Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Workshop
February 14th 2025
Faenza, Italy

Geopolymer for Environmental Remediation

Preliminary Program & Speakers' Abstracts

Finanziato dall'Unione europea NextGenerationEU | Ministero dell'Università e della Ricerca | Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Geopolymer for Environmental Remediation
Faenza – February 14th 2025

SCIENTIFIC COMMITTEE

Valentina Medri
Francesco Miccio
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CNR-ISSMC, Italy

Dario Frascari
Matteo Minelli
Davide Pinelli
DICAM-University of Bologna, Italy

Angelo Vaccari
"Toso Montanari" University of Bologna, Italy

LOCATION

International Museum of Ceramics
Viale Baccarini 19 Faenza, Italy
https://www.micfaenza.org/

The workshop is carried out as part of the MUR PRIN 2022 project GEA-GEopolymer based Adsorbents for effective adsorption and selective separation of CO_2 and eutrophication pollutants (grant No 20229THRM2) funded by the European Union – Next Generation EU.
The workshop is organized by the Institute of Science, Technology and Sustainability for Ceramics (CNR-ISSMC) and the Department of Civil, Chemical, Environmental and Materials Engineering - DICAM of the University of Bologna.

Consiglio Nazionale delle Ricerche

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

The Workshop is in the frame of the one-day-meeting organized since 2008 by the Group of Study on Geopolymers of the Italian Ceramic Society.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

WORKSHOP
Geopolymer for Environmental Remediation

February 14th 2020
INTERNATIONAL MUSEUM OF CERAMICS
Viale Baccarini 19 Faenza, Italy
https://www.micfaenza.org/

Daily Program

09.30-10.00:	**Registration & welcome coffee**
10.00-10.20:	**Opening** **Dr. Valentina Medri**, GEA PI, CNR-ISSMC, Italy **Dr. Claudia Casali**, Director of MIC, Italy **Prof. Cristina Leonelli**, Coordinator of the Italian Working Group on Geopolymers, University of Modena and Reggio Emilia, Italy
GEA session	**Chair: Dr. Valentina Medri**
10.20-10.35:	Dr. Elettra Papa, CNR-ISSMC, Italy, *Geopolymer-based adsorbents: a tunable platform for pollutant removal*
10.35-10.50:	Prof. Dario Frascari, DICAM-University of Bologna, Italy *Geopolymer-based adsorbents for Nitrogen/Phosphorus removal and recovery from wastewater*
10.50-11.05:	Prof. Matteo Minelli, DICAM-University of Bologna, Italy *Geopolymer-based adsorbents for CO_2 capture*
Morning session	**Chair: Prof. Angelo Vaccari**
11.05-11,30:	Keynote – **Prof. Luisa Pasti**, University of Ferrara, Italy *Adsorbent Materials in Environmental Remediation*
11.30-11.55:	Keynote – **Prof. Roberto Canziani, Eng. Lorenzo Esposito**, Politecnico di Milano, Italy *Phosphorus recovery from wastewater, sludge and sewage sludge ashes – a short overview*
11.55-12.20:	Keynote – **Prof. Enzo Mangano**, University of Edinburgh, UK *Caracterisation of novel adsorbents for carbon capture: from mg to kg scale*
12.20-12.50:	**Poster flash presentation**
12.50-14.00:	**Light lunch & poster session**
14.00-14.45:	**Visit at the Museum**

Afternoon session Chair: Prof. Davide Pinelli

14.45-15.00: Prof. Tero Luukkonen, Oulu University, Finland
Recent advances in using geopolymers and alkali-activated materials as adsorbents

15.00-15.15: Prof. Rui Novais, CICECO-University of Aveiro, Portugal
Advancing wastewater treatment systems with 3D-printed geopolymer lattices

15.15-15.30: Dr. Giulia Masi, DICAM-University of Bologna, Italy
Asymmetric membranes for wastewater treatment by alkali activation

15.30-15.45: Prof. Sebastiano Candamano, University of Calabria, Italy
Preparation of foamed and unfoamed geopolymer/NaX zeolite/activated carbon composites for CO_2 adsorption

15:45-16:00: Coffee break

PRIN session Chair: Dr. Francesco Miccio

16:00-16:15: Prof. Oreste Tarallo, Università degli Studi di Napoli Federico II, Italy
Engineering of eco-sustainable geopolymer-based adsorbent materials for the removal of emerging pollutants and environmental remediation

16:15-16:30: Prof. Barbara Liguori, Università degli Studi di Napoli Federico II, Italy
Design multifunctional foams for water remediation: the ZEOREMEDIA project

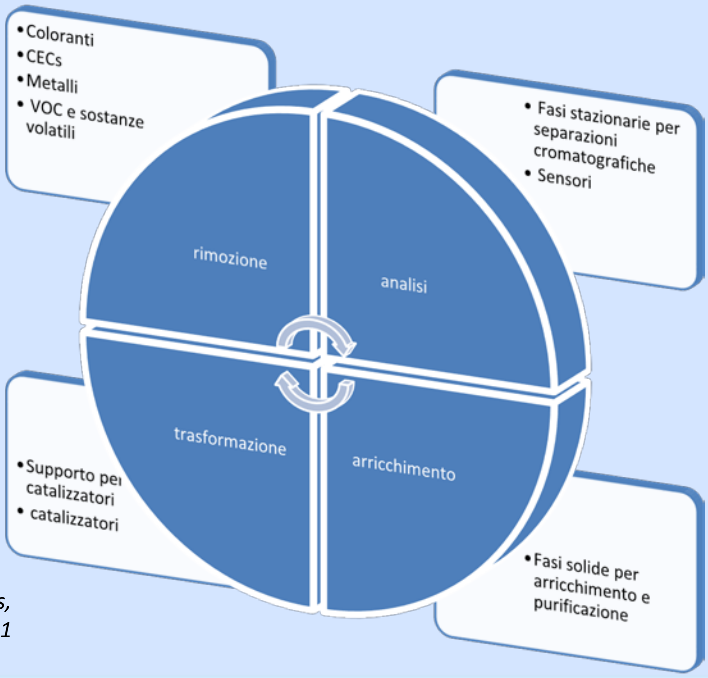
16.30: Poster Awards & Conclusive Remarks

Keynote ID: 01

Adsorbent Materials in Environmental Remediation

Luisa Pasti[1], Tatiana Chenet[1], Claudia Stevanin[1], Annalisa Martucci[2]
[1]Department of Environmental and Health Sciences, University of Ferrara, Ferrara, Italy;
[2] Department of Physics and Earth Sciences

Among the various separation techniques, adsorption, a well-established technology, is still regarded as a reliable and robust method for purifying fluids at low cost and with high efficiency. One of the key advantages of adsorption-based technologies is their effectiveness in treating contaminants at very low concentration levels—an operational condition where most other separation techniques prove inefficient due to the small concentration gradients involved. Additionally, adsorption is a versatile method capable of simultaneously removing a wide variety of organic and inorganic compounds, provided an appropriate adsorbent medium is employed. A distinguishing characteristic of adsorption systems is that multiple components in a solution can interact with the sorbent surface, exhibiting differences in the strength and location of their interactions with the adsorbent. Moreover, the adsorbent surface may also show an affinity toward the solvent. Consequently, adsorption is, in most cases, a multicomponent process, even when a single solute is considered. Adsorption-based technologies have been successfully employed in numerous applications, including environmental remediation methodologies. The primary categories of substances that commonly pollute the aquatic environment include heavy metals, detergents, disinfection by-products, pesticides, petroleum hydrocarbons, volatile organic compounds, perfluorinated aliphatic substances, and contaminants of emerging concern. This lecture presents a brief overview of liquid-solid adsorption processes using different adsorbent materials for the removal of various classes of contaminants. Since the efficiency of the adsorption process is influenced by the number and type of interactions between the adsorbent and the adsorbate, the various microscopic mechanisms involved in adsorption phenomena are also discussed.



Contact:
Luisa Pasti, email: luisa.pasti@unife.it
Department of Environmental and Health Sciences, University of Ferrara, Via L. Borsari, 46 44121 Ferrara, Italy

Curriculum vitae

Luisa Pasti is a Full Professor of Analytical Chemistry at the Department of Environmental and Health Sciences at the University of Ferrara. Research activity of Luisa Pasti has been mainly devoted in the field of separation science. In particular, her activity in this field can be outlined as follows: a) theoretical description of chromatographic separations and multicomponent separations: development of statistical tools for optimization of complex mixture separations, dynamic and reaction chromatography; b) applied aspects of linear and nonlinear (preparative) chromatography; c) retention mechanisms and characterization of adsorbent media for application in environmental and agri-food sectors, d) biomass waste-based adsorbents; e) catalysts and photocatalysts characterization and their application in environmental remediation. She is the author of 135 papers published in international journals and 7 book chapters. She has participated as a speaker at several national and international conferences. She is the Scientific Director of the Terra&Acqua Tech Laboratory Network at the Ferrara Technopole, which is part of the High Technology Network of the Emilia-Romagna Region, and she is Coordinator of the Ph.D. Program in Environmental and Health Sciences at the University of Ferrara.

Keynote ID: 02

Phosphorus recovery from wastewater, sludge and sewage sludge ashes – a short overview

Roberto Canziani[1], Lorenzo Esposito[1], Gaia Boniardi[2], Andrea Turolla[1]
[1]Politecnico di Milano, DICA – Environmental Section, Piazza L. da Vinci, 32 – 20133 Milano, Italy;
[2] School of Chemical Engineering, The University of Queensland, Brisbane QLD 4072, Australia

This short overview will list and describe briefly some technologies for the recovery of phosphorus from (i) wastewater, (ii=) sludge, (iii) liquid streams form sludge treatment units, (iv) incinerated sewage sludge ashes, pointing out their operational principle, current TRL, problems and possible perspectives.

Contact:
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Curriculum vitae

Roberto Canziani – PhD since 1987, is now full professor of Sanitary Environmental Engineering at Politecnico di Milano. Teacher of Water and Wastewater Treatment Technologies (taught in English). He is author or co-author of more than 200 publications, of which 50 are papers published in international peer-reviewed journals. His research has been always focused on wastewater and sludge treatment technologies.

Lorenzo Esposito (presenter) – Environmental Engineer, graduated in April 2024, assistant researcher since July 2024, he works on upgrading phosphorus recovery from sewage sludge ashes.

Gaia Boniardi – Environmental Engineer, PhD (2024), she is now post-doc researcher at the School of Chemical Engineering, The University of Queensland, Brisbane. She is author or co-author of 11 papers published in international peer-reviewed journals and other contirbutions in international conferences.

Andrea Turolla – PhD (2014), he is now associate professor in Sanitary Envronmental Engineering at Politecnico di Milano. Teacher of the Pollution Management for Geoinformatics, and Environmental engineering for sustainable agriculture for Agricultural Engineering (both taught in English). Author or co-author of 70 papers published in international peer-reviewed journals. His research activities have been focused on different technologies for water and wastewater treatment and recently are mainly devoted to innnovative technologies for material recovery from liquid waste streams.

Keynote ID: 03

Caracterisation of novel adsorbents for carbon capture: from mg to kg scale

Enzo Mangano, Stefano Brandani
The University of Edinburgh, School of Engineering, Edinburgh, UK

The development of new process to capture CO_2 from different sources, from post combustion capture to direct air capture, requires the synthesis and manufacturing of adsorbents with tailored properties to perform at different concentrations of CO_2, temperature and in presence of different gases and contaminants. This has pushed significantly the research on novel materials with the objective of developing adsorbents that can improve the performance of the process, be easily scaled up and be competitively cheap compared to the current commercial options. Novel adsorbents are normally synthesised in small quantities (<100mg) therefore it is essential to develop experimental techniques capable to measure accurately the adsorption properties of porous materials with very small amount of sample. The Adsorption Group at the University of Edinburgh specialises in the experimental characterization of prototype adsorbents using very small sample masses. The Zero Length Column (ZLC) is a key tool to measure accurately adsorption equilibrium and kinetics using <10 mg of sample. Thanks to the small quantities used it also allows to assess the stability of materials to prolonged flue gas exposure in a very short time and with minimal gas consumption compared to conventional breakthrough apparatuses. In addition to the ZLC we present a number of techniques (chromatographic and volumetric) and experimental approaches that we routinely use to characterise different aspects of the adsorption performance using sample masses from mg to kg scale.

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Enzo Mangano (E.Mangano@ed.ac.uk)
The University of Edinburgh, School of Engineering,
Mayfield Road, EH9 3FB, Edinburgh

Curriculum vitae

Dr Enzo Mangano (EM) is a Senior Lecturer in Chemical Engineering at The University of Edinburgh, where he focuses his research on the equilibrium and kinetic characterisation of novel nanoporous materials for gas adsorption. He also leads the research on high pressure adsorption for a number of applications including gas storage and pressure swing adsorption. He has developed a new differential volumetric system for the measurement of equilibrium and kinetic at high pressure with very high accuracy using small sample masses (< 100 mg). The system was used to generate the CH_4 reference isotherm on NaY as part of the international round-robin effort coordinated by NIST. He is co-author of the IUPAC technical report “Diffusion in Nanoporous Materials” lead by Prof. by Prof. Jörg Kärger. The report, recently published in Pure and Applied Chemistry, provides the fundamental guidelines on the use of experimental techniques to measure gas transport kinetics. EM is the receiver of the 2016 Italy Made Me Award (Young Researcher Award) from the Italian UK Embassy.

Invited ID: 01

Recent advances in using geopolymers and alkali-activated materials as adsorbents

Tero Luukkonen[1]

[1] Fibre and Particle Engineering Research Unit, University of Oulu, Finland

Geopolymers, and a wider group of alkali-activated materials (AAMs), are amorphous zeolite- or tobermorite-like synthetic products. During the last decade, their application as adsorbents has attracted a great deal of scientific interest with also some commercial implementations. This is stemming from their low material costs (e.g., common calcined clays or industrial aluminosilicate side streams can be used as raw materials) and sustainable manufacturing process requiring only near-ambient conditions. In this presentation, an overview of some recent advances in the preparation and use of geopolymers and alkali-activated materials as adsorbents is provided based on research conducted at the University of Oulu.

In the first example of recent studies, composite adsorbent granules containing either metakaolin geopolymer or alkali-activated slag and $MgCO_3$/MgO/Mg silicate-rich commercial adsorbent or hydroxyapatite were prepared and tested. In such systems, the geopolymer or AAM acts as a binder for the powdered adsorbent but also provides additional adsorption capacity. One bottleneck in the adsorbent development is frequently the preparation of granular materials from powdered adsorbents – geopolymers or AAMs could be a widely applicable solution. The regeneration of the granules with the Mg-rich adsorbent with 0.3 M HNO_3 after metal sorption from mine seepage water in a field experiment showed that their adsorption amount clearly improved upon repeated adsorption/desorption cycles.

In the second example, the modification of geopolymer surface with silane coupling agents was demonstrated to create a superhydrophobic material capable of effectively separating microplastics from water. Silane coupling agents can be reacted with the geopolymer surface silanol (Si-OH) groups to covalently attach organic functionalities to the material. In the case of superhydrophic materials, triethoxy(octyl)silane was used. It was shown that such material could maintain ≥ 99% separation of 59-63 µm-sized plastics for more than 200 bed volumes of water while a non-modified geopolymer decline in the uptake already after 1 bed volume.

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Curriculum vitae

Dr. Tero Luukkonen is an Associate Professor at University of Oulu, Finland. He received his PhD degree in 2016 from physical chemistry. Between 2010 and 2017, he worked in R&D positions at three start-up companies operating in the clean-technology sector. Since 2017, he has worked at the Fibre and Particle Engineering Research Unit, at the University of Oulu. In his current position, he is leading a research group focusing on the development of materials for environmental engineering. His research interests include water and wastewater treatment, materials science, and advanced environmental applications of geopolymers and alkali-activated materials in which areas he has authored or co-authored more than 90 peer-reviewed publications.

Invited ID: 02

Advancing wastewater treatment systems with 3D-printed geopolymer lattices

Rui M. Novais[1], M.M. Almeida[1], Ana P.F. Caetano[1], J.G. Cuadra[1], Nuno P.F. Gonçalves[2], J.A. Labrincha[1]

[1]Department of Materials and Ceramic Engineering / CICECO-Aveiro Institute of Materials, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal.
[2]Dept. of Chemistry/CICECO-Aveiro Institute of Materials, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

In the past few years, porous geopolymers and alkali-activated materials have attracted unparalleled interest in the research community, as they combine excellent performance with low production costs and environmentally friendly synthesis protocols. The production of highly porous geopolymers can be achieved by employing various techniques, including mechanical and chemical foaming, freeze-casting, and sacrificial fillers. Although these approaches can deliver geopolymers with high porosity, precise control over pore distribution and interconnectivity remains challenging. Additive manufacturing (AM) technologies can be used to overcome the limitations of conventional manufacturing methods, enabling the fabrication of lattices with strict control over pore size and interconnectivity. In this lecture, the feasibility of using AM to produce highly porous geopolymer structures for the depollution of synthetic wastewater and real industrial effluents will be demonstrated.

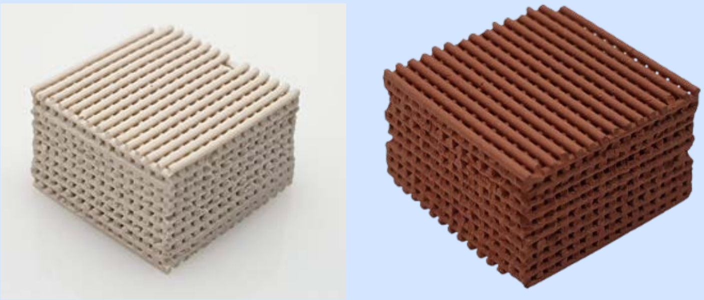

Fig. 1 Optical micrographs of 3D-printed geopolymer lattices prepared by direct ink writing.

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Curriculum vitae

Rui Novais is an Assistant Professor at the Department of Materials and Ceramic Engineering and CICECO-Aveiro Institute of Materials at University of Aveiro (UA). Rui Novais professional path began with a Degree in Physics and Chemistry (Teacher Training) in 2005. This was followed by a PhD in Polymer Science and Composites (July 2012) from the University of Minho with the topic "Functionalized carbon nanotubes for polymer based nanocomposites". Since 2012, he has been working on the development of materials to decarbonize the construction sector, energy production, and environmental remediation applications, with a particular focus on waste recycling and product sustainability. To date, he has published over 100 articles, including 84 indexed in the Science Citation Index. Their publications include 6 book chapters and more than 130 presentations (oral and poster) at international conferences. He has >3500 citations and an h-index of 35 (SCOPUS).

Invited ID: 03

ASYMMETRIC MEMBRANES FOR WASTEWATER TREATMENT BY ALKALI ACTIVATION

Giulia Masi

[1]Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna (Italy)

Wastewaters are usually treated by applying microfiltration processes. For this purpose, polymeric or ceramic membranes are usually applied due to low production cost or excellent durability properties, respectively. An emerging approach is to use alkali activated materials as an alternative to produce self-sustained membranes. This class of materials exhibits outstanding durability properties, considerably low production costs and environmental impacts, because the sintering process, typical of ceramics, can be avoided. In literature, few studies investigated asymmetric alkali activated membranes, mainly focusing on the separation by adsorption mechanisms. For these reasons, the aim of this study is to synthesise asymmetric membranes based on alkali activation with comparable performances compared to commercial ceramic membranes for physical separation processes in the field of industrial wastewater containing oil-water emulsions. Initially, the optimization of the support preparation was carried out by pressing alkali activated mixes obtained by tailoring the fundamental molar ratios, the water content, and the forming pressure. Then, the membrane supports were selected based on the results of their open porosity and permeability to pure water measurements. At the end, alkali activated supports were produced by applying 5 MPa of uniaxially pressing to a dry mixed powder consisting of metakaolin and anhydrous sodium silicate, sprayed with 12 wt% water. A selective layer, obtained by mixing metakaolin, sodium silicate and 8M sodium hydroxide solutions, was applied by a spatula coating, showing a thickness around 40 µm and a pore size in the range of 0.1-1.0 µm. Permeability and rejection of the obtained asymmetric membrane to pure water and oil-water emulsions showed comparable performances with commercial ceramic membranes, suggesting that the developed microfiltration system by alkali activation is a suitable alternative to ceramic membranes.

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Curriculum vitae

Giulia Masi got her PhD in Materials Engineering in 2018 in the framework of a European project dealing with the development of protective coatings against outdoor corrosion of bronze Heritage (EU M-ERA.net project B-IMPACT (2015-2017). During her first stage of career, she was Visiting Researcher abroad: 7-month-internship at the Geopolymer Centre Group of the Curtin University in Perth, Western Australia (2013) and 6-month-visiting at the Laboratoire TRACES of the University of Toulouse, France (2017). Her PhD research was awarded by two prizes: Winner of the National Grant AIMAT 2021 for the best PhD thesis in the field of Materials Science (ING-IND/22) between 2018-2020 and of Coating 2023 Early Career Investigator Award promoted by MDPI for young researchers that made a significant contribution to the advancement of the field of coatings.

After her PhD, she was a post-Doc in the Department of Civil, Chemical, Environmental and Materials Engineering at the University of Bologna for 3 years (2018-2021), collaborating in an Italian project (funded by Cariplo Foundation) on the use of reclaimed asphalt pavement as recycled aggregates for concrete in view of the circular economy concepts (RAPCON project).

Since 2021, she is an assistant professor at the University of Bologna in the Materials Science laboratories leaded by Prof. Maria Chiara Bignozzi. She is currently focusing on the development of sustainable inorganic materials by alkali activation in the industrial and construction fields, especially investigating the durability aspects with a multi-analytical approach.

She is author of 36 papers published on peer-reviewed International journals and more than 20 papers for conference proceedings. She is currently Guest Editor of the special issue “Women in Science: Materials 2023” for the Frontiers in Materials journal.

Invited ID: 04

Preparation of foamed and unfoamed geopolymer/NaX zeolite/activated carbon composites for CO_2 adsorption

S. Candamano[1], A. Policicchio[1], G. Conte[1], R. Abarca[1], C. Algieri[2], S. Chakraborty[1], S. Curcio[1], V. Calabrò[1], F. Crea[1], R.G. Agostino[1]

[1]University of Calabria, 87036, Rende, Italy;

[2]Institute on Membrane Technology, National Research Council of Italy (ITM–CNR), 87036, Rende, Italy

Novel composites with hierarchical porosity have been evaluated as CO_2 adsorbents. An activator solution and metakaolin were used as starting mix. Activated carbon, characterized by a surface area of 528 m^2/g and a bimodal porosity centered at 4.2 Å and 10 Å, was added to the starting mix to produce hybrid composites. It was in-house produced by thermo-chemical activation of olive pomace waste. H_2O_2 and egg protein were added to the mix as a facile method to produce foamed composites. Multiphase reaction–crystallization processes, characterized by one or two thermal steps, were designed to favor geopolymerization and in-situ NaX zeolite gel conversion of metakaolin. Both the thermal procedures produce composites in forms of monoliths, as needed for application in real processes. The two thermal steps process, of which the latter is hydrothermal, increases the amount of NaX crystalline phase produced. The foaming process decreases the density and the mechanical properties of the monoliths, but it does not affect the geopolymerization and crystallization reactions or the topology of the produced zeolite. The combination of raw materials and thermal treatments affect the textural properties of the adsorbents, mainly in terms of different contribution of ultramicroporosity (<7 Å) and super microporosity (7–20 Å). Several CO_2 adsorption/desorption measurements at room temperature (298 K) up to 15 bar were carried out on all the prepared adsorbents. Notably, all the adsorbents store, already at 1 bar, almost 60% of the CO_2 uptake at the maximum analyzed pressure, with the maximum adsorption value close to 23 wt%. The strength of solid-gas interaction was also assessed by the calculating the values of Toth equation fitting parameter K. The proposed robust and facile preparation processes are aimed to obtain adsorbents able to overcome the shortcomings of conventional packed beds by exploiting the binding properties of geopolymer, the adsorption properties of zeolite NaX, the tailored pore structure, the electrical conductibility and the high stability of activated biochar and the macroporosity introduced by the foaming agent.

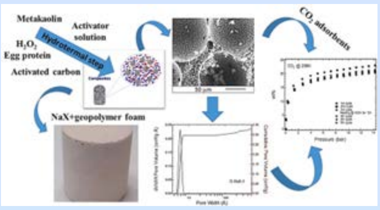

Fig. 1 Production and characterization of Geopolymer/NaX zeolite/activated carbon composites for CO_2 adsorption

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Curriculum vitae

Sebastiano Candamano is an Associate Professor in the sector of Materials Science and Technology (IMAT-01/A) at University of Calabria (Rende, Italy), in the Department of Mechanical, Energy and Management Engineering. His research is mainly focused on: the development, characterization and optimization of traditional, advanced and innovative binders, mortars and concretes (cements, geopolymers, alkaline activated materials) and fiber-reinforced composites; the synthesis and characterization of zeolites; preparation of catalysts for the production of hydrogen using POX, ASR, SR reactions; production of materials for CO_2 adsorption; anaerobic digestion; materials for water pollution remediation; materials and catalysts for the pre-treatments of waste cooking oils and their conversion in biodiesel. He was the scientific responsible for the financed project POR CALABRIA FESR PFU-PREDECORE "Use of PFU (End-of Use Tires) for the production of PRemiscelates for the ECO-compatible and Energy-saving Construction, CUP J88C17000310006 -PORCALABRIA FESR 2014-2020. He is currently the scientific responsible of the Unical research unit in the financed research program PRIN 2022: Integration of Artificial Intelligence and Ultrasonic Techniques for Monitoring Control and Self-Repair of Civil Concrete Structures (CAIUS) codice 2022AZPLL8.

Invited ID: 05

Engineering of eco-sustainable geopolymer-based adsorbent materials for the removal of emerging pollutants and environmental remediation

Oreste Tarallo[1], Giuseppina Roviello[2]
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[2] Dipartimento di Ingegneria, Università degli Studi di Napoli Parthenope, Napoli(IT)

Emerging contaminants (CECs), including compounds from consumer products such as detergents, paints, personal care items, and pharmaceuticals, are increasingly found in wastewater and soil. Due to their potential environmental and health risks, CECs are monitored to preserve ecological and human health. Adsorption processes are among the most effective methods for CEC removal, offering high efficiency, low operational costs, and no harmful by-products. This contribution discusses the use of new geopolymer-based materials obtained from secondary raw materials for adsorption. These materials have been produced as massive or sponge-like continuous filters via simple, cost-effective processes like direct foaming and have been effectively used for the adsorption of cationic, anionic, and neutral species. Additionally, surface engineering with catalytically active species have allowed in situ or continuous degradation of adsorbed pollutants. The proposed materials and processes are designed for scalable, environmentally friendly production, offering an alternative to traditional high-footprint adsorption products like carbon black or polymer foams, thus supporting environmental remediation efforts. These research activities have been funded by PRIN – Bando 2022 PNRR Project P2022S3KER, CUP E53D23017810001.

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Curriculum vitae

Prof. Oreste Tarallo has a long and solid experience in the obtainment and structural characterization of geopolymer based materials. During the last years, he has contributed to the development of innovative composite and hybrid geopolymer materials by developing new synthetic methodologies for the production of materials characterized by reduced fragility and improved mechanical properties, such as resistance to compression and bending, compared to traditional non-modified geopolymers. These materials have been synthesized from secondary raw materials such as fly ash or clays. More recently he has focused his attention on the use geopolymer-based materials in the field of environmental remediation. The results of these researches have been published in about 20 papers in high impact international journals and have led to the filing of 2 patents.

Invited ID: 06

DESIGN MULTIFUNCTIONAL FOAMS FOR WATER REMEDIATION: THE ZEOREMEDIA PROJECT

Barbara Liguori[1], Assunta Campanile[1], Claudio Ferone[2], Paolo Aprea[1]

[1]ACLabs - Applied Chemistry Labs, Department of Chemical, Materials and Industrial Production Engineering, University of Naples Federico II, Italy;
[2]Department of Engineering, University of Naples Parthenope, Italy

Many industrial applications need supporting or shaping powdery zeolites. Since geopolymers can be considered the amorphous counterpart or precursors of crystalline zeolites, it is possible to promote zeolite crystallization inside the geopolymeric matrix by tuning pH, temperature and time of the geopolymerization reaction (Figure 1). Moreover, combining zeolite crystallization with a foaming process, a multifunctional self-supporting zeolitic foam can been obtained with pores ranging from the micro to the macro range. The presence of a geopolymer backbone that supports and shapes the zeolitic powder can expand its technological application fields, by means of tailoring the type and amount of the zeolites for each specific application. The ZEOREMEDIA project (P20224KCJW), funded by the European Union-Next Generation EU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR), aims at designing multifunctional foams based on zeolites supported on geopolymer matrix and validating their application as sorbents for the removal of pollutants from contaminated water due to their special features, such as controlled porosity, low flow resistance, mechanical and chemical stability, and controlled chemical composition.

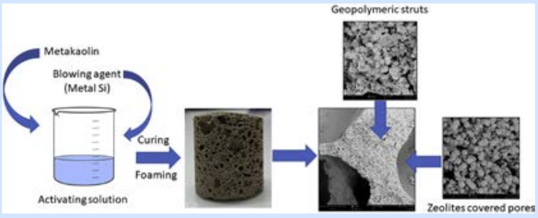

Fig. 1 Layout of the Multifunctional Foam production process

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DICMaPI
Applied Chemistry Labs

Curriculum vitae

Barbara Liguori is Associate Professor of Materials Science and Technology at the Department of Chemical, Materials and Industrial Production Engineering (DICMaPI) of the University of Naples Federico II.
Lecturer in “Ceramics Technologies” and “Materials and Techniques in Cultural Heritage” in the Master program in Materials Engineering of the University of Naples Federico II.
Her research activity is developed in two main topics:
-**Materials for the Environment** focused on waste treatment and recovery such as inertization, valorization and reuse of zeolitic sludge, reuse of plastic waste, sludge and waste recovery by alkaline activation, development of multifunctional porous materials for water and air remediation.
-**Cultural Heritage and Built environment** focused on development and characterization of innovative and sustainable restoration mortars and on consolidation and protection of stone surfaces.
Co-author of more than 130 scientific paper, 87 of them published on indexed international journal (Scopus citation report: 2411 Citations, h-index: 27 -visited on Decembre 2024).
She is involved in national and international projects. Among the most recent: Principal Investigator (PI) of PRIN 2022 PNRR ZEOREMEDIA: zeolitic sorbents for water remediation funded by the European Union-Next Generation EU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR); Component of the Research Unit of ERC-2024-COG (2024) "TabulaRasa. Clay, wax, and the impact of erasable writing technologies on manuscript cultures“; Scientific Manager of the local Research Unit in the Project: manifacture of artificial aggregates by means of multi step cold bonding pelletization of harzadous and non-harzardous wastes (PRIN 2020); Component of the Research Unit of MICS 2022 (Made in Italy – Circular and Sustainable) Extended Partnership and received funding from the European Union Next-GenerationEU (PNRR).