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Abstract: *The research aims to test polymer materials as the plastic materials: UHMWPE and POM, to observe there characteristics, to determing how they can be used and what we can obtain from them. We wanted to see the strong and the weak values that characterize them, what kind of parts we can produce from them and in what case we can use it. By applying this tests is necessary in order to see real datas that can help you compare them, and lead you to conclusions. Using these methods of testing materials leads to the establishment of real properties of the material and to the establishment of new configurations necessary to be made to the manufactured parts.*

Key words: tensile test, polymer materials, plastic materials

1. Introduction

In this paper we tried to compare the result of testing two composite materials used in the machine building industry, one is UHMWPE (ultrahigh-molecular-weight polyethylene) an the other one is POM (Polyoxymethylene). The UHMWPE is a polietilen that differentiates by other polymers due to the molecular chains that are very long and resistant. The POM is a polymer with a high level of crystallinity, ranking among the hardest and most rigid technical plastic.

2. Traction machine

The traction machine testing, with who we do the tests is an electromechanical testing system, a Instron machine Series 5587, placed in the laboratory of University "Lucian Blaga" from Sibiu. The traction test machine, Instron 5587, includes an extensometer with the calibrated length about 50 mm, who has the possibility of mounting by the elongation direction of specimen that causes the local specific deformation using a measuring optic system called Aramis, created by the Gom company. [1] Using this machine, we assay after calibrate the system 12 specimens, from every material tested to determined there deformation at different speeds. In our traction test we used an European standard dimension for specimens apply for traction test, SR EN 1002-1:2002, so the specimen dimensions are: 20 mm wide, 160 mm long and 3 mm thickness.

Figure 1: Specimens tested

This system offers the possibility of measuring in real time the deformations appeared in the test specimen at the uniaxial traction. In tension testing, the test specimen is held securely in the jaws of upper and lower grips of the traction machine. [2]

3. Samples of UHMWPE

UHMW (ultra high molecular weight polyethylene) is a composite material, an extremely tough plastic with high abrasion and wear resistance. The versatility of this polyethylene has made it a popular plastic for countless industrial applications that need durability, low friction, and chemical resistance. [3]

The modulus of elasticity taken into account is the one determined on the basis of the traction curve. Traction materials were tested at three different speeds: 10 m/s, 50 m/s and 100 m/s. The first tested material was the UHMWPE composite material, and down below we can see the curve resulted by the tensile strain and tensile stress. We tested three samples for each speed.

This material has very good rigidity, tenacity and amortization properties, frazzle resistance and is low welding. Generaly this type of material is used in mechanical applications. [4] The material we choose is used in engineering industry, in flexible manufacturing lines, where positioning platforms for car body and special conveyer for the moving car body exist, they are called conveyance station from a work station to another. [5]

**Figure 3: Tensile stress / Elongation
at traction speed 10 mm/s**

**Figure 4: Tensile stress / Elongation
at traction speed 50 mm/s**

Figure 5: Tensile stress / Elongation at traction speed 100 mm/s

Figure 6: Tensile test specimens at speed 10 mm/s

From the analysis of the variation graphs tensile stress - tensile strain for the UHMWPE material, it is observed that after reaching the yield stress, the tension increases continuously on a relatively full slope until reaching the maximum value where the first rupture cracks appear.

Table 1: Machine testing results

UHMWPE	Nr. specimen	Modulus (MPa)	Maximum Tensile stress (MPa)	Tensile strain at Maximum Tensile stress (%)	Load at Maximum Tensile stress (N)	Extention at Maximum Tensile stress (mm)	Tensile strain at Break (mm/mm)	Tensile stress at Break (MPa)	Tensile strain at Yield (mm/mm)	Tensile strain at Yield (MPa)
Speed 10mm/s	1	477.838	28.780	336.240	1,726.851	302.616	3.362	15.796	0.862	19.549
	2	433.557	28.078	314.629	1,684.729	283.166	3.161	1.558	0.738	19.937
	3	451.028	26.743	309.666	1,604.633	278.699	3.108	1.567	0.876	19.701
Average		454.141	27.867	320.178	1,672.071	288.160	3.210	6.307	0.825	19.729
Speed 50mm/s	1	538.125	29.735	307.314	1,784.102	276.583	3.074	28.967	0.366	0.366
	2	497.447	30.043	314.537	1,802.581	283.083	3.150	24.752	0.354	0.354
	3	507.397	28.789	290.092	1,727.350	261.083	2.907	28.786	0.297	0.297
Average		514.323	29.522	303.981	1,771.344	273.583	3.044	27.501	0.339	0.339
Speed 100mm/s	1	661.161	32.742	325.370	1,964.549	292.833	3.253	32.742	0.198	0.198
	2	602.299	31.665	287.037	1,899.931	258.333	2.874	19.415	0.353	0.353
	3	564.914	34.050	326.481	2,043.052	293.833	3.268	19.692	0.438	0.438
Average		609.458	32.819	312.962	1,969.177	281.666	3.131	23.949	0.329	0.329

The centralizing table shows the values of maximum tensile stress, load at maximum tensile stress, extension at maximum tensile stress, tensile strain at break, tensile stress at break and tensile strain at Yield, for the UHMWPE samples.

4. Samples of POM

POM (polyoxymethylene) is a thermoplastic material, which has good fatigue resistance and high impact strength, and can replace parts made of Cu, Zn, iron casting and stainless steel, and it is

used in the automobile industry or in the electronic appliance industry. [6]

The second material which we tested is a POM material. Traction materials were tested at three different speeds: 10 mm/s, 50 mm/s and 100 mm/s. The samples are a POM composite material, and down below we can see the curve resulted by the tensile strain and tensile stress. We tested three samples for each speed.

Figure 7: Tensile stress / Elongation at traction speed 10 mm/s

Figure 8: Tensile stress / Elongation at traction speed 50 mm/s

Figure 9: Tensile stress / Elongation at traction speed 100 mm/s

Figure 10: Tensile test specimens at speed 10 mm/s

From the analysis of the variation graphs tensile stress - tensile strain for the POM material at a speed of 10 mm/s, it is observed that after reaching the yield stress the tension decreases sharply by about 1/3, after which it remains approximately constant until the moment of rupture. For the same type of material at a speed of 50 mm/s, after reaching yield stress, the tension decreases slowly, until the rupture occurs. For the same type of material, at 100 mm/s, after reaching yield stress, the tension decreases continuously until the rupture occurs.

Table: 2 Machine testing results

POM	Nr. specimen	Modulus (MPa)	Maximum Tensile stress (MPa)	Tensile strain at Maximum Tensile stress (%)	Load at Maximum Tensile stress (N)	Extention at Maximum Tensile stress (mm)	Tensile strain at Break (mm/mm)	Tensile stress at Break (MPa)	Tensile strain at Yield (mm/mm)	Tensile strain at Yield (MPa)
Speed 10mm/s	1	1,000.118	27.605	8.685	1,656.350	7.816	1.181	1.007	0.427	16.520
	2	1,022.633	28.387	9.111	1,703.277	8.199	2.246	1.037	0.432	17.511
	3	969.014	27.550	9.166	1,653.002	8.250	1.824	1.039	0.411	16.855
Average		997.255	27.847	8.987	1,670.876	8.088	1.750	1.027	0.423	16.962
Speed 50mm/s	1	2,214.159	75.464	11.944	4,527.847	10.749	0.164	74.819	-----	-----
	2	1,875.064	73.100	15.925	4,386.049	14.333	0.325	70.828	-----	-----
	3	1,891.778	73.868	16.111	4,432.132	14.499	0.302	69.674	-----	-----
Average		1,993.667	74.144	14,660	4,448.676	13.193	0.263	71,773	-----	-----
Speed 100mm/s	1	1,289.013	32.977	8.146	1,978.655	7.331	0.531	1.725	0.400	1.589
	2	1,293.816	31.645	7.219	1,898.711	6.497	0.404	1.720	0.325	1.604
	3	1,172.765	33.152	8.702	1,989.154	7.832	0.590	0.707	0.353	18.623
Average		1,251.864	32.591	8.022	1,955.506	7.220	0.508	1.384	0.359	21.816

The centralizing table shows the values of maximum tensile stress, load at maximum tensile stress, extention at maximum tensile stress, tensile strain at break, tensile stress at break and tensile strain at Yield, for the POM samples.

After seeing the values from the centralizing tables, we used a chart to establish the modulus, the maximum tensile stress and the extention at maximum tensile stress at the three speeds we tested the POM material.

Conclusions

After seeing the values from the centralizing tables, we used a chart to establish the Maximum Tensile stress for UHMWPE and the Maximum Tensile stress for POM, at the three speeds we tested the specimens.

Table 3: Comparation between Maximum Tensile stress of UHMWPE and POM

The results of the tensile tests at the three test speeds for the UHMWPE material lead to the following conclusions: the modulus of elasticity increases with the increase of the test speed, as well as Maximum Tensile stresses, and Extension at Maximum Tensile stress has values close to a slight

decrease at valued speed of 50mm/s.

The results of the tensile tests at the three test speeds for the POM material lead to the following conclusions: the modulus of elasticity has a maximum value at the speed of 50mm/s (1,993.667 MPA), the next immediate value being is at 100mm/s (1,251.864 MPA) and the most smallest value is obtained at a speed of 10 mm /s (997.255 MPA). The same variation model has Maximum Tensile stress and Extention at Maximum Tensile stress.

From the analysis of these graphs we can conclude that the test speed influences not only the value of the Maximum Tensile stress, Extention at Maximum Tensile stress but also the shape of the test graphs. In conclusion, the material POM is much more influenced by the test speed than the UHMWPE.

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