

<https://doi.org/10.7250/CONNECT.2026.047>

## LINOLEUM FOR MCCA RECOVERY FROM FERMENTATION BROTH

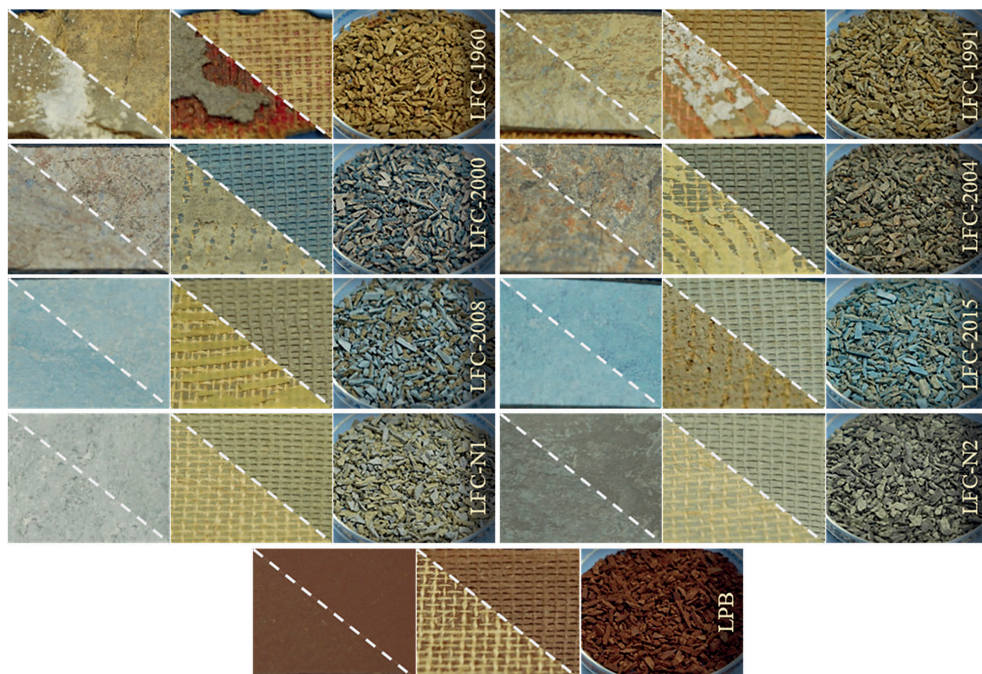
Patrick BRANDES<sup>1\*</sup>, Iris STEINBERG<sup>2</sup>

<sup>1,2</sup> Darmstadt University of Applied Sciences, Department of Civil and Environmental Engineering, 64295 Darmstadt, Germany

\* Corresponding author. Email address: [patrick.brandes@h-da.de](mailto:patrick.brandes@h-da.de)

**Abstract** – The fermentative production of medium-chain carboxylic acids (MCCAs) from biogenic residues and waste streams offers the opportunity to further exploit the potential of corresponding biomass, which remains only partly utilized to date, even in countries with advanced waste management systems. One of the most critical challenges within the process, also known as ‘carboxylate platform’, is product recovery. Currently used separation methods for the recovery of MCCAs produced by anaerobic fermentation, such as solvent extraction, adsorption with ion-exchange resins, membrane processes, distillation or precipitation lead to high energy consumptions, high operating/investment costs, the formation of significant additional waste streams and/or low recovery rates. This study examines an alternative potentially economically and environmentally viable separation method, the recovery of MCCAs from an aqueous solution by employing linoleum as an adsorbent. Within the scope of this study, six different linoleum waste samples with previous utilization as floor coverings for 10 to 65 years, two new floor coverings and unused linoleum printing block (intended for linocut printing) are examined and compared to heptane and rapeseed methyl ester as conventional solvents for MCCA recovery. Experiments are conducted at laboratory scale and examine two potential scenarios for the adsorption process within the carboxylate platform under different operating conditions. The first scenario is product recovery after fermentation is completed, under favorable conditions for recovery. For this application pH is set to 3.0 and experiments are conducted at room temperature. In the second scenario product recovery and fermentation take place simultaneously, operating conditions are therefore set to pH 5.7 and 35 °C to simulate respective (suboptimal) conditions. The experiments revealed that selective separation of MCCAs from an aqueous solution by linoleum and linoleum waste is possible. Achieved separation efficiencies as well as advantages and disadvantages largely align with those of conventional solvent extraction. The adsorption rates for the individual carboxylic acids increase with an increasing chain length of the acids and depend on the pH of the fermentation broth. The adsorption process generally works better at low pH (significantly below the pKa value of the corresponding acids). However, adsorption rates can also be optimized by increasing the surface area of linoleum or conducting several successive adsorption cycles. Furthermore, even after several decades of utilization as floor covering, the first life cycle does not appear to impair the adsorption properties through potential decomposition or chemical alteration of the organic compounds.

**Keywords** – *Adsorption; carboxylate platform; carboxylic acid recovery; circular economy; medium-chain carboxylic acids; product recovery*



Linoleum used as adsorbent, linoleum floor covering (LFC) and linoleum block print (LPB), top and bottom sides respectively before/after cleaning and crushed material

### ACKNOWLEDGEMENT

The study was supported by the Research Centre for Sustainable Processes and Technologies of Darmstadt University of Applied Sciences, a member of EUt+.

The authors wish to express their gratitude to Henning Böckemeier-Beckmann (Darmstadt University of Applied Sciences, Department of Chemistry and Biotechnology) for valuable discussions on the chemical background of this study.