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The Characteristics of Oxygen-Enriched Gasification for Fluff SRF

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Abstract

In the gasification process, the composition of the syngas and its heating value are influenced by the oxidization agents. The oxidization agents include air, oxygen, oxygen enriched air or steam. A preliminary study on oxygen-enriched gasification of fluff solid refuse fuel (SRF) was carried out in a bench-scale down-draft fixed bed reactor. The purpose of this study is investigation for the influence of the oxygen concentration in the oxidization agent on the gasification characteristics such as syngas heating value, carbon conversion ratio and cold gas efficiency with a bench-scale fixed bed reactor.

Low heating values (LHV) of sample 1 and 2 are 3,821 kcal/kg and 4,946 kcal/kg, respectively. The down-draft fixed bed reactor consists of nitrogen, oxygen and air inlet zone, reaction zone, gas purification zone and gas analysis zone. An electric heater with variable power is attached to the fixed bed reactor. The fluff SRF is fed inside the reactor. The dust, tar and moisture in the gas are separated by a cyclone, a venturi scrubber and a water separator. The purified gas was analyzed with gas chromatography (Inficon Micro GC 3000) at an interval of 3 minutes.

The concentrations of H_2 and CO in the syngas for test 3 were 15.51 % and 19.00%, respectively. However, in the case of test 4 the concentrations of H2 and CO in the syngas were 26.30 % and 23.21%, respectively. Therefore the concentration of combustible gas such as H_2, CO and CH_4 increased with increasing O_2 concentration in the oxidization agent. However syngas cold gas efficiency and carbon conversion ratio was not increased with increasing O_2 concentration in the oxidization agent.

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1. Introduction

Gasification is a process in which a material containing carbon, such as coal, biomass and waste, is converted into a gas. It is a thermochemical process, meaning that the feedstock is heated to high temperatures, producing gases which can undergo chemical reactions to form a syngas. The heat needed for all the above reactions to occur is usually provided by the partial combustion of a portion of the feedstock in the reactor with a controlled amount of air, oxygen or oxygen enriched air [Juniper, 2007].

In the gasification process, the composition of the syngas and its heating value are influenced by the gasifying agents.The gasifying agent can be air, oxygen, oxygen enriched air or steam. Using air dilutes the syngas with nitrogen, which adds to the cost of downstream processing, particularly compress process. However using oxygen avoids this, but oxygen production cost is expensive, and so oxygen enriched air can also be used [E4tech, 2009].

The purpose of this study is bring into focus the influence of the oxygen concentration in the gasifying agent on the gasification performance such as syngas heating value, carbon conversion and cold gas efficiency by the bench-scale fixed bed reactor.

2. Materials and Methods

The physical and elemental analysis of the SRF sample 1 and 2 is shown in Table 1. Low heating value(LHV) of sample 1 and 2 was 3,821 kcal/kg and 4,946 kcal/kg, respectively.
The downdraft type fixed bed reactor used in this research is shown in Figure 1 which comprises of nitrogen, oxygen and air input zone, reaction zone, gas purification zone and gas measurement zone. An electric heater with variable power is attached to the fixed bed reactor.

The fluff SRF is fed inside the reactor. The dust, tar and moisture in the gas are separated using the cyclone, venturi scrubber and water separator. The purified gas was analyzed using gas chromatography (Inficon Micro GC 3000) at an interval of 3 minutes. The experimental conditions of this research are shown in Table 2.

Table 1: Physico-chemical characteristics of fluff SRF sample 1 and 2

Analysis		Sample 1	Sample 2
Proximate Analysis [wt.%]	Moisture	25.4	6.0
	Volatile matter	64.5	74.6
	Ash	3.3	12.6
	Fixed Carbon	6.9	6.9
Proximate Analysis + Ultimate Analysis [wt.%]	Moisture	25.4	6.0
	C	38.5	39.5
	H	5.5	6.1
	N	0.6	0.7
	S	0.0	0.0
	Cl	0.0	0.3
	O	26.7	34.7
	Ash	3.3	12.6
	Sum	100.0	100.0
Calorific Value [kcal/kg]	HHV	4,271	5,312
	LHV	3,821	4,946

Carbon conversion and cold gas efficiency (CGE) is defined as equation (1) and (2), respectively.