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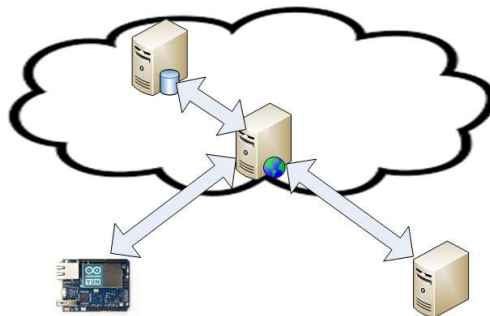
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## **LIST OF PROJECTS OFFERED TO INCOMING STUDENTS FROM THE COOPER UNION UNIVERSITY – DIN<sub>per</sub> research group.**

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 design.

STUDENTS PROFILES:

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

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

**LIST OF PROJECTS OFFERED TO INCOMING STUDENTS FROM THE  
COOPER UNION UNIVERSITY – DIN<sub>per</sub> 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 design.

STUDENTS PROFILES:

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

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

## **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. Fernando Aguilar Romero ([faguilar@ubu.es](mailto:faguilar@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 or energy generation, 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 precision 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 immiscibility range, distillation curve, mixing enthalpy and heating values) at different pressure and temperature conditions.

**Priority Area:**

Renewable energy, sustainability, energy efficiency, Climate Change, Thermodynamics.

**Student profile:**

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



**Recent references:**

H. Lifi, R. Aitbelale, M. Lifi, N. Muñoz-Rujas, F. E. M'hamdi Alaoui, F. Aguilar. Thermodynamic analysis of excess molar enthalpy dynamics in mixtures containing ethanol, methanol, and alkoxyethanols as biofuels for enhanced combustion performance. *Journal of Chemical Thermodynamics*, 2025, 201, 107406.

M. El Bachtoui, M. Lifi, F. Aguilar, M. Dakkach, M. Allouch, N. Muñoz-Rujas. Thermophysical Properties of 1-Hexene with Alcohols and Ether: Experimental and Modeling Insights. *Journal of Chemical and Engineering Data*, 2024, 69, 3819 – 3833.

F.E. Yatim, R. Ait Belale, I. Abala, Y. Chhiti, N. Muñoz Rujas, F. Aguilar, F.E. M'hamdi Alaoui. Blending biomass-based liquid biofuels for a circular economy: Measuring and predicting density for biodiesel and hydrocarbon mixtures at high pressures and temperatures by machine learning approach. *Renewable Energy*, 2024, 234, 121146.

M. Lifi, N. Muñoz-Rujas, G. Rubio-Pérez, F. Aguilar, F. E. M'hamdi Alaoui. Measurement of Liquid Density of Mixtures of 1-Propanol + 2-(2-Methoxyethoxy)ethanol at Temperatures from 298.15 to 393.15 K and Pressures up to 140 MPa and Modeling Using PC-SAFT and Peng–Robinson Equations of State. *Journal of Chemical and Engineering Data*, 2024, 69, 2554-2568.

N. Muñoz-Rujas, G. Rubio-Pérez, J.M. García-Alonso, R. Briones-Llorente, F.E. Yatim, F. Aguilar. ( $\rho$ , T, p) Measurements of the Methyl Nonfluorobutyl Ether (HFE-7100) + 1-Propanol Mixture at Pressures up to 70 MPa and Temperatures from 298.15 to 393.15 K. *Journal of Chemical and Engineering Data*, 2024, 69, 150-162.

M. Lifi, G. Rubio-Pérez, H. Lifi, N. Muñoz-Rujas, F. Aguilar, F. E. M'hamdi Alaoui. Excess properties of mixtures containing 2-(2-ethoxyethoxy)ethanol, methylcyclohexane, cyclohexane and 1-hexene as fuel representative, *Journal of Chemical Thermodynamics*, 2023, 177, 106933.

M. Lifi, I. Abala, R. Briones-Llorente, N. Muñoz-Rujas, F. Aguilar, F. E. M'hamdi Alaoui. Thermophysical Study on the Mixing Properties of Mixtures Comprising 2-(2-Methoxyethoxy)ethanol, Butan-1-ol, Butan-2-ol, and Propan-1-ol. *Journal of Chemical and Engineering Data*, 2023, 68, 3062-3076.

I. Abala, M. Lorenzo-Bañuelos, H. Lifi, M. Lifi, N. Muñoz-Rujas, F. Aguilar, F. E. M'hamdi Alaoui. Density, Viscosity, Refractive Index, and Related Thermophysical Properties of Dibutyl Ether + 2-Butanol + Cyclohexane Ternary Systems. *Journal of Chemical and Engineering Data*, 2022, 67, 3532-3542.

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*, 2022, 170, 106762.

M. Lifi, I. Abala, N. Muñoz-Rujas, F. Aguilar, E. A. Montero, L. Negadi, F. E. M'hamdi Alaoui. Thermophysical properties of binary liquid mixtures of oxygenated compounds: 2-Methoxyethanol + alcohols at T = 298.15 K and 313.15 K. *Journal of Chemical Thermodynamics*, 2022, 164, 106593.

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.

I. Abala, M. Lifi, F. E. M'hamdi Alaoui, N. Muñoz-Rujas, F. Aguilar, E. A. Montero. Experimental data and modeling of liquid density, speed of sound, refractive index and derivative properties of ternary mixtures dibutyl ether + 1-butanol + heptane or + methylcyclohexane: Application of PC-SAFT equation of state. *Journal of Chemical Thermodynamics*, 2021, 161, 106549.

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.





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



WEBSITES OF THE GROUP:

<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>

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

## **POSITION 1: Reuse of by-products from steelmaking industry in building and civil applications**

STUDENT PROFILE: Civil Engineering.

COORDINATORS: Dr. Juan Manuel Manso ([jmmanso@ubu.es](mailto:jmmanso@ubu.es)), Dr. Vanesa Ortega-López ([vortega@ubu.es](mailto:vortega@ubu.es)) and Marta Skaf ([mskaf@ubu.es](mailto:mskaf@ubu.es))

### **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 this project, 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).

### **Videos:**

<https://youtu.be/xPaoZ--YF-I>



**POSITION 2: Concrete manufacturing incorporating wind turbine blade waste and recycled concrete aggregate**

STUDENT PROFILE: Civil Engineering.

COORDINATORS: Dr. Juan Manuel Manso ([jmmanso@ubu.es](mailto:jmmanso@ubu.es)) and Dr. Vanesa Ortega-López ([vortega@ubu.es](mailto:vortega@ubu.es))

**PROJECT DESCRIPTION:**

In the wind-energy sector, an important technological change is taking place that means that wind turbines with a working life of over 25 years have to be replaced by others of greater power. It is estimated that 50% of all installed wind-power capacity (30 GW) before 2030, will be renewed in Spain (5<sup>th</sup> highest wind power capacity in the world). This fact acquires special importance in Castile and Leon, because it is the region with the most wind farms (6.4 GW) in Spain.

The removal of obsolete wind turbines generates enormous amounts of waste, among which its turbine blades and concrete foundations, for which solutions have to be sought for their reuse, with a view to protecting the natural, economic, and industrial environment.

This project seeks to use both crushed wind-turbine blades and Recycled Concrete Aggregate (RCA) as waste products for the precast concrete industry. To do so, their mechanical processing will in the first place have to be defined, so that suitable raw materials for concrete manufacture may be obtained; secondly, work will take place on the design of high workability concretes, and the evaluation of their mechanical behavior and durability; thirdly, the environmental impact and the economic cost of manufacturing mixtures will be studied; and, finally, the waste content of the concretes will be optimized for different precast products on the basis of economic and environmental performance criteria, which will provide both innovative and competitive industrial solutions.

**Videos:**

<https://youtu.be/qXI91rURTek>

