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Gasification of lactose in supercritical water as a model compound of dairy industry effluent

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The adverse effects of climate change resulting from increasing greenhouse gas emissions and intense consumption of fossil fuels are well-known. The pollution of natural resources, such as water, air and soil, by refractory industrial wastes has also become a global environmental concern. The effluents from dairy industries are one of such wastes that require proper attention prior to disposal. Dairy effluents are comprised chiefly of spoiled milk, yogurt, cream, cheese whey, fat and other milk-based products. The dairy industry effluents, including whey waste and milk-based residues, are enriched in lactose and minor amounts of glucose that could potentially be converted to biofuels and biochemicals. Lactose was used in this work as a model compound of dairy effluents for gasification in supercritical water using a continuous flow tubular reactor. Four parameters impacting supercritical water gasification were studied, namely temperature (550-700°C), residence time (30-75 s), feed concentration (4-10 wt%) and catalyst concentration (0.2-0.8 wt%). The best total gas yields, carbon gasification efficiency, H_2 yields and other major gases (CO_2 and CH_4) were obtained at 700°C using a feed concentration of 4 wt% lactose and a residence time of 60 s at 25 MPa. Furthermore, catalytic lactose gasification involving 0.8 wt% Na_2CO_3 resulted in maximum H_2 yield (22.4 mol/mol) compared to those obtained by 0.8 wt% K_2CO_3 (21.5 mol/mol) and non- catalytic gasification (16 mol/mol). The results indicate that waste effluents from dairy industries could potentially serve as an attractive raw material for hydrogen production from gasification.

Biography

Janusz A Kozinski is the Founding Dean and Professor in Lassonde School of Engineering at York University, Canada. His multi-disciplinary research background relates to thermodynamics, space science, chemical and biological engineering. Some of his notable works are in supercritical water gasification for biofuel production, hydrothermal flames for toxic waste remediation, next generation nuclear energy reactors and development of immune buildings systems.

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