The problem

In EU, an average of 3.1 million tons of paddy rice is produced (ca. 450.000 ha). Around 80% of the EU rice production takes place in Italy and Spain, with a further 12% in Greece and Portugal. Globally, 750 million tons of rice husk (RH) are yearly produced, and it is estimated a continuous increase of 1.1% each year. Each ton of rice can produce 20% of RH, that must be eliminated since it accumulates in the environment due to its low degradability. RH generates 18-20% of RHA through a combustion process. The inadequate deposition of RHA pollutes the environment and deteriorates the respiratory system of humans and animals. During RH incineration, the burnt ash can spread into a large area facilitated by air, causing environmental pollution. According to these figures, large volumes of RHAs with low density are becoming a major challenge to the surroundings of dumping environment and dump fill areas.

The approach

The main goal of the project is to develop, validate and demonstrate zeolite-based multifunctional composite materials from rice husk ash (RHA) for its use in the removal of organic pollutants from water, and in heterogeneous catalysis for biodiesel production. VALZEO intends to employ RHAs as raw supplies to produce composite materials based on hierarchical zeolites modified by metal oxide nanoparticles (MON) and metal-organic framework (MOF) materials with a double purpose, the removal of pharmaceuticals, pesticides, dyes and microorganisms in water, and the catalytic production of biodiesel. VALZEO intends to develop novel zeolitic heterogeneous catalysts to produce biodiesel, from WCO (2.6 Mt in 2020) through affordable catalytic cracking, trying to reduce production costs.

The expected results

ER1) 20 Kg of RHAs as raw material characterized and transformed into 15 Kg of VALZEO materials, that prevent 100 Kg of RHs from being properly disposed.

ER2) 6 new zeolites, MONs, and MOFs manufacture methods implemented, and tested.

ER3) 2 viable alternatives to valorize RHAs through 2 materials with adsorbent and photocatalytic properties for water treatment and 2 catalyzer candidates for biodiesel production.

ER4) A water treatment pilot plant including development materials able to treat 3 types of pollutants (drug, dye, or pesticide) during demonstration stages at 10 L/h flow.

ER5) 2 Tested catalyzers (at 1-3% wt. ratio) able to treat 200 L/day of used cooking oil with yield 92-98% to obtain 184-196 L of biodiesel/day.

ER6) 3 alternative exploitation routes for VALZEO outputs, including scalability and economic feasibility studies reports.

ER7) 26 disciplines of 5 research areas contributing through 6 types of activities to achieve 5 ToKs.

ER8) 120 I3 secondments for a total of 210 p/m

ER9) 33 ER, 7 ESR, 3 TECH, 1 MNGT with acquired skills on the development of functionalised porous materials for water treatment and biofuel catalysis, covering material fabrication and characterization, synthesis of nanoparticles, mechanisms of adsorption and photo-degradation, analytical chemistry, and water treatment or biodiesel engineering.

ER10) Enlargement of the original partnership to address future collaborative actions by engaging 3 additional research institutions and 3 companies, one for each of the target research avenues (RHAs valorisation, water treatment and biodiesel production).

The linked outcomes

O1) Capitalisation of learned practices for replication, implementation, and update of transferred knowledge, skills, and competences acquisition during the framework of VALZEO improves the individuals' employability and career prospects to address future circular economy approaches for rice production, water treatment and biodiesel generation.

O2) The developed ways of cooperation and ToK between sectors and disciplinners allow to convert targeted research into value generated through dissemination, communication and exploitation measures.

O3) Boosted R&I capacity because of the generated know-how allows testing new innovative ideas and check entrepreneurial options to evaluate their exploitation through dissemination, communication and exploitation measures.

O4) A consolidated and sustainable I3 network of key leading institutions offering sound knowledge, exploitable outputs and business opportunities for the valorisation of RHAs and their application for water treatment and biodiesel production following a circular economy approach, to be extended during the framework of other international funding programmes. The network will enhance strategic collaboration, alliances, stronger linkages with linked stakeholders value chains, meetings with national relevant projects and better outreach for longer connections through some of the proposed dissemination, communication and exploitation measures.

O5) Enhanced networking and communication capacities because of strategic collaboration (fully exploited through secondments, outreach activities and meetings with scientific and industrial peers or society to broaden the R&I impact addressing the valorisation of RHAs for water treatment or biodiesel production.

Dissemination

- **10** articles in high-impact peer reviewed journals.
- **4** Network-wide training events.
- **3** modules of on-line (as MOOCs for e-learning to be capitalised through webinar sessions) training material addressing ToKs.
- **10** oral presentations at international and national conferences and **20** posters presentation.
- **3** policy briefs for recommendation of new technologies.

Communication

- **1** Official project website.
- **+300** downloads via Open Access.
- **16** Participations at EU Researchers' Night for **4** years and Biennial edition of ESOF.
- **4** VALZEO annual open days at UAB, UPO, UNIVPM and UH.
- **4** informal Science Cafes and **4** brokerage events for speed dating among attendants for quick exchange of information and outputs during the **4** scheduled user workshops.
- **2** visits to Large Infrastructure Facilities in ES and IT.
- **4** trade press and presentations at fairs and trade shows.

Exploitation

- Synthesis and characterisation of novel multifunctional zeolites, MONs, and MOFs as water adsorbent or catalysers for biodiesel production (*Patenting, licensing, service creation or consultancy services*)
- Adsorbent materials within integrated pilot plants for water treatment (*Renting, joint venture, collaborative research*).

Partnership

UNIVERSITAT AUTÒNOMA DE BARCELONA

UNIVERSIDAD PABLO DE OLAVIDE

UNIVERSITA POLITECNICA DELLE MARCHE

AERIS TECNOLOGIAS AMBIENTALES SL

SUSTAINABLE INNOVATION TECHNOLOGY SERVICES LIMITED

ZPRIME LIMITED

UNIVERSIDAD DE LA HABANA

ESTACIÓN EXPERIMENTAL DE PASTOS Y FORRAJES "INDIO HATUEY"

INSTITUTO DE INVESTIGACIONES DE GRANOS

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VALZEO

Valorisation of agro-industrial wastes via the production of zeolite-based composite materials and their use in environmental remediation and biofuel production

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