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The characterization of unidirectional and woven water hyacinth fiber reinforced with epoxy resin composites

[Sulardjaka S.^{a, b}](#) ; [Iskandar N.^{a, b}](#); [Nugroho, Sri^a](#); [Alamsyah A.^a](#); [Prasetya M.Y.^a](#)[Save all to author list](#)^a Mechanical Engineering Department, Diponegoro University, Jl. Prof. Sudarto, SH, Semarang, Indonesia^b Advanced Materials Laboratory, CoRES Diponegoro University, Jl. Prof. Sudarto, SH, Semarang, Indonesia2 62th percentile
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Abstract

The high growth of Water Hyacinth/Eichhornia crassipes (WH) led to several problems such as ecosystem, irrigation, and sedimentation. The rapid growth of water hyacinth in natural rivers, reservoir, lake and canals causes drainage problems in many nations. As a result, local offices must spend significant annual budgets to dispose of water hyacinth wastes. Meanwhile, cellulose fiber from WH had a potential application in natural fiber composite (NFC). This study investigated the development and use of water hyacinth wastes for the production of unidirectional dan weaved fiber epoxy resin composites. The purpose of this research is to investigate at the mechanical and physical properties of unidirectional WH and woven fiber reinforced epoxy resin composites in variation of 0 % wt., 15 % wt., 25 % wt. and 35 % wt. of WH fibers. The WH fiber was obtained from a mechanically processed WH plants. The composites were manufactured through the hand lay-up method. The tensile and impact tests were carried out based on ASTM D3039 and ASTM D6110 respectively, while the density of composites was tested based on the Archimedes rule. The results of this study showed that increasing of % wt. of the WH woven fiber, the tensile strength of composite decrease. The impact strength of composites increases by the rise of % wt. of the WH woven fibers. The % wt. of WH woven fibers was in direct proportion to the amount of pore or void between the fibers and matrix, which led to a delamination mode fracture. Tensile and impact strength of unidirectional WH fiber increase by increasing the % wt. of WH fibers. © 2022 The Author(s)

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Composite; Epoxy-resin; Unidirectional fiber; Water hyacinth; Woven fiber

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The characterization of unidirectional and woven water hyacinth fiber reinforced with epoxy resin composites

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Abstract

The high growth of Water Hyacinth/*Eichhornia crassipes* (WH) led to several problems such as ecosystem, irrigation, and sedimentation. The rapid growth of water hyacinth in natural rivers, reservoir, lake and canals causes drainage problems in many nations. As a result, local offices must spend significant annual budgets to dispose of water hyacinth wastes. Meanwhile, cellulose fiber from WH had a potential application in natural fiber composite (NFC). This study investigated the development and use of water hyacinth wastes for the production of unidirectional dan weaved fiber epoxy resin composites. The purpose of this research is to investigate at the mechanical and physical properties of unidirectional WH and woven fiber reinforced epoxy resin composites in variation of 0 % wt., 15 % wt., 25 % wt. and 35 % wt. of WH fibers. The WH fiber was obtained from a mechanically processed WH plants. The composites were manufactured through the hand lay-up method. The tensile and impact tests were carried out based on ASTM D3039 and ASTM D6110 respectively, while the density of composites was tested based on the Archimedes rule. The results of this study showed that increasing of % wt. of the WH woven fiber, the tensile strength of composite decrease. The impact strength of composites increases by the rise of % wt. of the WH woven fibers. The % wt. of WH woven fibers was in direct proportion to the amount of pore or void between the fibers and matrix, which led to a delamination mode fracture. Tensile and impact strength of unidirectional WH fiber increase by increasing the % wt. of WH fibers.



Keywords

Composite; Epoxy-resin; Water hyacinth; Woven fiber; Unidirectional fiber

1. Introduction

Natural fibers are a useful class of materials that are environmentally clean, renewable, and biodegradable resources. They are also used in manufacturing natural fiber composites with advantages which include low impact on the environment, renewability, inexpensive and easily degraded [1, 2, 3, 4]. However, the use of natural fibers as a reinforcement of composites is still experiencing several problems such as, low mechanical properties, hydrophilic properties, limited processing temperatures, low matrix and fiber binding forces that are easily degraded [5, 6]. Furthermore, studies on the development of natural fiber properties were carried out by pretreating or engineering the manufacturing method [7, 8].

Water hyacinth (*Eichhornia crassipes*) is a type of aquatic plant that floats on the surface of the water. It grows aggressively and was a nuisance on almost all continents for more than 100 years. Furthermore, its high population growth led to several problems related to ecosystem balance, decreased fish production, loss of endemic organisms and sedimentation [9, 10, 11]. Numerous

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Research article

Energy drinks alter the surface morphology and roughness of composites, fissure sealants and titanium: An *in vitro* studyBéla Kolarovszki^{a,*}, Alíz Sándor^a, Péter Szabó^b, Judit Kopniczky^c, Dorottya Frank^a, Ákos Nagy^a, Kinga Turzó^a^a Dental School, Medical Faculty, University of Pécs, H-7623 Pécs, Tüzér u. 1., [Hungary](#)^b Szentágotthai Research Center, Environmental Analytical and Geoanalytical Research Group, H-7624 Pécs, Ifjúság útja 20., [Hungary](#)^c Department of Optics and Quantum Electronics, University of Szeged, H-6720 Szeged, Dóm tér 9., [Hungary](#)

HIGHLIGHTS

- Consumption of energy drinks is increasing amongst children and young individuals.
- Preventive, restorative, and orthodontic materials used in young individuals are affected by energy drinks.
- Roughness and morphological change of dental materials is observed in case of Hell and Burn impact.
- Burn damages more titanium, fissure sealant and composite materials.

ARTICLE INFO

Keywords:

Titanium
Fissure sealant
Composite
HELL
BURN
Energy drinks
Roughness
Morphology

ABSTRACT

Objectives: The influence of energy drinks on dental materials are relatively under addressed. Our aim was to investigate the effect of energy drinks on dental materials used intraorally in young individuals. Commonly used preventive, restorative, and orthodontic materials were tested *in vitro*.

Methods: The effect of two commercially available energy drinks (HELL, BURN) was investigated on different dental materials: machined, anodized Titanium (grade 5: Ti6Al4V) and composites (Grandio Seal, VOCO; Filtek Z250, 3M ESPE; Estelite SQ, TOKUYAMA). The roughness (Ra) and morphological changes were examined by atomic force microscopy (AFM) and scanning electron microscopy (SEM).

Results: AFM and SEM revealed significant differences in the Ra and morphology of the samples. AFM results for the machined and anodized titanium samples showed that the two energy drinks modified the surface roughness differently; BURN changed the roughness of machined samples significantly, while anodized discs were not altered significantly by the two energy drinks. In case of composite samples there was no significant difference for the Estelite SQ, relative low differences for the Filtek Z250 and significant changes in the morphology and surface roughness of Grandio Seal.

Significance: On all tested materials, changes in the surface roughness and morphology were more or less detected, proving energy drinks do in fact have a harmful effect. It can be concluded that material erosion depends on the material composition and particle arrangement. Where the surface is characterized by a regular, uniform particle arrangement, energy drinks are less able to influence the roughness, while for samples where the surface is rich in aggregates, the material erodes the surface much more easily.

1. Introduction

The consumption of energy drinks has become increasingly popular among children, adolescence, and young individuals worldwide, as they are advertised to provide higher athletic performance, concentration,

attention, wakefulness, to increase energy and reduce physical and mental stress [1]. Excessive consumption is further exaggerated by the fact that they are easily accessible as they are sold in numerous places [2, 3].

Many potential health problems have been proved to be related to the heavy and chronic consumption of these popular products including

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Research article

Obtaining interactions among science, technology, and research policy for developing an innovation strategy: A case study of supercapacitorsChika Ishii^{a,*}, Kimitaka Asatani^b, Ichiro Sakata^b^a Cisco Systems G.K., Tokyo, Japan^b Graduate School of Engineering, The University of Tokyo, Tokyo, Japan

ARTICLE INFO

Keywords:

Bibliometrics
Technology maturity
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ABSTRACT

Comprehensive observations of science, technology, and research policy transactions are important for developing an innovation strategy. We propose a new method that combines the academic landscape and matrix analysis to understand the relationships among activities of three aspects of the technological landscape: science, technology, and research policy. First, we divided academic research into 28 knowledge domains by clustering a citation network of scientific papers. Next, we developed a new matrix classifying them into three groups: “mature technology,” “intermediate technology,” and “emerging technology.” The results showed that research domains in “emerging technology” showed a high rate of patent increase, indicating that they were commercializing rapidly. Finally, we identified the group that each country focused on, and this result reflected the countries’ research policies. China and Singapore showed high rates, whereas Japan, France, and Germany had low values. This result reflects countries’ research policies and implies that specialty research areas differed by country. As above, our research result implies that academia, industry, and government have paid attention to knowledge domains in “emerging technology” and these are important for creating innovation. A supercapacitor, also known as an electric double layer capacitor or ultracapacitor, was selected as an example in our method. This research could help academic researchers, industrial companies, and policymakers in developing innovation strategies.

1. Introduction

In recent years, science and technology have been developing at a remarkable pace, and the number of research papers has continued to increase exponentially [1]. In 2016, approximately 2.2 million papers, an enormous number, were published in one year [2]. However, the rapid increase in the number of papers has caused issues such as the obscuring of the overall picture of the scientific field. The rapid increase in scientific papers has made understanding the entire picture of the scientific field difficult even for experts [3].

To deal with this issue, we use the approach of conducting a structural overview of knowledge using the visualization of vast volumes of academic papers and bibliographic information [4, 5, 6]. This visualization is used to understand the current situation and predict the knowledge domains that will grow in the future [7]. For researchers with limited research resources, it is important to predict knowledge areas that will grow in the future as it enables them to select research topics with a high potential of leading to innovation creation.

Previous methods consider that knowledge domains with a low level of maturity have room for innovation creation [8, 9]. Although there are various metrics to assess the maturity of knowledge domains, in most cases, it has been evaluated using one variable, such as average publication year and the rate of growth in publication [10, 11, 12, 13]. However, there may be some knowledge domains that have appeared recently and have already published an enormous number of papers, given that the number of publications has been increasing dramatically.

The visualization of academic articles is also used for developing an innovation strategy. As the triple helix of academia-industry-government relations is important for creating innovation, observing the interactions among these actors is necessary [14]. Earlier studies have reported methods for observing science, technology, and research policy as follows:

A landscape of science can be obtained by visualizing a high number of publications, for instance, a global map of science, science overlay maps, VOS mapping, and science maps [15, 16, 17, 18, 19]. In these methods, publications are classified into knowledge domains with similar subjects by citation network clustering, which assists in grasping

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