INCREaSE 2023

INternational CongRess on Engineering and Sustainability in the XXI cEntury

JULY 5–7, 2023
Algarve – Faro, PORTUGAL

BOOK OF ABSTRACTS
POSTER SESSIONS

Editors
Gonçalo Prates
Jorge Semião
Nelson Sousa
Rui Cruz

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3rd International Congress on Engineering and Sustainability in the XXI Century
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Faro, Portugal, July 5–7, 2023

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Preface

This book presents the abstracts of the posters' presentations of the 3rd International Congress on Engineering and Sustainability in the XXI Century, INCREaSE 2023. This book includes 31 abstracts from authors from different countries in several transversal areas, such as Climate Change, Food Safety and Quality Engineering, Sustainability in Water Management, Information Technology and Artificial Intelligence Applied to Sustainability, and Sustainable Building Technologies.

INCREaSE 2023 was organized by the Institute of Engineering and hosted by the University of Algarve during July 5-7, 2023, in Faro, Portugal.

The members of the organizing committee, reviewers, and authors contributed with their dedicated work and efforts for the success of the congress.

Thank you all!

July 2023

Editors
Gonçalo Prates
Jorge Semião
Nelson Sousa
Rui Cruz

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Nuno Ramos[1*] and Lília Alexandre[1]

[1] ISEC Lisboa, Alameda das Linhas de Torres, 179, 1750-142 Lisboa, Portugal
*email: 20210674@alunos.iseclisboa.pt

Abstract. Cement industry is responsible for 8 % of global carbon emissions, with concrete being the second most used material on the planet after water. Global demand for cement is expected to increase 48 % (4.2 to 6.2 billion tonnes) by 2050, mainly driven by developing nations. Scientists and Governments have called for increasingly stringent greenhouse gas emissions targets due to climate change. Reaching such goals by 2050 will be technically challenging for cement industry. In response to the decarbonization challenge and transitioning towards a net-zero economy, Secil Group leads the way with innovative solutions, laying foundations for zero-carbon cement. Main project to implement, *Clean Cement Line* (CCL), is targeting to reduce annually 164 $ktCO_2$, 811 Tj thermal energy and 41 GWh electric energy. CCL includes the technologies *Low Carbon Clinker* (LCC), *Clean4G*, *Zero Fossil Fuel*, *Combustion Boost* and *Sun2dry*. Other projects *BeInAHand*, *BeCharged*, *Baterias2030*, *OnThermalHp*, complement the commitment on sustainability and carbon emissions cut in their operations. Additionally, *Betão Verdi Zero*, *Climate Impact Partners* certified, is the first *CarbonNeutral*® concrete in Portugal, contributing with 24 % (vs. 10 % standard) recycled raw materials, integrating 14 % industry ashes. *Betão Verdi Zero* offsets emissions supporting energy and reforestation projects, contributing and developing local economies in the North Cape Wind (South Africa), the Solar Water Heating (India), and the Degraded Grasslands Afforestation (Uruguay), reducing 873, 436 and 145 tCO_2e in their carbon footprint respectively. Secil Group is at the forefront of decarbonization efforts in the cement industry, showcasing their commitment to sustainability through innovative technologies and practices.

Keywords: Decarbonization; Cement industry; Secil Group; Clean cement line; Betão verdi zero.

Alkalinity enhancement in intertidal environments: a tool to mitigate climate change?

Isabel Mendes[1*], Julia Lübbers[1], Alexandra Cravo[1], Joachim Schönfeld[2], Cátia Correia[1], Patricia Grasse[3], A. Rita Carrasco[1], Ana Gomes[4]

[1] Centre for Marine and Environmental Research (CIMA) - Infrastructure Network in Aquatic Research (ARNET), Universidade do Algarve, Faro, Portugal
[2] Helmoltz Centre for Ocean Research Kiel (GEOMAR), Germany
[3] German Centre for Integrative Biodiversity Research Halle-Jena-Leipzig (iDiv), Germany
[4] Centro Interdisciplinar de Arqueologia e Evolução do Comportamento Humano (ICArEHB) – Universidade do Algarve, Portugal
*email: imendes@ualg.pt

Abstract. Despite all efforts made during the last decades to reduce CO_2 emissions, the implemented political and technical measures are still insufficient to stop temperature rise. Marine alkalinity enhancement is one of the carbon dioxide removal measures, with high potential to increase oceanic carbon uptake and storage. Recent modelling and laboratory studies show that this process could be enhanced by deploying fine-grained alkaline minerals (e.g., olivine, basalt) to the ocean and coastal areas to mitigate climate change on shorter timescales. However, field experiments are required to evaluate the CO_2 sequestration potential, associated biogeochemical changes as well as the ecological impacts of ocean alkalinity are still missing. To contribute to answer to these constraints, the first European in-situ experiment, continually monitored for 2 years, was installed in the Ria Formosa Coastal Lagoon, southern Portugal. The experimental set-up was installed in September 2022, in the middle saltmarsh, and includes three replicates with five treatments each, coarse and fine olivine, coarse and fine basalt, and untreated control. Lagoonal, supernatant, and porewater waters are sampled from each treatment every month and analyzed for temperature, salinity, oxygen concentration, pH, total alkalinity, nutrients, and trace metals. Preliminary data show an increase in total alkalinity in the supernatant and porewaters shortly after minerals deployment, which have been decreasing through time. Sediment samples are analyzed for faunal and floral composition, for monitoring potential biodiversity changes. This novel field experiment will provide strategic knowledge on the benefits and risks of alkalinity enhancement in intertidal environments, contributing to understand if this tool is a suitable and applicable upscale measure to combat climate change and its impacts.

Keywords: Climate action, Carbon reduction, alkaline minerals, field experiment, Ria Formosa.

Acknowledgement. Research supported by the Portuguese Science Foundation, with the projects PTDC/CTA-CLI/1065/2021, UID/00350/2020CIMA, LA/P/0069/2020 and contracts DL57/2016/CP1361/CT0009, DL57/2016/CP1361/CT0002 and CEECINST/00146/2018/CP1493/CT0002.

Identification of potential district heating networks in Temuco and Valdivia (Chile) using bottom-up energy mapping

François Simon[1]

[1] Centro de Desarrollo Urbano Sustentable (CEDEUS), Pontificia Universidad Católica de Chile, Santiago, Chile
email: francois.simon@uc.cl

Abstract. District heating (DH) systems based on combined heat and power (CHP) generation have the potential to reduce household energy-related greenhouse gas (GHG) emissions, particularly in communities with high heating demand. The planning and design of DH networks require the heating demand to be mapped geographically so that thermal energy could be generated and distributed in an energy-efficient manner. The work introduces a bottom-up method for mapping the residential heating demand in Temuco and Valdivia, two mid-size cities of south-central Chile, where space heating accounts for 80 % of the total domestic energy consumption. The assessment of the energy demand and GHG emissions is carried out by processing data obtained from a questionnaire survey, which was conducted in August 2022. The survey collected information about i) energy expenditure by fuel type, ii) building type, and iii) household socioeconomic characteristics. In total, 384 households responded to the survey. The calculated household annual energy consumption and GHG emissions are weighted based on census data of population, building type, and household socio-economic level to account for unequal probability of home selection and clustering. Then, maps of energy consumption and GHG emission are developed using georeferenced data of household densities. The areas that have sufficient heating demand are pointed out for the development of DH systems based on wood-fueled CHP generation. Results show that the implementation of such systems can reduce household energy-related GHG emissions by 31 % on average in the cities under study. The findings can be useful for planners in developing DH network systems.

Keywords: District heating, Household energy demand, GIS energy mapping, Greenhouse gas emission, Chile.

Addressing the issue of siloxanes in biogas from wastewater treatment plants

Nuno Ratola[1,2*], Vera Homem[1,2] and Arminda Alves[1,2]

[1] LEPABE – Laboratory for Process Engineering, Biotechnology and Energy, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal
[2] ALiCE - Associate Laboratory in Chemical Engineering, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
*email: nrneto@fe.up.pt

Abstract. Volatile methyl siloxanes (VMSs) are ubiquitous anthropogenic organic chemicals that are present in the formulations and manufacturing processes of numerous industrial, personal care and other consumer products. They present a wide array of useful properties such as high flexibility, high thermal stability, low surface tension and lubricating characteristics. After their release into the environment, a fraction ends up in wastewater treatment plants (WWTPs). These facilities often resort to the production of biogas via anaerobic digestion to treat sludge and produce renewable energy namely through cogeneration. Due to their lipophilic and volatile nature, VMSs partition mainly to sludge and then to biogas in the digesters. When biogas is combusted, SiO_2 corrosive particles are formed and deposited in the cogeneration engine parts, causing severe damage and loss of energy yield. To address this issue, we present data from Project LANSILOT on the levels and behavior of VMS along the WWTP treatments (wastewater, sludge, biogas, and air) and the current ways and future possibilities to help the managers of WWTPs (and landfills, where a similar phenomenon occurs) to cope with the negative impact of these chemicals, while enforcing sustainable and circular economy practices.

Keywords: Volatile methyl siloxanes, Biogas, Anaerobic digestion, Renewable energy, WWTPs.

Acknowledgements: This work was financially supported by: (i) Projects LA/P/0045/2020 (ALiCE – Associated Laboratory in Chemical Engineering) and UIDB/00511/2020 and UIDP/00511/2020 (LEPABE – Laboratory for Process Engineering, Environment, Biotechnology and Energy), funded through FCT/MCTES (PIDDAC); (ii) V. Homem thanks FCT funds, under the Scientific Employment Stimulus-Individual Call - CEECIND/00676/2017.

Feasibility of hybrid plants in microregions of the state of Ceará: analysis of temporal complementary of wind-solar energy sources in selected cities in the state

Brenda Sousa de Medeiros[1], Audelis de Oliveira Marcelo Júnior[1], Eder Paulus Moraes Guerra[1*], and Enio Pontes de Deus[2]

[1] State University of Vale do Acaraú, Av. Padre Francisco Sadoc de Araújo, 850 - Alto da Brasília, Sobral - CE, 62010-295, Brazil
[2] Federal University of Ceará, Av. Humberto Monte, s/n - Pici, Fortaleza - CE, 60440-593, Brazil
*email: eder_paulus@uvanet.br

Abstract. In the search for problem solving and process optimization, engineering has been raising the flag of sustainability in recent decades. As holders of the best future perspectives for the environment, renewable energy was applied and developed in this study from its contextualization in the Brazilian scenario, focusing on the state of Ceará. The concept of hybrid plants is presented as a solution for the optimization of wind-solar parks, in order to motivate the understanding and use of these new technologies for the benefit of society. The complementarity of sources comes as a focus to be explored in the technical and academic environment, given the need for debate on the subject caused by the approaching regulatory establishment of hybrid enterprises. Due to the scarcity of research and scientific material about the wind-solar hybrid potential in Ceará, this work aims to analyze the energy potential of these sources, according to the availability of their energy resources in the state. For this, it was sought to characterize the micro-regions of the state of Ceará that presented both wind and sun data in greater intensity, thus indicating viability for hybrid plants. A quantitative statistical analysis of the hourly complementarity of solar and wind resources was performed in a city of each micro-region with greater potentials, through the Pearson Correlation Coefficient parameter. Also, to facilitate the understanding of the complementarity between the resources, graphs were made available with data of solar parameters and wind speed on a daily basis. Finally, a data validation was done through an analysis of variance to assign reliability to the study. It was possible to verify 4 regions with cities with favorable characteristics for hybrid generation. This material ends up seeking to give visibility to the hybrid potential of these regions and to enhance studies of public-private management in the area of renewable energy, serving as a reference for the incentive of these investments in Ceará.

Keywords: Hybrid plants, Microregions, Wind-solar parks, Renewable energy.

Simulation of the thermal performance of multiple rooms and associated air conditioning system without control of indoor relative humidity

Rodrigo Goddini de Oliveira Ferreira[1] and Celestino Rodrigues Ruivo[1,2*]

[1] Institute of Engineering, University of Algarve, Faro, Portugal
[2] ADAI, Coimbra, Portugal
*email: cruivo@ualg.pt

Abstract. Air conditioning systems are crucial devices for assuring thermal comfort and indoor air quality for the occupants, but energy consumption of most existing systems is significant. It is important to predict the combined behavior of building and system in extreme winter and summer design conditions but also at partial thermal load. This work aims to develop a model for analyzing the performance of air conditioning systems associated to spaces without indoor relative humidity control. The model allows a simulation of distinct scenarios, where is possible to change the region, envelope constructive building parameters, occupancy profiles, ventilation profile as well as the operation period of the terminal unit, a device responsible for the control of indoor air temperature. A simplified dynamic model for the evaluation of thermal loads for multi-zone systems was developed. The model is also capable of predicting the indoor air temperature when the coil of the terminal unit of each zone is thermally switched off. A data-base with annual information of outside air state for six cities of Portugal was created. Parametric studies were conducted in order to determine the cooling and heating capacities of the terminal unit, the indoor relative humidity and the thermal comfort indexes. The developed model can be applied for exploring the effect of different operating strategies of the air conditioning system in order to minimize energy consumption and thermal discomfort.

Keywords: Air conditioning, Multiple rooms, Dynamic simulation, Thermal performance, Simplified model.

Thermal performance evaluation of a building

Ricardo Nóbrega[1*] and Lília Alexandre[1]

[1] ISEC Lisboa, Alameda das Linhas de Torres 179, 1750-142 Lisboa, Portugal
*email: 20200038@alunos.iseclisboa.pt

Abstract. According to the European Environment Agency, 75 % of buildings are considered energy inefficient, consume 40 % of energy and emit 36 % of global CO_2 emissions, resulting in high economic and environmental costs. In Portugal, energy consumption in buildings has been decreasing and, according to the Energy Agency, in the period from 2014 to 2022, 24 % of buildings were in Energy Class C and 15 % in classes A and A^+. With the entry into force of Decree-Law 101-D/2020, for the optimization and regulation of energy efficiency in buildings, resulting from the strategies established by the European Union to increase the number of buildings with net zero energy consumption (nZEB), there was an increase to 23 % in classes A and A^+ by 2022. The present study aimed to estimate the coefficient of thermal losses of a habitable compartment with 12.7 m^2, based on the SCE methodology and a draft standard, through the monitoring of internal and external temperature, solar radiation, and electrical power, being a contribution to the evaluation of the energy performance of buildings. The mean results of temperature variation were 12.7 ºC, 39.0 W/m^2 for incident solar radiation and 1109.0 W for electrical power. The estimated thermal loss coefficient was 167.5 W/°C and 112.8 W/°C according to the calculation methodology and the draft standard respectively, contributing with greater significance the opaque envelope with 141.2 W/°C. The value obtained corresponds to about 70 % of the estimated value by calculation, considering it satisfactory, which is also justified by the solar gains.

Keywords: Building, Energy efficiency, Thermal performance, Energy certification system, Opaque and glazed envelope.

Life cycle analysis of sustainable aviation fuels production

Ana Ferreira[1*], Leandro Magalhães[2,3], Mauro Rocha[3], and André Silva[2]

[1] IDMEC, Instituto Superior Técnico, Universidade de Lisboa, Lisboa 1049-001, Portugal
[2] AEROG-LAETA University of Beira Interior, Covilhã 6201-001, Portugal
[3] ISEC Lisbon Institute for Education and Sciences, Lisbon 1750-142, Portugal
*email: filipa.ferreira@tecnico.ublisboa.pt

Abstract. The aviation sector has been showing continuous growth during the last decades, being one of the sectors that most contribute to environmental impacts, mainly in terms of carbon emissions, due to the use of fossil fuels. In this sense, sustainable aviation fuels (SAFs) emerge as a key to faster decarbonization of the aviation sector. Therefore, it is crucial to look for sustainable aviation fuels' life cycle and economy together with energy and climate policy goals. The present work focuses on the life cycle assessment (LCA) and techno-economic analysis of different SAFs, mainly e-fuels, production technologies integrating all the value chain (raw materials processing, production), to evaluate the environmental impacts, mainly CO_2 emissions, and the sustainability of introducing a given percentage of SAFs into the supply chain. The results were compared with the conventional fuels used in commercial aircraft, where it was possible to verify that the SAFs produced through fischer-tropsch using forest biomass residues show the lowest emissions compared with other production processes.

Keywords: Sustainable aviation fuel, e-fuels production, Life cycle analysis, CO_2 emissions.

Food safety and quality engineering

Food loss and food waste solutions

Use of nixtamalization in the Algarve's corn dish "milhos aferventados": does the ash matter?

Óscar Cabral[1] and Ludovina Galego[2,3*]

[1] Basque Culinary Center, Faculdad de Ciencias Gastronómicas, Universidad de Mondragón
[2] Instituto Superior de Engenharia, Universidade do Algarve, Campus da Penha, 8005-139, Faro. Portugal
[3] MED - Mediterranean Institute for Agriculture, Environment and Development & CHANGE – Global Change and Sustainability Institute
*email: lgalego@ualg.pt

Abstract. Algarve regional gastronomy has a vast diversity of products, techniques, and flavors. Originating in cultural exchanges and/or from the endogenous development of communities, this diversity is found in suis generis dishes such as the dish of "milhos aferventados" (corn meal stew). This dish, enriched with meat, sausages and vegetable products, is usually a holiday and exception dish and is made in the Algarve' barrocal and in the mountains, in the western part of the region. It stands out due to its differentiated preparation method in which corn is empirically pre-cooked in an alkaline solution composed of water and fig tree firewood ashes. This process, known as nixtamalization, makes it possible to increase the bioavailability of corn nutrients, although it is popularly done to eliminate unwanted components that impact the final taste of the dish. This cooking process finds similarities with the nixtamalization process used in Central America. Cultural and agroecological aspects of the dish were sought as well as a comparative study was made between different tree ashes in order to find a reason that might explain the popular fig tree ash preference. It was found that the pH of fig tree ash (12.66 ± 0.04) and the ion calcium content (75.19 ± 0.05 ppm) were higher than the carob tree ash (12.34 ± 0.03 and 55.31 ± 0.04 ppm respectively), but only calcium ion presents a significant difference, allowing the destruction of the corn pericarp, being the reason behind the usage of this technique.

Keywords: "Milhos aferventados"; Corn; Algarve; Nixtamalization; Fig wood.

Sodium reduction in green apples (*Malus domestica*) pickling: effects on quality characteristics

Daniela Constandache[1], Doina-Georgeta Andronoiu[1*], Gabriel-Dănuț Mocanu[1], Oana-Viorela Nistor[1], Oana-Emilia Constantin[1], Ira Adeline Simionov[1], Elisabeta Botez[1]

[1] Dunărea de Jos University, 111 Domnească Street, Galați, Romania
*email: Georgeta.Andronoiu@ugal.ro

Abstract. One of the oldest methods of vegetables preservation is pickling, which consists in production of organic acids by microorganisms under certain conditions. Moreover, during the fermentation process, physical and chemical transformations occur, inducing specific characteristics. Sodium chloride has a very important role in defining these characteristics, but it is incriminated for several health issues. The main objective of this work was to assess the implications of sodium chloride substitution by potassium and magnesium chlorides on the pickling process, as well as on the quality characteristics of apples (*Malus domestica*), Granny smith variety. Physical measurements (mass, diameter, texture and color), chemical and phytochemical analyses (dry matter, acidity, salt, polyphenols, flavonoids and carotenoids), as well as lactic bacteria viability were achieved every 7 days from the 35-day fermentation interval. Sensorial analysis was done at the end of the interval. The results indicate a reduction in fruits dry matter for the first 28 days, followed by a sharp rise for the last 7 days, for all the samples. The substitution salts had a favorable effect on lactic bacteria viability, likewise on phytochemical compounds development. Color and texture presented light variations both in instrumental and sensorial modes and the general acceptability was good. The main outcome of this study is the possibility to reduce sodium chloride in pickled green apples by substitution with potassium and magnesium chlorides.

Keywords: Pickles, Granny smith, sodium chloride, phytochemicals.

Contributions to the evaluation and improving of Romanian military diet

Ana-Maria Fundeanu[1], Gabriel-Dănuț Mocanu[1] Doina-Georgeta Andronoiu[1], Oana-Viorela Nistor[1*], Elisabeta Botez[1]

[1] Dunărea de Jos University, 111 Domnească Street, Galați, Romania
*email: Oana.Nistor@ugal.ro

Abstract. Active military duty is very specific to the type of occupation including the physical trainings or combat, which induce sleep disturbances, extreme environmental conditions or stress. For these reasons the military diet should be costumed by the nutritional and energetical needs for every single type of occupation. The present study proposes to evaluate the main anthropometric changes occurred in the three months of study, when the fat quantity from the main meal of the day was reduced with 15 %. For a proper reporting it was used as blank the anthropometric data obtained when the military consumed the initial diet. The study targeted a sample of 50 Romanian militaries (women and men), which activate on-site the garrison and do not have regular physical training. As expected, the fat reduction was observed in the energetical value of the meal by decreasing the monthly average value with 200 kcal. Regarding the anthropometric data, the weight, glycemia and blood pressure values of the military personnel were not generally influenced by the fat reducing. But in the body mass index values could be observed several changes, especially for the persons which were included in the initial study as overweight, they are registered lower values in the standard interval for overweight persons (25 – 30 kg/m^2) according to World Health Organization. In conclusion, many personal food habits especially related to the out of duty time could influence the results of the study. An integrate life quality evaluation is needed to reach proper results.

Keywords: Military, Diet, Fat reduction, Anthropometrics.

Sustainability in water management

Special Session on Water management challenges

Uncertainty analysis on Budyko framework's runoff estimations for climate change scenarios

Pâmela Melo[1*], Lívia Alvarenga[1], Javier Tomasella[2], Carlos Mello[1], Gilberto Coelho[1], Ana Santos[3]

[1] Departamento de Recursos Hídricos, Universidade Federal de Lavras (UFLA), Lavras, MG, Brasil
[2] Centro de Ciência do Sistema Terrestre, Instituto Nacional de Pesquisas Espaciais (INPE), Cachoeira Paulista, SP, Brasil
[3] Centro Nacional de Monitoramento e Alertas de Desastres Naturais (CEMADEN), Cachoeira Paulista, SP, Brasil
*email: pamela.ap.melo@gmail.com

Abstract. Budyko framework has been used in hydrology to estimate runoff from climate data as an empirical methodology. Since the sources of uncertainties in this methodological approach were not fully explored, the objective of this study was to evaluate the uncertainties in Budyko's runoff estimation and projections from the results obtained of a conceptual hydrological model (MHD-INPE). Each methodology was forced with bias-corrected results from four climate models and two emission scenarios (RCP's), in three basins with drainage areas of 1820 (Capivari River), 1960 (Aiuruioca River) and 2070 (Grande River headwaters) km^2, at Upper Grande River basin, Brazil. Budyko framework's curves parameters for each basin were estimated from 15-year moving averages aridity index (potential evapotranspiration/precipitation) and evaporative index (actual evapotranspiration/precipitation) from 1990 to 2010 by the non-linear least square method. The MHD-INPE was calibrated (from 1993 to 2003) and validated (2003 to 2013) from daily data. Budyko and MHD-INPE 15-year average runoff estimations were close to observed data in validation period (1997 to 2013), where the highest Root Mean Square Error were 40.95 mm (5.45 % of the average runoff) and 11.54 mm (1.54 % of the average runoff), respectively, in Grande River Basin, both super estimating the runoff. Future runoff from ensemble multi-model projections for both models followed the same qualitative pattern. In general, ensemble average runoff estimations were quantitatively close and, overall, Budyko's estimation were higher. The largest difference in the ensemble median runoff estimations occurred in the Grande River headwaters basin, where Budyko's runoff estimations were, on average, 51.49 mm higher than estimations from the hydrological model, in the RCP4.5 scenario. The results revealed that, in spite of Budyko model's simplifications, its long-term estimations for future scenarios were close to the conceptual hydrological model. Therefore, Budyko framework has potential to be further explored in future studies aiming the sustainability in water management.

Keywords: Hydrological model, Climate elasticity, Basins.

Pollutants of emerging concern in treated urban effluents and surface water – Portugal in the last decade

Camila Silva[1], Anabela Rebelo[2], and Manuela Moreira da Silva[1,3*]

[1] Universidade do Algarve, Instituto Superior de Engenharia. Campus Penha 8005-132. Faro, Portugal
[2] Agência Portuguesa do Ambiente, Rua da Murgueira, 9 Zambujal, Alfragide. 2610-124. Amadora, Portugal
[3] Universidade do Algarve, Centro de Investigação Marinha e Ambiental - CIMA, ARNET and Centro de Engenharia e Desenvolvimento (CEiiA). 8005-132. Faro, Portugal
*email: msanti@ualg.pt

Abstract. The planet's demographic evolution and current consumption patterns require an efficient and sustainable management of natural resources, to avoid the needs of future generations. Technological developments have introduced products on the market recognized as harmful for the environment and public health. Some of these substances began to be quantified and related to potential damage they caused in different organisms. Thus, emerged the Pollutants of Emerging Concern (PEC), which have been quantified in various types of water, namely in treated urban effluents and in surface water. In the Portugal drought scenario, the water reuse can constitute an important alternative source, to supply some (mainly) non-potable water needs, being considered a priority in the current Water Efficiency Plan. In this study, we used official public data available to assess the presence of nonylphenols, phthalate and diclofenac from 2010 to 2021 in the 8 River Basin Districts of Portugal, as well as in urban WWTPs with more than 100,000 e.p. It was found that higher concentrations of nonylphenols and phthalates frequently exist in treated effluents where anthropogenic pressure is more pronounced. Diclofenac was quantified in higher concentrations in the Tagus River and Ribeiras do Oeste, followed by the Douro River, coinciding with the largest population centers in the country. There was no defined pattern of evolution over time for PEC in water bodies. Nonetheless, this study showed that could be necessary measures to decrease PEC from treated urban effluents, since their presence may cause a constraint to the water reuse increase.

Keywords: Urban water cycle, Nonylphenol, Phthalate, Diclofenac, Water reuse.

Estimating open channel surface flow velocities using quinine-based tracers and a UAS under low luminosity conditions

Soheil Zehsaz[1,2*], João L. M. P. de Lima[1,2], Jorge M. G. P. Isidoro[1,3], M. Isabel P. de Lima[1,2] and Ricardo Martins[4]

[1] MARE–Marine and Environmental Sciences Centre/ARNET-Aquatic Research Network, Pole MARE–UCoimbra, Rua Sílvio Lima, 3030-790 Coimbra, Portugal
[2] Department of Civil Engineering, Faculty of Sciences and Technology, University of Coimbra, Pole II-Universidade de Coimbra, Rua Luís Reis Santos, 3030-788 Coimbra, Portugal
[3] Department of Civil Engineering, Institute of Engineering, University of Algarve, 8005-139 Faro, Portugal
[4] RISCO–Research Centre for Risks and Sustainability in Construction, Department of Civil Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
*email: s.zehsaz@dec.uc.pt

Abstract. Accurate measurement of flow velocities is an important issue in most hydraulic and hydrologic studies towards sustainable water resources management. This study presents quinine-based tracer techniques to estimate surface flow velocities in channels and streams under low luminosity conditions (e.g., night; twilight; shielded environments). Quinine glows when exposed to UVA light and in the concentrations used is not harmful to the environment. Fieldwork was conducted for studying surface flows in three open channels, with different hydraulic characteristics. Surface flow velocities were estimated based on the application of a quinine solution (liquid solution and ice cubes) into the water flow and by tracking the movement of the tracers (e.g., the leading edge of the tracer plume, solid particles of the tracer) in the flow over a certain time lapse. In these experiments' flowmeter-based velocity maps and a thermal tracer technique were used as a benchmark for assessing the performance of the quinine tracer. An Unmanned Aerial Systems (UAS) and an infrared camera were used to record the movement of the tracers in the flow. The results show that both forms of quinine tracers (liquid and solid) can be used to estimate open channel surface flow velocities under low luminosity conditions. The quinine and thermal tracing techniques yielded highly consistent estimates, with a variation of less than 4 % between them while, the flowmeter measurement velocities resulted between 3.5 % and 8.3% higher than the estimations using the quinine tracer. Although the volume of the solid tracer used in the experiment was smaller than the liquid tracer, the tracer in solid form was easier to track due to the diffusion of the liquid tracer in the channel flow. Nevertheless, the main advantage of using the liquid tracer was that it could be used anytime and did not have the limitation of melting. The use of UAS and similar monitoring techniques improves data collection accuracy and efficiency. Additionally, by using quinine-based tracer techniques, which rely on the natural luminescent properties of a quinine solution under UVA light, the study reduces environmental impact and aligns with sustainability goals.

Keywords: Leading-edge velocities, Night experiments, Open channel flow, Quinine, Remote sensing, Tracers.

Sustainable solutions for water management in arid and semiarid regions: examples from Chile and Brazil

Jorge M. G. P. Isidoro[1*], Abelardo A. A. Montenegro[2] and Joel Barraza Soto[3]

[1] Civil Engineering Department, Institute of Engineering, University of Algarve, 8005-139 Faro, Portugal; Marine and Environmental Research Centre (MARE) and Associative Laboratory ARNET, Coimbra, Portugal
[2] Agricultural Engineering Department, Rural Federal University of Pernambuco, Dois Irmãos, CEP 50910-130 Recife, PE, Brazil.
[3] Aquaculture Department, Faculty of Marine Sciences, Catholic University of the North, Campus Guayacán, 1781421 Coquimbo, Chile.
*email: jisidoro@ualg.pt

Abstract. Two case studies of sustainable solutions for water management in arid and semiarid regions are shown. The first regards a proposal for a solar energy-powered desalination system in La Higuera, Elqui province, Chile. The second is a wastewater reuse system currently in operation in Pesqueira, Pernambuco, Brazil. Both solutions highlight the importance of innovation and technology for sustainable water management. The solar-powered desalination system in Chile provides a reliable source of drinking water for communities in a region where water scarcity is a major challenge. Two configurations, I and II, were compared in terms of direct operating costs. Configuration II had a lower cost of 0.78 €/m^3 compared to configuration I (0.92 €/m^3). The sale of surplus solar energy and drinking water covered operational costs. Configuration II resulted in 28 % lower equivalent lower cost than configuration I. The project would bring social, environmental benefits and reduce carbon emissions by 632 tCO_{2eq}/year. The wastewater reuse system in Brazil contributes to the sustainable development of family-scale agriculture activity and livestock production Treated wastewater is used for irrigation of forage palm, under controlled soil and water conservation techniques. The experimental monitoring was carried out in nine plots with different coverage conditions (uncovered soil; natural cover; mulch cover; Forage Palm). Experiments under simulated rainfall shows that the mulch cover performed similarly to the natural tree vegetation cover for runoff control and sediment losses, with 40 % and 33 % of less soil and water losses, respectively. These examples demonstrate that sustainable solutions for water management in water-scarce regions are not only feasible but also crucial for the sustainable development of local communities and industries. Innovation, technology, and collaboration are key factors for addressing the challenges and opportunities for a sustainable water management in arid and semiarid regions.

Keywords: Water management, Sustainability, Arid regions, Desalination, Wastewater reuse.

Information technology and artificial intelligence applied to sustainability

Big data and data analytics applied to sustainability

Data and text processing for sustainability

Francisco M. Couto[1]

[1] LASIGE, Faculdade de Ciências, Universidade de Lisboa, Portugal
email: fjcouto@edu.ulisboa.pt

Abstract. Environment Ontology and Environmental conditions, treatments and exposures ontology are two examples of the current interest of the scientific community in providing comprehensive and accurate knowledge bases that help us more effectively to navigate and retrieve information from literature, find evidence, integrate data, generate hypothesis, or even discern relevant from irrelevant data. However, most of these benefits requires an in-depth understanding of complex and sophisticated technologies, that are constantly evolving. This manuscript proposes an alternative solution that is available to every sustainability specialist without becoming dependent on continuous financial support, third-party applications, or advanced computer skills. This alternative may not offer the full state-of-the-art potential, but offers a feasible and efficient starting solution to explore the main potential of automatically processing data and text using knowledge bases. The solution is to understand the basics of shell scripting in order to perform named-entity recognition and linking by following the book, intitled Data and text processing for health and life sciences, which shows how we can process data and text the same way we conduct a laboratory protocol i.e. testing and understanding its multiple procedural steps, variables, and intermediate results. Additionally, a fully functional shell script, MER - Minimal Entity Recognizer, (available also as a web tool) can be explored to recognize concepts related to sustainability. The open source software is available at: https://github.com/lasigeBioTM; the web tools and all the open access book material at http://labs.rd.ciencias.ulisboa.pt/

Keywords: Text processing, Semantics, Ontologies.

Detecting artificial reefs' usefulness for people using Industry 4.0 tools

Ana Camelo[1], Francisco Leitão[2] and Jorge Ramos[3*]

[1] FCT, University of Algarve, Faro, Portugal
[2] CCMAR, University of Algarve, Faro, Portugal
[3] CinTurs, University of Algarve, Faro, Portugal
*email: jhramos@ualg.pt

Abstract. Artificial reefs (AR) are structures that are currently used not only to provide ecosystem services and additional functions, but also to increase coastal sustainability. AR are deployed in the seabed and despite being detected by technology, are usually not seen by people. It is thus important to know AR usefulness to human users, namely those people who may benefit from the structures deployed (e.g., fishermen and divers/tourism). This knowledge – i.e., to know whether fishing or tourism activities become more appealing and worthier due to AR deployed – is of great value for coastal managers. In the present study we developed – by trial and error – some Bayesian models to frame the use of the Faro-Ancão AR by the main stakeholders. The models were adjusted by collecting data via a maritime traffic detection application (i.e., after achieving some AR knowledge based on monitoring using Industry 4.0 tools). The main challenge/achievement was to find out a model that best fits AR use and selected it for further research work. The analysis of the data after treatment served as a proxy for the perception of AR usefulness, from which we drew some conclusions that are useful for coastal managers (i.e., interaction of maritime traffic activities, namely fishing, passengers' transportation, recreation, tourism).

Keywords: Fisheries, Monitoring, Socioeconomics, Tourism, Usefulness.

SUR Project. School engagement for the engineers of the future

Yolanda Ceada[1*], Borja Millán[2], Joaquín del Pino[1], Daniel Ruíz[1], A. Javier Barragán[1], J. Manuel Enrique[1], Ramón Tirado[1] and J. Manuel Andújar[1]

[1] University of Huelva, Huelva 21071, Spain
[2] University of Oviedo, Gijón 33204, Spain
*email: yolanda.ceada@sc.uhu.es

Abstract. Engineering is one of the fastest growing fields of work and employability index. However, the number of STEM degree students is declining every year. A research group from the University of Huelva organized an educational project (SUR Project) to promote the study of STEM degrees in pre-university students. The SUR Project consists of building a solar vehicle capable of trans-porting a person in an urban environment and competing with it. The construction of the vehicle was done during the academic year, during class hours and through the pedagogical model of Project-Based Learning. The objective of this research was to analyse the effect of the SUR Project on the motivation and engagement of the participating students. The sample consisted of 383 pre-university students from the south of the Iberian Peninsula (Huelva, Badajoz and Portuguese Algarve). The data collection instrument consisted of an online questionnaire completed by the students. Data collection was carried out on the day of the competition for four years: 2018-19-21 and 22. The results obtained showed that the SUR Project favours students' engagement to learn.

Keywords: Based Learning, Engagement, Engineer studies, Sustainability.

Sustainable building technologies

Sustainable energy generation and management

Sustainable development and circular economy

Foamed polyurethane plaster for isolation uses

Álvaro Urbaneja[1], Saúl Vallejos[2], Raquel Arroyo[1*], Verónica Calderón[1], Jose Miguel García[2]

[1] Dpto. de Construcciones Arquitectónicas. Escuela Politécnica Superior, Universidad de Burgos, 09001 Burgos, Spain
[2] Dpto. De Química, Facultad de Ciencias, Universidad de Burgos, Burgos 09001, Spain
*email: rasanz@ubu.es

Abstract. In the last years, the construction sector has change in a deep way directing efforts towards new materials and lighter and isolation prefabricated elements, which contributes to sustainable construction. This study falls on the obtaining and characterization of lightweight plaster by means of the addition of new polyurethane formulated for interior uses in buildings. The plaster used is designated as B1/20/2 according EN 13279-1, dosed with different amounts of polymer and catalyst. The results obtained demonstrate that the final products decrease in a great amount the density maintaining enough mechanical properties to be applied as final coating. The microstructure confirms the matrix cohesion and compatibility of both phases. The crystals of calcium sulfate occupy the spaces left by the holes into the polyurethane cells, generating a continuous adhesive matrix between organic and inorganic phases. The thermal conductivity determined through isothermal curves at different temperatures establishes insulation parameters with better final performance than other existing traditional lightweight materials, with values around 0.17 W/(m°C), lower than the values for gypsum-based materials commonly used, which are between 0.25 and 0.5 W/(m°C). Concerning thermal behavior, the non-combustibility test against fire allows to classify these materials not contribute to fire. These results not only mean that accomplish with the catch fire properties for a wall or ceiling lining, but also refers to time of ignition, spread flame, flammability and smoke produced. This research demonstrates how the addition of polyurethane formulated for interior use in lightweight plaster can offer benefits in terms of thermal insulation, by obtaining values around 0.17 W/(m°C), lower than commonly used materials, which contributes to reduce energy loss and heating/cooling consumption, thus contributing to the energy efficiency of buildings and reducing the carbon footprint. It also has fire-resistant properties, which are advantageous from the point of view of safety and sustainability, helping to prevent the spread of fire in buildings and thereby reducing risks to people and personal properties. It also involves a reduction in density, bringing benefits in the amount of resources required for building construction, which can reduce energy consumption and greenhouse gas emissions associated with the production and transport of heavier building materials, and in terms of weight reduction in the building structure, which can result in a more efficient use of resources and less load on building foundations and support structures. All of these aspects contribute to sustainability in construction by improving energy efficiency, reducing the carbon footprint and improving safety in buildings.

Keywords: Foamed polyurethane, plaster, mechanical properties, thermal conductivity.

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Internal thermal insulation for swimming pools – In situ validation tests

Miguel José Oliveira[1*], Fátima Farinha[1], Maria Segura[1] Gina Matias[2], Luís Silva[3] and Francisco Carmo[4]

[1] Universidade do Algarve, Campus da Penha, 8005-139 Faro, Portugal
[2] Universidade de Coimbra, CERIS/Itecons, Rua Pedro Hispano, 3030-289 Coimbra, Portugal
[3] Weber Saint-Gobain Portugal, Esgueira, 3800-055 Aveiro, Portugal
[4] Cristal Construções, Apartado 91, 8501-903 Mexilhoeira Grande - Portimão, Portugal
*email: mjolivei@ualg.pt

Abstract. Heating outdoor swimming pools involve high energy consumption. To find solutions that allow minimizing energy losses through the tank is a great contribution to the sustainability of these equipment. This poster presents the tests carried out in order to validate an innovative thermal insulation system applied inside the pool tank. The solution proposed has high durability and low maintenance costs and its main goal is to reduce energy losses and, consequently, keep the water at a comfortable temperature. The system uses a concept similar to ETICS - External Thermal Insulation Composite Systems, frequently applied on facades with the aim to improve the thermal performance of buildings. In this case, the thermal insulation material used was cork. A natural material obtained in Portugal in a sustainable way. In situ validation tests were carried out on the prototype, such as: water absorption; impact resistance; crack resistance and adhesive strength. From the campaign of tests carried out it was verified that the inside thermal insulation system presented satisfactory results.

Keywords: Thermal insulation, Innovative system, Heated pools.

Sustainable building technologies by using admixtures to increase the durability of concrete structures

Visar Krelani[1], Driton Kryeziu[1*], Muhamet Ahmeti[1], Liberato Ferrara[2], Theodor Mentzikofakis[3]

[1] University for Business and Technology, Lagjja Kalabria, 10000, Pristina, Kosovo
[2] Politecnico di Milano, DICA, P.za Leonardo da Vinci, Milano Italia
[3] Penetron Hellas, Thrakomakedonon 50, Acharnes 13679, Greece
*email: driton.kryeziu@ubt-uni.net

Abstract. Cement production represents the most important material used in the production of concrete since it is the second most consumed material after water. The main challenge lies in reducing the use of cement production. On the contrary, if the latter is not possible, then high attention should be paid in the increase of cement-based materials' durability, thus creating an environmentally friendly concrete. In addition, this challenge of durability is an even bigger obstacle in countries with extreme exposure conditions, such as different seasons throughout the year. Another extreme environmental challenge for cement-based materials is undeniably the seaside, characterized by very severe saline factor. Different types of mix designs, with and without crystalline admixtures towards zero carbon concrete will be studied and tested to find out the characteristics of cement-based materials, from fresh concrete, mechanical properties, permeability, cracking, self-healing and lifecycle. Real scale buildings will be monitored in parallel with the laboratory condition due to the effect of the crystalline admixtures. The combination of detailed study conducted in the laboratory, together with monitoring of constructed buildings will undeniably contribute towards a comprehensive methodology for future development regarding adaption to climate change and perform new sustainable building technologies.

Keywords: Sustainability, Durability, Concrete, Crystalline admixture.

Evaluation of lignin extraction processes from sugarcane by-products: a sustainable approach

Filipa Antunes[1,2*], Inês F. Mota[1], João da Silva Burgal[1], Manuela Pintado[1] and Patrícia Santos Costa[1]

[1] Universidade Católica Portuguesa, CBQF - Centro de Biotecnologia e Química Fina - Laboratório Associado, Escola Superior de Biotecnologia, Rua Diogo Botelho 1327, 4169-005 Porto, Portugal

[2] Amyris Bio Products Portugal Unipessoal Lda, Portugal

*email: fantunes@ucp.pt

Abstract. In recent years, sustainability has become an important concept, particularly due to ecological and social challenges. The development of eco-friendly and cost-effective processes is a current demand for both academy and industry, which can be addressed through the circular economy approach. The use of lignocellulosic biomass, such as sugarcane by-products contribute to the sustainability of the processes. One of the main components of lignocellulosic biomass is lignin, a biopolymer with tremendous potential as renewable raw material to produce chemicals for the replacement of petrochemical resources. The aim of this study was to evaluate the sustainability of lignin extraction processes - alkaline, Deep Eutectic Solvents (DES), and organosolv - through the multi-criteria assessment by the good chemical manufacturing process using two biomasses, sugarcane bagasse (SCB) and sugarcane straw (SCS). Results showed that the processes had excellent scores using the multiple-criteria assessment by the good chemical manufacturing process, which includes the modified EcoScale, ranging from 84 to 93 %. As expected, the process with higher score was the alkaline extraction from SCB, based on the quality of the final product, mild conditions of extraction, low cost of reagents and energy consumption. The conditions of extraction included sodium hydroxide at 2 wt % with a solid to liquid ratio of 1:15 and reaction conditions of 90 °C for 30 minutes. This process obtained a score of 93 %, yielding a high-purity lignin (89.1 %), process yield was 11 %, and the estimated production cost of 31 $/kg.

Keywords: Extraction, Lignin, Sugarcane-by products, Sustainability.

Evaluation of new water treatment technology IP system

Joel Barraza Soto[1*] and German Merino Araneda[1]

[1] Universidad Católica del Norte, Coquimbo, Chile
*email: jbarraza@ucn.cl

Abstract. We have worked in collaboration with Japanese researchers to adapt a new technology for treating wastewater contaminated with organic matter. The treatment process is mainly based on biological microorganisms distributed in aerobic and anaerobic chambers. To this end, we conducted an evaluation using a 5 m^3 plug flow reactor to treat a fraction of the affluent from La Serena wastewater treatment plant. Two flow regimes were evaluated with hydraulic residence times (HRTs) of 24 and 12 hours. Among the parameters evaluated were the biochemical oxygen demand (BOD) and total suspended solids (TSS). The depletion of organic matter in the reactor´s effluent was compared against the Chilean regulation 1333 for water quality suitable for irrigation. Regarding to BOD and TSS, around 91 % depletion was observed for all treated water samples. The parameters related to Chilean regulation 1333 showed a depletion between 30 % and 97 % for some parameters. Not all parameters comply with the Chilean regulation 1333, but even though they presented a significant reduction in this evaluation. Importantly, no sludge was generated throughout the entire evaluation. Hence, there was no need to recirculate any sludge, which is the key feature that distinguishes this technology from activated sludge treatment.

Keywords: Microbiological treatment, Anaerobic treatment, Sludge.

Civil construction waste: A management model via digital application, for the city of Fortaleza – Ceará – Brazil

Eder Paulus Moraes Guerra[1*] and Audelis de Oliveira Marcelo Júnior[1]

[1] State University of Vale do Acaraú, Av. Padre Francisco Sadoc de Araújo, 850 - Alto da Brasília, Sobral - CE, 62010-295, Brazil
*email: eder_paulus@uvanet.br

Abstract. Solid waste from civil construction comes from the intense process of urbanization. Management systems that enable the efficient disposal of this waste have been one of the main challenges of contemporary society. The concept of sustainable development aims to ensure the quality of life necessary for the human species, making it necessary to restructure waste management as a way to reduce the impact on the environment. In the civil construction industry, the circular economy is part of an evolving process with the use of more efficient natural resources, and the perspective of economic value drives the fulfillment of social demands, at the same time, which can maintain a balanced environment. The context of this work concerns the Solid Waste Management process from civil construction in the city of Fortaleza in the State of Ceará - Brazil: the use of a Digital Platform model for the integrated management of information, from the perspective of the circular economy, for construction waste. This Digital Platform will be able to contribute to the improvement of monitoring, acting in the control of waste generation in the various stages of public and private works, carrying out environmental education activities, tracking waste to final destination, inspection, licensing of works and transport and disposal, structuring of suitable areas for waste sorting, environmentally appropriate collection and final disposal of RCC, preparation of reports on waste movement and issuance of certifications of adequate final destination for the respective generators.

Keywords: Solid waste, Sustainable development, Circular economy, Integrated management, Digital platform.

Sustainable ceramics for building structures with mining waste from coal mining

Terrones-Saeta J. M.[1*], Caparrós Espinosa M.A.[1], Manzano Diosdado F. J.[1], Balades Ruíz N.[1], Franco Oliva J.[1], Moreno Aguado F. J.[1], Rodríguez Aranda M. J.[1], and García Pareja[1]

[1] School of Technical Industrial Engineering of Algeciras, Av. Ramón Puyol s/n, 11202, Algeciras, University of Cádiz
*email: juanmaria.terrones@uca.es

Abstract. The construction sector is one of the most demanding sectors in terms of raw materials for the manufacture of new structural materials. At the same time, former mining activities produce huge amounts of waste that are currently an environmental problem. Therefore, in this research, mining waste from coal mining has been reused as a raw material for the manufacture of new ceramic materials for building. In this way, the extraction of clay as raw materials is reduced (with considerable environmental savings), the possible pollution that could be caused by mining waste is avoided and, at the same time, a much more sustainable and less expensive ceramic material for structures is developed. In order to carry out this research, different families of ceramics were made with varying percentages of coal mining waste, and their physical and mechanical properties were subsequently evaluated. As a result, it was possible to demonstrate that the incorporation of coal mining waste produced in the ceramic material some very interesting characteristics of density and thermal insulation, being, therefore, feasible its commercialization and avoiding the possible pollution produced to the environment by this waste.

Keywords: Structural, Coal, Mining, Environment.

Innovation reactions as an engine for regional resilience: The case of a traditional industry cluster in Brazil

Luiz Fernando Câmara Viana[1*], Valmir Emil Hoffmann[2], Hugo Pinto[3], Newton da Silva Miranda Júnior[4]

[1] University of Brasília and Federal Institute of Brasília, Brazil
[2] Federal University of Santa Catarina, Brazil
[3] University of Coimbra and University of Algarve, Portugal
[4] University of Brasília, Brazil
*email: luiz.viana0816@gmail.com

Abstract. This paper examines innovation as a reaction to a shock in the process of regional economic resilience. A single case study that considered the impact of the COVID-19 pandemic was conducted with a footwear cluster in São João Batista, Santa Catarina, Brazil. After the data were collected through interviews with different regional actors, a thematic analysis with categorical saturation was performed. The findings show that workers, small industries, and outsourced firms providing manufacturing services were particularly affected. In addition, the cost of rents led to the emigration of workers, which limited the region's economic recovery. The reaction included measures to absorb the shock, business expansion efforts, entrepreneurship, support for industries, and innovation, especially process innovation. In terms of its implications, this paper supports the complementarity of innovations as an adjustment to a shock. It also suggests that the nature of the shock influences the relationship between types of innovation and regional economic resilience. Finally, this paper argues that innovation is a robust mechanism that drives resistance and economic recovery, opposing the theoretical segmentation between moments of absorption and creative response. These results have practical implications. Pre-crisis capabilities may enable innovation in times of shock, suggesting the promotion of an innovation culture in the cluster to foster a creative response. In addition, in the event of massive layoffs, public policies to settle people in the region can reduce the exodus of skilled workers and boost employment and production levels when workers are able to return to work. These actions are linked to Sustainable Development Goal 9.

Keywords: Regional resilience, Innovation, Shock.

New Fuels and sustainable housing

Viso Pérez, J.A.[1*], Herrero-González, A.[1]. Martin-García, R.[1]

[1] School of Technical Industrial Engineering of Algeciras, Av. Ramón Puyol s/n, 11202, Algeciras, University of Cádiz.
*email: juanantonio.viso@uca.es

Abstract. Decarbonization, energy saving, energy efficiency, self-consumption, and distributed generation in buildings, in transport, and in industry motivate the incorporation of new fuels, new electric power generation systems, and/or thermal power and new propulsion systems, which expands the market for fuel products and new power generation systems, offering new business opportunities. Uncontrolled burning of the new fuels can give rise to an extraordinary event and this must be controlled and mitigated to safeguard the safety and physical integrity of people, property and animals, and the environment. prevention and protection measures must be implemented prior to the occurrence of the extraordinary event. The buildings are designed to be able to withstand earthquakes, strong winds and snowfalls, in addition to the loads of use throughout the entire useful life of the building, etc. and even for accidental actions. The accidental actions caused by the uncontrolled burning of fuel must be studied and must validate the structural behavior of the building, the non-displacement of materials and the maintenance of environmental pressure and temperature, as well as the quality of the air in the vicinity of people, or, design the facilities and their respective fuels in such a way that the effects of the extraordinary event have negligible consequences. Fuels such as biodiesel, bioethanol, biohydrogen, biomethanol, and mixtures of synthetic alcohols and their consequences on buildings are studied through conversion equivalent to TNT. Design criteria are provided to improve the safety of these building.

Keywords: ATEX, Buildings, sustainable, Fuels, Safety, accidental.

Laboratory model for the simulation of the plate load test for road surfaces

Caparrós Espinosa M. A.[1*], Terrones Saeta J. M.[1], Manzano Diosdado F. J.[1], Balades Ruiz N.[1], Franco Oliva J.[1], Moreno Aguado F. J.[1], Rodriguez Aranda M. J.[1] and García Pareja M.[1]

[1] School of Technical Industrial Engineering of Algeciras, Av. Ramón Puyol s/n, 11202, Algeciras, University of Cádiz.
*email: miguel.caparros@uca.es

Abstract. The static plate load test to control the compaction of soil layers on the road is carried out "in situ" by applying a load on a rigid plate that transmits tension to the ground in two load cycles, to thus being able to measure the deformations produced. All this in order to validate the execution of the compacted soil layers. The model presented for the laboratory allows to simulate with guarantees the behavior of the soil under the test conditions as it occurs "in situ". Thanks to the laboratory model it is possible to correlate under controlled conditions with another compaction control method such as the dynamic plate test. The dynamic load test is faster to execute, as well as in obtaining results (ODS 9.4), it is also standardized for use in compaction control as long as it has been previously correlated with the static test. The tests carried out to date in the laboratory on the model allow obtaining a strong correlation between static and dynamic tests with values of "R" greater than 85 %.

Keywords: Plate, Test, Soil, Laboratory, Correlation.

Recovery of the monumental clock of the cathedral of the holy cross of Cádiz

Martín-García R.[1*], Illana-Martos A.[1], Herrero-González, A.[1]

[1] School of Technical Industrial Engineering of Algeciras, Av. Ramón Puyol s/n, 11202, Algeciras, University of Cádiz.
*email: raul.martin@uca.es

Abstract. It was not until the last century that electrical systems began to be used to drive clocks in churches and cathedrals. Monumental watchmaking, characterized by a purely mechanical drive gradually fell into disuse in favor of electrically powered watchmaking, with the consequent abandonment of these watches. This supposes that there is a whole technological heritage, normally declared an asset of cultural interest, to be recovered. The communication will describe the most relevant aspects related to the mechanics, from the kinematic point of view, of the clock of the Cathedral of the Holy Cross of Cádiz. The general restoration process necessary to recover these machines will be described, highlighting the main problems to be solved. During the kinematic calculation, the main mechanisms will be shown, to help understand the operation of this impressive machinery.

Keywords: Monumental, Watchmaking, Recovery, Mechanical.

Occupational safety and health management in explosive atmospheres workplaces

J. E. Díaz-Vázquez[1*], P. A. Macías-Quintero[1], R. Tur-Cano[1] and D. Repeto-García[1]

[1] University of Cádiz, High Engineering School, Puerto Real 11519, Spain
*email: enrique.diaz@uca.es

Abstract. This paper aims to analyze the management of occupational safety and health (OSH) of Small and Medium-sized Enterprises (SMEs) that carry out work in the presence of Explosive Atmospheres (ATEX) or in confined spaces, usually as subcontractors of a main company. The tasks assumed are the inspection, maintenance, cleaning, and facilities repair in ATEX situations, in confined spaces or both simultaneously.

ATEX is defined as a mixture of dangerous substances with air, under atmospheric conditions, in the form of gases, vapors, mist or dust in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

Confined spaces, on the other hand, are enclosures with limited entry and exit openings and unfavorable natural ventilation, in which toxic or flammable contaminants may accumulate, or an oxygen-deficient atmosphere may exist, and which are not designed for continuous worker occupancy. The entry of workers to the site is sporadic, generally for short-term and unplanned operations, for example: construction, cleaning, maintenance, inspection, or rescue.

The approach to SMEs should be aimed at integrating the preventive activity of the company and reducing accident data by providing safe and healthy workplaces. The general lines must be established to promote a prevention plan, based on the company's OSH policy, as well as the evaluation of the risks associated with each workplace.

Keywords: OSH, ATEX, confined workplaces, SMEs, Management.

Reefer cable reel

Vílchez-Vílchez M.[1*], Illana-Martos A.[2] and Martín-García R.[2]

[1] Technical Director of Maintenance TTI Algeciras.
[2] School of Technical Industrial Engineering of Algeciras, Av. Ramón Puyol s/n, 11202, Algeciras, University of Cádiz
*email: mvilchez@ttialgeciras.com

Abstract. Most of the international trade of fresh products is made in refrigerated containers, from here on out "reefer". When they arrive at a container terminal or ship, have to be connected to the electrical power supply. For this, they have an electrical hose that ends in a plug connected to the reefer socket, this electrical hose is housed in an open created cabin, accessible from outside the reefer, to deposit the electrical. Many times, the plug and part of the cable are outside the volume of the container, due to the manual nature of the disconnection and collection operations of the electric hose. The result is that the reefer container is transported with several meters of cable hanging, with danger of snags and interferences in the stack. Additionally, there is another problem, both in automated terminals and manual terminals, the cranes can hoist a container that is not disconnected from its reefer plug. In this case, the crane that transports the container carries the cable suspended to the place of destination hose. A self-roll up electric hose mechanism is presented, designed specifically for reefer containers, formed by: a drum, a linear guiding mechanism, a receiver to house the connection plug, a cable guiding system inside the drawer, and some light indicators.

Keywords: Reefer, Container, Electrical, Power, Supply.

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