COMPARING SOME OF PHYSIOMECHANICAL PROPERTIES OF MIXTURE POLYETHYLENE SABIC6006N MANUFACTURED FOR TWO DIFFERENT PIPES DIAMETER

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الملخص

في هذا العمل اجريت دراسة على نوعين من الانابيب ذو قطرين مختلفين والمستخدمة في انتاجهما خلطة تتكون من خام البولي ايثلين SABIC6006N مع مخلفاته المعاد تدويرها بنسبة SABIC6006N 83.3% RECYCLE) (16.6% وذلك للتعرف على الخواص الفيزوميكانكية لهما، مثل معدل التد فق، اجهاد الشد والاستطالة وتحملهما لضغط الماء وذلك بأجراء التجارب على عدد خمس عينات لكل اختبار مع اخذ متوسط النتائج وعلى نوعين من الأقطار للأنابيب mm (110 , 90) فكانت متوسط النتائج المتحصل عليها للقطرين على التوالي معدل التدفق (0.1266 g\10 min) (0.1243 g\10 min) واجهاد الشد M Pa) (12.56 (11 M Pa) ونسبة استطالة (366%) (278.8 %) وضغط الماء (25.84 bar)(26.03 bar) ، بينما كانت للخام البولي ايثلين SABIC6006 N قيم على التوالي لمعدل تدفق ، اجهاد الشد و الاستطالة (0.23 g\10 min) (23 Pa) (603.11 %) وضغط الماء يكون تأثيره قليل على الخام او الخليط ، من خلال النتائج نلاحظ تأثرها القليل باختلاف القطر للأنبوب خاصة في اختبار اجهاد الشد والاستطالة أيضا عند المقارنة مع الخام يوجد فارق في النتائج المتحصل عليها لاختبارات معدل التدفق واجهاد الشد والاستطالة.

A b s t r a c t

In this work studied some physical and mechanical properties such as melting flow, tensile strength and elongation on the two different pipes diameter manufactured from mixture, raw Polyethylene SABIC 6006N and its waste, **(**SABIC 6006N 83.3% RECYCLE 16.6%).

That were achieved by experimenting with five samples for each test and taken average the **results** for both types of pipes diameter (90, 110) mm. The average results obtained from both diameters respectively were Melting flow rate (0.1266 g\10 min) (0.1243 g\10 min), tensile stress (12.56 MPa) (11 M Pa), elongation (366%) (278.8%) and water pressure (25.84 bar) (26.03 bar) The Melting flow rate, tensile stress and elongation of the raw polyethylene SABIC6006N are (0.23 g\10 min) (23 MPa)) (603.11%), and the water pressure has little effect on the raw material or the mixture. From the results we observed that the difference in diameter had little an effect. That were variations especially on the tensile stress with elongation tests. There were also differences in the results for the melting flow rate, tensile stress, and elongation tests compared to **the** raw material.

Keywords: Polyethylene, Recycling, Melting Flow, Stress, Elongation Pressure

1.Introduction

Polyethylene (PE) has become one of the most widely used and especially thermoplastic materials in the world. Today's modern (PE) resins are highly using and suitable for demanding applications such as gas pipes, circulating water, drinking water systems, energy systems, plastic membranes and other demanding applications (fig.1)[1][2] . Recently, great effort has been made to improve its properties like quality composite materials to suitable and economical different engineering requirements[3].

The some requirements for modern technology for these materials depend on their physical and mechanical behavior[4] [5].

Plastic waste, when collection separated sample for chemical analysis, it was contained of 54% Polypropylene (PP), 39% High Density Polyethylene (HDPE) 6% Low Density Polyethylene (LDPE), and 1% Polystyrene (PS). When reusing waste, the mixture provided a reasonably consolidated and homogeneous structure with a different Morphology. So that finding importance in the possibility of using waste plastic recycling[6][7].

(PE) is a promising material plastic with great physical and chemical properties. It has a perfect combination of high-level mechanical properties and good electric properties. In addition to molding process is satisfactory and its cost is low. Especially important to use for corrosion-resistant such as pipes and linings and etc.[8]. The melting point of HDPE ranges from 132 to 135°C, and LDPE at approximately 112°C, it cannot be dissolved at room temperature with any a known solvent [9].

The recycling of plastic holds significant importance in many countries. However, the mechanical properties of recycled plastic tend to diminish as a result of contamination during the sorting or processing stages[8][10].

Recycling (rHDPE) were blended with pure PE100 quality HDPE in different proportions, the blends were thoroughly characterized to determine their suitability for pipe applications.

Properties were such as yield strength, elongation at breaking and flexural modulus were above the minimum values required for PE100 quality for all blends. In addition, two important mechanical properties of polyethylene pipes, resistance to slow crack growth (SCG) and rapid crack growth (RCP), they studied in details, Significantly, a dual correlation was found between SCG and RCP with the recycled (PE) content in the blends, enabling the development of predictive capabilities to ensure compliance with requirements and specifications for pressure pipe applications[11][12]. In this work, the studding carried out on the two different pipes diameter that production from raw polyethylene SABIC6006N and recycling of polyethylene SABIC6006N waste**, (**SABIC 6006N 83.3% RECYCLE 16.6%) (fig. 2). The aim of this of study is to shed light on some of physical and mechanical of pipes properties with different two diameters and using same mixture.

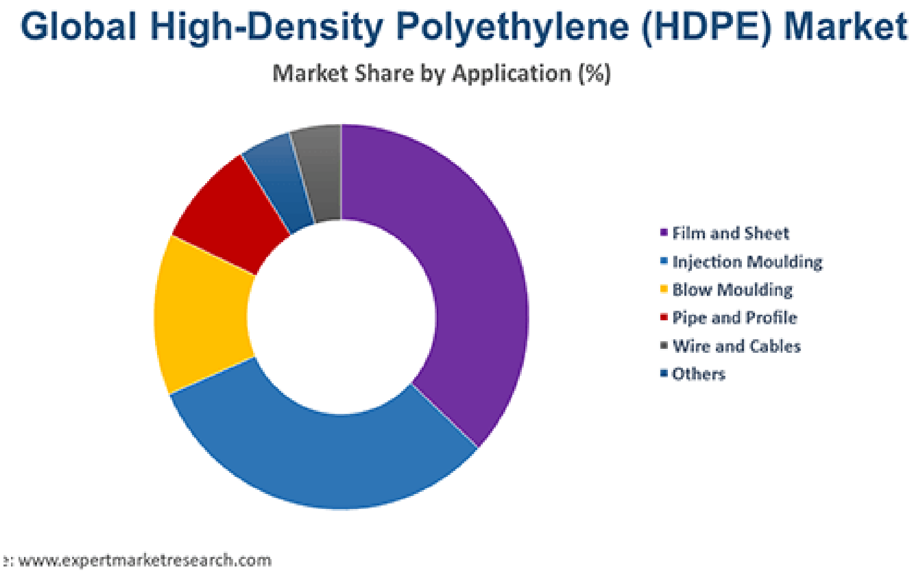


Fig (1) Global polyethylene market

Fig (2) (SABIC 6006N 83.3% RECYCLE 16.6%)

2. Methodology and Tests

Experiments were conducted on the two types A&B of pipes diameter were respectively (90, 110) mm, that manufactured from the same (mixture) raw Polyethylene SABIC6006N and waste Polyethylene SABIC6006N by percentage (SABIC 6006N 83.3% RECYCLE 16.6%). For each test of the following, five samples were tested obtained from the (mixture) and the average reading value was taken, then compared with the data values of raw (SABIC 6006N).

2.1 Melting Flow rate testing:

Melting flow rate test Conducted on the two types A&B of pipes, taken five samples for each type, to calculated the melting flow rate used measuring device (Melt Flow Index Tester) From DEEPAK POLYPLAST Company. The device was designed to measure the melt flow rate accordance more accurately with the

stipulated specifications by standards national and international (ASTMD 1238 Method A&B ISO 1133).
The device operates at a temperature of 190℃ and it leaves for a period of time until it reaches the that required temperature. Sample was added to the device through a special opening, then 5kg of weight was placed on the top of the piston. Waited four minutes, Then the sample extracted from the device was cutting into several pieces, and each piece was mass weighed by using a sensitive scale with an accuracy of 0.001. The previous test was repeated to obtain accurate results. The average mass (g) was measured to calculate the melting flow rate by using ((average mass of the cut samples \ time measured (g\ 10 min)) Then, calculated and obtained that the average of melting flow rate for type (A) equal 0.1266 g/min and the average melting flow rate for type (B) equal 0.12435 g/min (fig. 3**)**.

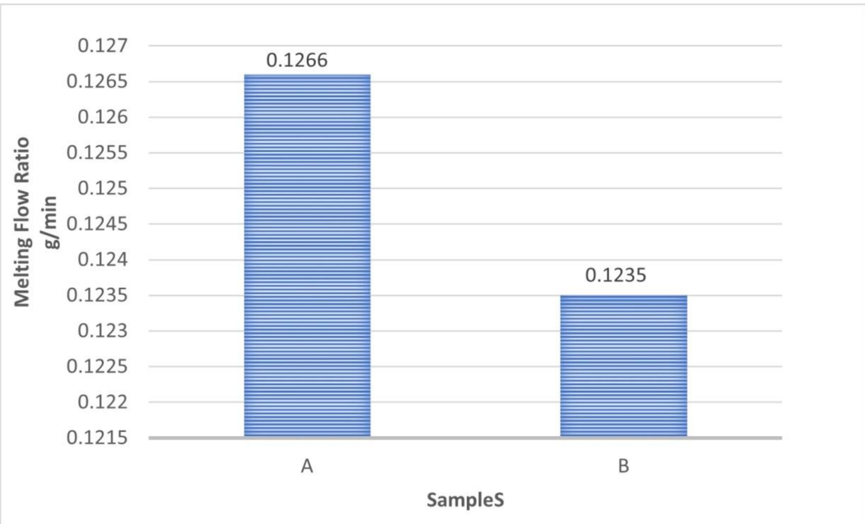
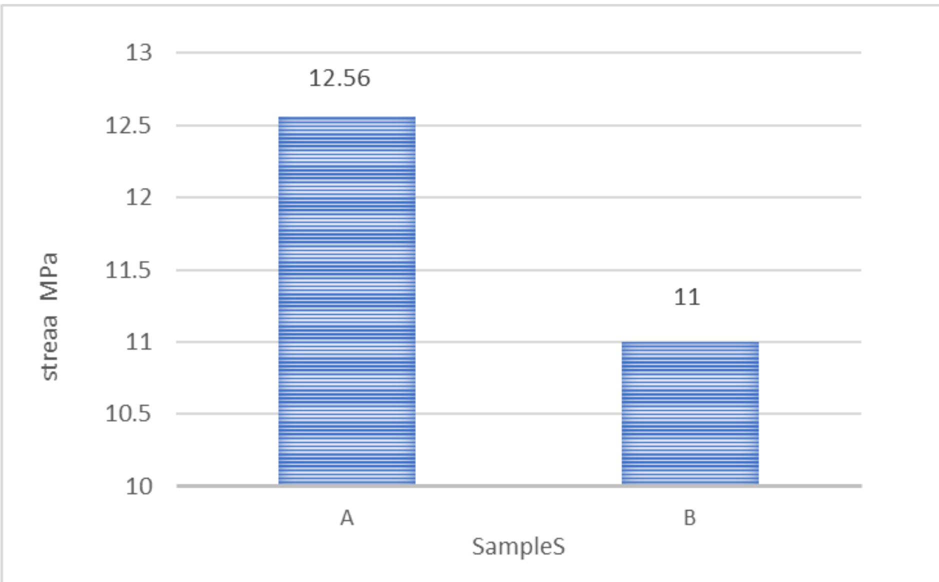


Fig (3) Average results of Melting flow test for samples of types A&B

2.2 Tensile test

The test conducted on the two types of A&B and also taken five samples for each type, to determine the tensile stress and elongation by using that a device which was manufactured in India by DEEPAK POLYPLAST. The sample was cutting according to the specifications dimensions and it placed into the device, which applied the force gradually to it while monitoring its effect on elongation until reached the point of failure and the sample broken. Repeat the test on the two types of samples, the readings record directly from the device then calculate the average value. The samples of type (A) had averaged a tensile stress equal (12.56 MPa) and a percentage of average value elongation equal (366%).

The samples of type (B) had average value of a tensile stress equal (11.00 MPa) and the average value of an elongation equal (278.8%)



(4) Average results of tensile stress test samples for types A&B

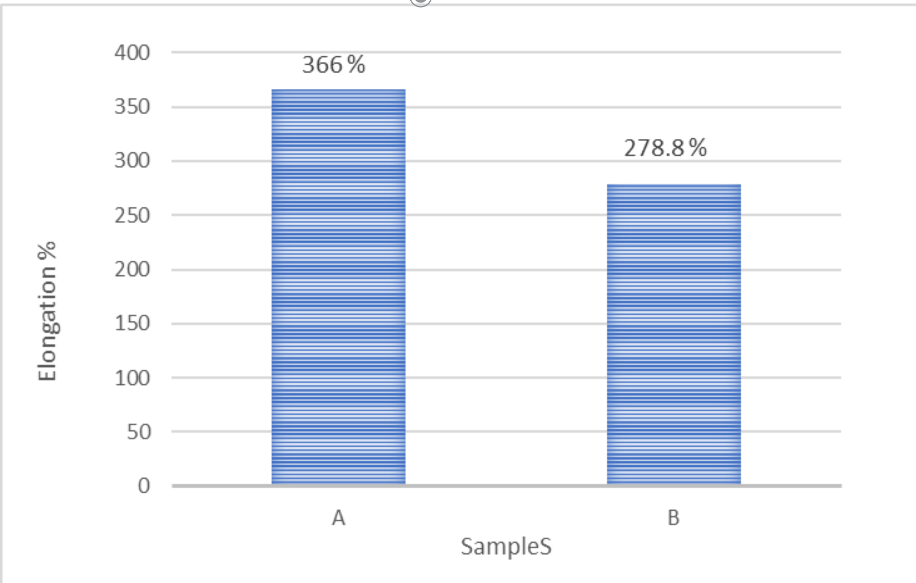


Fig (5) Average results of elongation test samples for types A&B

2.3 pressure test

In this test, a comparison was made between the two types of A&B, that five samples were taken to test the ability of water pressure resistance and measure the internal pressure resistance of pipes (Hydrostatic Pressure Tester). The device that was used manufactured by DEEPAK and using the international standard (DIN 821). The test was conducted on the samples for each types A&B, the sample cutting, sanding process and carried out, then it was placed according to the specifications of device required. The samples for type (A) had average value of pressure water resistance recorded at 100 hours equal (25.84 Bar), the samples of type (B) had average value of pressure water resistance recorded at 100 hours equal (26.03 Bar) (fig.6).

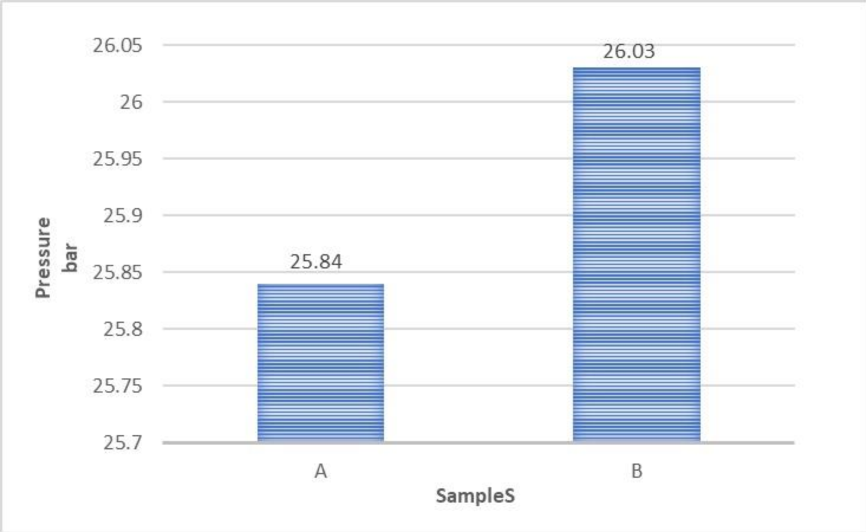


Fig (6) Average results Pressure water test of samples for types A&B

3. Discussion

Observed that average reading value of melting flow rate for both types of different diameter were very similar because the samples were made from the same mixture and thickness. The average values of tensile stress and percentage of elongation were increased with type (A) compared with type (B), as result may be from the influence of operational procedures on the type(B), and for both types had a good water pressure resistance at100 hours, from the results that obtained observed that the difference diameter had a little effect, that were especially variation on the tensile stress with elongation test.

The Melting flow rate, tensile stress and elongation of the raw polyethylene SABIC6006N without recycle respectively from data (0.23 g\10 min) (23 MPa) (603.11%), and the water pressure had a little effect on the mixture or the raw material because it was related to the product to be manufactured. Also, observed that variation of the results for tests had conducted on the mixture when it compared to **the** raw material.

The short-term properties, yield strength, elongation at break and flexural modulus of all blends are above the minimum values required for polyethylene (PE100) grades. Therefore, these properties did not represent any limitation for the potential use of recycled polyethylene materials in the production of pressure pipes[11]. In terms of intermolecular cohesion, raw materials have better performance than recycled materials (waste) because recycled materials are considered to be brittle due to the random nature of their molecular bonds[8][13]. The mechanical and physical properties of polyethylene decrease with the number of recycling stages due to the degradation and reduction of the polymer chains. The degradation of recycled polyethylene is more than pronounced due to its previous processing [14]

4. Conclusions

The results indicate that the two different types of pipes diameter share to similar mechanical and physical properties in terms, as evidenced by the tests result. However, variations were observed in the elongation with tensile test between the two types. Furthermore, the study revealed that the mechanical and physical properties of raw SABIC6006N outperform for mixture **(**SABIC 6006N 83.3% RECYCLE 16.6%).

Notably the results of (mixture) for two types A&B were exhibited weaker melting flow ratio tensile strength, elongation, and resistance properties comparing with raw SABIC6006N, so that Determining the right applications for the recycled material is necessary because it is adding to the raw material reduces some of its characteristics.

Recycled materials offer flexibility in their usage depending on the product's intended purpose and the proportion of recycled materials in the plastic blend. given these considerations and the prevailing economic conditions, using recycled plastic is a viable option, leading to improved economic.

5. References

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