

Production of Bio Fuel from low Density Polyethylene through Modeling and Simulation

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Abstract

While efforts have been made to create future biodegradable plastics, there haven't been many significant initiatives taken to address the environmental issue caused by low density polyethylene (LDPE), which has become a part of our everyday life. In this study, waste LDPE was utilized for pyrolysis to produce fuel oil with the same physical properties as fuels like gasoline, diesel, etc. The process of turning waste LDPE into biofuel was modeled and simulated using Aspen Plus. When LDPE is pyrolyzed, two processes take place at a high temperature of around 500°C without oxygen process reaction and drying process. The process model was created, and simulation results were obtained. The results indicate that the drying process yielded 1100.572 kg/h, while the flash separator at 135°C produced 4999.428 kg/h. Differences in enthalpy and entropy between the initial and final products were noted.

Keywords: Production of Bio Fuel, Low Density, Polyethylene through Modeling, and Simulation

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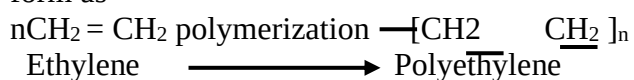
Introduction

Around the world, it has been shown that the average lifespan of humans is declining, particularly in poorer countries. The primary cause is the waste solid, liquid, and gaseous that pollutes the environment. Municipal and public garbage management is currently the biggest environmental issue confronting emerging nations, particularly Nigeria. The massive, unmanageable solid waste is

causing the city to smell. Because of Nigeria's current economic climate, water is packaged in low-density polyethylene (LDPE) sachets, which are the least expensive packaging material and are widely used in practically every community. Unfortunately, because LDPE degrades very slowly, this has created a new source of solid waste. Pyrolysis is the least expensive way to turn LDPE waste into a usable product. It is anticipated that the pyrolysis process occurs between 3250 and 8500 degrees Celsius (Galvagno et al., 2002). In a spouted bed reactor, (Santos et al., 2019) catalytically pyrolyzed polyethylene to produce compounds ranging from C_2 to C_9 . Methane and olefins like propene and ethane, together with a few aromatic oils, were the primary constituents of the product gas for polyethylene and polypropylene. Methane, butadiene, ethylene propylene, carbon dioxide, and carbon monoxide were the principal gases generated at low temperatures. Carbon monoxide, ethylene, methane, carbon dioxide, benzene, and hydrogen were all created at high temperatures. (Kusenberget al., 2022) investigated the pyrolysis of waste polyethylene (clean water sachets) to produce fuel oil. To supplement current landfill and mechanical recycling technologies, a variety of waste polymer treatment methods have been studied.

Converting the garbage into a product with added value would be ideal. Synthetic lubricants are a particularly intriguing possible product in the case of polyethylene waste. Additionally, because they don't contain aromatic chemicals, they are said to be less harmful to the environment. On the other hand, when traditional lubricants are used in two-stroke engines, some of its aromatic chemicals may be discharged into the environment. Compounds that are similar to 1-decene in molecular structure and chain length are the best degradation products from polyethylene for the generation of light gases and hydrocarbon liquid products. Waste LP (low density polyethylene) and PP (polypropylene) have been transformed into value-added products using a variety of thermochemical processes. In order to create light liquid hydrocarbon compounds, thermal cracking of plastic waste has been investigated at temperatures between 510 and 520°C (Hussein et al., 2022). A study on the conversion of plastic trash into low-temperature light hydrocarbon fuel with and without a catalyst was carried out (Singh et al., 2020). Numerous potential reaction processes have been proposed by studies on the breakdown of addition polymers and the makeup of the products. Consequently, a number of mathematical models have been put out to explain how addition polymers degrade. Theoretically, the highest rate of weight loss for a fully random process would occur at 26.4% decomposition.

Alexander Parkes created plastic, a substance with a high molecular weight, in 1862. Bridson (Mutlu & Barner, 2022). Another name for plastics is polymers. The term polymer means a molecule made up by repetition of simple unit. For example, the structure of polyethylene can be written in a form as



Typical manifestation of the molecular structure of polyethylene.

One of the most widely used materials in daily life, plastic can be categorized in a variety of ways, including by its density, production method, chemical structure, and other characteristics. The Society of Plastic Industry (SPI) established a resin identification code system that separates plastics into the following seven groups according to their chemical composition and intended use in order to facilitate recycling of waste plastic (Coltro et al., 2008):

PET (Polyethylene Terephthalate)

HDPE (High Density Polyethylene)

PVC (Polyvinyl Chloride)

LDPE (Low Density Polyethylene)

PP (Polypropylene)

PS (Polystyrene)

Others

Since plastic was initially produced commercially, its output has increased from 1.5 million tons in 1950 to 260 million tons in 2007, mostly due to its ease of use and manufacturing. (Greene, 2022) The disposal of waste plastic is one of the main issues with the widespread usage of plastics. Furthermore, plastics are a non-sustainable product since they are made from coal or oil that is not sustainable. In 2007, 30.7 million tons of plastic garbage were produced in the United States, making about 12.1% of all municipal solid waste. (Drewniok et al., 2023) In 2007, 4.9 million tons of plastic were used in the United Kingdom. Approximately 25% of the world's plastic manufacturing, or 60 million tons annually, is consumed in Europe. If no alternative solutions are developed, the world's excessive use of fossil fuels and energy may soon lead to an energy deficit and environmental issues. However, waste streams and renewable energy sources may be processed to provide fuels and energy. Pyrolysis of waste plastic is a cost-effective way to address the issue of waste plastic and provide high-quality liquid fuel with characteristics that are comparable to those of widely used petroleum fuels.

Simulation of Process Plants

Process engineers now have access to a new learning environment through computer simulations of chemical plants, where they may study and comprehend the plant by varying factors and monitoring reactions. In addition, simulation facilitates the application of some engineering techniques, the development of problem-solving abilities, and the investigation of chemical processes by engineers through data collection, analysis, and validation on pilot plants and in general industrial use (Cristina Dos Reis & Teles Madureira, 2023). The goal of validation is to ensure that the processes used for development and verification of a system, service, or product produce a system, service, or product that satisfies the original specifications, rules, and requirements. Validation processes for new development or verification flows may include modeling the flow and use simulation to identify flaws or gaps that might result in inaccurate or insufficient system, service, or product development or verification. A development flow or verification flow for a system, service, or product may then be qualified using a set of validation standards, specifications, and rules (McMillan et al., 2019).

Additional validation processes also include those created especially to guarantee that changes made to an already-existing qualified development flow or verification flow will result in a system, service, or product that satisfies the original design specifications, rules, and requirements; the flow remains qualified thanks to these validations. Analyzing single unit actions and how they combine to create complex processes is done through process simulation. The interdependencies of various process phases, which are often categorized as fluid packages like NTRL, UNIQUAC, Peng Robinson, and so forth, are shown by mass and energy balances derived by linking process variables and parameters. The outcomes of the simulation are useful for process design, enhancement, optimization, and scaling up. Chemical engineering mathematical models are solved using industrial standard process simulation software tools (Aspen HYSYS, CHEMCAD, IPSEpro, etc.). There are a number of tools that are used in simulation; if such tools are not accessible, new process units are created and included into the existing tools. It should also be made clear that it is possible for a product to pass verification but fail validation. This can occur when a product is constructed in accordance with the requirements, but the specifications do not adequately meet the needs of the user (Hoehne, 2017).

Methodology

Chosen outlet condition for the validation of the model Simulation of processes.

Steady state process simulation procedure set up

Because it is one of the models that predicts two liquid phases, the chosen fluid package (property

package) is NRTL under the activity model(Fernández et al., 2022).

Drying process

Drying is a mass transfer process that involves removing water or another solvent from a solid, semi-solid, or liquid via evaporation (Khan et al., 2022). In the most typical scenario, a gas stream, such as air, delivers heat by convection and removes the vapor as humidity. Other options include vacuum drying, in which heat is provided by radiation, conduction, or microwaves, and the vacuum system removes the vapor that is created (Mühlbauer & Müller, 2020).

Application of hot air (convective or direct drying)

Air heating speeds up drying by increasing the drying force for heat transfer. Additionally, it raises the relative humidity of the air, which intensifies the drying action. The solids heat up during the decreasing rate period, and the greater temperatures accelerate the diffusion of water from the solid's core to its surface. The solid surface can be nearly entirely dehydrated by air that is too hot.

Process simulation for drying

The washer receives waste sachets of pure water for cleaning; the mass ratio of LDPE to water is 1:1. While the clean LDPE was being transferred to the crusher, the washer's waste water was let to run off. Following the shredding process, the clean waste LDPE is crushed into tiny, spherical bits with an average particle size of 3 mm. Using nitrogen gas at 176.7°C, the wet LDPE is dried and purified.

Process simulation for reaction

The pyrolysis reactor receives waste LDPE from the drying operations. The pyrolysis reactor's working conditions are set to 1 atm, the temperature is kept at 500°C, and the reaction duration is 30 minutes (Jerzak et al., 2024). Before being sent to the first separator, the gaseous products from the reactor are fed into a cooler that cools them from 500 to 300°C. At the top, fuel gas products such as hydrogen, ethylene, propene, ethane, and methane are separated and utilized to heat the reactor. To separate the bottom products into light and heavy fuel oil products, they are transferred to a second separator (Gomi & Takahashi, 1971). While heavy oil is categorized as diesel range hydrocarbon, light oil is classed as gasoline range hydrocarbon. To prevent wax buildup in pipelines, light fuel oil will be heated to room temperature and heavy fuel oil will be chilled to the same temperature as light fuel oil. The storage tanks are where both goods are kept. After the flow chart was created, Aspen Plus was used to simulate it. Simulation findings have been used to determine the plant's material and energy balances. 10,000 tons per year are used as the foundation for the material balance (Ismail et al., 2024).

Equipment description for the unit's operation

Washer

Usually used to spread the load of a threaded fastener, such a load or nut, a washer is a thin plate, usually disk-shaped, with a hole in the middle. Typically, washers are made of plastic or metal.

Crusher

An apparatus called a crusher is made to break up big rocks into smaller ones, gravel, or rock dust. In order to distinguish between pieces of different composition, a crusher can be used to reduce the size of waste materials, change their form so they can be recycled or disposed of more easily, or reduce the size of a solid or recycled material or a solid mix of raw materials (like rock ore).

Dryer

A dryer is a device that removes water or another solvent from a liquid, solid, or semi-solid.

Heater

A heater is a machine that generates and emits heat, usually to increase a space's or building's temperature.

Pump

A pump is a machine that uses mechanical action to transport fluids (gases or liquids), and occasionally slurries. Based on how they transfer fluid, pumps may be divided into three main categories: Pumps for gravity, displacement, and direct lift. Pumps use energy to move fluids through mechanical effort using a mechanism, usually a rotary or reciprocating pump.

Separator

In oil terminology, a separator is a pressure vessel that separates fluids from gas and oil wells into their liquid and gaseous components. A huge vessel used in petroleum production to separate production fluids into their component parts oil, gas, and water is called a separator. The terms oil and gas separator, stage separator, trap, knockout vessel, flashing chamber, expansion separator or expansion vessel, scrubber, and filter can all be used to describe a separating vessel. These separation vessels are often used to separate fluids from oil and gas wells into liquid and gas or oil and gas on a producing lease or platform close to the wellhead, manifold, or tank

Results

Simulation Results from Drying Process

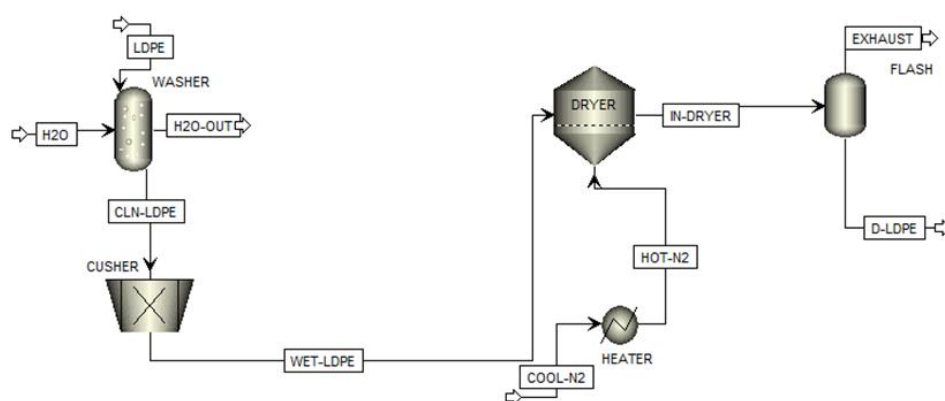


Figure 1. Flow sheet for the drying process of LDPE

Results obtained from simulation of drying process

Heat and Material Balance Table											
Stream ID		CLN-LDPE	COOL-N2	D-LDPE	EXHAUST	H2O	H2O-OUT	HOT-N2	IN-DRYER	LDPE	WET-LDPE
From		WASHER		FLASH	FLASH		WASHER	HEATER	DRYER		CUSHER
To		CUSHER	HEATER			WASHER		DRYER	FLASH	WASHER	DRYER
Phase		LIQUID	VAPOR	LIQUID	VAPOR	LIQUID	LIQUID	VAPOR	MIXED	LIQUID	LIQUID
Substream: MIXED											
Mole Flow	kmol/hr										
N		0.0	178.4855	.0204106	178.4651	0.0	0.0	178.4855	178.4855	0.0	0.0
WATER		0.0	0.0	0.0	0.0	61.05928	61.05928	0.0	0.0	0.0	0.0
LDPE		39.21043	0.0	39.21043	2.6379E-77	0.0	0.0	0.0	39.21043	39.21043	39.21043
Total Flow	kmol/hr	39.21043	178.4855	39.23084	178.4651	61.05928	61.05928	178.4855	217.6959	39.21043	39.21043
Total Flow	kg/hr	1100.000	5000.000	1100.572	4999.428	1100.000	1100.000	5000.000	6100.000	1100.000	1100.000
Total Flow	l/min	158.6417	73741.80	162.5521	1.00937E+5	18.44480	18.44480	1.11584E+5	1.11287E+5	158.6417	158.6417
Temperature	C	25.00000	25.00000	135.0000	135.0000	25.00000	25.00000	178.0000	176.1826	25.00000	25.00000
Pressure	bar	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
Vapor Frac		0.0	1.000000	0.0	1.000000	0.0	0.0	1.000000	.8198050	0.0	0.0
Liquid Frac		1.000000	0.0	1.000000	0.0	1.000000	1.000000	0.0	.1801950	1.000000	1.000000
Solid Frac		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enthalpy	cal/mol	-1671.921	0.0	-1628.757	766.6900	-68262.20	-68262.20	1067.912	574.4254	-1671.921	-1671.921
Enthalpy	cal/gm	-59.59705	0.0	-58.05845	27.36861	-3789.128	-3789.128	38.12136	20.50001	-59.59705	-59.59705
Enthalpy	cal/sec	-18210.21	0.0	-17749.30	38007.61	-1.1578E+6	-1.1578E+6	52946.34	34736.13	-18210.21	-18210.21
Entropy	cal/mol-K	354.8748	.0261396	356.3055	2.214680	-38.96517	-38.96517	2.916329	66.64957	354.8748	354.8748
Entropy	cal/gm-K	12.64981	9.33109E-4	12.70082	.0790576	-2.162896	-2.162896	.1041045	2.378580	12.64981	12.64981

Table 1. Simulation results from drying process using nitrogen gas

Heat and Material Balance Table											
Stream ID		CLN-LDPE	COOL-N2	D-LDPE	EXHAUST	H2O	H2O-OUT	HOT-N2	IN-DRYER	LDPE	WET-LDPE
From		WASHER		FLASH	FLASH		WASHER	HEATER	DRYER		CUSHER
To		CUSHER	HEATER			WASHER		DRYER	FLASH	WASHER	DRYER
Phase		LIQUID	VAPOR	LIQUID	VAPOR	LIQUID	LIQUID	VAPOR	MIXED	LIQUID	LIQUID
Substream: MIXED											
Mole Flow	kmol/hr										
N		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER		0.0	0.0	0.0	0.0	61.05928	61.05928	0.0	0.0	0.0	0.0
LDPE		39.21043	0.0	39.21043	1.9450E-77	0.0	0.0	0.0	39.21043	39.21043	39.21043
F		0.0	131.5900	.0163081	131.5737	0.0	0.0	131.5900	131.5900	0.0	0.0
CL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Flow	kmol/hr	39.21043	131.5900	39.22674	131.5737	61.05928	61.05928	131.5900	170.8005	39.21043	39.21043
Total Flow	kg/hr	1100.000	5000.000	1100.620	4999.380	1100.000	1100.000	5000.000	6100.000	1100.000	1100.000
Total Flow	l/min	158.6417	54366.80	162.5429	74415.77	18.44480	18.44480	82265.92	82030.01	158.6417	158.6417
Temperature	C	25.00000	25.00000	135.0000	135.0000	25.00000	25.00000	178.0000	175.8525	25.00000	25.00000
Pressure	bar	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
Vapor Frac		0.0	1.000000	0.0	1.000000	0.0	0.0	1.000000	.7703525	0.0	0.0
Liquid Frac		1.000000	0.0	1.000000	0.0	1.000000	1.000000	0.0	.2296475	1.000000	1.000000
Solid Frac		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enthalpy	cal/mol	-1671.921	0.0	-1628.974	847.3023	-68262.20	-68262.20	1190.329	533.2458	-1671.921	-1671.921
Enthalpy	cal/gm	-59.59705	0.0	-58.05759	22.29931	-3789.128	-3789.128	31.32708	14.93092	-59.59705	-59.59705
Enthalpy	cal/sec	-18210.21	0.0	-17749.81	30967.42	-1.1578E+6	-1.1578E+6	43509.83	25299.62	-18210.21	-18210.21
Entropy	cal/mol-K	354.8748	.0261396	356.3424	2.441540	-38.96517	-38.96517	3.240481	84.39743	354.8748	354.8748
Entropy	cal/gm-K	12.64981	6.87943E-4	12.70026	.0642564	-2.162896	-2.162896	.0852829	2.363134	12.64981	12.64981

Table 2. Simulation results for drying process using florin gas

Heat and Material Balance Table											
Stream ID		CLN-LDPE	COOL-N2	D-LDPE	EXHAUST	H2O	H2O-OUT	HOT-N2	IN-DRYER	LDPE	WET-LDPE
From		WASHER		FLASH	FLASH		WASHER	HEATER	DRYER		CUSHER
To		CUSHER	HEATER			WASHER		DRYER	FLASH	WASHER	DRYER
Phase		LIQUID	VAPOR	LIQUID	VAPOR	LIQUID	LIQUID	VAPOR	MIXED	LIQUID	LIQUID
Substream: MIXED											
Mole Flow	kmol/hr										
N		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER		0.0	0.0	0.0	0.0	61.05928	61.05928	0.0	0.0	0.0	0.0
LDPE		39.21043	0.0	39.21043	1.0192E-77	0.0	0.0	0.0	39.21043	39.21043	39.21043
F		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CL		0.0	70.51649	.5811487	69.93534	0.0	0.0	70.51649	70.51649	0.0	0.0
O		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Flow	kmol/hr	39.21043	70.51649	39.79158	69.93534	61.05928	61.05928	70.51649	109.7269	39.21043	39.21043
Total Flow	kg/hr	1100.000	5000.000	1141.207	4958.793	1100.000	1100.000	5000.000	6100.000	1100.000	1100.000
Total Flow	l/min	158.6417	29134.09	163.1996	39554.19	18.44480	18.44480	44084.68	43672.13	158.6417	158.6417
Temperature	C	25.00000	25.00000	135.0000	135.0000	25.00000	25.00000	178.0000	174.2583	25.00000	25.00000
Pressure	bar	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
Vapor Frac		0.0	1.000000	0.0	1.000000	0.0	0.0	1.000000	.6395483	0.0	0.0
Liquid Frac		1.000000	0.0	1.000000	0.0	1.000000	1.000000	0.0	.3604517	1.000000	1.000000
Solid Frac		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enthalpy	cal/mol	-1671.921	0.0	-1616.041	913.0084	-68262.20	-68262.20	1278.041	223.8630	-1671.921	-1671.921
Enthalpy	cal/gm	-59.59705	0.0	-56.34811	12.87643	-3789.128	-3789.128	18.02460	4.026852	-59.59705	-59.59705

Table 3. Simulation results from drying process using chlorine gas

Heat and Material Balance Table											
Stream ID		CLN-LDPE	COOL-N2	D-LDPE	EXHAUST	H2O	H2O-OUT	HOT-N2	IN-DRYER	LDPE	WET-LDPE
From		WASHER		FLASH	FLASH		WASHER	HEATER	DRYER		CUSHER
To		CUSHER	HEATER			WASHER		DRYER	FLASH	WASHER	DRYER
Phase		LIQUID	VAPOR	LIQUID	VAPOR	LIQUID	LIQUID	VAPOR	MIXED	LIQUID	LIQUID
Substream: MIXED											
Mole Flow	kmol/hr										
N		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER		0.0	0.0	0.0	0.0	61.05928	61.05928	0.0	0.0	0.0	0.0
LDPE		39.21043	0.0	39.21043	2.3092E-77	0.0	0.0	0.0	39.21043	39.21043	39.21043
F		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O		0.0	156.2559	.0223786	156.2335	0.0	0.0	156.2559	156.2559	0.0	0.0
Total Flow	kmol/hr	39.21043	156.2559	39.23281	156.2335	61.05928	61.05928	156.2559	195.4663	39.21043	39.21043
Total Flow	kg/hr	1100.000	5000.000	1100.716	4999.284	1100.000	1100.000	5000.000	6100.000	1100.000	1100.000
Total Flow	l/min	158.6417	64557.56	162.5522	88362.89	18.44480	18.44480	97686.21	97407.09	158.6417	158.6417
Temperature	C	25.00000	25.00000	135.0000	135.0000	25.00000	25.00000	178.0000	176.0060	25.00000	25.00000
Pressure	bar	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
Vapor Frac		0.0	1.000000	0.0	1.000000	0.0	0.0	1.000000	.7993066	0.0	0.0
Liquid Frac		1.000000	0.0	1.000000	0.0	1.000000	1.000000	0.0	.2006934	1.000000	1.000000
Solid Frac		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enthalpy	cal/mol	-1671.921	-8.898E-13	-1628.629	780.4384	-68262.20	-68262.20	1092.233	537.7446	-1671.921	-1671.921
Enthalpy	cal/gm	-59.59705	-2.781E-14	-58.04919	24.38962	-3789.128	-3789.128	34.13357	17.23130	-59.59705	-59.59705
Enthalpy	cal/sec	-18210.21	-3.862E-11	-17748.80	33869.61	-1.1578E+6	-1.1578E+6	47407.74	29197.48	-18210.21	-18210.21
Entropy	cal/mol K	254.8740	0.761300	254.3879	2.757631	-38.96517	-38.96517	2.978848	73.84744	254.8740	254.8740

Table 4. Simulation results from drying process using oxygen gas

Discussion

1100 kg/h of LDPE and 1100 kg/h of water are fed into the washer at the start of the process. The simulation results show that 1100.572 kg/h is recovered from the splash separator as the final product at a temperature of 135⁰C using N₂, which indicates that 99.95% of dried LDPE is present while 0.05 percent is nitrogen gas. The same results are recovered using O₂, and using F₂, 1100.620 kg/h is recovered from the separator as the final product, which indicates that 99.94% of dried LDPE is present while 0.06 % is F₂. The simulation findings indicate that a large proportion of CL₂ is combined with LDPE, making CL₂ a poor drying agent whereas other employed gases are regarded as great drying agents. As a consequence, the dried LDPE is mixed with very little N₂, O₂, and F₂ gas. The dryer is heated by 500 kg/h of nitrogen gas; nevertheless, the heat and material balance table indicates that 4999.428 kg/h of nitrogen gas is exhausted from the splash separator at a temperature of 135⁰C and 1 bar pressure. The enthalpy for dried LDPE is -1628.757 cal/mol while the exhaust gas has the enthalpy of 766.6900 cal/mol this shows that the exhaust gas has high heat than dried product. The entropy of dried LDPE is 356.3055 cal/mol.k and the exhaust gas have 2.214680 cal/mol.k.

Process reaction

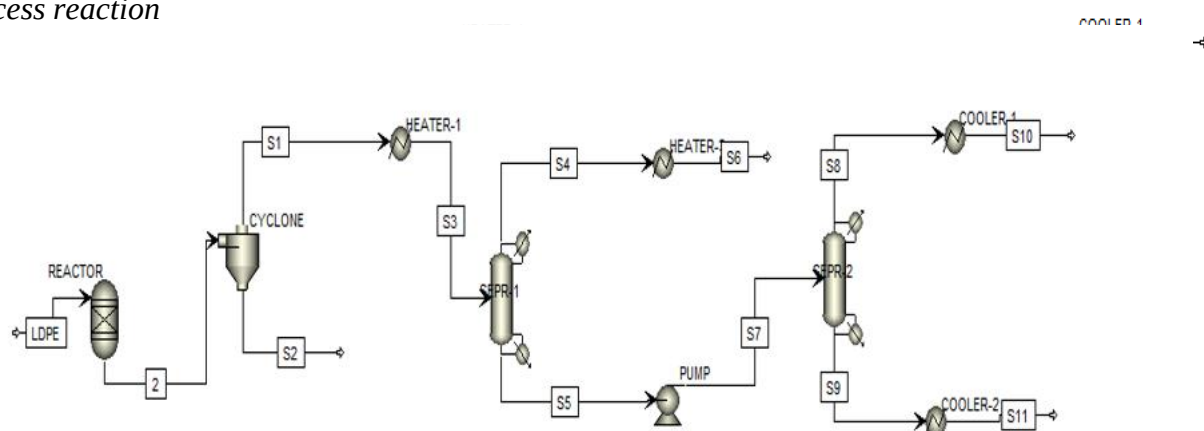


Figure 6: Flow sheet for process reaction of pyrolysis plant

Conclusion

The ecology and culture of today are seriously threatened by plastics; each year, more than 14 million tons of plastic are discarded into the oceans, killing several marine animals. Although humanity has recognized this threat and responded by developing biodegradable plastics, no concrete steps have been taken to repair the damage that has already been done. In this regard, the pyrolysis that is being studied here offers a very effective, clean, and efficient way to get rid of the debris that has accumulated over the past few decades. Two problems were resolved by turning plastics into fuel: the massive plastics oceans and the gasoline crisis. Considering the project's financial advantages, our economy will greatly benefit. Lastly, this study is restricted to the drying process alone. Although a model for the process reaction was created, the reaction was not carried out because of time constraints and a lack of relevant literature, so the simulation results for the process reaction are not available. By removing solid waste and producing eco-friendly non-fossil fuel, the pyrolysis of low density polyethylene will reduce environmental pollution. Because nitrogen, oxygen, and fluorine gases provided higher yields than chlorine gas, the simulation findings suggested that these gases be used in the drying process.

Conflicts of Interest

No conflict of interest

Author contribution

Conceptualization, methodology, validation: Umar Muhammad Salisu; formal analysis, investigation; resources, data curation: Yusuf Ibrahim; writing-original draft preparation: Yusuf Ibrahim writing-review and editing, visualization, Umar Muhammad Salisu: All authors have read and agreed to the published version of the manuscript.

Declaration of generative AI in scientific writing

The author acknowledges having used the Generative AI tool Grammarly-AI for grammar/language improvement, summarizing supporting literature. The author is solely responsible for all published content and has verified the accuracy and authenticity of the AI output.

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