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ECOCORK

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Contents

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- Ecocork Newspaper
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ECOCORK

- Ecocork is an Erasmus+ project that focusses on Cork in Aerospace.
- Budget: 269.045 Euro
- Duration: 2020-2023
- Aims:
  - To have knowledge on cork composites
  - To understand the eco-friendly and sustainable properties of cork
  - To know about cork sectors
  - To discover potantial sectors for cork
  - To study about cork composites in aerospace industry

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Partners

- Eskişehir Osmangazi Üniversitesi, Türkiye
- University of Aveiro, Portugal
- Vilnius Gediminas Technical University, Lithuania
- Wrocław University of Science and Technology, Poland
- Catalan Institute of Cork, Spain
- Amorim Cork Composites, Portugal

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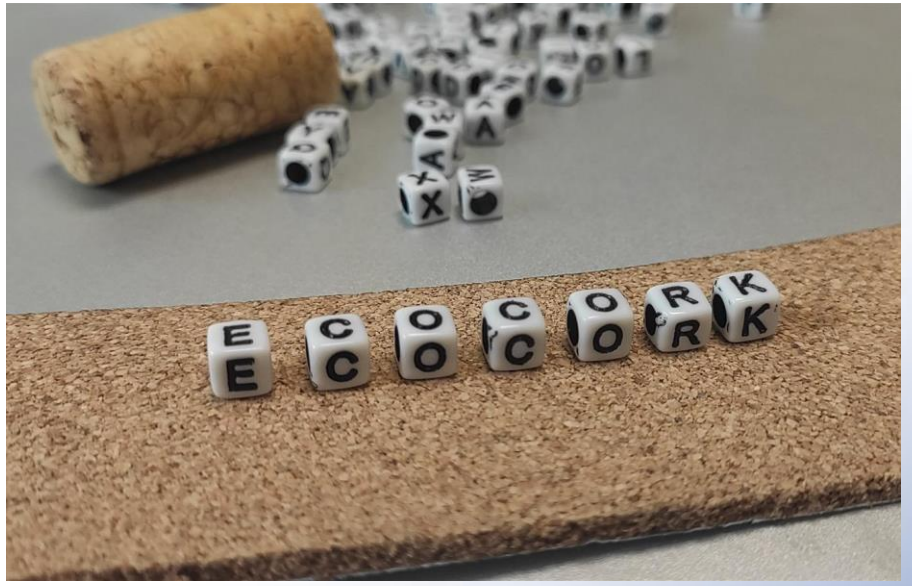
Organization

The organization scheme consists of;

- *Steering Commitee*
- *Project Management Teams*
- *Quality Management Team*



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Activities

Transnational Meetings

- In Ecocork, 5 TPMs were held in different locations.
- Intellectual outputs, organizations, dissemination activities, scientific works etc. were discussed in TPMs.

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Activities

Learning/Teaching/Training

- 5 LTTs were organized in each partner.
- Each LTT lasted 1 week.
- Students were selected from the departments given below.
  - Aerospace Engineering
  - Mechanical Engineering
  - Materials Engineering
  - Electronical Engineering
  - Pilot Training
  - Air Traffic Control

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Activities

Learning/Teaching/Training

Number of students:

- ESOGU: 32
- Aveiro: 26
- Vilnius: 29
- Wroclaw: 30

TOTAL: 117

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Activities

Learning/Teaching/Training

- ***Introduction to Cork Science: Cork Cultivation, Harvesting and Processing***

Amorim Cork Composites

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Activities

Learning/Teaching/Training

- ***Sustainability, Carbon Footprint and Potential Products of Cork***

Catalan Cork Institute (ICSURO)

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Activities

Learning/Teaching/Training

- ***Sectors for Cork Products, Cork Properties and Future Trends for Cork***

Wrocław Uni of Science and Technology

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Activities

Learning/Teaching/Training

- ***Manufacturing and Implementation of Cork-Based Composites in Aviation***

Vilnius Gediminas Technical University

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Activities

Learning/Teaching/Training

- ***Aeronautical/Space Applications of Cork Composites***

Eskişehir Osmangazi University

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Activities

Conferences

During Ecocork, two International Conferences were organized.

«*International Conference on Technologies for the Wellbeing and Sustainable Manufacturing Solutions*»

was held in May 2022 and May 2023 at Aveiro.

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Activities

Conferences

The paper «Sustainable and Eco-friendly Cork Composite in Aerospace Engineering» was presented in the first Conference in 2022.

universidade de aveiro | dem department of mechanical engineering | tema centre for mechanical technology and automation

Sustainable and Eco-friendly Cork Composites in Aerospace Engineering

Educational Perspective for Cork Composites in Aerospace Applications

*Susana Silva [a], Fábio Fernandes [b] *, Ricardo Sousa [b], António Pereira [b], Maria Verdum [c], Albert Mares [c], Mariusz Ptak [d], Marek Sawicki [d], Virginija Leonavičiūtė [e], Justas Nugaras [e], Melih Cemal Kuşhan [f], Alper Sofuoğlu [f], Selim Gürgen [f]*

(a) – Amorim Cork Composites, Portugal; (b) – TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, Portugal; (c) – Catalan Institute of Cork, Spain; (d) – Wroclaw University of Science and Technology, Poland; (e) – Vilnius Gediminas Technical University, Lithuania; (f) – Eskişehir Osmangazi University, Turkey

(b*) – fabiofernandes@ua.pt

***Abstract*— Materials science is continuously being developed, and major industries take advantage of cutting-edge technologies in their applications. Since lightweight materials with superior strength are demanded by the market, composites have come to the fore as the substituent for metal alloys. Although the technical side of industrial applications is compensated by the rise of composites, sustainability and eco-friendly properties of materials, which have important places within the EU policy areas, still require efforts from institutes and companies. At this juncture, composites produced from natural materials such as cork become more of an issue due to their environmentally friendly properties. Leading companies make investments in this issue. Still, there is a lack of human resources in the field since syllabuses in engineering programs focus on technical sides rather than the environmental effects of engineering materials. This work aims to develop educational tools for gaining environmental awareness of eco-friendly composites as well as understanding the importance of cork composites in sustainability. Within this scope, an educational scheme was developed, focusing on individuals at the college level, leading to the development of curricula, course materials, and learning platforms as well as organizing internships for the students. Staff skills are enhanced in a particular and promising field with the interactions between pacemaker partners. The industrial partner contributes to the preparation of training programs on sustainability and carbon footprint of cork products since it is a leading cork producer globally. In addition, this partner provides internship positions for engineering students. Within this scope, there is an established bridge from the homeland of cork (Portugal and Spain) to Eastern Europe, where vast amounts of investments have been paid for aerospace applications. Hence, there is a chance to have a good partnership in developing sustainable cork composites for the aerospace industry. In this work, the main target group is engineering students, while research staff also benefit from this partnership. In the current educational system, engineering students are led to pure technical courses and thus, students who graduated from engineering faculties feel a lack of environmental consciousness. This point is crucial for humanity because competition in the market leads to rapidly growing technologies, resulting in irreversible processes harmful to the environment. For this reason, technology developers, mainly engineers, should be aware of the side effects on the environment and humanity. Hence, we aim to gain awareness in the aerospace industry to use eco-friendly and sustainable cork composites. The main reason for selecting the aerospace industry as the implementation sector is that the aerospace industry is familiar with cork in aircraft, helicopters, and space shuttles. Moreover, aerospace industry is the leading sector for the development of composites since vast amounts of investments are made by the companies, resulting in significant scientific and technological developments.**

***Keywords*— sustainability; cork; aerospace applications.**

ACKNOWLEGEMENTS

This work is produced within the project "Educational Development for Sustainable and Eco-friendly Cork Composites in Aerospace Applications (ECOCORK)", which is funded by the Erasmus+ Program of the European Union - 2020-1-TR01-KA203-092763.

TOPIC

1) Sustainable Manufacturing Solutions
   c. Manufacturing for Circular Economy

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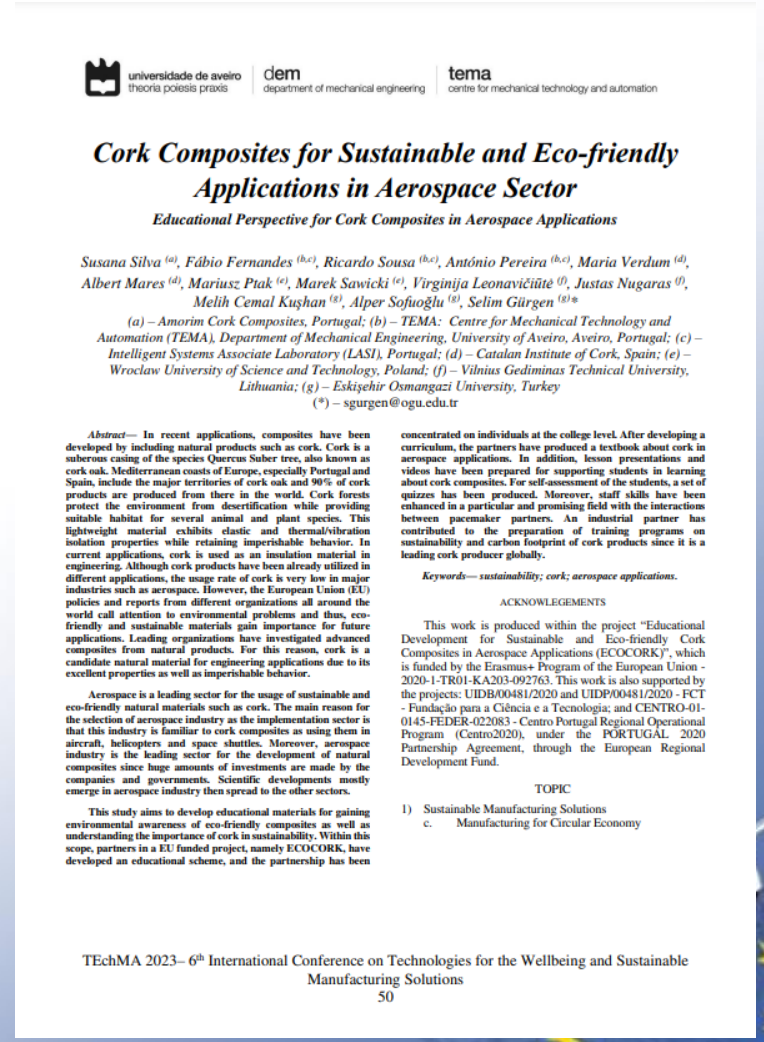
Activities

Conferences

The paper «Cork Composites for Sustainable and Eco-friendly Applications in Aerospace Sector» was presented in the second Conference in 2023.



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Cork Composites for Sustainable and Eco-friendly Applications in Aerospace Sector

Educational Perspective for Cork Composites in Aerospace Applications

*Susana Silva [a], Fábio Fernandes [b,c], Ricardo Sousa [b,c], António Pereira [b,c], Maria Verdum [d], Albert Mares [d], Mariusz Ptak [e], Marek Sawicki [e], Virginija Leonavičiūtė [f], Justas Nugaras [f], Melih Cemal Kuşhan [g], Alper Sofuoğlu [g], Selim Gürgen [g]**

(a) – Amorim Cork Composites, Portugal; (b) – TEMA: Centre for Mechanical Technology and Automation (TEMA), Department of Mechanical Engineering, University of Aveiro, Aveiro, Portugal; (c) – Intelligent Systems Associate Laboratory (LASI), Portugal; (d) – Catalan Institute of Cork, Spain; (e) – Wroclaw University of Science and Technology, Poland; (f) – Vilnius Gediminas Technical University, Lithuania; (g) – Eskişehir Osmangazi University, Turkey

(*) – sgurgen@ogu.edu.tr

***Abstract*— In recent applications, composites have been developed by including natural products such as cork. Cork is a suberous casing of the species Quercus Suber tree, also known as cork oak. Mediterranean coasts of Europe, especially Portugal and Spain, include the major territories of cork oak and 90% of cork products are produced from there in the world. Cork forests protect the environment from desertification while providing suitable habitat for several animal and plant species. This lightweight material exhibits elastic and thermal/vibration isolation properties while retaining imperishable behavior. In current applications, cork is used as an insulation material in engineering. Although cork products have been already utilized in different applications, the usage rate of cork is very low in major industries such as aerospace. However, the European Union (EU) policies and reports from different organizations all around the world call attention to environmental problems and thus, eco-friendly and sustainable materials gain importance for future applications. Leading organizations have investigated advanced composites from natural products. For this reason, cork is a candidate natural material for engineering applications due to its excellent properties as well as imperishable behavior.**

Aerospace is a leading sector for the usage of sustainable and eco-friendly natural materials such as cork. The main reason for the selection of aerospace industry as the implementation sector is that this industry is familiar to cork composites as using them in aircraft, helicopters and space shuttles. Moreover, aerospace industry is the leading sector for the development of natural composites since huge amounts of investments are made by the companies and governments. Scientific developments mostly emerge in aerospace industry then spread to the other sectors.

This study aims to develop educational materials for gaining environmental awareness of eco-friendly composites as well as understanding the importance of cork in sustainability. Within this scope, partners in a EU funded project, namely ECOCORK, have developed an educational scheme, and the partnership has been concentrated on individuals at the college level. After developing a curriculum, the partners have produced a textbook about cork in aerospace applications. In addition, lesson presentations and videos have been prepared for supporting students in learning about cork composites. For self-assessment of the students, a set of quizzes has been produced. Moreover, staff skills have been enhanced in a particular and promising field with the interactions between pacemaker partners. An industrial partner has contributed to the preparation of training programs on sustainability and carbon footprint of cork products since it is a leading cork producer globally.

***Keywords*— sustainability; cork; aerospace applications.**

ACKNOWLEGEMENTS

This work is produced within the project "Educational Development for Sustainable and Eco-friendly Cork Composites in Aerospace Applications (ECOCORK)", which is funded by the Erasmus+ Program of the European Union - 2020-1-TR01-KA203-092763. This work is also supported by the projects: UIDB/00481/2020 and UIDP/00481/2020 - FCT - Fundação para a Ciência e a Tecnologia; and CENTRO-01-0145-FEDER-022083 - Centro Portugal Regional Operational Program (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund.

TOPIC

1) Sustainable Manufacturing Solutions
   c. Manufacturing for Circular Economy

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Intellectual Outputs

Five moduls were desgined in IOs.

- **Modul-1:** Introduction to Cork Science: Cork Cultivation, Harvesting and Processing
- **Modul-2:** Sustainability, Carbon Footprint and Potential Products of Cork
- **Modul-3:** Sectors for Cork Products, Cork Properties and Future Trends for Cork
- **Modul-4:** Manufacturing and Implementation of Cork-Based Composites in Aviation
- **Modul-5:** Aeronautical/Space Applications of Cork Composites

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Intellectual Outputs

Üretilen fikri çıktılar;

- Educational Curriculum
- Educational Materials
  - Books
  - Lesson presentations
  - Lesson review presentations
  - Lesson summary presentations
  - Quizzes
  - Video lectures
  - Video reviews
  - Video summaries
- E-Learning Platform
- A Case Study with Cork Composites

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Educational Curriculum

Educational Curricula were designed by considering;

- Modul description
- Target groups
- Learning aims
- References – sources
- Self assesment

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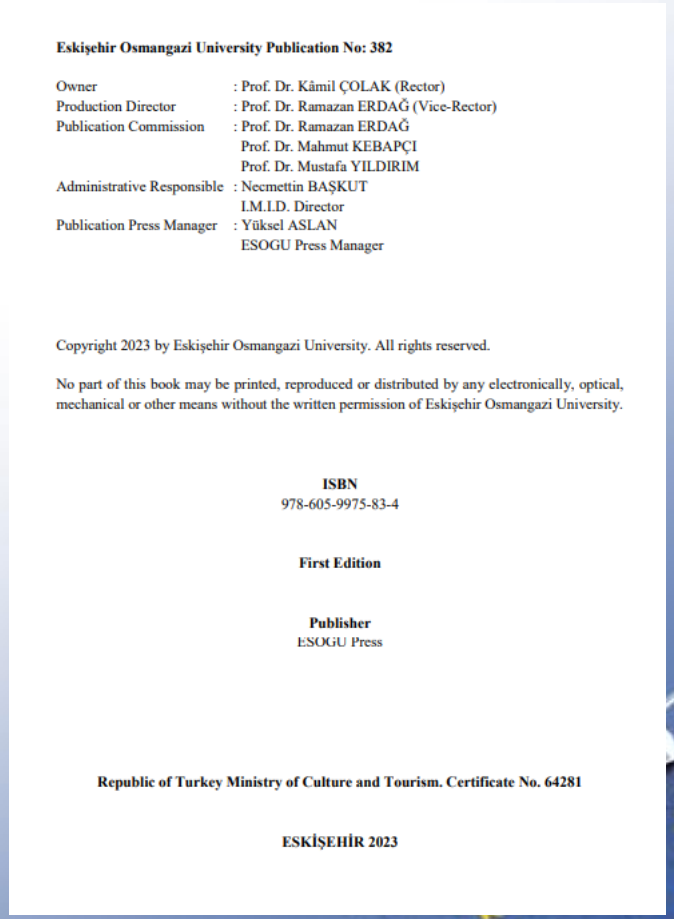
Educational Materials

Educational Materials include;

- Books
- Lesson presentations
- Lesson review presentations
- Lesson summary presentations
- Quizzes
- Video lectures
- Video reviews
- Video summaries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ESKİŞEHİR 2023

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Educational Materials

- The English version of the book «*Cork in Aerospace: Cultivation to Application*» was published by ESOGU Press.
- ESOGU team took the role of editorship in this book.
- Partners translated the book in their local languages.

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E-Learning Platform

- This platform includes all the materials produced in the previous stage.
- The materials are Open Access to reach out all the targets.
- Anyone is able to have these outputs.
- This platform is designed based on Open University mentality.

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A Case Study

In the context of «Cork Composites in Aerospace», a drone application was designed by using cork.

Cork has;

- Low density (0.15–0.25 g/cm³)
- High vibration insulation
- Advanced energy absorbing
- Eco-friendly behavior

So that a drone is produced by using cork composites in the structures.

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A Case Study

- The main frame of the drone was produced with cork based materials.
- A sandwich structure was desgined for this application.
- Cork was used in the core material while facesheets were produced with CFRP.

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Scientific Studies

JOURNAL OF THEORETICAL AND APPLIED MECHANICS
60, 4, pp. 593-602, Warsaw 2022
https://doi.org/10.15632/jtam-pl/152970

VIBRATION DAMPING CHARACTERISTICS OF THE CORK-BASED COMPOSITE MATERIAL IN LINE WITH FREQUENCY ANALYSIS

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Contents lists available at ScienceDirect
Composite Structures
journal homepage: www.elsevier.com/locate/compstruct

Anti-impact design of multi-layer composites enhanced by shear thickening fluid

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Contents lists available at ScienceDirect
Composite Structures
journal homepage: www.elsevier.com/locate/compstruct

Smart polymer integrated cork composites for enhanced vibration damping properties

Selim Gürgen [a,*], Mehmet Alper Sofuoğlu [b]
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[b] *Department of Mechanical Engineering, ESOGU, 26480 Eskişehir, Turkey*

Contents lists available at ScienceDirect
Composite Structures
journal homepage: www.elsevier.com/locate/compstruct

New hybrid cork-STF (Shear thickening fluid) polymeric composites to enhance head safety in micro-mobility accidents

Gabriel Ferreira Serra [a,d], Fábio A.O. Fernandes [a,d], Ricardo J. Alves de Sousa [a,d], Eduardo Noronha [b], Mariusz Ptak [c,*]
[a] *TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal*
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[c] *Faculty of Mechanical Engineering, Wroclaw University of Science and Technology, Łukasiewicza 7/9, 50-371 Wroclaw, Poland*
[d] *LASI—Intelligent Systems Associate Laboratory, Portugal*

Archives of Civil and Mechanical Engineering (2023) 23:2
https://doi.org/10.1007/s43452-022-00544-z

machines

Article

Energy-Absorbing and Eco-Friendly Perspectives for Cork and WKSF Based Composites under Drop-Weight Impact Machine

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Applied Composite Materials (2021) 28:165–179
https://doi.org/10.1007/s10443-020-09859-7

ORIGINAL ARTICLE

Deceleration behavior of multi-layer cork composites intercalated with a non-Newtonian material

Mohammad Rauf Sheikhi[1,2] · Selim Gürgen[3]

Received: 24 June 2022 / Revised: 4 September 2022 / Accepted: 1 October 2022 / Published online: 10 October 2022

HAVACILIK VE UZAY YAPILARINDA MANTAR KOMPOZİTLER VE ECOCORK PROJESİ

Doç. Dr. Selim Gürgen
Eskişehir Osmangazi Üniversitesi
Uçak Mühendisliği Bölümü
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Development of Eco-friendly Shock-absorbing Cork Composites Enhanced by a Non-Newtonian Fluid

Selim Gürgen[1] · Fábio A. O. Fernandes[2] · Ricardo J. Alves de Sousa[2] · Melih Cemal Kuşhan[3]

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Ecocork Newspaper


Seasonal Magazine — Issue 1 (December 2021)

news ecoCORK

Welcome to the first issue of ECOCORK magazine.

ECOCORK is a three-year (2020-2023) ERASMUS+ funded project to gain environmental awareness in the applications of cork composites as well as understanding the importance of eco-friendly natural composites in sustainability.

ICSURO ?

Catalan Institute of Cork (ICSURO) *is dedicated to cork science researches. The Institute name proves a strong experience in cork science for many years. The Cork Center, the laboratory of the Catalan Cork Institute was created in 2001 to provide services to the different components of the value chain in the cork sector.*

First Student Training activity was organized at ICSURO!

Students from partners joined the first training program at ICSURO. There were 24 students from four partner universities while one staff from each partner accompanied with the students. In this organization, experts in cork science shared their experiences with the students. There was a busy training program during the event. Main topics in this event were;

- cork and sustainability
- carbon footprint of cork products
- potential uses of cork

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Seasonal Magazine — Issue 2 (April 2022)

news ecoCORK

Student Training at WUST !

Polish partner WUST organized a great training program for participants. The program was on sectors for cork products, cork properties and future trends for cork. Experts shared their knowledge about mechanical behavior of cork composites, cork reponse under impact and dynamic properties of cork structures. Students were also introduced to **TRIZ** method «*theory of inventive problem solving*». As the engineers of future, participants will benefit from this unique training in their professional business lives. Training at WUST provided great experience for the participants.

Wroclaw University of Science and Technology

Wroclaw University of Science and Technology (WUST) *is notable for cork composites and has jointly studied with University of Aveiro in a long-term collaborations. WUST team is good at mechanical side of cork composites. They conduct several great works on impact behavior and mechanical properties of cork composites.*

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Seasonal Magazine — Issue 3 (August 2022)

news ecoCORK

AMORIM CORK COMPOSITES

Amorim Cork Composites (ACC) *is one of the largest and dynamic multinationals of Portuguese origin. Its origins were back in 1870 and today it is the world leader in the sector. It is also willing to serve the aerospace industry since cork products have been recognized in aerospace due to their properties.*

Since the Scout rockets in the 1960´s passing through the iconic Space Shuttle to today's Falcon, Delta or Ariane and Vega programs, ACC has consistently supplied quality grade products to the Aerospace industry.

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Seasonal Magazine — Issue 4 (December 2022)

news ecoCORK

Vilnius Gediminas Technical University *has experience in projects under the Erasmus+, Horizon2020, Marie-Curie and other EU funded programs. It has strong experience. Dean of Aviation Institute has been awarded Quality of the Year award by National Agency of Lithuania.*

Antanas Gustaitis' Aviation Institute is licensed by the Transport Competence Agency. There is an Aviation Training Center in Vilnius Technical University. Pilot training is carried out in this center by using an airfield and flight simulators.

LTT-4 event was held between 3 and 7 Oct. in Vilnius, Lithuania. Students from all the partners met the Antanas Gustaitis' Aviation Institute at Vilnius Gediminas Technical University.

The students visited the facilities in the Antanas Gustaitis' Aviation Institute. This center provides great opportunities for the students. Some of the facilities are:

- Airfield
- Aircraft Fleet
- Flight Simulators
- Aviation Labratories

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During the training event at Vilnius, the students learned about aircraft components, manufacturing of components and cork based products in aircraft parts.

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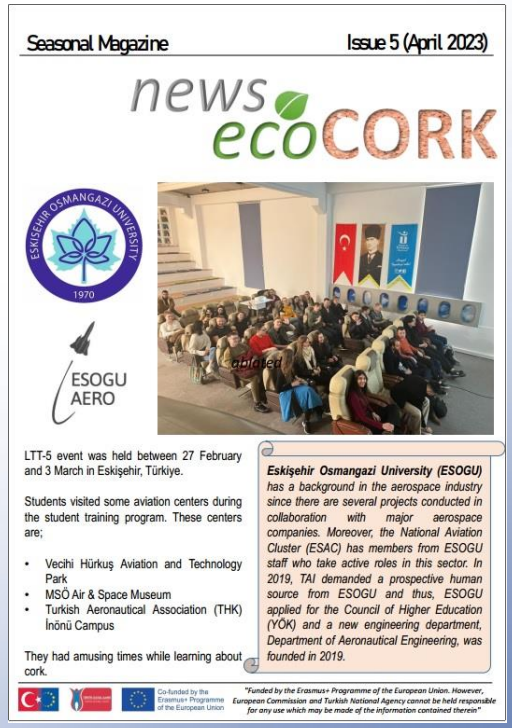
Seasonal Magazine — Issue 5 (April 2023)

news ecoCORK

ESOGU AERO

LTT-5 event was held between 27 February and 3 March in Eskişehir, Türkiye.

Students visited some aviation centers during the student training program. These centers are;

- Vecihi Hürkuş Aviation and Technology Park
- MSÜ Air & Space Museum
- Turkish Aeronautical Association (THK) İnönü Campus

They had amusing times while learning about cork.

Eskişehir Osmangazi University (ESOGU) *has a background in the aerospace industry since there are several projects conducted in collaboration with major aerospace companies. Moreover, the National Aviation Cluster (ESAC) has members from ESOGU staff who take active roles in this sector. In 2019, TAI demanded a prospective human source from ESOGU and thus, ESOGU applied for the Council of Higher Education (YÖK) and a new engineering department, Department of Aeronautical Engineering, was founded in 2019.*

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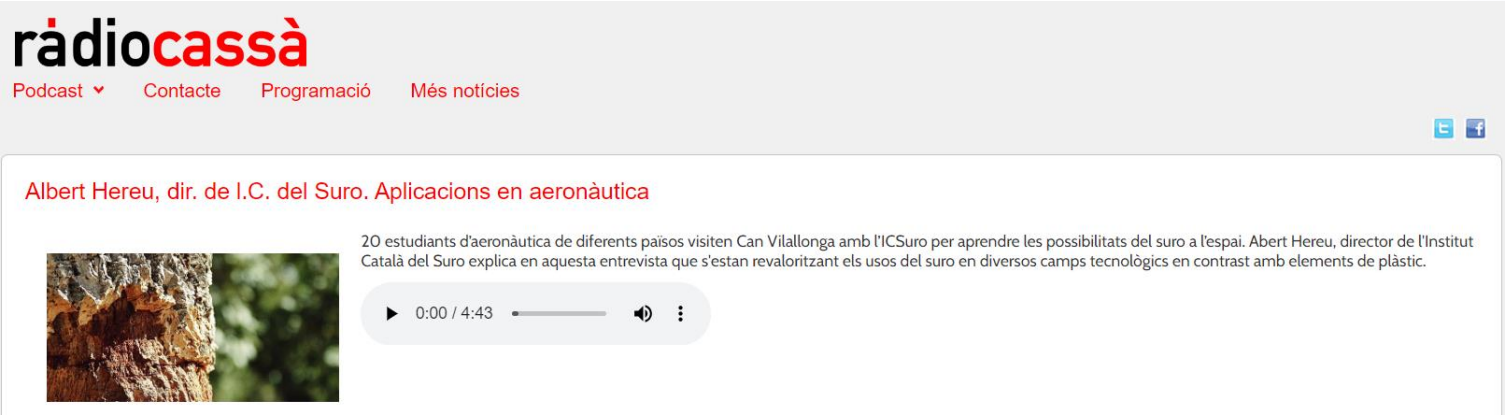
Promotion and Dissemination



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Promotion and Dissemination

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Thank you!...

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