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

PROCEEDINGS

52nd International Conference of the Slovak Society of Chemical Engineering SSCHE 2026

Hotel SOREA TRIGAN
Štrbské Pleso, Slovakia
May 26 - 29, 2026

Editors: Assoc. prof. Mário Mihaľ

ISBN: 978-80-8208-177-3, EAN: 9788082081773

Published by the Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2026

Pipíška, A., Rejl, F.: Multi-Emissivity Measurement Device for Monitoring and Control of Radiative Heating Systems, Editors: Mihaľ, M., In *52nd International Conference of the Slovak Society of Chemical Engineering SSCHE 2026*, Štrbské Pleso, Slovakia, 2026.

Multi-Emissivity Measurement Device for Monitoring and Control of Radiative Heating Systems

Adam Pipíška, František Jonáš Rejl

University of Chemistry and Technology, Technická 5, 166 28 Prague, Czech Republic

e-mail: pipiskaa@vscht.cz

Key words: radiative heating systems, radiative heat flux, convective heat transfer, process monitoring, multi-emissivity targets, heat transfer measurement

Radiative heating systems are widely applied in industrial buildings due to their ability to deliver heat efficiently over long distances without heating the entire air volume. In practice, however, system performance is usually assessed only from air temperature or surface temperature, while the incident radiative heat flux is not measured directly. This reduces the reliability of predicting the thermal response of heated objects. As a consequence, heating control may be inaccurate, resulting in increased energy consumption and deviations from the desired temperature conditions. Although instruments for direct measurement of radiative heat flux already exist, their high cost makes large-scale installation in industrial applications economically impractical. To address this limitation, a multi-emissivity measurement device for monitoring and control of radiative heating systems was developed and experimentally validated. The proposed device consists of four aluminium targets with different surface emissivities in the range of 0.05 to 0.94. The rear side of each target is thermally insulated, while the front side is exposed to a radiative heat source. During the experiment, the temperatures of the targets and the surrounding air are continuously recorded. The incident radiative heat flux and the convective heat transfer coefficient are determined from the transient energy balance of each target. By combining the responses of targets with different emissivities, a system of independent equations is obtained, enabling simultaneous evaluation of both unknown parameters from the measured temperature curves. The experimental results confirmed the expected emissivity-dependent heating behaviour of the targets, whereas the surrounding air temperature remained nearly constant during the measurement. For the investigated configuration, the evaluated radiative heat flux was 195 $W \cdot m^{-2}$ and the convective heat transfer coefficient was 6.5 $W \cdot m^{-2} \cdot K^{-1}$, corresponding to the typical range of natural convection in indoor environments. The calculated radiative heat flux differed by approximately 6% from the theoretical model of the source under identical geometric conditions. Compared with conventional radiometric methods, the proposed approach enables separation of radiative and convective heat transfer components without the use of expensive radiometers. The developed device therefore represents a promising low-cost tool for measurement, monitoring, and future control of radiative heating systems in industrial applications.