TEchMA2022

5th International Conference on Technologies for the Wellbeing and Sustainable Manufacturing Solutions

Aveiro, 27th of May 2022

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TEMA - Centre for Mechanical Technology and Automation

Pursuing excellence, cutting-edge and impact Research & Innovation since 1996

The Centre for Mechanical Technology and Automation (TEMA) has been pursuing excellence, cutting-edge research and innovation since 1996. It is the main research interface of the Department of Mechanical Engineering, aligned to University of Aveiro commitment for innovation, quality, and international recognition in the areas of Engineering Education, Research and Cooperation with Society.

In a world of constant change, the capacity of adjustment is essential. TEMA is highly aware of this factor and fully comprehends the relevance of the R&D conducted in the research unit and its impact on society (academic, industrial/business and civil) and is experiencing a crucial transition period of structural adaptation to ensure the continued pursuit of scientific excellence with a contextualized translation in(to) innovation, competitiveness and citizenship of the community.

TEMA is focused on current societal challenges and upcoming global requirements, translated into three main mobilizing projects (MP): Mobilizing Project 1 – Sustainable Manufacturing Solutions; Mobilizing Project 2 - Technologies for the Wellbeing; and Mobilizing Project 3 - Research Infrastructure, involving TEMA's members as one coherent group. MP1 is focused on the development and innovation on manufacturing engineering and technologies, with subsequent industrial applications. It is intended to increase productivity, improve products'quality and reduce waste in production processes. The strategy of the MP2 aims to increase the quality of life of society by means of engineering systems, focusing on people and their needs. MP3 aims at a rational and efficient management of TEMA's material and human resources (including its 14 laboratories), its vast array of scientific equipment in a large diversity of areas available to society, making the research infrastructure an "open facility" for several (academic, research and industry) end-users.

Recently, PM3 had new developments, namely in joint participation in two new projects (call) of the National Infrastructure Roadmap:
1 – TEMA+
With Researchers from TEMA, and i3S-University of Porto.
TEMA+ provides the physical, chemical, and structural characterization of materials, allowing the development of new products and processing techniques, in order to help promote greater efficiency and sustainability in the use of resources. The infrastructure helps companies transform science and knowledge into products, processes, and services, as well as supporting the scientific community by providing advanced laboratory facilities.
TEMA+ is made up of 18 diverse laboratories equipped to respond to a comprehensive set of services focused on academia and industry.
2 - Portuguese advanced materials surface characterization – PT|MATSURF
With Researchers from Universidade NOVA de Lisboa/I3N|NOVA; Universidade de Trás-os-Montes e Alto Douro/CQVR; International Iberian Nanotechnology Lab./INL; Universidade do Porto/CEMUP; Universidade do Minho/SEMAT|3Bs; Universidade de Aveiro/ CICECO|I3N|TEMA; Universidade de Coimbra/CEMMPRE; Universidade de Lisboa/IST; and Universidade de Évora/HERCULES.

PT|MATSURF is a distributed RI (9 nodes) covering all the universities with research efforts in Materials Science and Physical Sciences, from North to South regions, being coordinated by i3N|NOVA. PT|MATSURF is specialized in the surface analysis of advanced materials, including state-of-the-art instruments operated by highly specialized personnel. This RI is a unique and world class facility, whose investment, running, and maintenance costs are relatively high in comparison to other RIs, but whose importance and strategic character justifies its presence to the entire R&D community, industry, and society as a whole. The aim of PT|MATSURF is to provide an unprecedented collection of nano-scale surface analysis instrumentation to be used for the characterization of a wide variety of innovative materials/interfaces. The surface analysis of advanced materials has become a well-known and strategic area due to the growth of research dedicated to nanotechnology and nanostructured materials in a very large range of fields, such as microelectronics, optoelectronics, heterogeneous catalysis, anti-corrosive/anti-wear coatings, biomedicine, biotechnology, gas sensing, etc. The importance of surface analysis is constantly increasing due to the downscaling of devices and the increasing role of processes taking place on the materials surface, defining the growing demand for the surface characterization of innovative materials.

Presently, PT|MATSURF RI laboratories are equipped with major surface analysis techniques: XPS (7), UPS (3) AFM (9), TOF-SIMS (1), SAM (1), ISS (2), and REELS (1), as well as complementary thin film characterization techniques such as micro-Raman (5) and FTIR (6), representing already a direct investment of ~15 M€, which is essential for fundamental and applied research in Materials Science, Nanotechnology and Physical Sciences.

This RI has a multidisciplinary nature and aims to fill a gap of the Portuguese Roadmap of RI.

TEMA is also actively working on the new Intelligent Systems Associate Laboratory (LASI). TEMA was part of the creation of LASI, which consists of 13 Research Units(ALGORITMI Research Center; Applied Artificial Intelligence Laboratory (2Ai); Artificial Intelligence and Computer Science Laboratory (LIACC); Centre for Informatics and Systems of the University of Coimbra (CISUC); Centre for Mechanical Technology and Automation (TEMA); Centre of Mathematics of the University of Porto (CMUP); Centre of Technology and Systems (CTS); Coimbra Institute for Biomedical Imaging and Translational Research (CIBIT); Institute for Polymers and Composites (IPC); Institute of Electronics and Informatics Engineering of Aveiro (IEETA); Research and Development Unit for Mechanical and Industrial Engineering (UNIDEMI); Research Centre in Real-Time and Embedded Computing Systems (CISTER); Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development (GECAD)), with more than 500 PhD researchers. This is a unique opportunity to leverage the growth of the TEMA at all levels, from the financial to the scientific.

LASI establishes five inter-disciplinary research thematic lines to give response to social, scientific, health, sanitary, social, economic, and environmental challenges. The goal is to pave the next generation of knowledge and technologies for the development and transformation of the industry and society. In fact, each thematic line aims to tackle specific societal challenges, going from good health (UN's Goal 3), quality education (UN's Goal 4), and gender equality (UN's Goal 5), to renewable and sustainable energy (UN's Goal 7), better jobs and economic growth (UN's Goal 8), innovation and infrastructure (UN's Goal 9), reduced inequalities (UN's Goal 10), smart and sustainable cities (UN's Goal 11), Climate Action (UN's Goal 13), and boost partnerships (UN's Goal 17). Within the Portuguese landscape, the goals are also set to answer societal challenges, including demographic changes and well-being; safe, clean, and efficient energy; intelligent, ecological, and integrated transportation systems; and inclusive, innovative, balanced, and fair societies. Innovative and Sustainable Industries is a thematic line that focuses on advanced manufacturing, decarbonization, factories of future, green AI, Industry 5.0, intelligent materials and products, and collaborative robotics. On the other hand, Smart Cities, Mobility and Energy aims to promote sustainable and green cities, focusing on urban computing, intelligent transportation systems, e-Citizenship as well as intelligent environments. The Health and Well-being thematic line focuses on active ageing, ambient assisted living, and smart intervention with personalized health, biomedical informatics, and medical robotics. Infrastructures and Highly Connected Society aims to tackle all society specific challenges based on methods and techniques that include cyber security, quantum computing, computational support, internet of things, and virtualization. Finally, the Public Administration and Governance research line focuses on E-governance, digital transformation, ethics, data protection and privacy, e-Services, and fair and effective governance.

Aveiro, May 19th, 2022
The Director,
António Bastos Pereira

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Book of abstracts

Constitutive models and statistical analysis of the short-term tensile response of geosynthetics after damage

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Abstract — Geosynthetic is a generic name given to planar products, mostly composed of thermoplastic polymers, and used in contact with soil, rock or with any other material as part of a construction system [1]. Geosynthetics have several functions and may perform more than one simultaneously, such as soil reinforcement, stabilization of steep slopes, filtration, drainage, fluid barrier, erosion control and coastal protection [2].

The objective of this research was to analyse the short-term tensile response of three geosynthetics using the procedures described by [3], and to apply constitutive equations to represent the nonlinear behaviour of the materials. Data on specimens of a nonwoven polypropylene geotextile (GTX), a woven polyester geogrid (GGR) and a reinforcement polyester geocomposite (GCR) were analysed. Some specimens of each material were submitted to mechanical damage [4], abrasion [5], and mechanical damage followed by abrasion. Nonlinear regressions of the experimental data were performed to fit the load-strain curves to a hyperbolic-based equation depending on the tensile response of the geosynthetic: type A (GTX) or type B (GGR and GCR) [6]. For each geosynthetic, the results of damaged specimens were statistically compared to those of the undamaged specimens to observe the influence of the induced damage on the tensile behaviour of the material. Experimental data were statistically compared with those fitted by the constitutive models to verify if the tensile properties were properly estimated – namely the secant stiffness for 2% strain, the ultimate tensile strength, and the strain at maximum load.

For the GTX, significant changes in tensile properties occurred only after mechanical damage followed by abrasion. For the GGR and the GCR, abrasion was the predominant damage due to considerable changes in the tensile properties and the shape of the load-strain curves. In general, the hyperbolic-based models presented good approximation of the empirical data. Curves for damaged materials were plotted using undamaged model parameters and applying adjustment coefficients and reduction factors allowing for damage, in which the goodness-of-fit was considered promising.

Keywords — Geosynthetics; constitutive models, hypothesis tests, tensile response; mechanical damage, abrasion damage.

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TOPIC

1) Sustainable Manufacturing Solutions
    a. Manufacturing Processes & Simulation

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