Improved Functionally of Bimodal Polyethylene for Chemical Plants

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ABSTRACT

Introduction. It is the fact that polymer plants are increasing by their useful features and also more beneficial sides. With conducting special chemical reactions, adding more different characteristical additional chemicals, peculiar extruder equipments and changing S_{ex} and MI measurements we can obtain more influential and modern bimodal polymers. In this article, we researched about how to develop bimodal polymers by some important changes

Keywords: Bimodal, extruder, ultraviolet stabilizers, phthalate, feldspar, glass fibers, antistatic agents, dodecylbenzenesulfonic Acid (Statsafe 6000)

Research Methods:

Today, different types of high density polyethylene (HDPE) polymers are considered the most demanded modern plastics due to their consumer properties and wide range of uses. As in the rest of the world, the production of bimodal and unimodal polyethylenes with adjusted structure and properties that fully meet world standards which is the key to the countrys' great opportunities.

It is an essential task to take samples of new types of polymer composite materials of bimodal polyethylene, to study their physical and chemical properties, to match their structure and properties, and to theoretically compare the samples. This new project consists in studying the structural properties of bimodal polyethylene, the extraction and the effect of additives, antioxidants, fillers, antistats and other components on the properties of bimodal polyethylene.

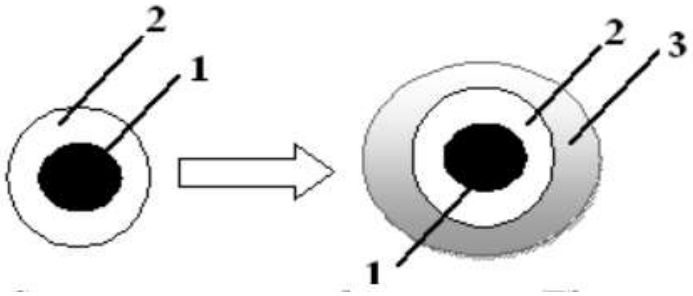

Figure 1. Mechanism of formation of bimodal polyethylene. 1-active catalyst; 2-high macromolecular polyethylene; 3-lower macromolecular polyethylene.

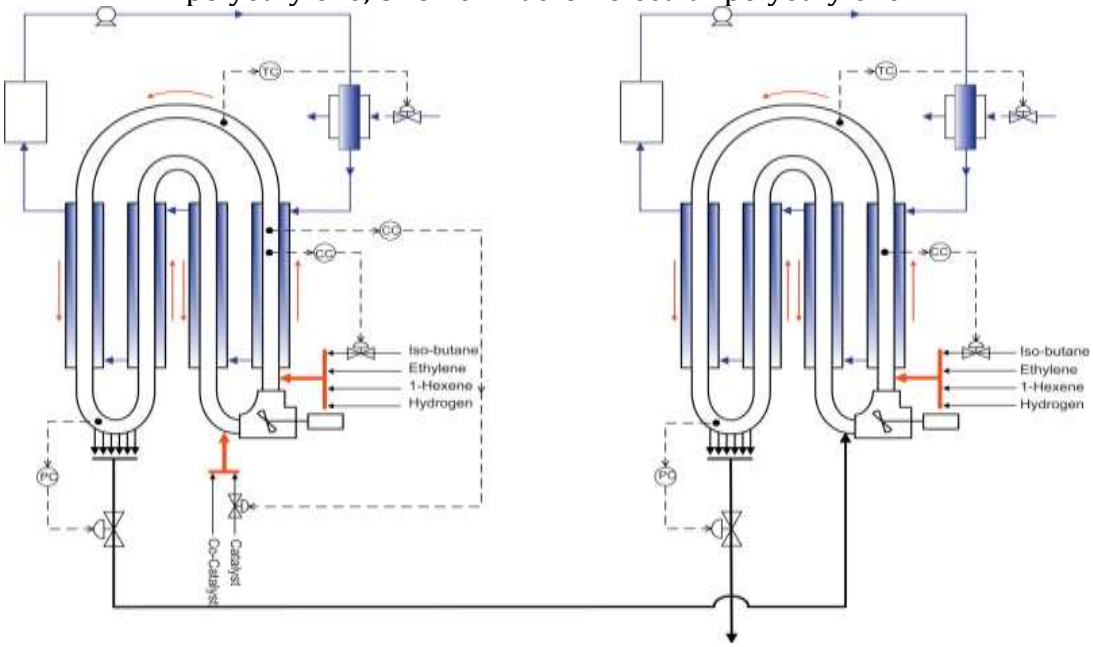

Figure 2. Reactors for obtaining bimodal polyethylene

With the help of this new project, it is necessary to study the technology of obtaining a new type of bimodal polyethylene and to further improve the methods of obtaining bimodal polyethylene. The study of the structure and properties of the newly obtained bimodal polyethylene consists in the production of a quality polyethylene composition. The goal of the master's thesis under study is to further improve the production of quality products using new technology.

Only the polymers in the powder state are transferred to a viscous flowable state and then brought to the granule state by adding solid powdery additives.

The quality of polymers obtained based on new technologies depends on their polymerization temperatures. Because polymer macromolecules are longer when polymerization takes place at a lower temperature. This determines the quality of the polymer. In obtaining bimodal polyethylene, T=70-110 C and P=4.4-4.5MPa pressure.

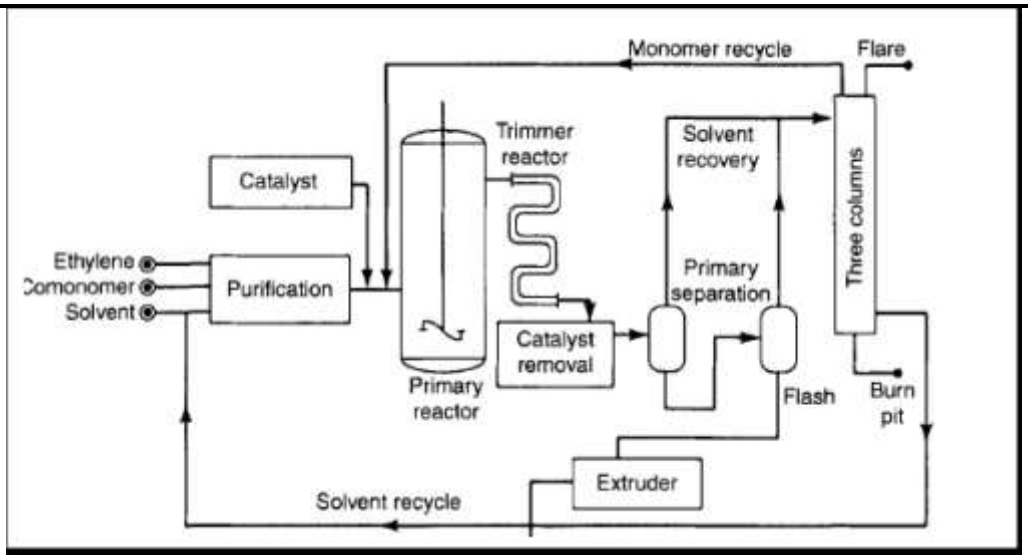

Figure 2. Process from monomers to the extruder

This new bimodal polymer works with using loop slurry polymerization technology, to produce high performance bimodal polyethylene products. With these expanded capacities, manufacturing plants will be able to expand its current polyethylene grade slates and introduce additional products for higher-value applications.

Modern plants sometimes use two or more individual reactors in series (e.g.,) two or more slurry reactors, two gas-phase reactors, or a combination of slurry and gas phase reactor), with each reactor operating under slightly different conditions, so that the properties of the different end-products from the individual reactors are present in the resulting polymer mixture. This leads to a broad or bimodal (low and high) molecular weight distribution and improved mechanical properties (e.g., stiffness and toughness) in the final plastic product, a bimodal polymer. Unimodal polymers, on the other hand, are polymers of either low or high molecular weight distribution and have lesser flexibility and applicability compared to bimodal polymers. From A_1 to A_5 resins were selected and experimentations has conducted to identify their MI and S_{ex}. With conditions of 190°C and 10 min, 2160 and 6480 g, melting levels of polymer were measured. Results has written on tables.

Antioxidants.

We can use the following types of antioxidants: AO8, AO6, AO2 UV8 Tinuvin622-Chemasorb (ultraviolet stabilizers), antioxidant1010, Irganox168, irgafos1076, Antioxidant 1330 are used.

Fillers.

There are different types of fillers and they are divided into the following types: Inorganic fillers. Available in fiber or powder form. Inorganic fillers used in the form of fiber include fiberglass, asbestos, and wollastonite. Powdered fillers include kaolin, talc, metal oxides (TiO, ZnO, Fe2O3, etc.) and salts (CaCO3, etc.).

Glass fibers.

Because glass fibers are resistant to chemical and thermal effects, have low relative elongation and high strength, they are mainly used as a reinforcing filler in polymer compositions. Products made from glass wool (based on glass fibers), glass textolite (made from glass fabric) are used in various industries.

Monocrystalline fibers of oxides.

The development of cosmonautics led to obtaining monocrystalline fibers from various oxides and creating polymer materials resistant to heat and mechanical effects from them. Currently, in practice, monocrystalline fibers (sapphire fibers) obtained from aluminum oxide are used to obtain such polymer compositions.

Many powder fillers are used in the production of composite polymer materials.

Powdered inorganic fillers.

1. Calcium carbonate (CaCO3). One of the most commonly used fillers. It is very common in nature and easy to grind. It is widely used in the preparation of compositions based on polyvinyl chloride, polypropylene polymers.

2. Kaolin. Also called white clay. Hydrated form of aluminum silicate. Kaolin is used both hydrated and dehydrated at higher temperatures.

3. Feldspar. The composition is anhydrous alkaline aluminosilicates. High resistance to chemical effects is used in obtaining these fillers, polymer compositions used in chemical environments.

4. Talc. Talc in the form of a plate is used as a filler. Therefore, adding talc to polymers increases their strength. Talc is a hydrated magnesium silicate (3MgO(4SiO2(H2O)) It is used in obtaining compositions from polypropylene and polyvinyl chloride. It is widely used in the rubber industry.

5. Silicon carbide. It is added to polymer compositions to increase their abrasion resistance.

6. Metal oxides. Me_xO_y

Plasticizers

Plasticizers are added to polymer materials in order to increase their elasticity, improve their processing at high temperatures, and display many other positive indicators. There are the following types of industrially produced plasticizers: Dimethyl phthalate, diethyl phthalate, dibutyl phthalate, phthalate, dialkyl phthalate, etc.

Dyes.

Powdered dyes are added to polymer raw materials to give them different colors. They provide color and increase light tolerance. Generally, composite dyes with higher lightfastness than unity are used. Iron oxide based dyes, which are resistant to UV rays of the sun, are used more often. But dyes rich in different colors make the product more attractive. While they produce excellent colors, they are slightly more lightfast than iron oxide based dyes.

Lubricants.

For the lubrication of composite polymer materials, stearic acid, epoxidized soy oils, etc. are used. Lubricants are usually added to keep the composite materials in a highly viscous flow state on the screw surface and extruder shell and through the extrusion tool with low friction. Some lubricants act as consistency modifiers in addition to lubricating the composition.

We will use these additives to obtain future bimodal polyethylene compositions. Also, we will be able to squeeze the obtained powdery product in the following double type extruders and get the product of polyethylene.The polymer/additive blend is melted and homogenized in the extruder. The molten polymer is pumped through the screen pack and steam heated die plate for pelletizing. The extruder is specially designed to homogenize the bimodal product and minimize gels in the product polymer. The extruder is equipped with a hydraulically operated screen changer and dump valve. A number of support systems are included with the extruder on

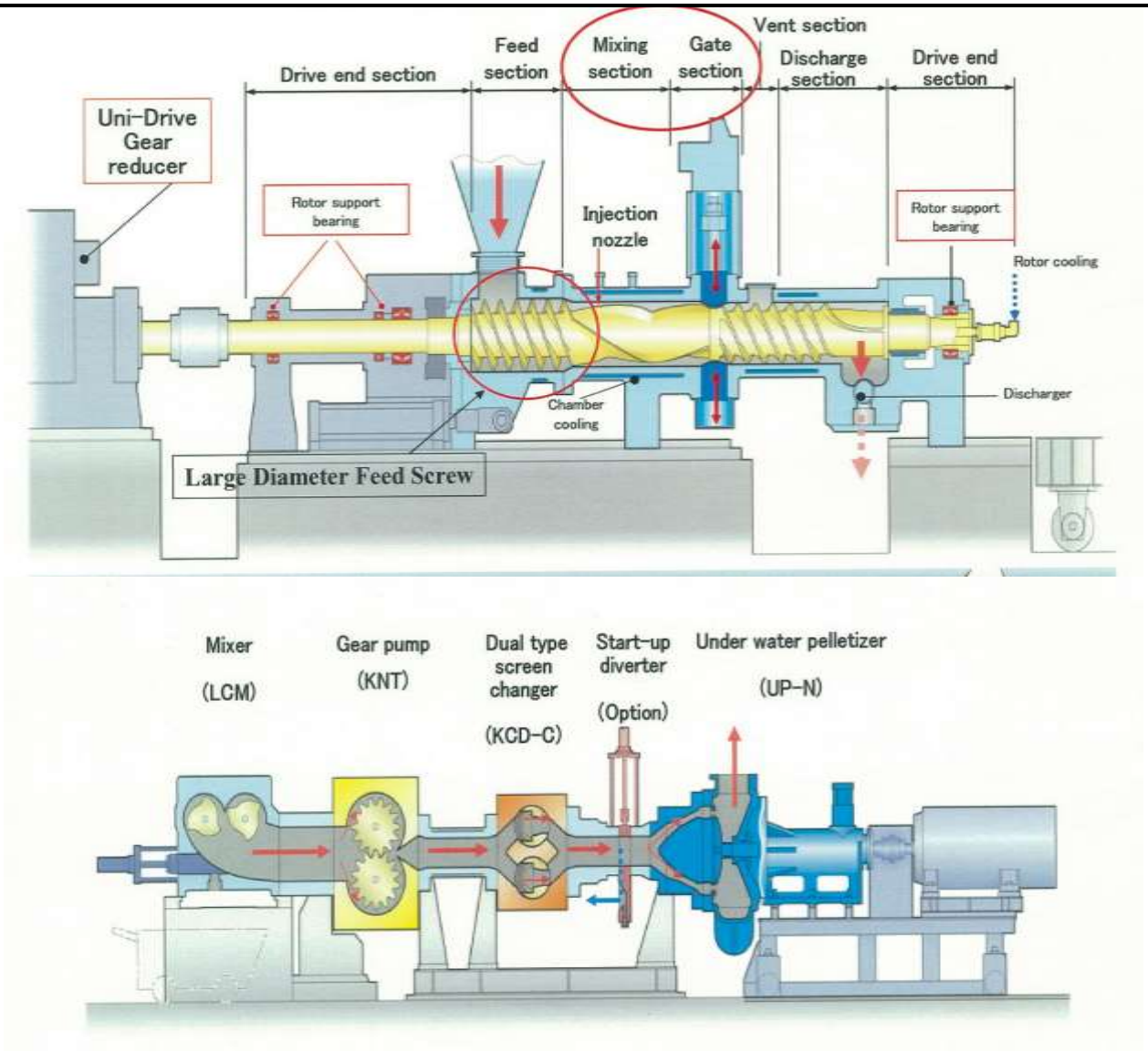

Figure 4. Double-type-extruder

Manufacturing contemporary polyethylene is difficult without good extruder. Customers always want to get the best price and high quality of products, in this case having lots of characteristics of polymers are demandable.

Results And Discussion:

Resin	Market application	Density (g/cc)	MI [HLML] (g/10 min)
A_1	Bimodal Pipe	0,949	(9,00)
A_2	Bimodal Film	0,955	(11,00)
A_3	Bimodal Wire& Cable	0,940	0,5
A_4	Bimodal Blow Mold	0,959	0,27
A_5	Bimodal Blow Mold’	0,955	(5,00)

Table 1.Identified results to taking bimodal HDPE in proportions.

5 types of resins were taken and measured by their density and MI indications in laboratories. The polymer plants can use these types of bimodal resins.

Antistatic agents

Antistatic agents are used to reduce the conductivity of polymer materials. This feature can appear during the processing and processing of polymers. Often, materials have the ability to accumulate electrostatic charges. In this case, great attention is paid to the dielectric properties of polymer materials for places where there is a risk of explosion and fire when they are used. Accumulation of electrical charges not only causes explosions and fires, but also accelerates plastic products' severe pollution and chemical destruction. As a result of these, toxic substances can also be released. Also, during operation, it causes low-quality production, reduces the productivity of the device. Antistatic agents prevent the formation of electrostatic charges caused by friction. It is poorly soluble in ether and CCl4, but insoluble in white alcohol.

We can use such types as GSM55, Statsafe 6000, Statsafe 3000 for obtaining bimodal polyethylene. We can dissolve these antistats themselves or prepare them by dissolving them in Hepan, Hexen-1. Examples of conductive fillers include acetylene saja, pencil graph, aluminum powder, spirit paint, and others.

The following substances are used as antistats. Types such as Dodecylbenzenesulfonic Acid (Statsafe 6000), Decamethylzirconocene Dichloride.

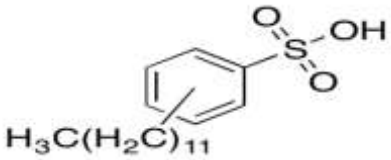

Figure 3. Structure of Statsafe 6000

Table 2. Chemicals to making Antistatsafe 6000 for bimodal HDPE

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
n-Heptane	142-82-5	70
Proprietary non-hazardous ingredients	N/A	18
Dodecylbenzenesulfonic acid	27176-87-0	9
Castor oil	8001-79-4	3

Conclusion:

Bimodal and Unimodal polymers are developing rapidly, so this article contributes to features of bimodal polymers and develop to future prospects of chemical plants. This is an important interval stage to learn unimodals. Bimodal process technology is unique because this results to higher quality, higher performance, and specialty HDPE applications.

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