

# X Workshop Gruppo Interdivisionale Green Chemistry – Chimica Sostenibile

## 1a Giornata Congiunta con la Divisione di Chimica Industriale

Firenze – 6 Ottobre 2023

### “Deep eutectic solvents as sustainable extractants to reduce formaldehyde content in special paper scraps”.

**Gallo Davide<sup>1,2\*</sup>, Fantini Diego<sup>2</sup>, Maurino Valter<sup>1</sup>, Barolo Claudia<sup>1,3</sup>, Bonomo Matteo<sup>1</sup>**

*1-Dipartimento di Chimica and NIS Inter-Department Centre, Università degli studi di Torino, Via P. Giuria, 10125 Torino, Italy*

*2– AHLSTROM-MUNKSJÖ ITALIA SPA, Via Stura 98, I-10075 Mathi, Turin, Italy*

*3- Istituto di Scienza, Tecnologia e Sostenibilità per lo sviluppo dei Materiali Ceramici (ISSMC-CNR), Via Granarolo 64, 48018, Faenza, RA, Italy*

*E-mail: d.gallo@unito.it*

Ahlstrom-Munksjo's special papers are suitable for a wide variety of applications but are mainly applied in filtration systems typically employed in the automotive sector<sup>1</sup>. The production of these papers consists in impregnating cellulose with different types of thermosetting resins, mainly phenolic and melamine-based, using formaldehyde (FA) as curing agent. Commercially, it is essential that the polymerization of the resins does not reach completion, which unfortunately causes a high FA content inside paper scraps. FA is of concern from both a human health and environmental perspective, due to its toxicity and carcinogenicity<sup>2</sup>. This implies that waste containing high levels of FA (>1000ppm) must be disposed as hazardous waste (CER 15.02.02)<sup>3</sup>, with an extreme environmental impact and higher costs. Hence, the aim of our work is to find a simple but effective way to reduce FA content in paper scraps, taking advantage of new extraction technologies coupled with the use of sustainable solvents (easy to prepare, non- or low-toxic, non-volatile and recyclable), such as Deep Eutectic Solvents (DESs). DESs can generally be defined as mixtures, whose melting point is lower than those of the components and it's stabilized through hydrogen bonds formed within the mixture, caused by the presence of a hydrogen bond acceptor and a hydrogen bond donor (HBA, HBD)<sup>4</sup>. These solvents have been proved as excellent extractants, both for relevant organic compounds and for metals<sup>5</sup>. In this context, Choline chloride-based DES would be used to remove FA from paper scraps, using a microwave-assisted extraction. The influence of some key parameters including temperature, extraction time, shape and size of the solid sample will be investigated, aiming to develop a mild condition treatment, also through multivariate analysis. Finally, different methods for recycling and reusing the FA rich solvent will be investigated.

**Acknowledgements:** This research acknowledges support from the project CH4.0, under the MIUR program “dipartimenti di Eccellenza 2023-2027” (CUP D13C22003520001). DG acknowledges Decreto-Legge 6 maggio 2021, n. 59 (PNRR) for funding the PhD scholarship.

<sup>1</sup> *Ahlstrom financial report– 2022.* <https://www.ahlstrom.com/Investors/reports-and-presentations/ahlstrom/2022>

<sup>2</sup> *List of Classifications – IARC Monographs on the Identification of Carcinogenic Hazards to Humans.* <https://monographs.iarc.who.int/list-of-classifications>

<sup>3</sup> *Elenco dei rifiuti istituito dalla Decisione della Commissione 2000/532/CE del 3 maggio 2000, allegato D*

<sup>4</sup> *Smith E, Abbott A, Ryder K „Deep Eutectic Solvents (DESs) and Their Applications” Chemical Reviews (2014) 114(21) 11060-11082*

<sup>5</sup> *Cunha S, Fernandes J „Extraction techniques with deep eutectic solvents” TrAC Trends in Analytical Chemistry (2018) 105 225-239*