

Microwave-assisted catalytic fast pyrolysis process and system for renewable energy production from solid wastes

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Abstract:

Microwave-assisted pyrolysis (MAP) is an alternative conversion method to extract the energy and produce value-added products from solid wastes. Microwave-assisted technology has many advantages comparing with conventional conversion methods, such as more uniform heating at molecular level, process flexibility and equipment portability, lower thermal inertia and faster response, low capital cost and more energy efficient. In this presentation, a continuous fast microwave-assisted pyrolysis and gasification process and system will be introduced. The process and system is designed, fabricated, and tested for various solid wastes such as lignocellulosic biomass and recycled plastics. The system is equipped with continuous waste raw material feeding, mixing of feedstock and microwave absorbent, and a separated catalytic upgrading step. For microwave gasification of lignocellulosic biomass, extremely high temperature (>1200 °C) can be obtained efficiently when combining with microwave absorbents, making the gas product much cleaner than in lower temperature and the energy consumption much lower than that of traditional fluidized bed gasifier. With this process, it is possible to obtain a H₂-rich gas with low tar content, and can be usable in cogeneration systems, F-T synthesis, or fuel cells. For microwave pyrolysis of waste plastics for hydrocarbon fuel production, the two-step microwave catalytic pyrolysis improved the bio-oil quality; help produced the liquid product with high heating value (HHV). There are clear potentials for commercializing the microwave-assisted catalytic pyrolysis and gasification process and system for complete solid waste utilization.

Biography:

Dr. Ruan is the Director of Center for Biorefining and Professor of Bioproducts and Biosystems Engineering Department at the University of Minnesota, and Fellow of ASABE. He has published over 450 papers in refereed journals, books, and book chapters, and holds 18 US patents. He is also a top cited author in the area of agricultural and biological sciences with h-index of 52 and over 10,000 citations. He has supervised over 80 graduate students, 110 post-doctors, research fellows, and other engineers and scientists, and many of his Ph.D. students and post-doctors hold university faculty positions. He has received over 170 grants totaling over \$40 million in various funding for research, including major grants from USDA, DOE, DOT, DOD, and industries. He has served as editorial board member of Bioresource Technology, Renewable Energy, Engineering, etc. Professor Ruan has given over 290 keynote lectures, invited symposium presentations, company seminars, and short courses.