World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Kinetic Rate Comparison of Methane Catalytic Combustion of Palladium Catalysts Impregnated onto ɣ-Alumina and Bio-Char

Authors : Noor S. Nasri, Eric C. A. Tatt, Usman D. Hamza, Jibril Mohammed, Husna M. Zain

Abstract : Climate change has becoming a global environmental issue that may trigger irreversible changes in the environment with catastrophic consequences for human, animals and plants on our planet. Methane, carbon dioxide and nitrous oxide are the greenhouse gases (GHG) and as the main factor that significantly contributes to the global warming. Mainly carbon dioxide be produced and released to atmosphere by thermal industrial and power generation sectors. Methane is dominant component of natural gas releases significant of thermal heat, and the gaseous pollutants when homogeneous thermal combustion takes place at high temperature. Heterogeneous catalytic Combustion (HCC) principle is promising technologies towards environmental friendly energy production should be developed to ensure higher yields with lower pollutants gaseous emissions and perform complete combustion oxidation at moderate temperature condition as comparing to homogeneous high thermal combustion. Hence the principle has become a very interesting alternative total oxidation for the treatment of pollutants gaseous emission especially NOX product formation. Noble metals are dispersed on a support-porous HCC such as ɣ- Al2O3, TiO2 and ThO2 to increase thermal stability of catalyst and to increase to effectiveness of catalytic combustion. Support-porous HCC material to be selected based on factors of the surface area, porosity, thermal stability, thermal conductivity, reactivity with reactants or products, chemical stability, catalytic activity, and catalyst life. ɣ- Al2O3 with high catalytic activity and can last longer life of catalyst, is commonly used as the support for Pd catalyst at low temperatures. Sustainable and renewable support-material of bio-mass char was derived from agro-industrial waste material and used to compare with those the conventional support-porous material. The abundant of biomass wastes generated in palm oil industries is one potential source to convert the wastes into sustainable material as replacement of support material for catalysts. Objective of this study was to compare the kinetic rate of reaction the combustion of methane on Palladium (Pd) based catalyst with Al2O3 support and bio-char (Bc) support derived from shell kernel. The 2wt% Pd was prepared using incipient wetness impregnation method and the HCC performance was accomplished using tubular quartz reactor with gas mixture ratio of 3% methane and 97% air. Material characterization was determined using TGA, SEM, and BET surface area. The methane porous-HCC conversion was carried out by online gas analyzer connected to the reactor that performed porous-HCC. BET surface area for prepared 2 wt% Pd/Bc is smaller than prepared 2wt% Pd/ Al2O3 due to its low porosity between particles. The order of catalyst activity based on kinetic rate on reaction of catalysts in low temperature is prepared 2wt% Pd/Bc > calcined 2wt% Pd/ Al2O3 > prepared 2wt% Pd/ Al2O3 > calcined 2wt% Pd/Bc. Hence the usage of agro-industrial bio-mass waste material can enhance the sustainability principle.

Keywords : catalytic-combustion, environmental, support-bio-char material, sustainable and renewable material
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020