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CO-PYROLYSIS OF WASTE POLYSTYRENE FOAM AND MICROALGAE AT LOW TEMPERATURES

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Abstract

Fossil fuel reserves have depleted. So, renewable and sustainable energy form an important issue. Microalgae as a third generation biomass can be an alternative carbon neutral fuel source. But its fuel quality is low. Co-pyrolysis is important technique to upgrade fuel quality of microalgae. In this study, we aimed to carry out pyrolysis of polystyrene and Spirulina sp. microalgae at low temperatures (350, 400, 450 ºC). The experiments were done by using semi-batch reactor setup. Co-pyrolytic product yields were calculated. Composition of liquid products was enlightened by using GC-MS. As a result of the analysis, it was detected aromatic compounds like styrene, toluene in the co-pyrolytic liquid. Besides that it was observed co-pyrolysis was increased solid residue yield while it was decreased liquid and gas product yield.

Keywords: Polystyrene, plastic wastes, microalgae, biomass, pyrolysis

Introduction

Carbon neutral fuels have huge importance on the sustanability. Microalgae as an non-edible feedstock occur an alternative to the first generation biomass sources [1]. However, it has been known that the fuel which is obtained from microalgae pyrolysis has some disadvantages like high humidity and protein content. So co-pyrolysis with several materials like tires, plastics and bamboo waste seems the good way to obtain high quality fuel [2]. In this study, it was aimed to determine the effect of blending PS to SP feed on the liquid yield and composition compared to PS pyrolysis. The experiments were conducted several temperatures (350, 400, 450 ºC) which were selected as possible as low.

Materials and Method

The plastic waste source, polystyrene (PS), was supplied as an electronic device package. Before the pyrolysis it was divided small pieces and dried in oven. The microalgae source, Spirulina *(SP), was bought in powder form commercially.*

Pyrolysis setup covers ceramic furnace, Nitrogen bottle, PID temperature controller, thermocouples, glass reactor and condensers. (Fig. 1) Before the experiments, setup was purged with nitrogen.

Product yields were calculated. Liquid products were analysed via GC-MS. Co-pyrolysis of SP and PS was done by adding equal amount of feedstock to the reactor.

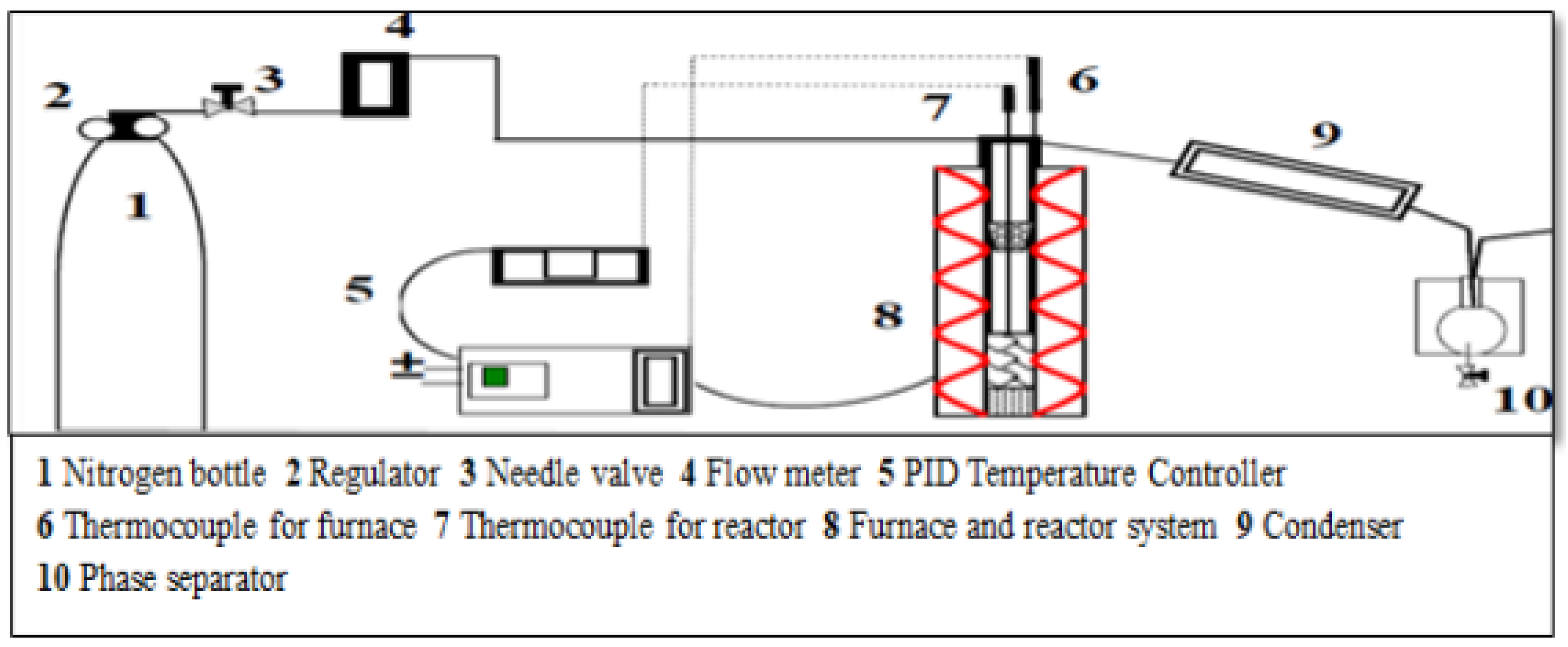

Figure 1. Pyrolysis set up [3]

Results and Discussion

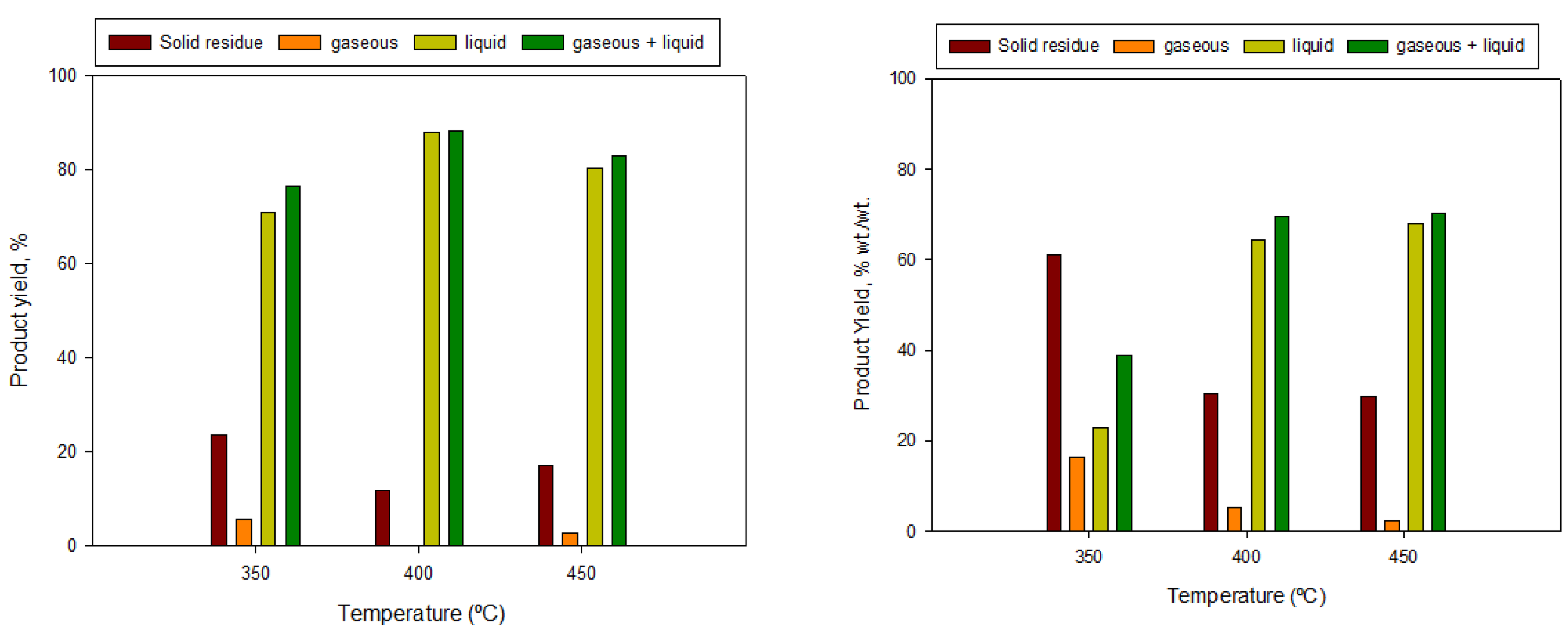

Figure 2. Pyrolytic product distribution by weight for PS (left) and PS:Algae (right)

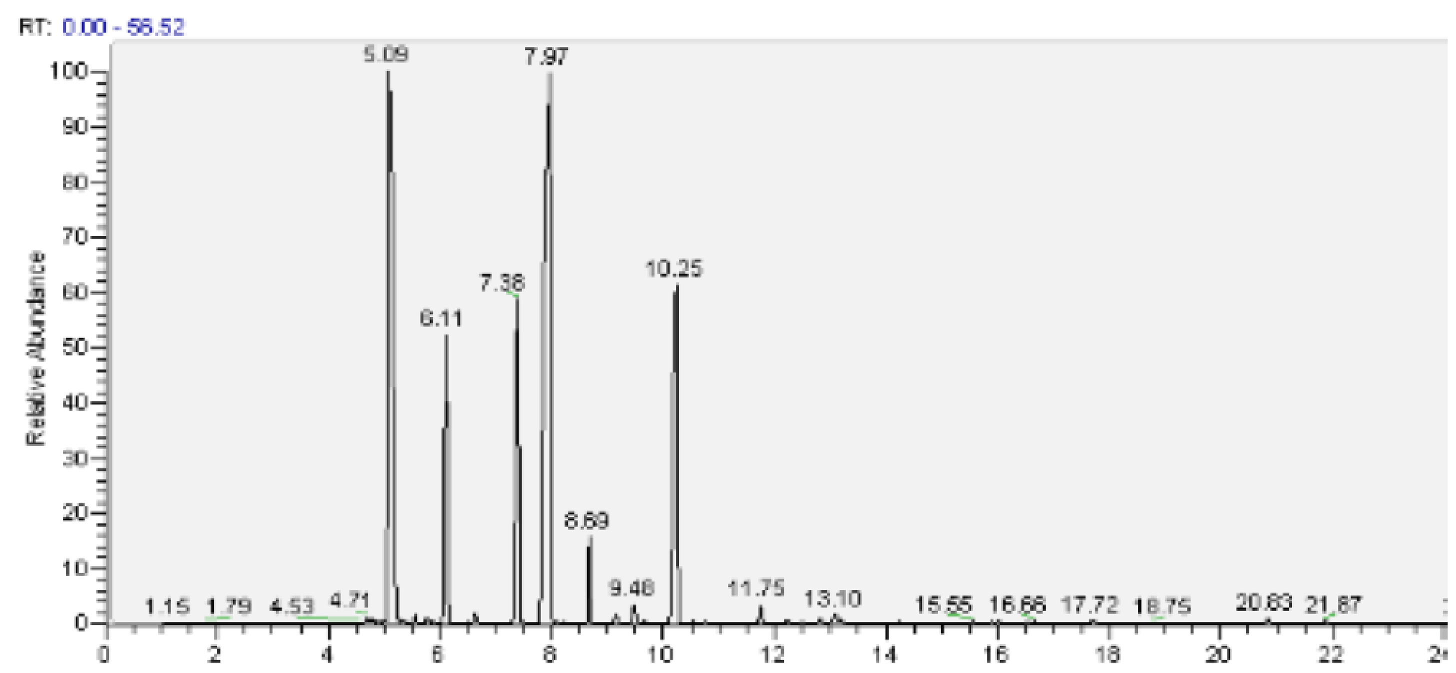

Figure 3. GC-MS chromatogram for the Liquid Product obtained from PS-Algae co-pyrolysis at 450 ºC

Table 1. Detecting components in the pyrolytic liquid products by GC-MS

PS	Temperature (ºC)			PS + Algae	Temperature (ºC)		
	350	400	450		350	400	450
Compound	Peak area, %			Compound	Peak area, %		
Benzene	0.5	0.85	0	Toluene	5.5	6.62	5.9
Toluene	9.25	3.5	6.6	Ethyl benzene	7.25	9.66	7.85
Ethyl Benzene	8.75	4.7	7.92	Styrene	24.8	26.89	26.7
Styrene	46.7	16.05	29	Phenol	0	1.2	0.9
Methyl styrene	24.15	9.5	10.6	Methyl styrene	9.45	14	10.65
Other	10.75	65.45	46	Other	51.22	43	49.04

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