Effect of Fe/Ca-based composite conditioners on syngas production during different sludge gasification stages: Devolatilization, volatiles homogeneous reforming and heterogeneous catalyzing

Qiang Zhang a, Huan Liu a,b,**, Xiuju Zhang a, Geng Lu a, Jiaxing Wang a, Hongyun Hu a, Aijun Li a, Hong Yao a,b,*

a State Key Laboratory of Coal Combustion, School of Energy and Power Engineering, Huazhong University of Science and Technology, Wuhan 430074, China
b Department of New Energy Science and Engineering, School of Energy and Power Engineering, Huazhong University of Science and Technology, Wuhan 430074, China

A B S T R A C T

The process of sewage sludge steam gasification can be divided into three stages: devolatilization, volatiles homogeneous reforming and heterogeneous catalyzing. This study investigated the direct and indirect impacts of Fe/Ca-based conditioners on syngas generation at different stages using a special decoupling reactor. The results show that the highest H₂ production for raw sludge gasification was 190 mL/g at 1273 K. The maximum promotion of H₂ yield was 51.2% for Fenton's reagent (Fe²⁺+H₂O₂) addition at 1273 K and 132.5% for CaO addition at 1073 K. Among that, 52.8% and 62.9% of H₂ increment was attributed to the catalytic effect on devolatilization stage respectively. Fenton oxidation was conducive to the conversion and fixation of protein structure while the corresponding organic matter in CaO-conditioned sludge was aromatics. The catalysis of volatile reforming was proven an important process, thus reusing char/ash as bed material or cracking catalysts maybe a promising method for hydrogen energy production.

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