



Slovak Society of Chemical Engineering  
Institute of Chemical and Environmental Engineering  
Slovak University of Technology in Bratislava

## PROCEEDINGS

51<sup>st</sup> International Conference of the Slovak Society of Chemical Engineering SSCHE 2025

Hotel DRUŽBA  
Jasná, Demänovská Dolina, Slovakia  
May 27 - 30, 2025

Editors: Assoc. Prof. Mário Mihaľ

ISBN: 978-80-8208-158-2, EAN: 9788082081582

Published by the Faculty of Chemical and Food Technology Slovak Technical University in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2024

Koritár, M., Nazari, M., Haydary, J.: Optimization of thermochemical conversion feedstock parameters for an integrated waste (bio)refinery, Editors: Mihaľ, M., In *51st International Conference of the Slovak Society of Chemical Engineering SSCHE 2025*, Jasná, Demänovská Dolina, Slovakia, 2025.

## **Optimization of Thermochemical Conversion Feedstock Parameters for an Integrated Waste (Bio)refinery**

Matej Koritár, Juma Haydary

*Department of Chemical and Biochemical Engineering, Faculty of Chemical and Food Technology, Slovak University of Technology, Radlinského 9, 812 37 Bratislava, Slovakia*

*e-mail: matej.koritar@stuba.sk*

Waste generation is a growing environmental problem that requires ideas and new research for its solution. Energy and material recovery are suitable for mixed waste, which cannot be recycled easily. To increase the total conversion and efficiency of mixed waste processing, it is necessary to integrate several waste treatment methods, creating an integrated waste (bio)refinery. Thermochemical conversion unit, i.e. gasification process, is an integral part of such (bio)refinery. Gasification unit is suitable mainly for processing of residual waste streams with low moisture content and high calorific value, such as refuse-derived fuel (RDF) or lignocellulosic biomass. Feedstock for the gasification in an integrated waste (bio)refinery contains a mixture of waste types combined with the waste streams from different processing units in the (bio)refinery. The main challenge in processing such feedstock is its always changing composition, which implies the changing properties of products and operating conditions. Therefore, this work investigates optimization methods to achieve constant parameters for the mixed gasification feedstock. This is done by changing the ratios of different components in the feedstock. Feedstock for gasification in an integrated waste (bio)refinery typically consists of RDFs from municipal solid waste and mixed plastic waste, lignocellulosic biomass, solid residue from biological waste treatment in the (bio)refinery (e.g. digestate from anaerobic digestion) and various waste streams generated in the (bio)refinery. The most important parameters of the mixed feedstock for thermochemical conversion, which have to be fixed, are heating value, moisture and ash content, concentrations of S, N and Cl contaminants and ratios between oxygen, hydrogen and carbon. Mathematical model was developed in MATLAB environment, which optimizes the amounts of lignocellulosic biomass and RDF from plastic waste in the mixed feedstock. It was confirmed that using this method it is possible to fix the parameters of the feedstock to desired values. This is very important to ensure the smooth operation of the gasification unit and production of the desired products.

**Keywords:** waste biorefinery; gasification; feedstock optimization

### **Acknowledgement:**

*This work was supported by the Slovak Research and Development Agency under the contract No. APVV-19-0170 and by the program for supporting young researchers funded by the Slovak University of Technology.*