**BIOCOMEM**

**BIO**-BASED **CO**POLYMERS FOR **MEM**BRANE END PRODUCTS FOR GAS SEPARATIONS

**H2020-BBI-JTI GRANT AGREEMENT NUMBER: 887075**

# NEWSLETTER Nr. 5

## 30th May 2023

**Figure 1** Picture of the 4th Consortium Meeting held presential and online

Dear BioCoMem friends, I am glad to welcome you to the fifth project newsletter! As you can see from the picture, the last project meeting was held in presence in May 2023, hosted by Hereon in Hamburg, allowing all the consortium members to thoroughly, discuss assess and coordinate project progress.
BioCoMem Project is glad to inform you about the main results achieved so far: after suffering some delays due to covid-19, the project has boosted activities and is on-track. We are trilled to announce that membrane modules for the final demonstration at TRL5 have been well received at the demo sites.
Looking forward to start the demonstration campaign and present the results in the next (and last!) Project Meeting at TECNALIA premises in November. Enjoy the newsletter reading!

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## Project Objectives

The overarching objective for the BIOCOMEM project is to demonstrate that membrane-based separation techniques using PEBA-type (Polyether block amide) copolymers are more efficient than their heat-based equivalent methods. This will reduce the overall environmental impact through some mechanisms. With this, the BIOCOMEM project has three specific objectives.

- First, to produce two new bio-based PEBA co-polymers at pilot scale. Each of these will be specifically designed to add value to three $CO_2$ separation market sectors: biogas upgrading, natural gas upgrading, and post-combustion flue gas treatment.
- Second, to validate – again at pilot-scale, in an industrially representative environment – a process for manufacturing three different gas separation hollow-fiber membranes that meet specific performance requirements.
- Third, to provide proof of the principle that bio-based membranes can genuinely bring value to the gas separation market.

## Partnership

The BioCoMem consortium gathers now 7 organizations from 4 countries including top-level European Research Institutes, Universities, and representative top industries in different sectors (3 SMEs and 1 IND).
The consortium brings together multidisciplinary expertise in catalysts synthesis, membranes development, chemical and process engineering development, and construction of turn-key solutions in the energy sector including operation and maintenance (i.e. biogas upgrading plants design), modeling and simulation, LCA, and industrial risk study.

# BioCoMem in progress

Following the successful upscaling of the multilayer thin-film composite membrane (TFCM) prepared using the prototype A bio-PEBA as selective layer, **Hereon** fabricated two envelope-type membrane modules at two different scales:

1. A demonstrator module "K100 PN40" containing 0.45 m² of membrane area, which will be tested at the DMT facilities in Netherlands for natural and biogas upgrading.
2. A lab-scale module "K100" with 0.06 m² of total membrane area to be tested at TUE in its new membrane gas separation test rig for diverse applications.

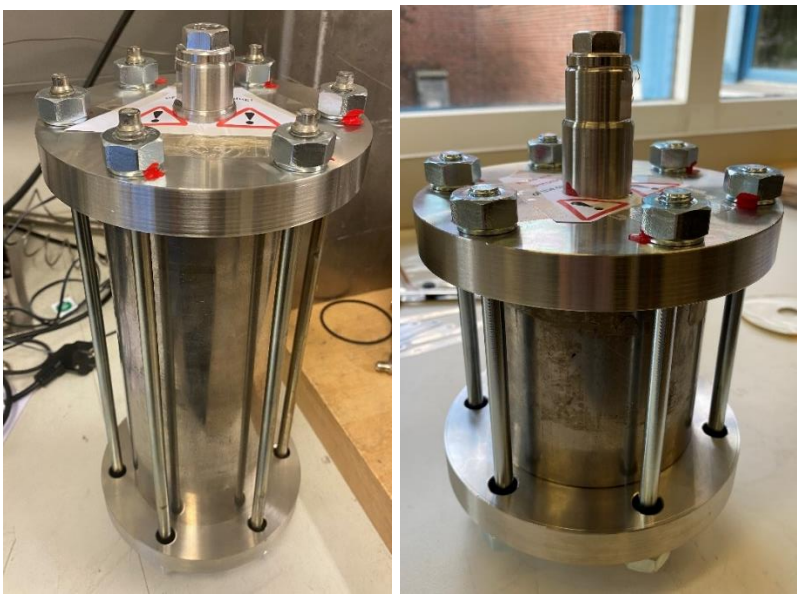

**Figure 2. Demonstration (left) and lab-scale (right) envelope-type membrane modules fabricated at the Institute of Membrane Research of Helmholtz-Zentrum Hereon with the prototype A multilayer TFCM.**

Both modules consist of a stainless steel pressure vessel with the membrane envelopes stacked onto a perforated permeate tube, which are in turn divided into compartments by baffle plates. The working principle of this module type is illustrated in the Figure 3 below.

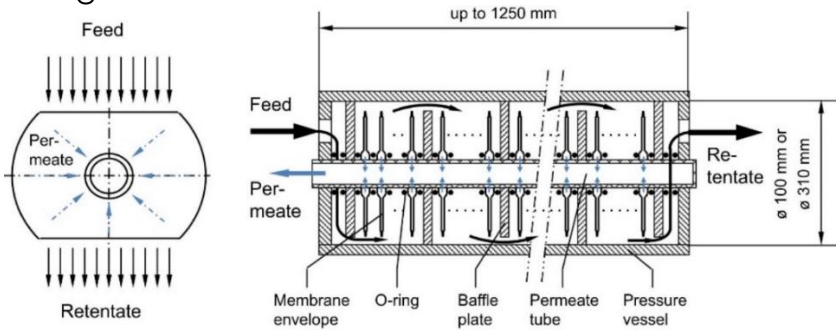


**Figure 3. Membrane envelope and envelope-type membrane module principle[1].**

[1] T.Brinkmann et al. / Journal of Membrane Science 489 (2015) 237–247.

**Maastricht University** and **TECNALIA** studied the recycling potential of PEBA prototype A at different conditions for depolymerizing PEBA on lab scale microreactor. They investigated the influence of temperature, pressure, time and catalyst. The depolymerization results in a fraction of PEO and a fraction of polyamide and monomers from the polyamide. The further scale up of the depolymerization process to 1 liter scale was achieved. The PEO after depolymerization was reused to make a new PEBA and this PEBA synthesis was also successful. The PEBA made with recycled PEO was used by Tecnalia to make flat sheet membranes. Compared to membranes made from pure prototype A, the membranes from recycled PEO have slightly lower CO2 permeability at a comparable selectivity as it can be observed in table below (35ºC and 3 bar feed pressure):

| | **$PCO_2$ (Barrer)** | **$CO_2/N_2$** |
|---|---|---|
| **Pebax renew** | 311 | 47 |
| **PEBA-repolymerized** | 240 | 45 |

Maastricht University and TECNALIA are currency investigating the use of repolymerized PEBA as a mix with the original PEBA.

**ARKEMA** has announced an increase on its global Pebax elastomers production capacity by 25% through an investment at its Serquigny plant in France. This investment will notably enable increased production of the bio-circular Pebax® Rnew® and traditional Pebax® ranges. This new capacity will produce a variety of highly specialized grades to meet growing demand in numerous demanding applications thanks to the lightweight, flexibility and excellent energy return of these materials. These properties are particularly appreciated in sports equipment, such as soles for running shoes, ski boots or technical textile, in consumer goods such as smartphones and flexible screens, as well as in other markets such as medical equipment. More information available in this press release

**Eindhoven University of Technology** is ready to host one of the membrane modules for demonstrating the BioCoMem concept at TRL5 (1 $Nm^3/h$ feed gas). The full separation prototype is ready to operate.

For Biocomem, **B4Plastics** was tasked with scaling up the bio-based polyamide to 10 Kg. 1 KG has already been successfully delivered, with the 10 kg currently on hold and set as an achievable target towards the future!

B4Plastics is a Belgian scale-up tech company that designs, develops and distributes eco-plastic products. Tomorrow's sustainable world will increasingly

require the use of local, renewable and/or biodegradable raw materials, and that is exactly what B4Plastics is doing today.

Mass flow controllers, CEM and pneumatic valves, chillers and pressure readers

Operator desk, GC, chiller, vessels with level sensors

**Figure 4: BioCoMem membrane separation set-up at Eindhoven University of Technology for TRL5 campaign**

# The BioCoMem Dissemination Activities and Events

## Scientific papers

### Ramezani R, Di Felice L, Gallucci F. A Review on Hollow Fiber Membrane Contactors for Carbon Capture: Recent Advances and Future Challenges. Processes 10, Article number 2103, 2022

This paper aims at covering all areas related to hollow fiber membranes, including membrane material, membrane modification, membrane surface modification, shape, solvent characterization, operating parameters and costs, hybrid process, membrane lifetime, and energy consumption as well as commercially available systems. Current progress, future potential, and development of pilot-scale applications of this strategy are also assessed carefully. Link here

## Upcoming Events

### 16th International Conference on Catalysis in Membrane Reactors

**Date:** 16th -18th October, 2023

The conference will be held in Donostia-San Sebastian (ES), hosted by TECNALIA. The aim of the ICCMR conferences is to promote the research and progress in the area of catalytic membrane systems by bringing together academic scientists and industry working in the membrane, catalysis and process engineering fields. The meeting will highlight recent developments, bring new ideas, help making contacts and create a platform for discussion between academics and practitioners. All the participants will have a great opportunity to make beneficial contacts and exchange ideas. The conference is addressed also to young researchers who will have a chance to interact closely with senior scientists. http://www.iccmr16.org/

### WEBINAR: Biobased membranes for $CO_2$ separation

**Date:** June 26th – 10:00-12:00

A dedicated BioCoMem webinar to discuss the main methodologies, challenges and achievements of the BioCoMem project. Speakers are Dr. Angeles Ramirez/ Dr. Sergey Shishatskiy (Hereon), Dr. Oana David (Tecnalia), Dr. Rouzbeh Ramezani (Eindhoven University of Technology), Stefan Frehland (Quantis).

Link to join the meeting here

## Second Dissemination Video

**Date:** M42 of the project

The second dissemination video of BioCoMem, will be produced at month 42 and will cover the project's achievements. Stay tuned!

## Final Biocomem Consortium Meeting

**Date:** October 2023

The main objectives of the meeting will be to present the results of the final experimental campaigns. The final project's achievements (milestones and deliverables and advancements) will be assessed. This time the meeting will be held in person in TECNALIA.
https://www.biocomem.eu/

# BIOCOMEM Website

Visit the BIOCOMEM project at the address – www.biocomem.eu and follow the project on LinkedIn and YouTube.
Let us have your comments!
The next issue of the Newsletter will be released in May 2023.

# The BIOCOMEM Researchers

## Maria de los Angeles Ramirez Kantun

Maria de los Angeles Ramirez Kantun obtained her B.Sc. in Industrial Chemical Engineering (2012) at the Universidad Autonoma de Yucatan (Mexico). After several years working as process engineer in the extraction and refining of vegetable oil, she pursued her master's degree in Chemical and Bioprocess Engineering (2019) at the Hamburg University of Technology (TUHH) with the specialization in general process engineering. During this time, she conducted her thesis at the Institute of Membrane Research at Helmholtz-Zentrum Geesthacht (Hereon since 2021), working on the development of polymeric thin-film composite membranes for high temperature applications, namely for the separation of $H_2$ from $CO_2$. In 2022, she returned to Hereon as a doctoral researcher within the BIOCOMEM project, where she is currently further developing flat-sheet membranes with the newly investigated bio-based block copolymers for their later application in $CO_2$ separations.

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# BIOCOMEM in figures:

- ✓ ***8 partners***
- ✓ ***5 countries***
- ✓ *3.1 M€ project*
- ✓ *Start June 2020*
- ✓ *Duration:* ***36 months***
- ✓ *Key* ***Milestones:***
  - ❖ Development of two new PEBA co-polymers suitable for monolithic hollow fiber membrane production
  - ❖ Optimized recipe for HF membrane production by coating using reference bio-PEBA
  - ❖ Optimized recipe for HF membrane production by spinning using new aromatic/cycloaliphatic polyamide-b-polyether bio co-polymer
  - ❖ Optimized recipe for HF membrane production by spinning using new lignin-g-(polyether-b-polyamide 11) bio co-polymer

Project Manager:
Dr. Oana David
Tecnalia
Oana.david@tecnalia.com

Project Innovation Manager:
Ass. Prof. Ketrien Bernaerts
University of Maastricht
Katrien.bernaerts@maastrichtuniversity.nl

Dissemination Manager:
Dr. Luca Di Felice
Eindhoven University of Tecnology
l.d.felice@tue.nl

Exploitaion Manager Manager:
Dr. Oana David
Tecnalia
Oana.david@tecnalia.com

More information on BIOCOMEM available at the project website:
https://www.biocomem.eu/