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Technological aspects for thermal plasma treatment of municipal solid waste using pyrolysis and gasification

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Municipal solid waste has various chemical compositions which vary from region to region whereas developed countries with wealthier population show higher inorganic material content such as plastic wastes, paper, electronic wastes and metals (B Ruj 2014). Thermal plasma pyrolysis and gasification have been in active development due to high volume reduction capabilities, increase in reactivity and temperature control. RF thermal plasma specifically has major advantages such as large plasma volume, higher thermal plasma purity and efficient delivery of heat energy which enhances chemical and physical changes in solid waste (H Huang 2007). Conventional MSW pyrolysis and gasification have some process limitations which are enhanced by thermal plasma such as syngas purity, energy efficiency, product yield and temperature control (F Fabry 2013). Added to that, thermal plasma accelerates reaction kinetics for both pyrolysis and gasification and thermally crack impurities at high temperatures. On the thermal aspect, thermal plasma provides an advantage of temperature control over current which makes the process independent of the oxidizing ratio and the nature of the plasma medium (F Fabry 2013). Gasification reactions are heterogeneous equilibrium reactions carried in updraft/downdraft or fluidized bed reactors in limited oxygen supply at 1100°C to 1300°C. Therefore, plasma pyrolysis and gasification are acknowledged as a novel technology with the potential to improve chemical recycling through faster heating rates of reaction particles, rapid heat and mass exchange as well as eliminate landfilling and incineration (L Tang 2013). Incineration has very low thermal efficiency up to 40% and highest CO_2 and NO_2 emissions as well as high cost of emission control (VV Sergeev 2016). On the contrary, pyrolysis has the highest thermal efficiency of 90% followed by plasma gasification which can reach up to 85%.

Biography

Mohamed Aboughaly graduated from University Technology Petronas with first class honors in 2012 followed by 3 years industrial experience at mega-projects as a process engineer including petrochemical 400 KTA LLDPE/HDPE chemical plant, 100 tpd LDAN (Low-density ammonium nitrate) chemical plant and 100 tpd MIDOR oil refinery chemical plant followed by MASc Mechanical Engineering from the University of Ontario Institute of Technology in 2017 and working as a quality control engineer at Haremar Plastics Manufacturing, Vaughan, Ontario, Canada.

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