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Assessment of Thermochemical Processes of Municipal Solid Waste (MSW) Feedstocks in a Downdraft Gasifier

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Extended Abstract

According to a study conducted by International Solid Waste Association (ISWA) in 2015, annual total waste generation, at a global scale, was accounted for 7–10 billion tonnes [1]. Municipal solid waste (MSW), of the total waste generated, was approximately 2 billion tons with only 3% of waste used for energy production [1]. The depletion of fossil fuels, increasing world's population, living standards, rapid urbanisation and increase of energy demands are considered to be the critical factors leading to the significant growth of waste generation worldwide. In the UK, the latest data published by DEFRA (Department for Environment Food and Rural Affairs), suggests that around 60% of the total solid waste (MSW) in 2016 (approximately 16 million tonnes) was sent to landfill [2]. There is a considerable potential to use the residual waste for energy production through advanced thermochemical processes (such as gasification), providing sustainable waste management while also generating clean / low-carbon energy [3].

The main goal of the current research presented in this paper is to investigate the mechanisms of complex thermochemical processes of MSW gasification with the particular aim to optimise the syngas production and gasification processes through a combination of modelling and experimental studies. MSWs are mechanically processed to solid recovered fuels (SRF) [4], and the paper will present the chemical analysis (ultimate and proximate) results of four different SRF. A stoichiometric modelling code is developed to study the gasification of these feedstocks at different working parameters (such as air equivalence ratio, gasification temperature, moisture content, etc). A downdraft gasifier reactor model is also developed by CFD (Computational Fluid Dynamics) to further investigate the thermochemical processes taking place inside the gasifier, with particular focus on the characterisation of its design and operating conditions to predict the optimum outcome. Experimental development of the research is also underway to validate the modelling results and also to further investigate the gasification processes of MSW-SRF feedstocks.

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