Sudan University of science and Technology
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THE EFFECTS OF LINEAR LOW-DENSITY POLYETHYLENE (LLDPE) ON THE MECHANICAL PROPERTIES OF LOW-DENSITY POLYETHYLENE (LDPE) FILM BLENDS

تاثير مادة بولي ايثلين الخطى منخفض الكثافة على الخواص الميكانيكة لماده البولي ايثيلين منخفض الكثافة في خلطات الاكياس

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قال جل وعلا:

(قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ
أَنتَ الْعَلِيمُ الْحَكِيمُ)

البقرة آية (32)

صدق الله العظيم

المستخلص:

قد أصبح مجال البلاستيك من أكثر المجالات انتشارا واستخداما في جميع الصناعات، وتختلف منتجات البلاستيك حسب الماكنة المستخدمة في التصنيع.

في صناعه الاكياس هنالك عده خامات مستخدمه منها البولي اثيلين منخفض الكثافة وعالي الكثافة والخطي وماده البولي بروبلين، يعتبر البولي إيثلين عالي الكثافة الاكثر استخدما والبولي بروبلين اقل انتشارا وذلك لصعوبة تبريده ولا يمكن استخدامه للسماكات الخفيفة.

وتهدف هذه الدراسة لتحسين ماده البولي إيثلين منخفض الكثافة بإضافة ماده البولي إيثلين الخطي وذلك لوجود بعض المشاكل عند استخدام ماده البولي اثيلين منخفض الكثافة لوحده، ومن هذه المشاكل عدم انتظام السماكة في الكيس وعدم استقرار الماكنة يؤدي الي زيادة التالف او الفاقد.

وفي هذه الدراسة تم استخدام ماكينة الفلم لخلط ماده البولي إيثلين منخفض الكثافة مع ماده البولي إيثلين الخطي علي عكس التجارب السابقة تم الخلط بواسطة خلاط خارجي.

وأجريت عده اختبارات منها اختبار معامل انسياب المصهور وقوه الشد والتمزق لمعرفه مدى تأثر خواص البولي ايثلين منخفض الكثافة عند أضافه ماده البولي إيثلين الخطي.

وقد تحصلت علي عده نتائج منها كلما زادت ماده البولي إيثلين الخطي زاد التمدد في الانبوب وقوه الشد في الكيس ولكن تقل معامل انسياب المصهور والتمزق، وبذلك يمكن التحكم في السماكة لدرجه كبيره.

Abstract:

Plastic filed has become most usable in all industries plastic products vary depending on the machine used in production process.

In film industry there are different type of material can be use , like HDPE, LDPE.LLDPE and PP HDPE is considered as the most important one , and PP is use rarely due long cooling cycle and it's difficult to produce small thickness film it .

The objective of the study is to improve LDPE by adding LLDPE because there is problem when using LDPE only. Like irregular thickness

Across the film and instability in machine cause increase in defects and waste.

In this study plastic film machine is used to mix the film grade LLDPE and LDPE, in contrast other research they used mixer , several test have been done ,MFI, Tensile, Tear, to determine the effect of LDPE properties on LLDPE .

The result obtained from tests, LLDPE increase the elongation in the film bubble strength, and tensile strength in the film. However, there is reduce in MFI and Tear .and this an advantage since it help to control the film thickness.

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List of syllables

BPE	branched polyethylene
LCB	long chain branched
CD	compositional distribution
MWD	molecular weight distribution
DSC	differential scanning calorimeter
HDPE	high-density polyethylene
LDPE	low-density polyethylene
LLDPE	linear low-density polyethylene
PP	polypropylene

Chapter I

Introduction

1.1 Introduction:

Blown film extrusion is one of the most widely used thin gauge fabrication process. The majority of plastic film such grocery bags. Agricultural films and other flexible packaging film are produced by the thin technique.

The method of producing film by extruding plastic melt is a simple process, the blown film line consist of extruder die, bubble, air ring, collapsing frame and a winder. It is one of the most important polymer processing technologies. Several billions kilograms of polymer, mostly polyethylene are processed annually by this method.

While some application for the blown flown films are complex such as scientific balloons the maximum product manufactured on blown film equipment are used in commodity application with lower profit margins:

Grocery sacks , gar bags and flexible packaging and flexible packaging ,low density poly ethylene is used mainly in flexible film while ,while high density poly ethylene is used for heavy duty bags for fertilizer , merchandise , seat covers , electrical insulation etc.

The high-density polyethylene film tend to be brittle .the linear low-density polyethylene has improved physical properties quite superior to the low-density polyethylene. the linearity in LLDPE imparts better tensile properties which are generally more useful than those associated with LDPE in several application also it has a better sealing characteristics and yield cheap end products by allowing up to 30% down gauging when compared with LDPE. In addition, it is more suitable for stretch film application.

Plastic bags usually use less material than comparable to boxes, cartons. The history of the plastic bags, American and European patent applications relating to the production of plastic bags can be found dating back to the early 1950s. The modern lightweight plastic bag is the invention of Swedish engineer Sten Thulin. In the early 1960s, Thulin developed a method of forming a simple one-piece bag by folding, welding and die-cutting a flat tube of plastic for the packaging company Celloplast of Norrköping, Sweden. Thulin's design produced a simple, strong bag with a high load-carrying capacity, and was patented worldwide by Celloplast in 1965, form the mid-1980s plastic bags become common and using than the paper bags.

The advantages of plastics bags:

It is durable, low cost, water resistant, lesser energy and heavy chemicals requirements in manufacture and are lightweight. Many studies comparing plastic versus paper for shopping bags show that plastic bags have less net environmental effect than paper bags, requiring less energy to produce, transport and recycle; however, these studies also note that recycling rates for plastic are significantly lower than for paper. Plastic carrier bags can be reused as trash bags or bin bags. In addition, plastic bags are complimentary in many locations but are charged or "taxed" in others.

The properties of the film, such as tensile strength, flexural strength, toughness, and optical properties, drastically change depending on the orientation of the molecules as the transverse or hoop direction properties increase, the machine or longitudinal direction properties decrease. For instance, if all the molecules were aligned in the machine direction, it would be easy to tear the film in that direction, and very difficult in the transverse direction.

1.2 The Process Of Extrusion Film

Typically, blown film extrusion is carried out vertically upwards, however horizontal and downward extrusion processes are now becoming shows that are more common a schematic of the set-up for blown film extrusion. This procedure consists of four main steps:

The polymer material starts in a pellet form, which are successively compacted and melted to form a continuous, viscous liquid. This molten plastic is then forced, or extruded, through an annular die.

Air is injected through a hole in the center of the die, and the pressure causes the extruded melt to expand into a bubble. The air entering the bubble replaces air leaving it, so that even and constant pressure is maintained to ensure uniform thickness of the film.

The bubble is pulled continually upwards from the die and a cooling ring blows air onto the film. The film can also be cooled from the inside using internal bubble cooling. This reduces the temperature inside the bubble, while maintaining the bubble diameter.

After solidification .at the frost line, the film moves into a set of nip rollers, which collapse the bubble and flatten it into two flat film layers. The puller rolls pull the film onto windup rollers. The film passes through idler rolls during this process to ensure that there is uniform tension in the film. Between the nip rollers and the windup rollers, the film may pass through a treatment center, depending on the application. During this stage, the film may be slit to form one or two films, or surface treated

1.2.1 Advantages:

Blown film generally has a better balance of mechanical properties than cast or extruded films because it is drawn in both the transverse and machine directions. Mechanical properties of the thin film include tensile and flexural strength, and toughness. The nearly uniform properties in both directions allow for maximum toughness in the film.

Blown film extrusion can be used to make one large film, two smaller ones, or tubes that can be made into bags. In addition, one die can make many different widths and sizes without significant trimming. This high level of flexibility in the process leads to less scrap material and higher productivity. Blown films also require lower melting temperatures than cast extrusion. Measured at the die opening, the temperature of cast film is about 220°C, whereas the temperature of blown film is about 135°C. Furthermore, the cost of the equipment is approximately 50% of a cast line.

1.2.2 Disadvantages:

Blown film has a less effective cooling process than flat film. Flat film cooling is done by means of chill rolls or water, which have significantly higher specific heat capacities than the air that is used in the blown film cooling process. The higher specific heat capacity allows the substance to absorb more heat with less change in the substance temperature. Compared to cast film, blown film has a more complicated and less accurate method to control film thickness; cast film has a thickness variation of 1 to 2% versus the 3 to 4% for blown film. The resins used for casting typically have a lower melt flow index, which is the amount of polymer that can be forced through a standard die in 10 minutes according to a standard procedure. The melt flow index for cast film is about 5.0 g/10 min whereas for blown film it is about 1.0 g/10 min. Consequently, the production rates for cast film are higher: cast film lines can reach production rates of up to 300m/min whereas blown film lines are usually less than half this value. Finally, cast film has better optical properties, including transparency, haze, and gloss.

1.3 Common Problems:

Air entrapment between film layers and rollers – this may cause film scratching or wrinkling, or processing problems when winding up the film due to reduced friction. Possible solutions to this is using a vacuum to remove entrapped air or by using, winding rolls with a diamond shaped groove in the rubber cover to increase surface area and decrease amount of entrapped air in the film.

Large output fluctuations from the die – this causes thickness variations, and can be prevented by keeping the extruder clean and by using more consistently shaped pellets in the extruder.

Melt fractures – these appear as roughness or wavy lines on the film surface, and can be eliminated by lowering the viscosity of the polymer melt. This can be done by increasing the melting temperature or by adding an internal lubricant to the material composition.

Thickness variations in the film – this can be avoided by centering the die in the extrusion line before every run, adjusting the air speed of the cooling system, or by using heated die lips.

Die lines on the surface of the film – this defect reduces the aesthetic appeal of the film, reduces optical properties, and weakens mechanical properties such as tear strength. This can usually be avoided by routinely cleaning the inner surfaces of the die and by refinishing scratched or roughened flow surfaces.

Gels – these defects are small, hard globules encapsulated in the film or stuck on the film surface and reduce the aesthetic appeal of the film and cause stress concentration points which may result in premature failure. These are caused by overheating to the point of polymer degradation in the die, and can therefore be avoided by cleaning the inner surfaces of the die on a regular basis

1.4 Objective of the research:

To analyze the process of film blowing in order to determine the specific parameters that affects the filmmaking.

Study the effect of the different blend of linear low-density polyethylene and low-density polyethylene on the properties of the product film and process parameters.

Chapter II

Literature Review

2.1 Literature review:

The thermodynamic behavior of linear and branched polyethylene (BPE) blends using rheological methods has been the subject of many studies (Yamaguchi and Abe 1999; Lee and Denn 2000; Liu et al. 2002; Ho et al. 2002; Hussein et al. 2003; Hussein and Williams 2004a, b; Fang et al. 2005). It has been reported that the thermo rheological and processing properties of the blend are largely determined by molecular parameters, which include: (1) long chain branching content (LCB), which is the number of long branches, typically branches which have a number of carbon atoms more than 13 (Wagner et al. 2004; Kissin 2005), (2) compositional distribution (CD), which is the number and length of long chain branches for a given LCB macromolecule, or the amount and type of commoner in the case of LLDPE (Gabriel and Münstedt 2003; Hussein and Williams 2004b; Fang et al. 2005; Kissin 2005), (3) molecular weight, Mw (Hussein and Williams 2004b; Gabriel and Lilge 2006)[13], and (4) molecular weight distribution (MWD; Dealy and Wissbrun 1990). Most studies agree that linear low-density polyethylene and low-density polyethylene (LLDPE/LDPE) are miscible blends at low LDPE contents, which become immiscible at higher LDPE.[12]

(Lee and Denn 2000; Ho et al. 2002). Hexene commoner promotes immiscibility (Hussein et al. 2003; Hussein and Williams 2004b), whereas octane commoner promotes miscibility (Fang et al. 2005). In addition, low molecular weight LLDPEs promote miscibility better than high Mw ones (Hussein and Williams 2004a). In a recent review, Zhao LDPE blends were immiscible in the melt state, with LCB being the determining factor of their immiscibility behavior.[14]

Recently, Wagner et al. (2004) performed a quantitative analysis of melt elongation behavior of LLDPE/LDPE blends. They have reported that the complex behavior of these blends can be understood by assuming the existence of two phases; one phase composed of the highly branched low Mw chains of both polyethylenes and a second phase composed of the high Mw chains (mostly linear) of both polyethylenes. Differential scanning calorimetry (DSC) thermograms of LLDPE/LDPE blends reported by Fang et al. (2005) support the existence of a third phase composed of chains from the two polyethylenes that have the ability to cocrystallize, additionall enhancement in the crystallization behavior of BPE blended with linear polyethylene (LPE) was explained in terms of co-crystallization due to the incorporation of the linear segments of BPE into rich-LPE lamellae and the segregation of the most branched chains (Puig 2001). The LLDPE/LDPE blend miscibility studies mentioned above make use of thermal techniques, such as DSC, and rheometrical techniques, such as linear viscoelasticity of blends at different temperatures (Van Gurp and Palmen 1998; Mavridis and Shroff 1992; Hatzikiriakos 2000). Failure of time–temperature superposition can be interpreted as an immiscibility criterion (Van Gurp and Palmen 1998; Peón et al. 2003; Wagner et al. 2004; Pérez et al. 2005). Positive deviation of zero shear rate viscosity from the logadditivity-mixing rule is also an indication of immiscibility (Lee and Denn 2000; Liu et al. 2002; Hussein et al. 2003). The Cole–Cole plot, representation between the imaginary (η0) and real part (η00) of the complex viscosity, has been used by several authors as criteria for miscibility in polyethylene blends (Kim et al. 2000; Ho et al. 2002). The determination of the weighted relaxation spectra based on linear viscoelasticity is another method used to infer the thermo rheological behavior of polyethylene blends. The spectra have been used to determine whether the blend components are immiscible due to an additional relaxation mechanism associated with interfacial tension (Gramespacher and Meissner 1992; Lacroix et al. 1997; Fang et al. 2005). In this paper, we study systematically the thermorheological behavior of a LLDPE with four LDPEs that have viscosity curves that lie above, about the same, and below that of the LLDPE. The miscibility of the various blends is studied with DSC and linear viscoelastic measurements with the application of several thermo rheological complexity criteria [time–temperature superposition (TTS), VanGurp plot, Cole–Cole plot, zero-shear viscosity vs composition, and relaxation spectrum]. All the methods are compared to check consistency of the results. The extensional rheological properties of the blends are also studied to examine the effects of LCBand Choi (2006) have reported that LLDPE.

M.Sabetzadeh et al in his research Study on Ternary Low Density Polyethylene/Linear Low Density Polyethylene/Thermoplastic Starch Blend Films In 2014, in his work, low-density polyethylene/linear low-density polyethylene/thermoplastic starch (LDPE/LLDPE/TPS) films are prepared with the aim of obtaining environmentally friendly materials containing high TPS content with required packaging properties. Blending of LDPE/LLDPE (70/30 wt/wt) with 5-20 wt% of TPS and 3 wt% of PE-grafted maleic anhydride (PE-g-MA) is performed in a twin-screw extruder, followed by the blowing process. Differential scanning calorimetric results indicate starch has more pronounced effect on crystallization of LLDPE than LDPE. Scanning electron micrograph shows a good dispersion of TPS in PE matrices. Fourier transfer infrared spectra confirm compatibility between polymers using PE-g-MA as the compatibilizer. Storage modulus, loss modulus and complex viscosity increase with incorporation of starch. Tensile strength and elongation-at-break decrease from 18 to 10.5 MPa and 340 to 200%, respectively when TPS increases from 5 to 20%. However, the required mechanical properties for packaging applications are attained when 15-wt% starch is added, as specified in ASTM D4635. Finally, 12% increase in water uptake is achieved with inclusion of 15 wt% starch.

Ulku Yilmazer effects of blending low-density polyethylene (LDPE) with linear low-density polyethylene (LLDPE) were studied on extrusion blown films. The tensile strength, the tear strength, the elongation at break, as well as haze showed more or less additivity between the properties of LDPE and LLDPE except in the range of 20–40% where synergistic effects were observed. The LLDPE had higher tensile strength and elongation at break than did the LDPE in both test directions, as well as higher tear strength in the transverse direction. The impact energies of the LLDPE and the LDPE were approximately the same, but the tear strength of the LLDPE was lower than that of LDPE in the machine direction. The comparative mechanical properties strongly depend on the processing conditions and structural parameters such as the molecular weight and the molecular weight distribution of both classes of materials. The LLDPE in this study had a higher molecular weight in comparison to the LDPE of the study, as implied from its lower melt flow index (MFI) in 0comparison to that of the LDPE. The effects of processing conditions such as the blow-up ratio (BUR) and the draw-down ratio (DDR) were also studied at 20/80 (LLDPE/LDPE) ratio. Tensile strength, elongation at break, and tear strength in both directions became equalized, and the impact energy decreased as the BUR and the DDR approached each other.

Chapter III

Methodology

3.1 Raw material:

A- High a density polyethylene (LDPE).

b- Low density polyethylene (LDPE).

c- Linear Low density polyethylene (LLDPE).

d- Polypropylene (PP)

3.1.1 High-density polyethylene (HDPE)

Polyethylene high-density (PEHD) is a polyethylene thermoplastic made from petroleum. It is sometimes called "alkathene" or "polythene" when used for pipes or blow molding. With a high strength-to-density ratio, HDPE is used in the production of plastic bottles, corrosion-resistant piping, and plastic lumber.

3.1.1.1 Properties:

HDPE is known for its large strength-to-density ratio. The density of HDPE can range from 0.93 to 0.97 g/cm3 or 970 kg/m3. Although the density of HDPE is only marginally higher than that of low-density polyethylene, HDPE has little branching, giving it stronger intermolecular forces and tensile strength than LDPE. The difference in strength exceeds the difference in density, giving HDPE a higher specific strength. It is also harder and more opaque and can withstand somewhat higher temperatures (120 °C/ 248 °F for short periods). High-density polyethylene, unlike polypropylene, cannot withstand normally required autoclaving conditions. The physical properties of HDPE can vary depending on the molding process that is used to manufacture a specific sample; to some degree a determining factor are the international standardized testing methods employed to identify these properties for a specific process. For example, in Rotational Molding, to identify the environmental stress crack resistance of a sample the Notched Constant Tensile Load Test (NCTL) is put to use.

3.1.1.2 Applications:

HDPE is resistant to many different solvents and has a wide variety of applications:

- Swimming pool installation
- Blow molding film
- Backpacking frames
- Ballistic plates
- Food storage containers
- Fuel tanks for vehicles
- Corrosion protection for steel pipelines
- Folding chairs and tables
- Geothermal heat transfer piping systems
- Heat-resistant firework mortars
- Last for shoes
- Natural gas distribution pipe systems
- Fireworks

It is used to produce shopping bags, which are the highest consumed bags. The trademarks used in Sudan are:

- Sabic (ksa).
- Altasne (Qatar).
- Rawia.
- Petro rabh.
- Kwaiti.
- Marlex.
- Borouge.

Each material has different processing technique for example sabic HDPE extrusion temperature is (190-200) °C, while kwaiti HDPE extrusion temperature is 220°C.[16]

3.1.2 Low-density polyethylene

Locally it is called the soft polyethylene all this is material imported form sabic .its price is the highest among all polyethylene.

The low density poly ethylene is used to produce film winded on rolls and then cutted and sealed in small shops to produce small bags used for packaging of home made ice-cream , peanuts ,tsali, sawood etc.

3.1.2.1 LDPE branching structure:

Low-density polyethylene (LDPE) is a thermoplastic made from the monomer ethylene. It was the first grade of polyethylene, produced in 1933 by Imperial Chemical Industries (ICI) using a high-pressure process via free radical polymerization. Its manufacture employs the same method today. The EPA estimates 5.7% of LDPE (recycling number 4) is recycled. Despite competition from more modern polymers, LDPE continues to be an important plastic grade. In 2013, the worldwide LDPE market reached a volume of about US$33 billion.

3.1.2.2 Properties:

A density range of 0.910–0.940 g/cm3 defines LDPE. It is not reactive at room temperatures, except by strong oxidizing agents, and some solvents cause swelling. It can withstand temperatures of 80 °C continuously and 95 °C for a short time. Made in translucent or opaque variations, it is quite flexible and tough.

LDPE has more branching (on about 2% of the carbon atoms) than HDPE, so its intermolecular forces (instantaneous-dipole induced-dipole attraction) are weaker, its tensile strength is lower, and its resilience is higher. [16]

3.1.2.3 Applications:

LDPE is widely used for manufacturing various containers, dispensing bottles, wash bottles, tubing, plastic bags for computer components, and various molded laboratory equipment. Its most common use is in plastic bags. Other products made from it include:

- Blowing film

- A piece of packaging foam made from LDPE.

- Trays and general purpose containers.

- Corrosion-resistant work surfaces.

- Parts that need to be weldable and machinable.

- Parts that require flexibility, for which it serves very well.

- Very soft and pliable parts such as snap-on lids.

3.1.3 Linear low-density polyethylene:

It is the best raw material to produce film. it is added to HDPE and low density poly ethylene . When added to HDPE the material becomes more soft and the elongation increase. It is added to LDPE for economical reasons and to produce stable bubble.

There is a major difference between the die used for HDPE and LDPE. The HDPE die contains a torpedo while LDPE die does not this because ,the material of LDPE stick to the torpedo causing trouble . This problem is overcome if the LDPE contains anti –tack.

Linear low-density polyethylene (LLDPE) granules.

Linear low-density polyethylene (LLDPE) is a substantially linear polymer (polyethylene), with significant numbers of short branches, commonly made by copolymerization of ethylene with longer-chain olefins. Linear low-density polyethylene differs structurally from conventional low-density polyethylene (LDPE) because of the absence of long chain branching. The linearity of LLDPE results from the different manufacturing processes of LLDPE and LDPE. In general, LLDPE is produced at lower temperatures and pressures by copolymerization of ethylene and such higher alpha-olefins as butene, hexene, or octene. The copolymerization process produces an LLDPE polymer that has a narrower molecular weight distribution than conventional LDPE and in combination with the linear structure, significantly different rheological properties.

3.1.3.1 Production and properties:

The production of LLDPE is initiated by transition metal catalysts, particularly Ziegler or Philips type of catalyst. The actual polymerization process can be done either in solution phase or in gas phase reactors. Usually, octene is the comonomer in solution phase while butene and hexene are copolymerized with ethylene in a gas phase reactor. LLDPE has higher tensile strength and higher impact and puncture resistance than does LDPE. It is very flexible and elongates under stress. It can be used to make thinner films, with better environmental stress cracking resistance. It has good resistance to chemicals. It has good electrical properties. However, it is not as easy to process as LDPE, has lower gloss, and narrower range for heat sealing.

3.1.3.2 Processing:

LDPE and LLDPE have unique rheological or melt flow properties. LLDPE is less shear sensitive because of its narrower molecular weight distribution and shorter chain branching. During a shearing process, such as extrusion, LLDPE remains more viscous and, therefore, harder to process than an LDPE of equivalent melt index. The lower shear sensitivity of LLDPE allows for a faster stress relaxation of the polymer chains during extrusion, and, therefore, the physical properties are susceptible to changes in blow-up ratios. In melt extension, LLDPE has lower viscosity at all strain rates. This means it will not strain harden the way LDPE does when elongated. As the deformation rate of the polyethylene increases, LDPE demonstrates a dramatic rise in viscosity because of chain entanglement. This phenomenon is not observed with LLDPE because of the lack of long-chain branching in LLDPE allows the chains to slide by one another upon elongation without becoming entangled. This characteristic is important for film applications because LLDPE films can be downgauged easily while maintaining high strength and toughness. The rheological properties of LLDPE are summarized as "stiff in shear" and "soft in extension". It is not taken in most curbside pickups in communities. LLDPE can be recycled though into other things like trash can liners, lumber, landscaping ties, floor tiles, compost bins, and shipping envelopes

3.1.3.3 Application

LLDPE has penetrated almost all traditional markets for polyethylene; it is used for plastic bags and sheets (where it allows using lower thickness than comparable LDPE), plastic wrap, stretch wrap, pouches, toys, covers, lids, pipes, buckets and ,blowing film, covering of cables, geomembranes and mainly flexible tubing. In 2013, the world market for LLDPE reached a volume of $40 billion.

LLDPE manufactured by using metallocene catalysts is labeled mLLDPE.

3.1.4 Polypropylene (PP):

Its quantity used in plastic bags is much less than PE types. It is used to produce thick bags of the large volume. Its machinery is different .the tube is extruded down –ward and the bubble formed in the down-words direction. Its cooling by water.

3.2 Plastic film and machines:

The machines used in Sudan to produce plastic film are:

1-chaina: (Chinese) its number one in Sudan diffusibility this is due to:

-it is low price

-it can used recycled material, because the area of it screen is large.

Disadvantages: repeated mal –function of the some parts.

2-taiwan: it is secondary to china machines it advantages:

-used virgin material (recycled block the screen)

-high productivity

-homogeneous thickness of the product better not to using with recycled material

Disadvantages: it is higher price than the Chinese machines

3-shawman: it is similar to the Chinese machines.

Temperature sitting in the extruder barrel:

- HDPE	from	(185-190-195-200) at the die.
- LDPE	from	(150-155-160-165) at the die.
- LLDPE	from	(155-165-175-180) at the die.
- PP	from	(195-220) at the die.

3.3 Procedures of production:

1. Sitting the barrel temperature according the material.
2. Make sure that the settled temperature valves are reached. if the machine is operated before the temperature is reached this lead to number of trouble :

A- Break of screw.

B- Break of the screen system (screen, screen plate and its screws).

3. Operate the air compressor.
4. Open air valve to allow for small flow of air at the beginning.
5. Input the raw material and operate the cooling fan then connect the bubble with upper cylinder (nip rolls).

6. The internal air is used to set the bubble diameter. Its thickness is controlled by the screw speed and the drawing roll speed.

The control panel of the machine contains:

a. Heater control.
b. Operating switches for the screw.
c. Cooling air fan switch.
d. The upper nip roll cylinder switch.
e. The drawing roll switch.

3.3.1 Plastic bags type:

Table 3.1 Bags type

Type	Dimension(cm*cm)	Thickness(micro)	usage
1 kg	21*30	1.5~2.5	Sugar and oil
½ kg	16*23	1.5~2.5	~
Coloured Orange – blue	24*37	3	Grocery &vegetables
Yellow (bread)	28*47	2	bakery
Aljoda	25*43	4	Bakery& milk& ice
Alshata (green)	20*30	1.5	For vegetable (lemon& pepper)
Soft roll	25 cm	4	Ice cream bags
Gar bags	60*100	5	Gar bags
Coloured strips	24*37	1.5	Any things
Shalha	55*100	3.5	Heavy material
Black	24*37	2.5	Charcoal not food stuff
Vegetable bags	50*70	3	vegetable
Shalha strips	36*60	6	various

Each of the blend was prepared using a blender to ensure through mixing. The blend is charged to Taiwan machine, the die head temp 165-screw speed 25 rpm and the motor amp 0.4 amp.

The blend is the passed through the die at the extruder head. The extruder film has blown - up ratio of 4.5:1.

Table 3.2 Blends ratio

Blend	1	2	3	4	5	6
LDPE	100	80	65	50	35	20
LLDPE	0	20	35	50	65	80

3.4 Testing parameters:

3.4.1 Tensile Test:

The tensile stress and elongation was obtained for each blend using specimens 12 7mm* 12.7 mm*8 micro.

The test are carried in the industrial research and consutancy at shambat ,at temperature 30 .the speed of cross –head of the tensile machines 50mm/min with force capcity is 50n . for each blend five sample are pprepard and tested the avarege of the result as flow

Fig 3.1 Tensile Tester

3.4.2 Melt flow index:

The blend samples were tested on the MFI machines is the laboratory available at the department.

Fig 4.2 Melt Flow Indexer

3.4.3 Tear strength test:

Test pieces (200-50) mm of the various film were cut out .a clean cut was made at one end of each specimen at distance of 75 mm (the cut was made central to the width of the film specimen). The two trouser legs were fixed in the jaws of the testing machines and a grip separation rate of 250mm /min was maintained. The tear strength was maintained . The tear strength was obtained by dividing the force in the plateau region by the film thickness (3mm).

Fig 4.3 Tear strength tester

Chapter IV

Results and Discussion

4.1 Tensile Test:

Table 4.1 Tensile result

Blend	**1**	**2**	**3**	**4**	**5**	**6**
Yield stress	18	21.7	27	29.8	35.3	39.5
Elongation %	61	65	74	125	182	230

4.2 Melt flow index:

Temperature of test 190

Load 5kg

MFI (g/10min)

Table 4.2 MFI result

Blend	**1**	**2**	**3**	**4**	**5**	**6**
MFI (g/10min)	15	10	7.3	6.1	5	4.5

4.3 Tear strength test:

Table 4.3 Tear strength.

Blend	**1**	**2**	**3**	**4**	**5**	**6**
N/m	25	23.5	19	16	12.5	11

Table 4.4 comparison between blend and test results

Blend / Test	1	2	3	4	5	6
Yield stress MPa	18	21.7	27	29.8	35.3	39.5
Elongation %	61	65	74	125	182	230
MFI (g/10min)	15	10	7.3	6.1	5	4.5
Tear strength	26	23.5	19	16	12.5	11

As shown before LDPE and LLDPE have been blend together with different ratios , and the change in properties of LDPE has been recorded ,it has been found that when the ratio of LLDPE increase , the elongation and tensile strength increased , And flows by decrease in melt flow index and tear strength .

There are same advantages when adding LLDPE to LDPE, stability in production machine this is reduce defect and waste. Having product with regular thickness. Its works as filler due its low price comparing to LDPE and helps open the film when use.

Chapter V

Conclusion and Recommendations

5.1 Conclusion:

As shown before LDPE and LLDPE have been blend together with different ratios , and the change in properties of LDPE has been recorded ,it has been found that when the ratio of LLDPE increase , the elongation and tensile strength increased , And flows by decrease in melt flow index and tear strength .

There are same advantages when adding LLDPE to LDPE, stability in production machine this is reduce defect and waste. Having product with regular thickness. Its works as filler due its low price comparing to LDPE and helps open the film when use.

5.2 Recommendations:

1-study the effect of LLDPE when adding to HDPE.

2-study the effect of HDPE when adding to PP.

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Appendix

SABIC® LDPE HP0722NN

LOW DENSITY POLYETHYLENE FOR BLOWN FILM - REGION GLOBAL

DESCRIPTION

HP0722NN is an additive free low density polyethylene grade suitable for producing medium duty films. It gives good toughness and optical properties in the film.

TYPICAL APPLICATIONS

HP0722NN can be used for medium duty bags, shrink films, shopping bags, lamination films and frozen food packaging.

TYPICAL PROPERTY VALUES Revision 20170206

PROPERTIES	TYPICAL VALUES	UNITS	TEST METHODS
POLYMER PROPERTIES			
Melt Flow Rate @ 190°C & 2.16 kg load (1)	0.75	g/10 min	ASTM D 1238
Density @ 23°C (1)	922	kg/m³	ASTM D1505
MECHANICAL PROPERTIES			
Tensile Strength @ break, MD (1)	26	MPa	ASTM D 882
Tensile Strength @ break, TD (1)	24	MPa	ASTM D 882
Tensile Elongation @ break, MD (1)	235	%	ASTM D 882
Tensile Elongation @ break, TD (1)	560	%	ASTM D 882
Tensile Strength @ yield, MD (1)	12	MPa	ASTM D 882

Tensile Strength @ yield, TD (1)	11	MPa	ASTM D 882
1% Secant Modulus, MD (1)	190	MPa	ASTM D 882
1% Secant Modulus, TD (1)	220	MPa	ASTM D 882
Dart Impact Strength (1)	2	g/µm	ASTM D1709
OPTICAL PROPERTIES			
Haze (2)	9	%	ASTM D1003
Gloss @ 45° (2)	60	-	ASTM D2457
FILM PROPERTIES			
Tear strength MD Elmendorf (1)	6	g/µm	ASTM D1922
Tear strength TD Elmendorf (1)	4	g/µm	ASTM D1922
THERMAL PROPERTIES			
Vicat Softening Point (1)	95	°C	ASTM D 1525

(1) Typical values; not to be construed as specification limits.

(2) Properties have been measured by producing 50 µ film with 2.5 BUR using 100% HP0722NN

PROCESSING CONDITIONS

Typical processing conditions for HP0722NN are: • Barrel temperature: 170 - 185°C • Blow up ratio: 2.0 – 4.0

MEDICAL & FOOD REGULATION

HP0722NN is suitable for Food contact application. Detailed information is provided in relevant Material Safety Datasheet and for additional specific information please contacts SABIC local representative for certificate. DISCLAIMER: This product is not intended for and must not be used in any pharmaceutical/medical applications.

STORAGE AND HANDLING

Polyethylene resin should be stored in a manner to prevent a direct exposure to sunlight and/or heat. The storage area should also be dry and preferably do not exceed 50°C. SABIC would not give warranty to bad storage conditions, which may lead to quality deterioration such as color change, bad smell and inadequate product performance. It is advisable to process PE resin within 6 months after delivery.

218 Series

Linear Low Density Polyethylene for Blown Film

Product Description

218 series resins are Linear Low Density Polyethylene grades suitable for general purpose packaging. They are easy to process giving good tensile properties, impact strength and optical properties.

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218 Series includes following grades:

218N:	No Slip & No Antiblock
218W:	1500 ppm Slip & 3500 ppm Antiblock

Typical Applications

Lamination film, thin liners, shopping bags, carrier bags, garbage bags, coextruded films, consumer packaging etc.

Typical data

Properties	Unit	Value (1)	ASTM Method
Resin Properties			
Melt Flow Rate @ 190°C & 2.16 kg load	g/10 min.	2	D 1238
Density @ 23°C	kg/m^3	918	D 1505
Mechanical Properties(2)			
Tensile Strength @ break, MD	MPa	35	D 882
TD		29	
Tensile Elongation @ break, MD	%	700	D 882
TD		750	
Tensile Strength @ yield, MD	MPa	12	D 882
TD		10	
1% Secant Modulus, MD	MPa	220	D 882
TD		260	
Puncture Resistance	J/mm	63	SABIC Method
Dart Impact Strength	g	85	D 1709
Elmendorf Tear Strength, MD	g	130	D 1922
TD		320	
Optical Properties(2)			
Haze	%	13	D 1003
Gloss @ 60°	-	80	D 2457
Thermal Properties			
Vicat Softening Point	°C	98	D 1525

(1) Typical values; not to be construed as specification limits.
(2) Properties have been measured by producing 30 μ film with 2.5 BUR using 100% 218N.

Processing Conditions

Typical processing conditions for 218 are:

Melt temperature: 185 - 205°C

Blow up ratio: 2 - 3

022009

Food Regulation

218 series resins are suitable for Food contact application. Detailed information is provided in relevant Material Safety Datasheet and for additional specific information please contacts SABIC local representative for certificate.