POLYURETHANE FOAMS: BIOLOGICAL ACTIVITY AND ENVIRONMENTAL FRIENDLINESS

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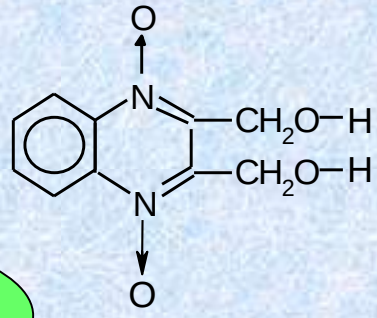
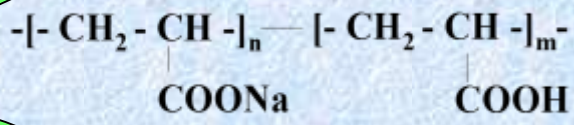
Biologically active polyurethane foams

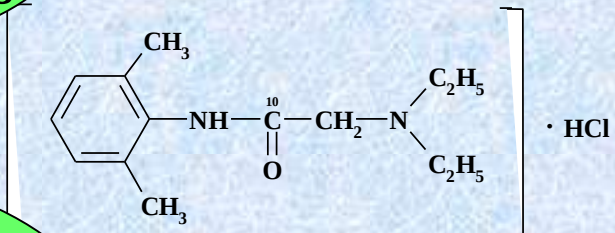
PUF-matrix



Bactericidal active PUF



Bactericidal active PUF with self-adhesive properties



Bactericidal active PUF with self-adhesive properties and analgesic effect

Biologically active polyurethane foams – **a range of polyurethane foam materials has been developed with immobilized biologically active (metal)organic and natural compounds (BAC) as macro chain extenders and/or end-group and PUF, containing BAC, not associated with a polymer carrier**

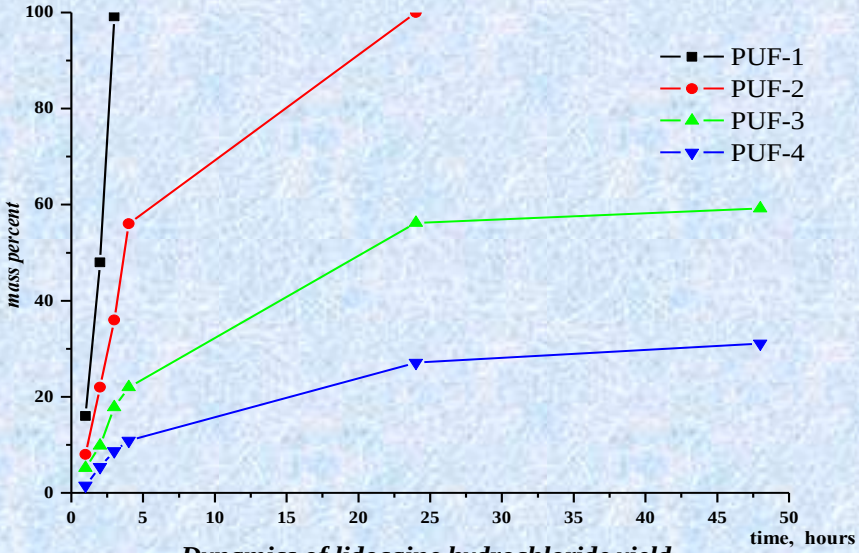
Bactericidal active PUF

Samples	Test culture							
	E. coli ATC 25922	E. coli 150	Klebsiella pneumon. 6447	S. aureus 180	Pseudomonas aeruginosa	Proteus mirabilis F - 403	Proteus mirabilis 6054	Proteus vulgaris 8718
Matrix	6-11	6-10	5-10	5-9	6-8	4-8	6-8	4-8
PUF-1	11	12	13	14	8	14	13	12
PUF-2	14	15	15	12	10	17	14	20
PUF-3	13	14	15	11	10	16	14	21
PUF-4	15	15	15	12	11	19	14	22
PUF-5	15	14	14	11	11	17	13	21

Bactericidal active PUF with self-adhesive properties

Samples	*Adhesion (MPa) in depending on the time of gluing (day)*			
	1	*5*	*10*	*20*
Matrix	*0*	*0*	*0*	*0*
PUF-1	*0,018*	*0,019*	*0,016*	*0,014*
PUF-2	*0,020*	*0,022*	*0,020*	*0,018*
PUF-3	*0,021*	*0,024*	*0,021*	*0,020*
PUF-4	*0,025*	*0,030*	*0,024*	*0,022*
PUF-5	*0,050*	*0,060*	*0,050*	*0,040*

Samples	*Adhesion / Exposure of samples after gluing (days)*				
	1	*3*	*5*	*10*	*20*
PUF-3	*0,015*	*0,017*	*0,017*	*0,014*	*0,012*
PUF-4	*0,020*	*0,022*	*0,022*	*0,020*	*0,020*



Dynamics of lidocaine hydrochloride yield from synthesized polyurethane foams into physiological solution

Bactericidal active PUF with self-adhesive properties and analgesic effect

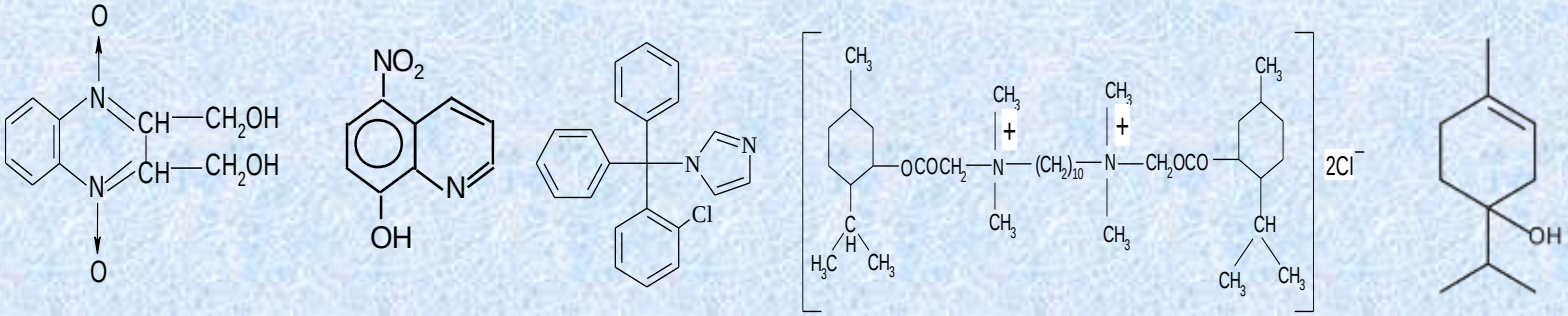
Samples	The content of lidocaine hydrochloride in the PUF		The dynamics of the release of lidocaine hydrochloride from the PUF in time, hours											
			1		2		3		4		24		48	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b
PUF-1	3,12	0,012	0,50	0,002	1,50	0,006	3,11	0,124	-	-	-	-	-	-
PUF-2	6,25	0,025	0,50	0,002	1,50	0,006	2,25	0,009	3,50	0,014	6,25	0,025	-	-
PUF-3	12,50	0,050	0,65	0,003	1,23	0,005	2,23	0,009	2,75	0,011	7,02	0,028	7,40	0,030
PUF-4	25,00	0,100	0,38	0,001	1,25	0,005	2,00	0,008	2,72	0,011	6,78	0,027	7,78	0,031

a - mass part, b - gram

PUF for veterinary medicine

Two-component biocompatible, bactericidal / fungistatic / fungicidal polyurethane foams of prolonged action have been developed, which are formed directly on the surface of the surgical suture of an animal (cattle) in 5-6 minutes

Biocides



molds

- *Aspergillis oryzae (Ahlburg) Cohn, A. niger van Tieghem, A. terreus Thom, Chaetomium varioti Bainier, Penicillium funiculosum Thom, P. chrysogenum Thom, P. cyclopium Westling, Trichoderma viride Pers. ex Fr*

bacteria

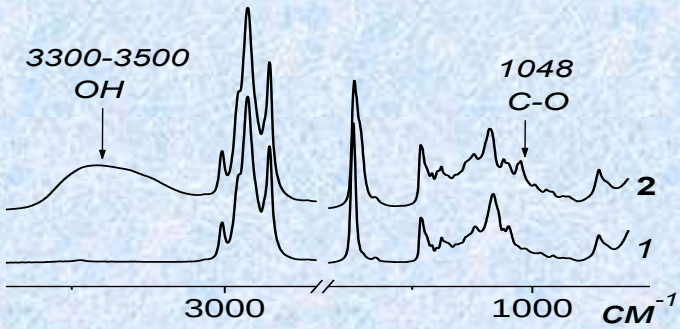
- *Candida albicans, C. tropicalis, C. krusei, C. parapsilosis, C.guilliermondii*

Toxicological studies of polyurethane foam regarding human erythrocytes

Estimation of microbiological control of PUF toxicity in process of their formation	*Estimation of microbiological control of PUF toxicity in process of PUF "aging" (after 14 days)*
After 72 hours of observation at $T=37^0C$ and at $T=22^0C$	*After 72 hours of observation at $T=37^0C$ and at $T=22^0C$*
There are no Erythrocyte hemolysis zones	*There are no Erythrocyte hemolysis zones*

Eco-friendly PUF

Eco-friendly PUF **are based on natural oils (canola, palm, soybean, linseed) and (exo)polysaccharides (starch, carboxymethylcellulose, xanthan) as an alternative to synthetic raw materials.**



Fragments of IR spectra of soybean oil (1) and its hydroxyl -containing reactable oligomer (2).

As result of glycerolizes of soybean oil is appearance of a strip of absorption of OH-groups: ν OH = 3300-3500cm^{-1} and ν S-O = 1047-1054 cm^{-1}.

PUF	The content of components, %			Tensile strength, MPa	Vapor permeability mg/cm^{2}hour	Moisture absorption , %
	OH -containing reactable oligomers of natural oils	*xanthan^1*	*xanthan^2*			
PUF/soybean oil	30	0	0	0,349	4,06	0,201
PUF/soybean oil/xanthan^1	30	33	0	0,324	3,97	1,23
PUF/linseed oil	30	0	0	0,341	3,97	0,216
PUF/linseed oil/xanthan^1	30	33	0	0,283	3,34	1,42
PUF/palm oil	30	0	0	0,342	4,09	0,197
PUF/palm oil/xanthan^1	27	41	0	0,231	4,21	1,11
PUF/soybean oil/xanthan^2	30	0	33	0,295	4,50	1,02
PUF/linseed oil/xanthan^2	30	0	33	0,258	3,94	1,21
PUF/palm oil/xanthan^2	30	0	33	0,201	4,82	0,93
PUF-matrix	0	0	0	0, 230	4,35	0,027

Xanthan^1 – native; xanthan^2 - in the form of 15 % water gel

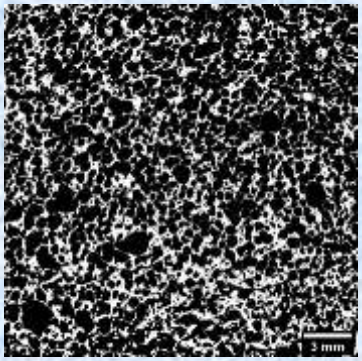
Compared to the matrix the content of 30% (mass.) functionalized oils increase the strength of PUF up to 50%, and moisture absorption - up to an order of magnitude.

PUF (bio) degradation

PUF	The content of components, %			Mass loss after ground incubation,%
	OH -containing reactable oligomers of natural oils	*xanthan[1]*	*xanthan[2]*	
PUF/soybean oil	30	0	0	16,63
PUF/soybean oil/xanthan[1]	30	33	0	36,62
PUF/linseed oil	30	0	0	16,45
PUF/linseed oil/xanthan[1]	30	33	0	44,36
PUF/palm oil	30	0	0	16,56
PUF/palm oil/xanthan[1]	27	41	0	44,35
PUF/soybean oil/xanthan[2]	30	0	33	42,95
PUF/linseed oil/xanthan[2]	30	0	33	43,79
PUF/palm oil/xanthan[2]	30	0	33	44,67
PUF-matrix	0	0	0	0,19

Xanthan[1] – native; xanthan[2] - in the form of 15 % water gel

PUF morphology



All elastic PUF are fine-meshed foam. Cells with a size of 0,02 mm^2 make up 1/3 of the total number, the rest are cells with an area of 0,02-0,05 mm^2.

The distribution of cells is close to normal.

Most of the investigated PUF cells have a form factor from 0,4 to 0,6.