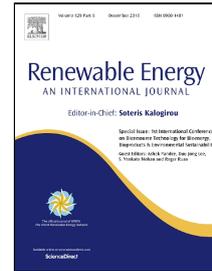


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Small-scale biogas plants in central Vietnam and biogas appliances with a focus on a flue gas analysis of biogas cook stoves

H. Roubík, J. Mazancová



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1 **Small-scale biogas plants in central Vietnam and biogas appliances with a**
2 **focus on a flue gas analysis of biogas cook stoves**

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4 H. Roubík, J. Mazancová*

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6 Czech University of Life Sciences Prague, Faculty of Tropical AgriSciences, Department of Sustainable
7 Technologies, Kamýcká 129, 165 00 Prague, Czech Republic

8 *Corresponding author: mazan@ftz.czu.cz; +420 22438 2508

9 **Highlights**

10 * Households use biogas mainly for cooking and not for lightening or electricity

11 * High CO emissions in flue gas are associated with low-quality biogas cook stoves and feedstock type

12 * Low air/gas efficiency was found for commercial cooking using household stoves

13 * CO₂ emissions increase with the age of biogas stoves and are highest for short cooking times

14 **Abstract.**

15 The major objective of this paper is to fill the research gap regarding small-scale biogas appliances by performing
16 a flue gas analysis of biogas cook stoves in Vietnam. The methods of data collection included a questionnaire
17 survey of rural households (n = 93), discussions with local consultants (n= 6) and observations in central Vietnam.
18 Furthermore, flue gas analyses of biogas cook stoves were performed (n = 93). As the most common appliances,
19 biogas cook stoves were reported as a substitute for conventional cook stoves, eliminating indoor smoke pollution
20 and related health risks. The majority (96%) of biogas cook stoves were two-flame burners that averaged 2.4
21 (± 0.74) years of age and were in use for over 3 hours per day. High concentrations of CO in its diluted
22 ($8,705.35 \pm 1,790.01 \text{ mg} \cdot \text{m}^{-3}$) and undiluted forms ($24,758.2 \pm 4,860.2 \text{ mg} \cdot \text{m}^{-3}$) were detected in biogas flue gas. The
23 concentration of unavoidable produced NO averaged $0.064 (\pm 0.12) \text{ mg} \cdot \text{m}^{-3}$, which is an acceptable value for the
24 transformation of biodegradable wastes into biogas that is consequently burned. The study contributes to covering
25 the data gap, as similar studies have not been conducted in Vietnam. The information and data gained are important
26 for further evaluations of biogas technology in Vietnam and other developing countries.

27
28 **Keywords:** biogas technology; cook stoves; Vietnam; flue gas analysis; emission

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