The Role of Functional Polymers in the Optimization of the Acrylic Biomaterials Used in Removable Prosthetic Restoration

II. Assessment of traction test and antifungal activity

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The work is part of a larger study, representing second note, being focused on the correlation between the behaviour of polymeric materials as such or as copolymers from the group of methyl methacrylate, maleic anhydride and silicone rubber, reinforced or not with polyethylene fiber and metallic copper mesh with antifungal activity for 12 matrix polymer systems used in removable prosthesis and the final, respectively.

Keywords: silicone and acrylic resin, maleic anhydride, removable prosthesis, traction resistance, modulus of elasticity, Poisson's coefficient, fungal activity

Acryliques and silicones copolymers are recognized by the medical community as highly effective and versatile biocompatible materials that are used in dental prosthetics practice [1-3]. This is attributed to their biochemical and physiological inertness, compatibility with living tissue, very low toxicity, and anti-adhesive properties suitable. Biochemical and physiological inertness, with their ecological behavior enables an exact replication lines teeth and gum, respectively [1].

Of the two polymers, silicones can aproximate the skin consistency and provide exceptional biochemical characteristics. Moreover, it is known that silicones are odorless and insipid, do not support bacterial growth, does not stain or corrode other materials and are easy to sterilize [1, 4-7].

In a previous paper both copolymers have been used in determination of mechanical characteristics, which were aimed at obtaining removable prosthesis based on two polymers as such or as a matrix layered for cushioning and comfort systems [8].

In dentistry, there are cases (complete or partial edentulous) in which the classical prostheses do not accomplish the biological integration requirements. The relining resilient materials are soft polymers that are applied in thin coatings on the mucosal surface of the removable complete or partial acrylic dentures. Soft liners are mostly used for reducing local point pressures [1,4-6, 8-12].

For this purpose are known a number of contributions to the use of matrix systems of these type of polymers in form of stacked structures (sandwich type) with inserts and reinforcement fibers of metallic mesh [8, 13]. In optimizing the design of this biomaterial matrix that correspond to structural and functional removable prosthesis and definitive or permanent, respectively, are involved a series of tests, including the very important Iosipescu traction test, shear and torsion tests respectively [8, 14-19] . These studies aimed to improve the skills of the two biomaterials used in total removable prosthesis, whose associations and corresponding structural changes determined the development of prosthetic devices whose solutions far exceed news from the dental practice.

Another key result is the adhering filaments for Candida albicans, frequently encountered bacteria in the mouth of elderly patients with different acrylic prosthetics. In this case, are aimed the situations in which it is possible to counteract these trends with microbial resistant structures [20-32]. Candida albicans and other bacteriological agents have negative effects on acrylates that adheres because of its filamentary structure, contributing significantly to degradation of acrylic material, so identifying and individualization possibilities for non-adhering materials is very important [33, 34].

In this way, the present paper, which is part of an extensive study, representing the second note, has in attention antifungal activity (antileaven) of the two matrix polymer systems used in removable and definitive prosthesis, based on acrylic resins and silicone resins.

Experimental part

Materials and method

Were used two groups of polymer's structures according with clinical particularities:

a) As basis material for samples it was used a conventional acrylic resin based on poly (methyl methacrylate) and acrylic monomer from the SPHOFA Company, Germany. When was poured in forms (molds) the conventional acrylic resin was reinforced with polyethylene fibres, randomly and longitudinal arranged (samples S01 and S02), and reinforced with metallic Cu mesh (sample S03) respectively.

b) Another samples group with the conventional acrylic resin was poured in sandwich layers type with copolymers of anhydrite maleic (AM) and methyl methacrylate (MMA) (fig. 1), in ratio moles AM:MMA = 1:1, 1:2 and 1:3. When

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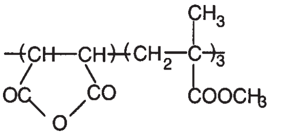

Fig. 1. The chemical structure of copolymer anhydride maleic – methyl methacrylate

was poured in forms (molds) the conventional acrylic resin/ copolymers AM+MMA was reinforced with polyethylene fibres transversal arranged (samples S04, S06 and S08), and reinforced with metallic Cu mesh (samples S05, S07 and S09) respectively (in according with table 1).

The copolymer AM with MMA was obtained after a proper recipe [35], through radical copolymerisation in solution followed by precipitation, purification through extraction and drying at 40°C and low pressure for 48 h. From the copolymer in the form of anhydride maleic was prepared the sodium salt through hydrolysis and neutralization with water solution diluted by sodium hydroxide solution at 60°C for 8 h[35, 36]. The solution obtained was purified by ultrafiltration and the polymer has been recovered by lyophilisation. The chemical structure of those two copolymers is presented in figure 1. The chemical composition of these two copolymers was AM:AMM 1:1, 1:2 and 1:3 (ratio moles), determined by conductometric titration in acetone-water mixture [37]. The molecular mass of 49000 was estimated from viscosimetric measurements.

All chemical products using for obtaining copolymer were purchased from Sigma-Aldrich Chemical Co., Inc., Milwaukee, WI.

c) In the same mode was poured in forms (molds) two samples for traction tests using conventional acrylic resin and silicone rubber, reinforced with polyethylene fibres transversal arranged (sample S10), and reinforced with metallic Cu mesh (sample S11) respectively (in according with table 1).

Candida

AFNOR artificial saliva was used according to French standards, to which some improvements have been made. This was inoculated with Candida albicans leaven, in the form of isolated strains from cases of prosthetic stomatitis (103 leaven / mm^2). Five recipients were placed in the test tube, incubated at 36°C for 72 h. Later, were placed in revealing dental plaque, rinsed with pure water, dried, then rinsed again. The basic components of AFNOR saliva are: NaCl 0.70 g/L, KCl 1.20 g/L, Na_2HPO_4 0.26 g/L, $NaHCO_3$ 1.50 g/L, KSCN 0.33 g/L, Uree 1.35 g/L –was added glucose - 5 g / L - and peptone from casein.

Prepared samples.

For a first examination of the biomechanical behaviour of the similar forces to those of the oral cavity there were performed a number of specimens in the form of rectangular thin plates with longitudinal dimension of 40 mm, a width of about 20 mm and thickness of between 1.8 and 2.5 mm. Of these specimens there have been performed traction specimens, associating the conventional acrylic resin with various forms of reinforcement [8, 14] having the ends with aluminium plates bonded with cyanoacrylat adhesive. The realised samples and the preparation conditions are presented in table 1.

The traction tests on specimens were made on the HEKERT 50 machine (on a scale of 10 kN) and on the Textenser machine (maximum force 500 N) [8].

The shearing specimens were made on a special made device that was put in the milling machine, its position being initially controlled by means of a dial comparator in order to ensure the perpendicularity/parallelism of surfaces on the edges of the cutting device trajectories during mass/ head machines's displacements. The attempt at pure shear is a method proposed by Nicolae Iosipescu [8] The specimen and the procedure of Iosipescu, developed especially for the metal study, were extended later on composite materials by Adams and Walrath from the Wyoming University [16, 38]. The specimen request was made in such a way that it does not arrive to the breaking, and the speed of loading (force growth was less than 3N/s) to provide compensation for creep and to allow precise control of the machine (the machine stoping for reading the deformation). The determination of the longitudinal elasticity module (E) and the Poisson coefficient (ν), is an absolutely necessary stage within the mathematics modeling stage of different two-dimensional structure of the total prostheses evaluating the transmission of tensions to the two essential components of the bone prosthetic field and mucous membrane [8].

Table 1

THE SAMPLES FOR TRACTION TESTS

Sample code	Sandwich layers composition of the samples	Molar ratio
SS	Standard sample from conventional acrylic resin	-
S01	Conventional acrylic resin reinforced between layers with polyethylene fibres, randomly arranged	-
S02	Conventional acrylic resin reinforced between layers with polyethylene fibres, longitudinal arranged	-
S03	Conventional acrylic resin reinforced between layers with metallic Cu mesh	-
S04	Conventional acrylic resin and copolymer AM-MMA reinforced between layers with polyethylene fibres, transversal arranged	MMA:AM 1:1
S05	Conventional acrylic resin and copolymer AM-MMA reinforced between layers with metallic Cu mesh	MMA:AM 1:1
S06	Conventional acrylic resin and copolymer AM-MMA reinforced between layers with polyethylene fibres, transversal arranged	MMA:AM 2:1
S07	Conventional acrylic resin and copolymer AM-MMA reinforced between layers with metallic Cu mesh	MMA:AM 2:1
S08	Conventional acrylic resin and copolymer AM-MMA reinforced between layers with polyethylene fibres, transversal arranged	MMA:AM 3:1
S09	Conventional acrylic resin and copolymer AM-MMA reinforced between layers with metallic Cu mesh	MMA:AM 3:1
S10	Conventional acrylic resin and silicone rubber reinforced between layers with polyethylene fibres transversal arranged	-
S11	Conventional acrylic resin and silicone rubber reinforced between layers with polyethylene fibres and metallic Cu mesh	-

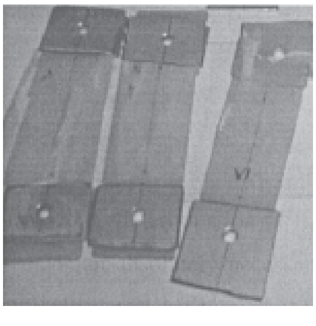

Fig. 2. Traction test samples

In figure 2 appears the image of a traction test samples.

Samples used for determination of the longitudinal elasticity module (E) and the Poisson coefficient (ν), similar to the traction ones (fig. 3), which were marked as follows:

- sample $\alpha1$ = acrylate + polyethylene + maleic anhydride;
- sample $\alpha2$ = acrylate + maleate + maleic anhydride;
- sample $\alpha3$ = acrylate + maleate.

Also, for transverse elasticity module (G), also similar to the ones in figure 2, were named as follows:

- sample $\alpha4$ = acrylate + silicon;
- sample $\alpha5$ = acrylate + silicon + metal mesh.

For the two groups of samples were used to assess mechanical resistance tests the following notation:

b - width of the samples;

d - thickness of the samples;

F_{max} - maximum force to which the sample broke;

σ_{max} - maximum tension (normal) ($\sigma_{max} = F_{max}/S_0$), where $S_0 = b \times d$ is the section in which breaking occurs (or the initial section of the study area of the samples);

$(\sigma_{max})_{real}$ - normal real maximum tension, calculated in the section in which the broke actually occurred, the request to the tensile being eccentric due to the asymmetric structure and because of the way of overtaking the charge by the structure.

Results and discussions

The results obtained subsequent to the submission to the traction forces [8] are represented in table 2.

Later examination of the routes of breaking of the tensile samples notice the following aspects: fragile breaking (lack of plastic deformations preceding the breaking) of all samples: SS – standard sample composed by *conventional acrylic resin* (non-reinforced material present in breaking cross-sections), slightly wavy in relation to direction of the traction force, and series samples from S01 to S11 reinforced asymmetric materials have succumbed in areas without reinforcement (cracks starting usually at the end of the fixing points). The cracks produced in the reinforcement areas had directions; parallel with the reinforcement fibres: at the sample S01 (acrylate and polyethylene fibre randomly arranged), sample S02, represented by acrylate, reinforced with polyethylene fibre; longitudinal the reinforcement fibres and sample S03 (acrylate, metalic mesh). For these samples the value of F_{max} and σ_{max} increases according to section and according to type of reinforcement: with polyethylene fibres randomly arranged, polyethylene fibres longitudinal arrangend and metallic Cu mesh respectively.

The break of the material was followed by taking charge of the reinforcement: small deformations (elastic) of acrylate were not simultaneous with reinforcement material deformations. The polyethylene fibres are made of twisted strands, presenting a module of elasticity significantly lower than that of acrylic resin, especially due to the fibres waves (samples S04, S06 and S08).

At the material reinforced with metallic Cu mesh (samples S05, S07 and S09) it was observed the cracking of the resin perpendicular on the force' direction; the metallic reinforcement was suffering an imperceptible deformation.

For these samples the value of F_{max} and σ_{max} decreases according to section and according to type of reinforcement: with polyethylene fibres longitudinal arrangend and metallic Cu mesh respectively.

The S03 sample reinforced with metallic mesh broke in the fixing area; by breaking of the adhesive that is reimbursed were pasted tabs.

The total length rupture of the unreinforced samples (SS sample) compared to those whose structure was reinforced, present in the conducted study, it is confirmed in the literature of specialty of research carried out by K. Earar [8] on test-pieces made of metal polymetacrylate reinforced with polyethylene fibres, compared with absence of reinforced fibres.

Observations made during preliminary tests (fragile breaking, lack of plastic deformations) suggest that the structure of the samples has not undergone essential changes.

The best resistance to the traction force was noticed in the case of the test-piece made of acrylate, reinforced with polyethylene fibres arranged longitudinally (confirmed in the research issues of N.H. Ladizesky et al. [29] as well as in case of the test-piece made of acrylate, followed by metal reinforcement of acrylate. We note that the presence of copolymer of maleic anhydride of methyl methacrylate increases the resistance of the test-piece reinforced with metal mesh, which indicates an increase of the degree of adhesion between the two structures, but decreases the resistance of the acrylate.

It is necessary to note the superiority in terms of resistance of the test-piece to which the metal mesh was cast subsequently adaptation in wax form compared to the sample to which the reinforce was achieved through prefabricated metal mesh.

An important aspect is represented by the resistance of the test-piece that presents the sandwich structure, explained due to very good adhesion of the component to place both silicone and metal at the end, contribute significantly acrylate and coupling agent.

The elastic constants of materials

The traction tests for determining how *longitudinal elasticity module (E), Poisson coefficient (ν)* and *transversal elasticity (G)* led to the results presented in table 3.

Further, the values of longitudinal elasticity module (E), Poisson coefficient (ν) and transversal elasticity (G) for five samples were evaluated in according with table 3.

Table 2
RESULTS OF TRACTION TEST SAMPLES

Sample Code	b (mm)	d (mm)	F_{max} (N)	σ_{max} (MPa)	$(\sigma_{max})_{real}$ (MPa)
SS	18.80	3,20	1300	21.60	26.55
S01	21.00	1.45	1750	34.50	82.72
S02	20.50	1.80	1550	57.47	81.53
S03	21.00	1.70	1125	31.51	83.72
S04	20.90	1.20	1145	37.88	65.97
S05	18.80	2.90	1750	32.10	39.44
S06	19.90	1.50	800	26.80	66.66
S07	21.00	1.30	1030	37.73	66.02
S08	17.90	0.90	450	27.93	27.93
S09	18.55	1.00	475	25.61	25.61
S10	18.40	3.20	1650	28.02	34.43
S11	18.80	1.30	1675	29.04	38.45

SS – standard samples; S01-S11 – experimental samples

Dimensions of the breaking section	Sample α_1	Sample α_2	Sample α_3
b (mm)	13.400	12.600	11.000
d (mm)	3.000	2.800	3.000
S_0 (mm^2)	40.200	35.280	33.000
$\sigma_{max} = F_{max}/S_0 = 500N/S_0$ (N/mm^2)	12.430	14.172	15.150

Dimensions of the breaking section	Sample α4	Sample α5
b (mm)	11.200	11.400
d (mm)	1.600	3.300
S_0 (mm^2)	17.920	37.620

Table 3
SAMPLES SUBJECTED TO BREAKING SECTIONS

Longitudinal elasticity module (E) and Poisson coefficient (ν):

Sample α1 (acrylate + polyethylene + maleic anhydride)
$E_{\alpha1}$ = 2495.5MPa, $\nu_{\alpha1}$ = 0.3588
Sample α2 (acrylate + maleate + maleic anhydride)
$E_{\alpha2}$ = 4278.9MPa, $\nu_{\alpha2}$ = 0.3431
Sample α3 (acrylate + maleate)
$E_{\alpha3}$ = 3045.2MPa, $\nu_{\alpha3}$ = 0.3593

Transverse elasticity module (G):

Sample α4 (acrylate + silicon)
$G_{\alpha4}$ = 1241.9MPa
Sample α5 (acrylate + silicon + metal mesh)
$G_{\alpha5}$ = 762.385MPa

During testing it was observed the phenomenon of deformations' growth due to traction applied to the traction request (creep). The creep speed is relatively small and decreases if the material is requested repeatedly. It installs a hardening similar to the metal materials.

The temperature measured at the level of the transducer was raised with no more than one degree (Celsius) during balance operations of the thensiometric bridge.

Correction of the readings was done with a relationship that takes into account the supply voltage and the cross-sensitivity transducers (according to manufacturer instructions):

$$\gamma_{1,2} = (\varepsilon_1 - \varepsilon_2) = \frac{1 - \nu_0 K_t}{1 + K_t}(\varepsilon_{cit.1} - \varepsilon_{cit.2})$$

Axes plan for lifting curves are:

- Tangential (τ) in main directions (1.2), where (1) is the axis of the notches, and (2) is the longitudinal axis of the test tube and was calculated using the equation:

$$\tau = \tau_{1,2} = \frac{F}{S_0},$$

where F = m×g is the force applied to the test tube through shear device , with m = mass of discs placed on the turntable stand trial and g = 9.81 [m/s^2] is the standard acceleration of gravity, and S_0 = b×d is the cross-sectional area of the shear;

Specific sliding (γ) in main directions (1.2) was determined using the equation:

$$\gamma = \gamma_{1,2} = (\varepsilon_1 - \varepsilon_2) = \frac{1 - \nu_0 K_t}{1 + K_t}(\varepsilon_{cit.1} - \varepsilon_{cit.2})$$

with corrected values in relation of the voltage and the deck cross-sensitivity transducers.

The four positions for samples α4 and α5 marked in tables 4 and 5 with data for specific sliding γ-1, γ-2, γ-3, γ-4 (corresponding notations A, B, C, D from titles of graphics drawn in figs. 3 and 4) are all possible positions of the shear test tube in traction device:

- position B is obtained from the position A by rotating the test tube around a vertical axis with 180° ;
- position C from position B, by turning around the horizontal axis with 180°;
- position D from position C, by turning around the vertical axis with 180°.

This strategy was adopted to eliminate the errors that may occur due to the dimensional variation of the samples and the application mode of load/task/stress.

The curves represent the whole application cycle (load-unload). Approximation line is marked on each curve and has the slope equal to the transverse modulus of elasticity (G), according to Hooke's law: τ = G . γ

Evaluation of shear modulus G is consistent with standard recommendations: $G = \frac{\Delta\tau}{\Delta\gamma}$

where Δτ is tangential tension variation and Dγ corresponding to specific slipping variation

Global assessment (for the entire cycle of application) leads to a shear modulus comparable to the amount that would be obtained if this operation would make the ascendendent branch, in an area with higher tension (in order to avoid influence the dimensional and load).

m	F	γ-1	γ-2	γ-3	γ-4	τ	γ—1–real	γ-2–real	γ-3–real	γ-4—real
(kg)	(N)					(MPa)				
1.85	18.1485	58	-109	99	-108	1.012751	0.000226	-0.00043	0.000386	-0.00042
3.7	36.297	221	-332	290	-306	2.025502	0.000862	-0.00129	0.001131	-0.00119
5.45	53.4645	402	-539	460	-492	2.98351	0.001567	-0.0021	0.001794	-0.00192
7.21	70.7301	579	-743	667	-705	3.946992	0.002258	-0.0029	0.002601	-0.00275
8.98	88.0938	834	-958	883	-904	4.915949	0.003252	-0.00374	0.003443	-0.00352
10.75	105.4575	1040	-1170	1090	-1097	5.884905	0.004055	-0.00456	0.00425	-0.00428
12.52	122.8212	1273	-1383	1284	-1307	6.853862	0.004964	-0.00539	0.005007	-0.0051
14.3	140.283	1481	-1580	1484	-1506	7.828292	0.005775	-0.00616	0.005786	-0.00587
16.05	157.4505	1684	-1800	1720	-1726	8.7863	0.006566	-0.00702	0.006707	-0.00673
14.3	140.283	1596	-1733	1665	-1670	7.828292	0.006223	-0.00676	0.006492	-0.00651
12.52	122.8212	1398	-1605	1485	-1515	6.853862	0.005451	-0.00626	0.00579	-0.00591
10.75	105.4575	1204	-1413	1325	-1353	5.884905	0.004695	-0.00551	0.005166	-0.00528
8.98	88.0938	1009	-1226	1102	-1114	4.915949	0.003934	-0.00478	0.004297	-0.00434
7.21	70.7301	817	-1033	908	-937	3.946992	0.003186	-0.00403	0.00354	-0.00365
5.45	53.4645	609	-817	698	-751	2.98351	0.002375	-0.00319	0.002722	-0.00293
3.7	36.297	398	-641	473	-545	2.025502	0.001552	-0.0025	0.001844	-0.00213
1.85	18.1485	205	-455	262	-338	1.012751	0.000799	-0.00177	0.001022	-0.00132

Table 4
EXPERIMENTAL DATA OBTAINED FROM TESTS PERFORMED ON α4

Table 5
EXPERIMENTAL DATA OBTAINED FROM TESTS PERFORMED ON $\alpha 5$

m	F	γ-1	γ-2	γ-3	γ-4	τ	γ—1–real	γ-2–real	γ-3–real	γ-4—real
(kg)	(N)					(MPa)				
1.85	18.1485	13	-84	102	-68	0.482416	5.07E-05	0.000328	0.000398	0.000265
3.7	36.297	130	-254	221	-223	0.964833	0.000507	0.00099	0.000862	0.00087
5.45	53.4645	305	-412	332	-371	1.421172	0.001189	0.001606	0.001295	0.001447
7.21	70.7301	458	-580	477	-525	1.88012	0.001786	0.002262	0.00186	0.002047
8.98	88.0938	621	-769	630	-694	2.341675	0.002421	0.002998	0.002457	0.002706
10.75	105.4575	764	-921	785	-857	2.80323	0.002979	0.003591	0.003061	0.003342
12.52	122.8212	916	-1105	928	-1029	3.264785	0.003572	0.004309	0.003618	0.004012
14.3	140.283	1084	-1290	1090	-1197	3.728947	0.004227	0.00503	0.00425	0.004667
16.05	157.4505	1219	-1445	1240	-1360	4.185287	0.004753	0.005634	0.004835	0.005303
14.3	140.283	1208	-1405	1228	-1345	3.728947	0.00471	0.005478	0.004788	0.005244
12.52	122.8212	1140	-1282	1132	-1205	3.264785	0.004445	0.004999	0.004414	0.004699
10.75	105.4575	982	-1131	1005	-1053	2.80323	0.003829	0.00441	0.003919	0.004106
8.98	88.0938	855	-986	853	-909	2.341675	0.003334	0.003845	0.003326	0.003544
7.21	70.7301	684	-816	704	-739	1.88012	0.002667	0.003182	0.002745	0.002882
5.45	53.4645	535	-660	546	-587	1.421172	0.002086	0.002573	0.002129	0.002289
3.7	36.297	387	-502	420	-441	0.964833	0.001509	0.001957	0.001638	0.00172
1.85	18.1485	215	-325	265	-247	0.482416	0.000838	0.001267	0.001033	0.000963

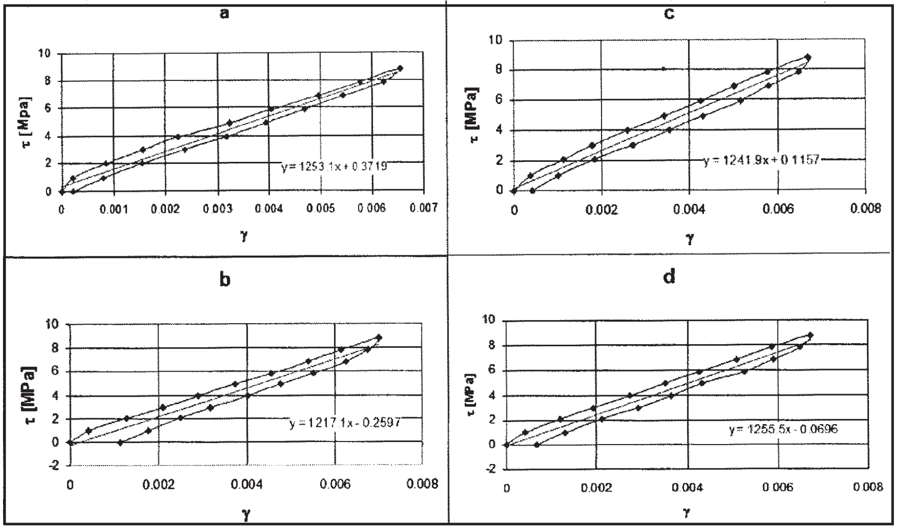

Fig. 3. Characteristic curves drawn according to traction tests on $\alpha 4$ sample, in positions: a – A, b – B, c – C and d – D

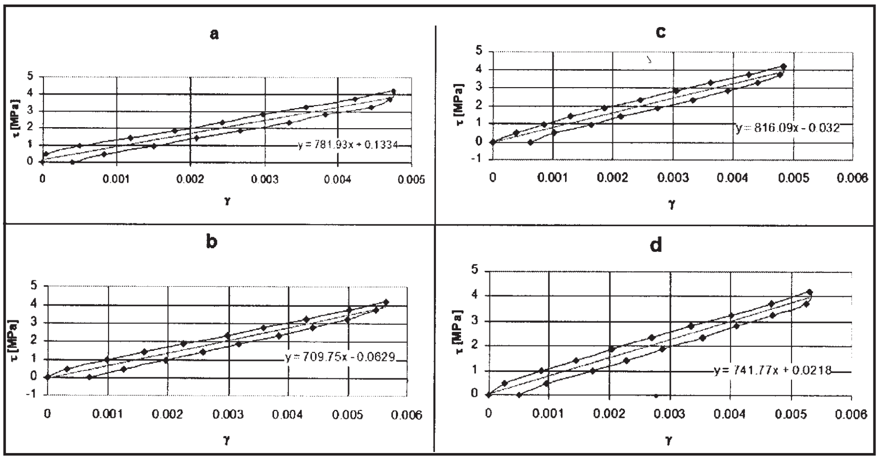

Fig. 4. Characteristic curves drawn according to traction tests on $\alpha 5$ sample, in positions: a – A, b – B, c – C and d – D

Table 6
THE VALUES FOR TRANSVERSE MODULUS OF ELASTICITY FOR SAMPLE $\alpha 4$

Position	Transverse modulus of elasticity (G) (Mpa)
A	1253.1
B	1217.1
C	1241.9
D	1255.5
The average value of transverse modulus of elasticity (G) (Mpa)	1241.9

Table 7
THE VALUES FOR TRANSVERSE MODULUS OF ELASTICITY FOR SAMPLE $\alpha 5$

Position	Transverse modulus of elasticity (G) (Mpa)
A	781.931
B	709.75
C	816.09
D	741.77
The average value of transverse modulus of elasticity (G) (Mpa)	762.385

Table 8
CANDIDA ALBICANS LEAVEN POPULATING
OF THOSE 12 STUDIED SAMPLES

Sample code	Population with *Candida albicans*
SS	Just noticeable present
S01	Significant present
S02	Significant present
S03	Insignificant present
S04	Significant present
S05	Insignificant present
S06	Significant present
S07	Insignificant present
S08	Significant present
S09	Insignificant present
S10	Non-present
S11	Non-present

Transversal modulus values obtained allowed the calculation of averages for two samples α4 and α5, using data from tables 6 and 7, when it obtained the values for:

$G_{\alpha 4}$ = 1241.9 Mpa and for $G_{\alpha 5}$ = 762.385 Mpa.

Activity evaluation of the antileaven samples

After immersing the samples in Candida albicans environment results on the antifungal activity were obtained according to table 8.

Negative results in terms of Candida albicans accession were observed to S09-S12 samples that had in the composition the copolymer and were reinforced with polyethylene and randomly longitudinally arranged, respectively samples S01, S02.

These significant results are based on the antibacterial effect of the two copolymers included in the study. From the scientific literature it is known that all of the maleic anhydride copolymers and their derivatives have bioactive properties [37].

In view of the above results it was expected that the two copolymers to induce these properties. Important to note is that the two copolymers studies may be related with eugenol and thymol groups, with strong antibacterial effect, making polymeric systems with controlled release of biologically active substances.

The chemical structure of the copolymer of maleic anhidride in the presence of carboxylate groups confers polyelectrolyte character that influences the antimicrobial action. The differences in the chemical structure of the two copolymers are made visible by the biomechanical behavior. Copolymer of sodium malate leads to elastic structures, extremely important property for finite element.

Comparing the Candida albicans leaven deposits on samples S01-S08, based on acrylic and the silicon composition, respectively, is remarkable intense deposition on acrylic composition, compared to discrete low silicon deposition. This fact allows the use of silicon as a material lining in removable prosthetics.

Conclusions

The experiments have lead to the following conclusions:

- for samples S01 – S03 the value of F_{max} and σ_{max} increases according to section and according to type of reinforcement: with polyethylene fibres randomly arranged, polyethylene fibres longitudinal arrangend and metallic Cu mesh respectively;
- the sample that was subjected to maximum breaking strength was that of reinforced acrylate with polyethylene fibres, arranged longitudinally (F = 1750 N);
- the specimens made of acrylate in combination with the two copolymers have succumbed to a breaking force of 1650 N in case of acrylate + maleic anhydride + metallic Cu mesh;
- satisfactory results have been registered in the case of combining maleic anhydride + acrylate in proportion of 3:1;
- the presence of copolymer of maleic anhydride and methyl methacrylate increases the resistance of the test-piece reinforced with metal mesh, which indicate an increase of the degree of adhesion between the two structures, but decreases resistance of acrylate;
- it is necessary to note the superiority in terms of test-piece' resistance to which the metal mesh was cast subsequently adaptation in wax form compared to the reinforce sample was achieved through prefabricated metallic Cu mesh;
- Aan important aspect is represented by the resistance of the test-piece that presents the sandwich structure, explained due to very good adhesion of the component to place both silicone and metal at the end, contribute significantly acrylate and coupling agent;
- for samples S04-S09 the value of F_{max} and σ_{max} decreases according to section and according to type of reinforcement: with polyethylene fibres longitudinal arranged and metallic Cu mesh respectively;
- comparing the Candida albicans leaven deposits for the S01-S08 samples, it is obvious the intense deposition on acrylic samples compared to discrete deposition or absence on the silicone rubber.

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