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Gasification improvement of a poor quality solid recovered fuel (SRF). Effect of using natural minerals and biomass wastes blends

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HIGHLIGHTS

- Valorisation of a poor quality solid recovered fuel (SRF) with high ash content and low volatile matter.
- Analysis of the viability production of fuel gas by poor quality SRF gasification.
- Effect of low cost natural minerals on gas quality and yield.
- Decrease of SRF negative bearing by co-gasification of SRF and biomass wastes blends.
- Selection of the most viable applications for gasification.

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ABSTRACT

The need to produce energy from poor quality carbonaceous materials has increased, in order to reduce European dependency on imported fuels, diversify the use of new and alternative fuels and to guarantee secure energy production routes. The valorisation of a poor quality solid residual fuel (SRF), with high content of ash and volatile matter, through its conversion into fuel gas was studied. The rise of gasification temperature and equivalent ratio (ER) led to higher gas yields and to lower undesirable gaseous components, though higher ER values led to a gas with lower energetic content. To reduce the negative effect of SRF unfavourable characteristics and to diversify the feedstocks used, SRF blended with three different types of biomass wastes: forestry pine, almond shells and olive bagasse was co-gasified. The use of biomass wastes tested was valuable for SRF gasification, as there was an increase in the overall reactivity and in H_2 production and a reduction of about 55% in tar released, without great changes in gas yield and in its HHV. The use of natural minerals mixed with silica sand was also studied with the aim of improving SRF gasification performance and fuel gas quality. The best results were obtained in presence of dolomite, as the lowest tar and H_2S contents were obtained, while an increase in gas yield was observed. Co-gasification of this poor quality SRF blended with biomass wastes in presence of dolomite increased gas yield by 25% while tar contents decreased by 55%.

1. Introduction

The total generation of municipal solid waste (MSW) in the EU-27 was around 2.52 billion tonnes in 2010, hence, each EU citizen produced an average of about 5.0 tonnes of waste per year [1]. Therefore, MSW management is a very important issue in modern societies, as even the best planned and managed landfills may bring environmental and public acceptance problems. On the other hand, MSW energetic content is worthwhile to be recovered and used. Landfills generate methane continuously, even after landfill closure, due to anaerobic microbiological activity. As methane is a greenhouse gas with commercial value, some effort has been made to use it for energy production. On the other hand, an important number of landfills are not suitable for the implementation of methane recovery systems, which are only viable for large landfills [2]. Thus, the amounts of MSW landfilled have been decreasing about 4.4% per year in European countries since 2002 [1]. MSW is often treated to be converted into different fractions by size reduction, sieving and separation, which improves its handling properties and homogeneity. Refuse derived fuel (RDF) is obtained by this procedure, it has a higher heating value and has more uniform physical and chemical compositions than MSW.

Therefore, many countries have implemented MSW incineration processes. Some European countries incinerate 38–51% of the MSW produced [1]. Besides combustion, other thermochemical

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