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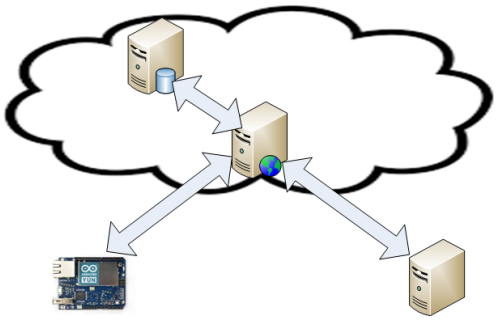
LIST OF PROJECTS OFFERED TO INCOMING STUDENTS FROM THE COOPER UNION UNIVERSITY – DIN*per* research group.

The University of Burgos is delighted to welcome students from The Cooper Union. The positions are offered by several research groups working on different engineering fields as described in the following sections:

Internet of Things.

One of the key evolutions of technological devices in the last few years has been oriented towards connectivity. Connected with the previous offer, connected technological devices can make life easier to people affected by many types of disabilities. Our research group is on the search for certain applications making use of the latest developments of technology and even for innovative ways to connect devices to the internet.



The whole process involves:

- Hardware designing.
- Wireless devices programming
- Database configuration
- Remote access
- Remote control

WHAT WE OFFER TO COOPER UNION STUDENTS:

- Design and manufacturing of wireless devices.
- C++, php...
- Web site desig.

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STUDENTS PROFILES:

- Electrical Engineering students (1 position).
- Computer Engineering (1 position).

COORDINATOR/CONTACT PERSON: Dr. José M. Cámara (checam@ubu.es).

LIST OF PROJECTS OFFERED TO INCOMING STUDENTS FROM THE COOPER UNION UNIVERSITY – DIN*per* research group & Electrochemical Processes and Energy Storage group.

Batteries.

Energy Storage Systems (ESSs) have become essential elements in our modern society. Among the various EESs, batteries have experienced a rapid growth driven by the expending market of portable electronics, implementation of energy from renewable sources, electrification of transportation, and other emerging technologies. In collaboration with Dr. Ventosa´s group from Chemistry Department, our research group develops strategies for automatization of processes during battery operation, which also include connectivity solutions.

In the three topics, the whole process involves:

- Hardware designing.
- Wireless devices programming
- Database configuration
- Remote access
- Remote control

WHAT WE OFFER TO COOPER UNION STUDENTS:

- Design and manufacturing of wireless devices.
- C++, php...
- Web site desig.

STUDENTS PROFILES:

- Electrical Engineering students (1 position).
- Computer Engineering (1 position).

COORDINATOR/CONTACT PERSON: Dr. José M. Cámara (checam@ubu.es) /Dr. Edgar Ventosa (eventosa@ubu.es).

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LIST OF PROJECTS OFFERED TO INCOMING STUDENTS FROM THE COOPER UNION UNIVERSITY - Research Group on Energy Engineering

Research Line:

Research on thermodynamic properties of new refrigerant and heat transfer fluids, formulated to mitigate the Climate Change. Website: https://www.ubu.es/energy-engineering-research-group-ienergia

Coordinator / contact person:

Dr. Natalia Muñoz Rujas (nmrujas@ubu.es).

Description:

The knowledge on thermodynamic properties of pure fluids and their mixtures is of common interest in any industrial area. In applications such as refrigeration, it is necessary to well know the boiling temperature of the fluid, as well as its change on density with pressure and temperature. In fields as high precission cleaning, the knowledge of viscosity or surface tension are of utmost importance. In the same way, the characterization of an azeotrope, its composition at a fixed pressure and temperature, has utility in most of industrial applications in which the fluid changes from liquid to vapor state. In the field of industrial fluids, the environmental issue has grown as a new requirement that has to be fulfilled for commonly used fluorocarbons: CFCs (chlorofluorocarbons), HCFCs (hydrochlorofluorocarbons), HFCs (hydrofluorocarbons), PFCs (perfluorocarbons) and PFPEs (perfluoropolyethers), among others. Some of these fluorocarbons had great ozone depletion potentials (ODP), while others shown high global warming potentials (GWP). Also, their long atmospheric lifetimes (ALT) made them extend their harmful effect over the years on the environment.

Hydrofluoroether fluids (HFEs), are a class of new industry fluids with low environmental effect. HFEs have been considered as good alternative in the replacement of CFCs, HCFCs, PFCs, PFPEs, and even HFCs, due to they exhibit values of thermophysical and chemical properties similar as the previously used fluorocarbons, including high volatility, low thermal conductivity, low surface tension, zero or near zero Ozone Depletion Potential (ODP), low Global Warming Potential (GWP), low toxicity, being most of them non-flammable.

This project deals with the accurate measurement, correlation and prediction of thermodynamic and transport properties properties of new refrigerants and their mixtures (density, viscosity, thermal

conductivity, isobaric heat capacity, vapor-liquid equilibrium behaviour, water inmiscibility range, distillation curve, mixing enthalpy and heating values) at different pressure and temperature conditions.

Priority Area:

Renewable energy, sustainability, energy efficiency, Climate Change.

Student profile:

Mechanical Engineering, Chemical Engineering, Mining Engineering, B.Sc. Physics, B.Sc. Chemistry.

Recent references:

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N. Lamia Benkelfat-Seladji, F. Ouaar, A. Hernández, I. Bahadur, N. Muñoz-Rujas, S. Kumar Singh, E. Montero, N. Chiali-Baba Ahmed, L. Negadi. Density, speed of sound, refractive index of binary mixtures

containing 2-ethoxyethanol and some alcohols: Measurement and correlation, Journal of Chemical Thermodynamics, 2021, 170 – 106762, 1-18.

I. Abala, M. Lifi, F. E. M'hamdi Alaoui, N. Muñoz-Rujas, F. Aguilar, E. A. Montero. Thermophysical Property Measurements and Modeling of (Ether + Alkanol + Hydrocarbon) Mixtures: Binary and Ternary Mixtures (Dibutyl Ether + 1-Butanol + 1-Hexene or + Iso-octane) at 298.15 K, Journal of Chemical and Engineering Data, 2021, 66, 3417 – 3431.

M. Lifi, J-P. Bazile, N. Muñoz-Rujas, G. Galliero; F. Aguilar, J-L. Daridon. Density, Viscosity, and Derivative Properties of Diethylene Glycol Monoethyl Ether Under High Pressure and Temperature, Journal of Chemical & Engineering Data, 2021, 66, 3 1457-1465.

I.Abala, M. Lifi, F. E. M'hamdi Alaoui, N. Muñoz-Rujas, F. Aguilar, E. A. Montero. Density, Speed of Sound, Isentropic Compressibility, and Refractive Index of Ternary Mixtures of Oxygenated Additives and Hydrocarbons (Dibutyl Ether + 1-Butanol + Toluene or Cyclohexane) in Fuels and Biofuels: Experimental Data and PC-SAFT Equation-of-State Modeling, Journal of Chemical & Engineering Data, 2021, 66, 1406 – 1424.

G. Rubio-Pérez, N. Muñoz-Rujas, F. Aguilar R. Ravotti, L. Müller, E. Montero. Evolution of the Study of Phase Diagram of Binary and Ternary Mixtures Involving Fatty Acid Esters, Materials, 2021, 14 – 369.

D. Belhadj, I. Bahadur, A. Negadi, N. Muñoz-Rujas, E. Montero, L. Negadi. Thermodynamic, Ultrasonic, and Transport Study of Binary Mixtures Containing 2-(2-Methoxyethoxy)ethanol and Alcohols at (293.15–323.15) K, Journal of Chemical & Engineering Data, 2021, 65, 5192 – 5209.

L. Müller, G. Rubio-Pérez, A. Bach, N. Muñoz-Rujas, F. Aguilar, J. Worlitschek. Consistent DSC and TGA Methodology as Basis for the Measurement and Comparison of ThermoPhysical Properties of Phase Change Materials, Materials, 2020, 13 – 4486.

M. Lifi, J. Lorenzo, F. Aguilar, N. Muñoz-Rujas, E. A. Montero, Y. Chhiti, F. E. M. Alaoui. Excess enthalpy, density, speed of sound and refractive index of binary mixtures {2-(2-ethoxyethoxy)ethanol + 1-hexene, or cyclohexane, or methylcyclohexane at (298.15 and 313.15) K: Application of the PPR-78 cubic equation of state, NRTL and UNIQUAC models, Journal of Chemical Thermodynamics, 2020, 153.

M. Lifi, G. Rubio-Pérez, F. E. M. Alaoui, N. Muñoz-Rujas, F. Aguilar, E. A. Montero. High-Pressure Volumetric Properties of the Binary Mixtures (Di-isopropyl Ether + n-Heptane or Methylcyclohexane), Journal of Chemical and Engineering Data, 2020, 65, 4892-4904.

N. Muñoz-Rujas, G. Rubio-Pérez, E. A. Montero, F. Aguilar. Isobaric Vapor−Liquid Equilibria at 50.0, 101.3, and 200.0 kPa. Density and Speed of Sound at 101.3 kPa and 298.15 K of Binary Mixtures HFE-7100 + 2-Propanol, Journal of Chemical & Engineering Data, 2020, 65, 4290-4298.

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I. Abala, F. E. M. Alaoui, A. S. Eddine, F. Fernando, N. Muñoz-Rujas, E. A. Montero. (ρ, VE, T) Measurements of the Ternary Mixture (Dibutyl Ether + 1-Heptanol + Heptane) at Temperatures up to 393.15 K and Pressures up to 140 MPa and Modeling Using the Peng−Robinson and PC-SAFT Equations of State, Journal of Chemical and Engineering Data, 2019, 64, 3861-3873.

I. Abala, F.E.M. Alaoui, Y. Younes, A. S. Eddine, N. Muñoz-Rujas, F. Aguilar. Density of biofuel mixtures (Dibutyl ether + heptane) at temperatures from (28.15 393.15) K and at pressures up to 140 MPa: Experimental data and PC-SAFT modeling, Fluid Phase Equilibria, 2019, 491, 35-44.

H. Makhlouf, N. Muñoz-Rujas, F. Aguilar, B. Belhachemi, E. A. Montero, I. Bahadur, L. Negadi, Density, speed of sound and refractive index of mixtures containing 2-phenoxyethanol with propanol or butanol at various temperatures, Journal of Chemical Thermodynamics, 2019, 128, 394-405.

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M. Darkaoui, N. Muñoz-Rujas, F. Aguilar, A. El Amarti, M. Dakkach, E. A. Montero, Liquid Density of Mixtures of Methyl Nonafluorobutyl Ether (HFE-7100) + n-Heptane at Pressures up to 80 MPa and Temperatures from 298.15 to 393.15 K, J. Chem. Eng. Data, 2018, 63, 2966−2974.

G. Rubio-Pérez, N. Muñoz-Rujas, A. Srhiyer, E. A. Montero, F. Aguilar, Isobaric vapor-liquid equilibrium, density and speed of sound of binary mixtures 2,2,4-trimethylpentane þ 1-butanol or dibutyl ether (DBE) at 101.3 kPa, Fluid Phase Equilibria, 2018, 475, 10-17

N. Muñoz-Rujas, F. Aguilar, J.M. García-Alonso, E. A. Montero, "High pressure density and speed of sound of hydrofluoroether fluid 1,1,1,2,2,3,4,5,5,5-decafluoro-3-methoxy-4-(trifluoromethyl)-pentane (HFE-7300)", Journal of Chemical Thermodynamics, 2018, 121, 1-7.

LIST OF PROJECTS OFFERED TO INCOMING STUDENTS FROM THE COOPER UNION UNIVERSITY – Structural Integrity research group.

Position 1: Fatigue and fracture of materials, components and structures.

STUDENTS PROFILES: Mechanical Engineering / Civil Engineering (2 positions).

COORDINATOR/CONTACT PERSON: Professor D. Jesús Manuel Alegre (jalegre@ubu.es).

Brief description:

The Structural Integrity research group of the University of Burgos is in one of the most relevant research group in Europe, related to the testing and numerical simulation of fatigue and fracture of metallic materials. In this research you will learn about fracture and fatigue testing methods, numerical simulation of fatigue and fracture of metallic materials and its application to the design of components and structures. Also you have the opportunity to initiate in some experimental techniques to measure residual stresses in components, such as the *hole drilling* method, and to know the effect of residual stresses in the fatigue behavior of metallic materials.

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LIST OF PROJECTS OFFERED TO INCOMING STUDENTS FROM THE COOPER UNION UNIVERSITY – Sustainable Construction Research

SUCONS
SUSTAINABLE CONSTRUCTION RESEARCH GROUP
UNIVERSITY OF BURGOS

Group SUCONS

The positions are offered by several working groups specialized on different engineering fields as described in the following sections:

TITLE: Maximizing the sustainable value of materials and products in the construction sector, incorporating by-products from steelworks

ACRONYM OF THE PROJECT: Greco

Introductory video: https://youtu.be/xPaoZ--YF-I

PROJECT DESCRIPTION:

From the science of material (knowledge) to the concept of final product (construction market), this project would climb the study of the incorporation of some industrial by-products of manufacturing steel in certain materials and building products. As a key sector of our country, the manufacture of electric steel industry, massively, generates two types of by- products: EAFS - black oxidizing slag and LFS - white reducing slag from steelworks. On the other hand, the construction industry is a major consumer of raw materials. Therefore, strengthening in the knowledge applied already existing on the subject, in addition to opening new fields of use, this project raises the reuse of the EAFS and LFS in applications for building and civil engineering, as a component of value added in inorganic matrices (cement pastes, mortar and concrete), organic (mixtures with asphaltic bitumen) and mixed (improvement of soils). All this by maximizing the sustainable value of the solutions adopted according to a triple perspective: functional, energetic and economic (market viability); for which in order to analyse the sustainable value of the solutions adopted, against other

more conventional. Ultimately, with BlueCons, it is tried to steer this new ways, which have been called the blue economy, towards the construction sector.

The relevance of this coordinated project is referred to the construction market in aspects such: "formula of work" (mortar/concrete/asphalt plants), "additions" (cement) and "types of soil" (paver).

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PROJECT (UBU): CIVIL CONSTRUCTION

Internship 1: HEAF IN PAVEMENT ROADS AND RADIOLOGICAL SHIELD (ONE STUDENT FROM COOPER UNION)

COORDINATOR/CONTACT PERSON:

PhD. Juan M. Manso (jmmanso@ubu.es) and
PhD. Vanesa Ortega (vortega@ubu.es)

Contents: Development of concrete formulations made with EAF slag (EAFC) applied to pavements: ground floors (industrial infrastructure) and wearing courses (roads). Laboratory formulations for basic characterization will be addressed according to applicable regulations and trying to meet the requirements of the industrial pavements and road wearing courses.

The use of EAFC is also studied as a shield against radiation for infrastructures and buildings for the nuclear sector (X-rays and gamma rays). Analyses will be performed on a small scale in the laboratory, using as a reference a regular concrete. Rules and conventional procedures will be used.

Internship 2: STUDY OF BITUMINOUS MIXTURES CON EAFS y LFS (ONE STUDENT FROM COOPER UNION)

COORDINATOR/CONTACT PERSON:

PhD. Juan M. Manso (jmmanso@ubu.es) and

UNIVERSIDAD DE BURGOS

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PhD. Marta Skaf (mskaf@ubu.es)

Contents: Manufacture of bituminous mixtures with EAFS as coarse aggregate and LFS as filler, analyzing their behavior as draining base and wearing course for roads. Abrasion and tire adhesion will be tested, as much as its mechanical behavior with heavy traffic in its key issues: flexibility, dissipation ability and fatigue resistance.

WHAT WE OFFER:

Collaborative working in laboratory testing of large structures and construction materials.

STUDENTS PROFILES:

One or Two Students of Civil Engineering

REFERENCES

https://www.ubu.es/construccion-sostenible-sucons

https://investigacion.ubu.es/grupos/1820/detalle

https://www.ubu.es/unidad-de-investigacion-consolidada-uic-231-tecnologia-de-estructuras

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Juan Manuel Manso, tercero por la izquierda, junto al resto del grupo SUCONS de la Universidad de Burgos. ECB

En España se generan al año miles de toneladas de desechos de la industria siderúrgica difíciles de procesar de manera segura para el medio ambiente y que lamentablemente, en muchas ocasiones, provocan vertidos incontrolados que suponen un importante peligro para el entorno. Nuestro país es el tercero, detrás de Alemania e Italia, en producción de acero eléctrico con unos 15 millones de toneladas al año y, por tanto, de los residuos generados en esta actividad. Dar una salida a estos materiales se hace imprescindible desde el punto de vista ecológico.

En esta línea de investigación llevan trabajando cerca de 20 años el grupo SUCONS (Sustainable Construction Research Group) de la Universidad de Burgos. Dirigido por el catedrático de edificación, Juan Manuel Manso, cuentan con varias patentes y artículos en revistas internacionales sobre materiales destinados a la edificación y la obra civil, cuya principal característica es la utilización de subproductos y residuos industriales difíciles de procesar y que les dotan de unas características muy específicas en cuantos a su resistencia y durabilidad.

Las más recientes han sido cinco tipos de hormigones, tres de ellos autocompactantes y dos de consistencia seca. Cada uno con sus propias especificaciones en cuanto a sus composiciones y características propias que utilizan tanto áridos reciclados de hormigón, los llamados Residuos de Construcción y Demolición (RCD), como escorias de horno de arco eléctrico, subproductos de siderúrgicas granulada molida, además de fibras metálicas o plásticas y eco-conglomerantes que sustituyen al cemento.

Como explica la investigadora, Vanesa Ortega, la novedad en las últimas patentes que han desarrollado en el laboratorio de la UBU es precisamente conseguir una dosificación adecuada para lograr un equilibrio en la mezcla de los diferentes componentes para que, tanto los áridos convencionales como los materiales de desecho se complementen generando un producto final de gran calidad y con unas prestaciones óptimas. De hecho, Juan Manuel Manso apunta que, aunque hormigones como los autocompactantes, ya existían en el mercado y su uso es habitual, los del grupo SUCONS son los primeros a nivel mundial que utilizan este tipo de técnica en la que incluyen fibras y subproductos industriales, como las escorias blancas y negras o los RCD, y que dan una mayor resistencia al propio material. En este campo Universidad de Burgos es pionera y ya hay otros grupos de investigación internacionales trabajando en ello y generando materiales sostenibles a partir de productos reciclados similares.

Vanesa Ortega también destaca que la utilización de los desechos generados en la industria acerera aporta «mayor resistencia, ya que la propia escoria tiene un peso específico mayor», así como unas condiciones y propiedades que hacen que los materiales sean más robustos. Así lo han comprobado en los ensayos mecánicos y físicos que han realizado y en los que sus prestaciones han sido muy satisfactorias, consiguiendo un material muy eficiente.

Una de las mayores novedades es la utilización de escoria blanca que se caracteriza por ser un material pulverulento, que tiene propiedades hidráulicas y con capacidad de endurecerse y transformarse en sólido como lo haría el cemento. Con la inclusión de pequeñas cantidades de este subproducto de la siderurgia en la mezcla, se ha conseguido que los hormigones finales tengan una menor contracción, con lo que hay menos riesgo de fisuras y, por tanto, que el producto final sea más estable.

Este material de desecho ya había sido utilizado por los integrantes del grupo de la UBU en otras líneas de investigación que vienen desarrollando, como en la estabilización de suelos y mezclas bituminosas aplicadas, por ejemplo, a carreteras, donde han conseguido muy buenos resultados.

Además de desarrollar aplicaciones de construcción utilizando materiales de desecho reciclados, el grupo SUCONS integrado por un grupo multidisciplinar de ocho investigadores procedentes de diferentes ramas de la ingeniería, también tiene otras líneas de trabajo como la de la defensa del patrimonio histórico o la sostenibilidad en la edificación. Actualmente están implicados en diferentes proyectos europeos y colaboran con grupos de investigación nacionales e internacionales como la Universidad de Aachen en Alemania, la Universidad de Padua o la de Lisboa. Además, pertenecen a la HORMEC (Red de Excelencia de Hormigones basados en materias primas alternativas para una Economía Circular) y son socios de RILEM (The International Union of Laboratories and Experts in Construction Materials, Systems and Structures), la asociación de expertos internacionales en materiales y estructuras. De hecho, estas cinco últimas patentes se han realizado en colaboración con un grupo de investigación de la Universidad del País Vasco.

Como hace hincapié Juan Manuel Manso, el grupo SUCONS ha tenido un apoyo muy importante desde la junta de Castilla y León aportando financiación a sus investigaciones y, gracias a ello, en los próximos años continuarán desarrollando diferentes líneas de trabajo para conseguir materiales más sostenibles, reducir la huella de carbono y contribuir a una economía circular con la vista puesta en el cuidado por el medio ambiente. «Queremos devolver a la sociedad lo que la sociedad nos está dando. A nosotros lo que nos interesa es que nuestras patentes se usen. De hecho, las investigaciones que empezamos hace 20 años ya tienen su aplicación como por ejemplo en el puerto de Bilbao. Queremos dar un salto y que nuestros materiales se utilicen para cosas importantes».

vos tipos de hormigones de altas prestaciones. Por **D. Andrés**