Catalytic cracking to optimize pyrolysis of plastic waste: preliminary study

Poster · June 2019

CITATIONS
0

READS
353

7 authors, including:

Joahnn H. Palacios
Institut de recherche et de développement en agroenvironnement
72 PUBLICATIONS **877** CITATIONS
SEE PROFILE

Stéphane Godbout
Institut de recherche et de développement en agroenvironnement
210 PUBLICATIONS **3,505** CITATIONS
SEE PROFILE

RESEARCH AND DEVELOPMENT INSTITUTE FOR THE AGRI-ENVIRONMENT

www.irda.qc.ca

PYROLYSIS HAS A HIGH POTENTIAL FOR RECYCLING AGRICULTURAL PLASTIC

Catalytic Pyrolysis of Agricultural Plastic Waste
Preliminary Study

Joahnn H. PALACIOS[1], Stéphane GODBOUT[1], Maria Camila DIAZ-ACOSTA[1,2,3], Patrick BRASSARD[1], Dan ZEGAN[1], Étienne LE ROUX[1], Patrice SEERS[3]

Paper # 601571

AIM

- To study thermochemical recycling of waste agricultural plastics by catalytic pyrolysis in order to obtain a fuel

HPOTHESIS

- It is possible to improve the production of pyrolytic oil of low-density polyethylene by using zeolite ZSM-5 as a catalyst

OBJECTIVE

- To study the influence of the quantity of zeolite ZSM-5 catalyst on the pyrolytic oil production.

METHODS

- Feedstock: Low-density polyethylene (LDPE); spherical pellets (2.5 mm diameter)
- Pyrolysis: Auger reactor (figure 1) at 559 °C and 24 min of residence time
- Catalyst: Zeolite ZSM-5 in pellets
- Study variable: Catalyst quantity (0, 13, 27 and 40 mg) for 130 g of LDPE plastic

RESULTS AND DISCUSSION

- Condensed product yield was reduced by using the catalytic system (13.6-33.6%)
- Condensed products seem be more homogeneous increasing catalyst
- Adequate consistency (reproducibility) of the method: low standard deviation (SD) and relative standard deviation (RSD)
- The increase of the solid residence time from 3 to 24 min increased the condensed product yield, from 33.4% to 52.7%, respectively. (compared to Godbout et al., 2017)

CONCLUSIONS

- The condensed products were not in a oily form (appearance is like cream)
- Carbon chains have to be reduced even more (pre- or post-treatment needed)
- Condensed product obtained from pyrolysis with catalyst was more homogeneous
- Catalytic system reduced yield
- Long residence time favored condensed product yield

1 RESEARCH AND DEVELOPMENT INSTITUTE FOR THE AGRI-ENVIRONMENT
2 UNIVERSIDAD NACIONAL DE COLOMBIA SEDE BOGOTÁ
3 ÉTS ÉCOLE DE TECHNOLOGIE SUPÉRIEURE Université du Québec

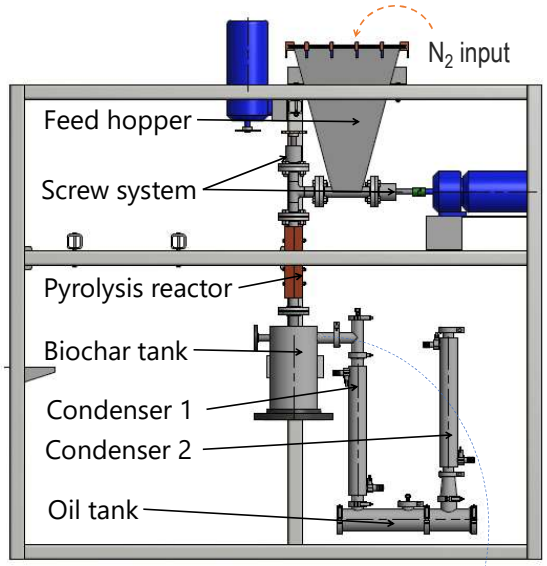

Figure 1. Schema of Auger reactor used for pyrolysis of plastic

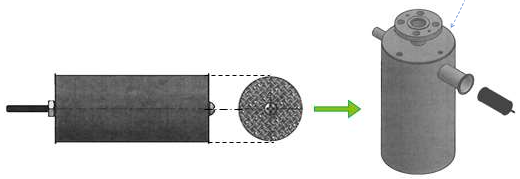

Figure 2. Schematic view of the cartridge for the catalytic system (left) for placing in the char canister (right) of the pyrolysis reactor

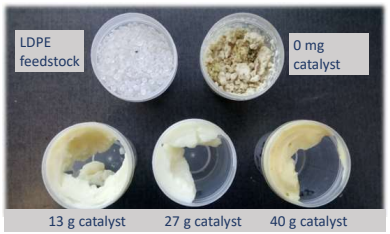

Figure 3. Plastic feedstock (LDPE) and condensed fractions

Table 1. Mass and yield of each pyrolysis product

Pyrolytic product	Without catalyst		With catalysis					
			Cartridge 1 (13 g)		Cartridge 2 (27 g)		Cartridge 3 (40 g)	
	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)
Condensed product	68.5	52.7%	51.8	39.8%	57,25	44,0%	45.5	35.0%
SD.			0.00		1,77		1.27	
RSD.			0.0%		3,1%		2.8%	
Solid from char canister	56.1	43.2%	50.8	39.1%	57	43,8%	60.8	46.8%
SD.			1.13		3,11		0.57	
RSD.			2.2%		5,5%		0.9%	
Gas and losses	5.4	4.2%	27	21.1%	16	12,1%	24	18.2%
SD.			1.13		4,88		1.84	
RSD.			4.1%		31,0%		7.8%	

Table 2. Heating value and total energy of condensed products (condenser 1)

Pyrolysis experience	Without catalyst		Cartridge 1 (13 g)		Cartridge 2 (27 g)		Cartridge 3 (40 g)	
Sample origin	C1	R1	C1	R1	C1	R1	C1	R1
Heating value (MJ/kg)	44.50	44.23	45.10	45.14	45.56	44.96	45.31	45.11
SD.				0.120	0.147	0.383	0.053	0.052
RSD				0.3%	0.3%	0.9%	0.1%	0.1%
Total energy (MJ)	0.76	1.90	0.91	1.19	1.10	1.01	0.83	0.84
SD.				0.179	0.096	0.007	0.094	0.187
RSD				15.1%	8.8%	0.7%	11.3%	22.3%

Scan me

To download the full paper

joahnn.palacios@irda.qc.ca