series of gauging points from the studied area. The presented case study is that of Bălăbăneşti Forest from Galati County. The study was conducted between 2005 and 2016. Preliminary results on the composition evaluations are promising and the research is ongoing.

Keywords: Forest model; RGB spectra; Minimal operational cost; Model validation.

R. Popa, I.C. Moga, M. Rissdorfer, M.L.G. Ilis, G. Petrescu, N. Craciun, M.G. Matache, C.I. Covaliu, G. Stoian

Duckweed Utilization for Fresh Water Conservation (Management) in Recirculated Aquaculture Systems

[Abstract] [Full Article - PDF] pp. 715-722

The paper aims at presenting key aspects of the use of duckweed in the industry applications and a concept for using duckweed bio filters in aquaculture systems. Duckweed is a plant adapted to aquatic systems and considered to be one of the smallest plants in the world, with a diameter of 1-15mm. Although it is a small plant, its properties make it suitable for industrial use (production of bio fuel, aquaponic, food source, waste water treatment). Several aspects of the duckweed crop management are mentioned in the paper. It has been shown that certain duckweed species can successfully lower the Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), total nitrogen (TN), total phosphorus (TP) and orthophosphate (OP). The authors propose a new waste water treatment technology with duckweed tanks for recirculated aquaculture systems.

Keywords: Duckweed; Ammonia; CBO5; Wastewater treatment; Recirculated aquaculture systems (RAS)

J.H. Karyamsetty

Floral Diversity, Phenology, and Pollination Mechanism of True Vivi-Parous and Crypto-Viviparous Mangroves of Godavari and Krishna Delta of Andhra Pradesh, India

[Abstract] [Full Article - PDF] pp. 723-730

Mangroves are salt tolerant plants that typically grow in inter- tidal zones and are referred to forests by the sea. Mangrove forests of Andhra Pradesh occur in Godavari and Krishna estuary inhabiting 35 mangrove species. The diversity of species in both the mangrove forests is different due to the change in geography of the location and disturbance from human intervention. Krishna mangrove forest has six true vivipary mangrove species with pure stands of Rhizophora species. 19 mangrove plants were studied to know the breeding mechanism, floral phenology, and reproductive phenomena of different groups of mangrove flora. Majority of plants commence flowering in summer and post monsoon periods and initiate fruiting subsequently. Cross and mixed breeding system is the most successful reproductive mechanism adopted by a good number of mangrove species studied revealed from the hand breeding experiments. The pollen carriers included bees, flies, butterflies, wasps, moths, birds, that acted as vectors and in-turn facilitated cross pollination in some species. The regeneration mode of mangrove plants is classified into three types, vivipary, crypto-vivipary and non- vivipary.

Keywords: Vivipary; Crypto-vivipary; Pollen vector; Cross pollination; Breeding systems.

P.C. Sahu

Status of Groundwater Sanctuary and Aspects of its Conservation

[Abstract] [Full Article - PDF] pp. 731-742

The study demonstrates the condition of ground water sanctuary in a Precambrian crystalline province of eastern India and aspects of its conservation .Ground water in the study area occurs primarily in four different aquifer systems such as weathered mantle, saprolitic zone, fractured zone and alluvial zone. The maximum thickness of the weathered mantle in the area is 20m where groundwater occurs in unconfined conditions and mostly developed by dug wells. The groundwater resource estimation of

the area has been calculated using the water table fluctuation method. The net annual usable groundwater resources of Bonai, Gurundia, Koira and Lahunipada blocks are 3524.23HM, 3935.15HM, 3557.37HM and 5245.66HM respectively. The stage of development of groundwater in Bonai, Gurundia, Koira and Lahunipada blocks are 7.17%, 7.65%, 3.20% and 4.34% respectively. The most suitable planning for the assured source of water supply round the year can be achieved by different types of groundwater structures like dug wells, dug cum bore wells and bore wells in favorable sites. Artificial recharge techniques play a major role for the groundwater conservation. Suitable sites for specific water harvesting structures/ artificial recharge structures such as percolation tank, check dam, gully plugs have been demarcated.

Keywords: Groundwater; Aquifer; Sustainable Development; Artificial Recharge.

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FABRICATION OF SILICA-TITANIA AS CONSOLIDANT AND SELF CLEANING FOR THE CONSERVATION OF ANDESITE STONE

Alfa Akustia WIDATI[1*], Abdulloh ABDULLOH[1], Miratul KHASANAH[1], Rina KUSUMAWATI[1], Nahar CAHYANDARU[2]

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[2] Borobudur Conservation Office, Ministry of Education and Culture, Indonesia

Abstract

The composites of silica-titania that have consolidant and self-cleaning property have been synthesized by mixing titania and colloidal silica. The coating of stone using silica-titania could improve the mechanical properties of andesite stone. In addition, the coating created the superhydrophilic properties and similar visual appearance with untreated andesite. The self-cleaning performance of treated andesite could remove the 92% of congo red and 67% of methylene blue as staining agents through photocatalysis process.

Keywords: *Colloidal silica; Titania; Consolidant; Self-cleaning; Andesite*

Introduction

Indonesia has lots of heritage building all over the country such as the temples of Borobudur, Prambanan, and other temples, whereas mainly composed by andesite stone. Andesite is an extrusive igneous rock, has porous texture and contains 50-65% of silica. Organic pollutant, soiling, staining and cracking are serious problems that needed to solve. Cleaning is an action to remove the dirt, stain, polluting fluids, and living organism such as fungi algae, lichen, and bacteria. Photocatalysis is a widespread of cleaning technique thus allowing the degradation of pollutants and living organism. Titania has been widely used as photocatalyst because effective, inert, cheap, stable, and high activity. When photons are absorbed by titania, electrons will be promoted from valence band to conduction band, generates holes. In contact with water, holes produce hydroxyl radical. These radicals have ability to degradate the organic matter. Under UV exposure, titania becomes superhydrophilic (low water contact angle) therefore prevents the contact between surfaces and dirt. Quagliarni et al. reported that the two properties of titania (photacatalysis and superhydrophilicity) contribute to the easier of degradation process, since the formation of a water film over treated surfaces and the photocatalytic degradation of organic pollutant [1]. Because of that mechanism, it possible to obtain self-cleaning surface. In the last few years, titania have been used in the fields of conservation the travertine, limestone, white marble, and lecce stone [1-3].

Cracking is a form of stone decay that implies rupture of parts of the same one or loss of mater. Consolidation is one of action to restore some strength. Consolidants will penetrated to the stone, improve the pore structure, and increase the hardness of stone. Consolidants are

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usually applied to the surface stone by brush, spray, pipette, or by immersion [4]. The addition of silica nanoparticles with grain size less than 50 nm have been successfully increase the compressive strength values of sandstone through the ability to fill the big pores between grains. It also cover the grains of the sandstone with almost homogenous polymer networks [5]. Colloidal silica has often been used as consolidant whereas the adhesion can be controlled through silica dilution. It has a minimal effect on water vapor permeability, stable, compatible with silica stone, low toxicity, and ease of use. The previous research reported that colloidal silica easy to match when mixed with sand, crushed sandstone, and local earth. It also doesn't leave the color residues in the stone [6].

From these findings, our research has been to prepare a material that has both properties, self-cleaning and consolidant for the preservation of historical stone, especially andesite. Titania based self-cleaning able to acts as depolluting and biocidal treatment through its photocatalytic effect. Colloidal silica based consolidant can provides the uniform coating, high compatibility with andesite because silica is the main component of andesite, approximately 50-65%. From this phenomenon, silica consolidant easy to insert on the pore of andesite since the similar acidity. The combination of silica-titania for the preservation of limestone have been reported by *L. Pinho and M.J. Mosquera* [7]. Colloidal titania was added to the silica oligomer in the presence of n-octylamine as surfactant. The aims of adding surfactant are prevent cracking and enhance the photocatalyic activity by creating a mesoporous nanocomposite.

In this study, we have prepared a silica-titania composite from titania particles mixed with colloidal silica. Titania particle was synthesized using titanium tetraisopropxide as titanium source and ethylene glycol as a dispersant. Colloidal silica was observed from Ludox HS40. We evaluated the performance of silica-titania for the following: (1) hydrophilicity; (2) hardness properties; (3) self-cleaning properties using congo red and methylene blue as pollutant model.

Experimental

Materials

Titanium tetraisopropoxide, TTIP (by Sigma Aldrich) and colloidal silica, Ludox HS-40 (by Sigma Aldrich), were the main components in our research. The following reagents were used for this synthesis: ethylene glycol, ethanol, congo red, methylene blue, hydrochloric acid, and demineralized water. That chemicals were purchased from Merck, analytical grade, and used as received without further purification. The used instruments were infrared spectrophotometer (Shimadzu 8400), XRD (Philips X'PERT), SEM-EDX (Zeiss EVO MA 10), Vickers Hardness (Mirutoyo HM 211), UV-Vis spechtrophotometer (Shimadzu UV 1800).

Preparation of silica-titania composite

Titania was prepared according to the previous literature [8]. TTIP was added to ethylene glycol with stirring at room temperature. After 30 min, water was added to the mixture. The acidity of mixture was kept at pH = 1.5 using HCl. Subsequently, the mixture was refluxed at 140°C for 16 h under vigorous stirring. The obtained solution was washed using ethanol and water till neutral. The solid titania was dried at 100°C and characterized using XRD. For application, titania was dispersed in water under ultrasonication. Composite silica-titania was prepared by mixing the suspension of titania with colloidal silica in each of the following ratios 3:7; 5:5: and 7:3. After the preparation of composite, the composite was analyzed using infrared spectrophotometer.

Coating of andesite stones

Before being used for coating, andesite stones were cut into dimension 3x3x1cm. The composites were brushed onto the stone. After that, the treated stone was dried and measured the water contact angle. The hardness and morphology properties of treated stone were characterized using Vickers and SEM-EDX.

Finally, the self-cleaning effectiveness of treated stone was tested using congo red and methylene blue as staining agents. The stain was dropped onto the surface of treated stone, and was then irradiated under UV exposure. The concentration of stain after irradiation was measured using UV-Vis spectrophotometer ~~UV-Vis~~ [9-16]. The percent of stain discoloration was calculated from the following equation: stain discoloration (%) = $100\times(C_0-C_t)/C_0$, where C_0 represents the initial concentration of stain, C_t represents the concentration of stain after irradiation. In this work, the composition of silica-titania and time of irradiation were investigated.

Results and Discussions

The structure of synthesized titania were clearly confirmed by XRD analysis. The XRD pattern of synthesized titania was shown in Figure 1. The diffractogram showed the intensive peak at 2θ = 25.36°; 37.88°; and 48.2° which confirmed as anatase TiO_2. Furthermore, the synthesized titania was combined with colloidal silica to produce the silica-titania composite. FTIR spectra was used for further screening the interaction of silica and titania in the various composition (Fig. 2). All of materials exposed the bands about 478, 910, 1111, and 3425cm^{-1}. The band about 478cm^{-1} was attributed to the Ti-O-Ti vibration [17]. The band at 910cm^{-1}, was consistent with Ti-O-Si vibration. The spectrum located at 1111cm^{-1} was attributed to Si-O-Si bending [18]. The broad band at 3425cm^{-1} verified the Si-OH groups [19]. Moreover, the large area of hydroxyl group able to increase the hydrophilicity and the rate of photocatalysis. The hydroxyl groups interact with holes, therefore they prevent the recombination of electron-holes [20]. The composite silica-titania with composition 7:3 displayed the larger area of hydroxyl group than others.

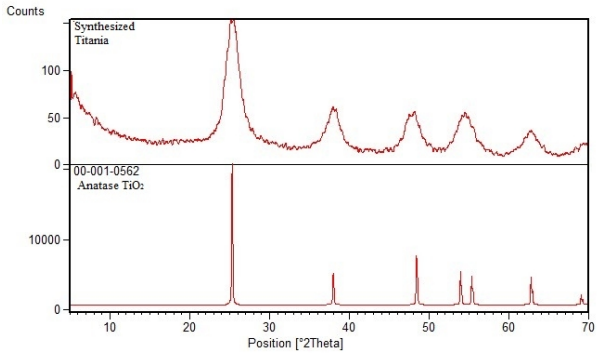

Fig.1. The diffractogram of synthesized titania

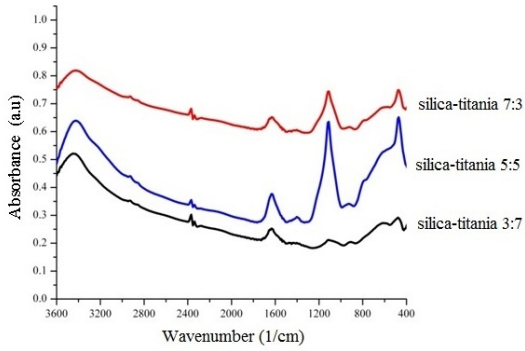

Fig. 2. The FTIR spectra of silica-titania composites with various compositions

The composites silica-titania was coated onto the surface of andesite. The result stated that treatment did not change the visual appearance of andesite, therefore we assume that composites silica-titania are promising of coating material (Fig. 3). The wettability of treated stone were assessed by measuring the water contact angle. The water contact angle of bare andesite, coated andesite using silica titania 3:7; 5:5; and 7:3 were 23.26°; 13.72°, 7.19°, and 0° (Fig. 3). In particular, the ratio of silica-titania amount greatly influenced the contact angle. The presence of silica able to enhance the surface acidity, whereas can adsorb the more of hydrophilic hydroxyl group [18].

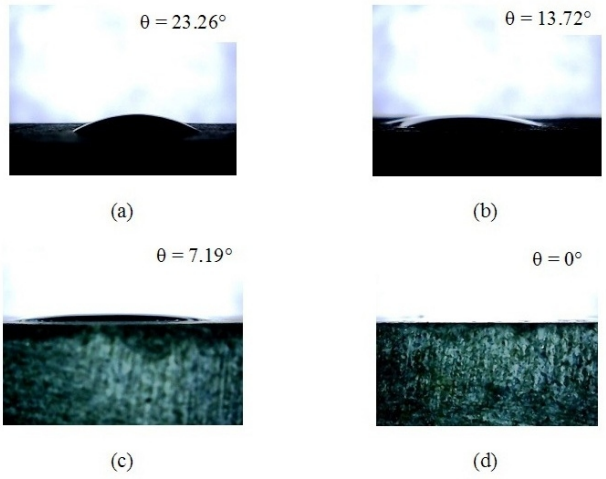

Fig. 3. The visual appearance of contact angle of investigated andesite areas:
a. treated with composition of silica-titania composite 3:7;
b. treated with composition of silica-titania composite 5:5;
c. treated with composition of silica-titania composite 7:3;
d. untreated andesite stone

The consolidation effectiveness of silica-titania were determined using Vickers hardness. The hardness of bare andesite, coated andesite using silica-titania 3:7; 5:5; and 7:3 were 141.68; 163.8; 177.84; and 285.4 VH. The greater the concentration of silica, the higher of obtained the hardness value. This behavior is due to many silica penetrates into the pore of andesite and builds the linkage whereas generates the rigid structure.

The presences of silica-titania over stone surface were clearly confirmed by SEM-EDX analysis. Figure 4 showed the micrographs of bare and coated andesite. From this result, we assumed that the andesite was successfully coated where there was an increasing amount of silica and titania in the coated andesite. The coating was also homogeneously spread over stone.

The self-cleaning property was assessed by photo discoloration of staining agents (congo red and methylene blue test). The influence of composition silica-titania toward the loss discoloration ability was shown in Figure 5. In this study, there was an interesting perspective where composition of silica-titania 7:3 exhibited the higher degradation than composition of 3:7. From this result, we assumed that discoloration process was influenced not only the amount of titania, but also the amount of silica. In other words, there was synergism effect between silica and titania. Silica can increase the surface area of titania because silica acts as support. The large surface area results the improvement of site active interaction in the photocatalysis process [18]. Moreover, silica also acts as a dopant that can reduces the gap energy of titania, therefore it promotes the easier electron excitation from valence band to the conduction band [21]. The effect of time irradiation towards the self-cleaning ability was displayed in Figure 6.

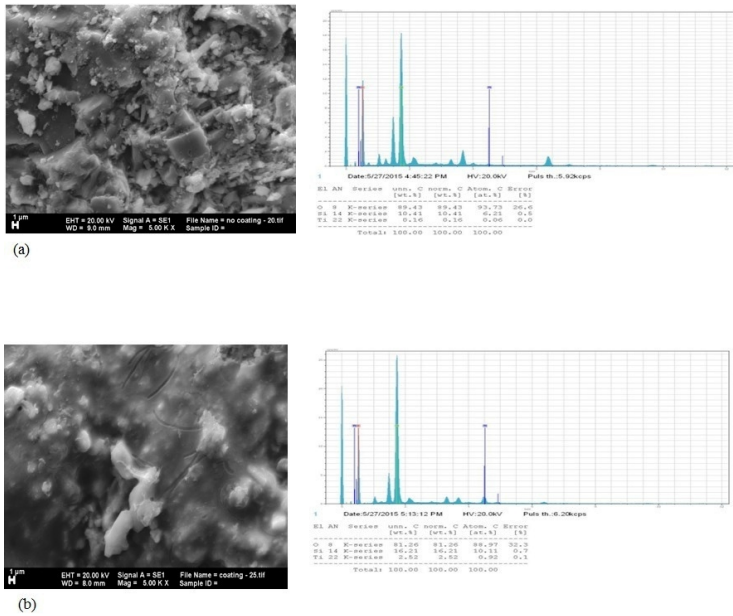

Fig. 4. The SEM-EDX analysis of untreated (a) and treated (b) andesite stone

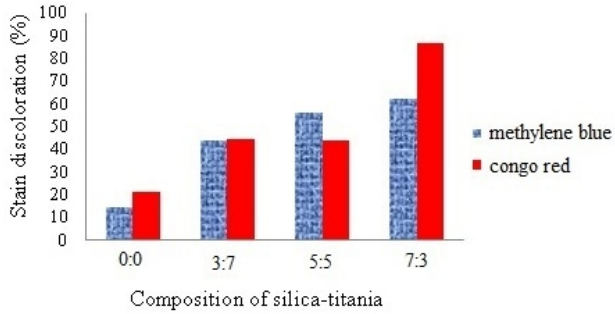

Fig. 5. Percentage of the stain discoloration with different composition of silica-titania

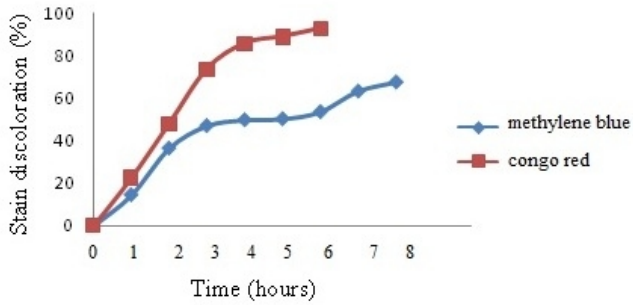

Fig. 6. The influence of irradiation time towards the percentage of the stain discoloration using silica-titania composites 7:3

The results indicated that the longer of irradiation time, the higher of degradation percent of staining agent. Silica-titania able to remove the congo red about 92% at 6 hours and methylene blue about 67% at 8 hours.

Conclusions

The composite of silica-titania as consolidant and self-cleaning coating for andesite stone, the main component of heritage building in Indonesia was reported. The application of silica-titania have required the basic criteria of preservation that it did not impact the visual appearance the stone. Furthermore, the composite increased the hardness properties of andesite. It also efficient to remove the staining agents on treated surface. In other word, the promising material have successfully synthesized. Further study are necessary to better assess suitability and durability of silica-titania coating for long term. The depth investigation also necessary to analyze the self-cleaning properties against biocidal agents.

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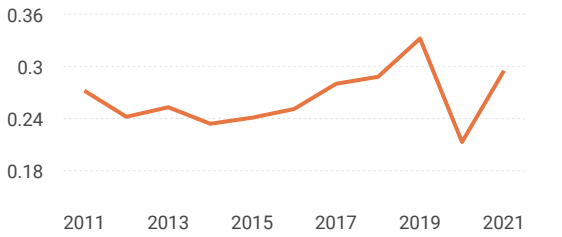

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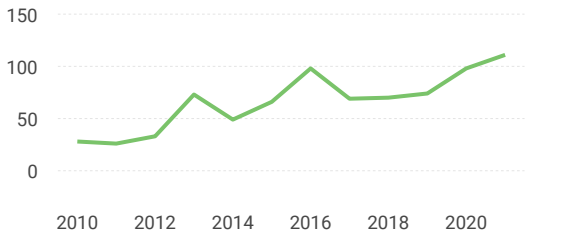

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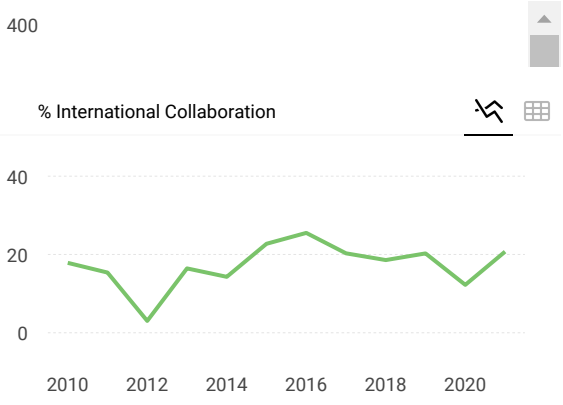

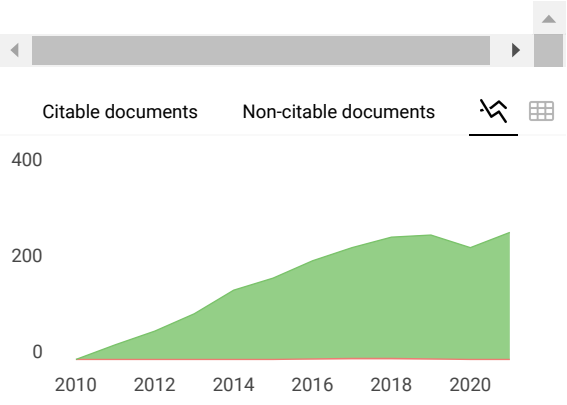

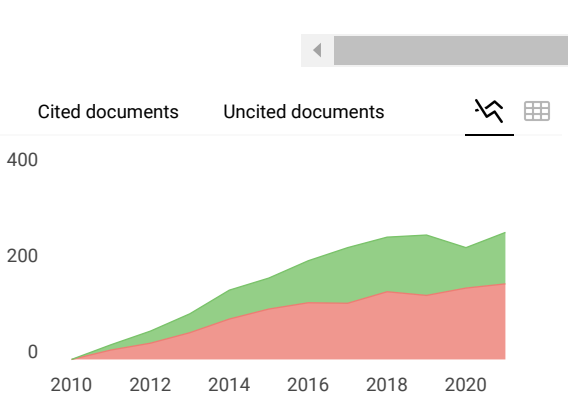

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