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Tensile Stress of Epoxy Coating Materials under Different Temperature Condition

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Abstract:- The aim of that study investigates the influence the changing climatic condition on 2 different kinds of epoxy coating material film. The first one is epoxy coating film water-borne and the second one is solvent-based epoxy coating film. The fluence will be solved by the accelerated aging through the changing the temperature air and the relative humidity in 30 cycles. During the testing, influence of 2 different kinds of epoxy material measured for tensile strength. The investigation assessed the influence of this accelerated aging on the quality of the finished surfaces. Correlation of liquid properties and rheological properties of finished surfaces. These 2 different kinds of epoxy coating material tested under the 4 different kinds of the temperature cycle.

Keywords:- *Tensile Stress, Coating Films, Epoxy.*

I. INTRODUCTION

The term surface treatment generally refers to wood, glass, marble, plastic, metal, etc. Refers to the final finishing operations applied to the work done using carrier materials. Depending on the type of material, the materials and methods used in the surface treatment differ. Paint, varnish, polish, etc. applied on wood surfaces. Top surface treatments are called "Woodwork Top Surface Treatments". Despite the fact that the definition of the top surface treatments is done in different ways by different environments, it has the same meanings. Top surface treatments to express the purposes and processes can also be defined as "Coloring, decoloring and forming a protective layer to protect the goods and products made of wood material and increase their aesthetic value" (Sönmez, 2000).

The surface material and method to be applied at the place of use of wood material changes. According to the place of use, we can divide it into 3: outdoor, indoor and changing usage areas.

1. Outside the Building; These are areas where the external weather conditions dominate. Wooden house, wooden facade cladding can be given as an example.
2. Inside the Building; Our furniture, parquet, wall and ceiling coverings that we use in our living spaces are included in this group.
3. Changing Uses; Garden furniture, areas that change according to the place of use, such as cut handle, shovel handle.

In order for the surface treatment to be successful, the appropriate one should be selected and used according to the above usage areas. Apart from these, the preliminary preparation made before the application, the quality of the applied tool, the quality of the wood material, the ability of the practitioner, the weather conditions during the application, the correct use of the application times, and the correct adjustment of the application amount affect the success of the upper surface (Kurtoğlu, 2000).

Top surface treatments provide convenience in hygiene and cleaning as well as two main purposes such as protecting wooden items and increasing their aesthetic value. Especially toy and food storage containers should be covered with a material suitable for health. On the other hand, the protective layer formed on wooden surfaces prevents contamination, easy to clean, fungus, microorganism, etc. prevents the reproduction of biological pests (Sönmez, 2000).

Epoxy coating material is one of the popular and preferred material as coating material one of the reason is epoxy coating material provide convenience in hygiene and cleaning as well as one main purpose such as protecting wooden items.

Top surface treatments are applied in terms of protecting the material against external effects such as abrasion, increasing its aesthetic value and ensuring cleanliness (Özdemir, 2003)

Surface treatments protect surface in many ways (Usta, 2015).

- Effects that force woodware to crack, break, wear and permanent deformation (mechanical).
- External effects (physical) that do not harm the internal structure, such as dusting, contamination and lubrication.
- Effects such as heat, moisture, water, dew (outside weather conditions).

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• Short wavelengths and ultraviolet radiation (light) of the sun's rays.
• Fungi, microorganisms, insects (biological pests).
• Acids, alkalis, salts, etc. that damage the structure of the wood material. (chemical pests).

According to Sönmez (2000), material based on can be covered with varnish or similar materials and can be protected against these effects. According to the use and purpose of the wooden material, it is necessary to select the appropriate varnish or paint and apply them with the appropriate technique, use the varnished or painted material appropriately, and maintain the applied varnish or paint layer on time (Kaygın & Aytekin, 2008).

There is a need to develop models that evaluate the interaction of epoxy resins at the macroscopic level to explain observations on the durability of different kind wood products and different kind of epoxy material with changing moisture, humidity and temperature conditions and the acceleration aging.

This work will emphasize a model that relates how react of epoxy resins to surface of the most commonly used woods with epoxy adhesive or surface, under the condition of repeated changing moisture and temperature.

The focus will be importance of the epoxy-wood interaction and finishing application for establishing the performance criteria.

Investigate will be properties of surface finishing of epoxide coating materials.

Adhesion to a wooden surface, hardness, resistance to the influence of cold liquids dry hot and wet hot, the assessment of the liquid water permeability of finished surfaces by epoxy coating materials, the assessment of resistance to natural weathering of the epoxy coating materials.

Due to these properties, it is used in a wide area with a strong, decorative, hygienic chemical and physical resistance, and in the production of surfaces which are not harmful to human health in both application and the following life cycle.

In this context, the epoxy product group is at the forefront of "modern" building materials that will be recognized, used and loved more in the future. The aim is to integrate the epoxy product into the furniture sector and increase the durability, aesthetics, economic and decorative advantages, extend the usage area and life span and reduce the disadvantages in the same direction.

II. USED METHODS

Principle

Two different epoxies were used in the experiment; first one is waterborne based epoxy resin and second one is solvent-based epoxy resin.
The brand of waterborne epoxy; Colorlak SK s.r.o V-1301
The brand of waterborne epoxy hardeners; Colorlak SK s.r.o V7002-A-C0000
The brand of solvent-based epoxy; Lignofix A S1300 S-1118/18
Solvent-based epoxy hardeners; Lignofix B S-1118/18
The waterborne based epoxy resin mixed with its hardeners regarding their user guide which is 100:30 ratios.
100gr Colorlak SK s.r.o V-1301waterborned based epoxy resin mixed with 30gr Colorlak SK s.r.o V7002-A-C0000 hardeners
The solvent based epoxy resin mixed with hardener regarding their user guide which is 100:40 ratios.
100gr Lignofix A S1300 solvent based epoxy mixed with 40gr Lignofix B S-1118/18 hardeners.
Two different kind of mixed epoxy materials with their hardeners was laid on foils.

The materials laid in the foil were allowed to dry for 1 week at average room temperature around 20 degrees Celsius. After 1 week waiting for drying process epoxy resins were scraped from the folio by sharp metal tool.
Epoxy films have been measured to suitable dimensions for tensile stress test machine testing.

All measured epoxy films weighted and films are counted after epoxy films has separated for 4 groups regarding testing under the different temperature condition chambers.
1st Group; 30 piece of epoxy film samples were left oven for 5 weeks in 23 Celsius degrees with 45-55 humidity conditions.
2nd Group; Epoxy films were left in the oven in 50 Celsius degree temperature with /75 humidity and stay over there for 5 weeks.
3rd Group; Epoxy films in the freezer in -30 degree with 0 humidity and stay over there for 5 weeks
4th Group; Epoxy films will have 30 cycle of 2 different extreme temperature condition.
1 hour +50 Celsius degree at the oven after that,
1 hour -30 Celsius degree at the freezer

When this cycle done its counted as a 1 cycle. Samples are waiting at the freezer rest of the time. (weekends and after cycles) After the samples are going to get tested in Instron 3360 Series Dual Column Table Top Testing System. The testing systems provide pulling test simplicity, performance, and affordability for quality control (QC) labs and production testing.

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Used Equipment
Instron 3360 Series Dual Column Tabletop Testing System
BMT Venticell 111 Labrotary Oven
El Cold Freezer Lab 11
Capable of precision measurement scales

Test Standarts
Tensile tests were performed using a test device by of the company Instron 3365 Machine Serial Number Locator with measurement software Blue hills
ČSN 910277 Furniture. Testing the furniture surface coating. Method of determining the surface impact resistance
ČSN EN ISO 527-3 Determination of tensile properties Part 3 The conditions for films and foils
ČSN EN ISO 527-1 Determination of tensile properties Part 1 General principles
ČSN EN ISO 2815 Buchholz indentation tests
ČSN EN ISO 2409 Adhesion Paints and varnishes cross-cut standard
BS 3962 part 6 The resistance of finished surfaces to mechanical damage - the impact tests

Tested Samples
30 samples of waterborne epoxy resin (70mm ±2)*(20mm±2) for each different group
30 samples of solvent based epoxy resin (70mm ±2)*(20mm±2) for each different group

III. RESULTS AND DISCUSSION

Below, tables and the figures there are published the results of the investigation of influence of different based epoxy resins under the different temperature conditions on the tested samples assessment. In figure numbers 1,2,4,5,8,9,11,12,14,15,17,18,20,21,23,24 are breaking point of each epoxy film samples for tensile stress testing. In the table numbers 1,2,3,4,5,6,7,8 are showing; Tensile stress (MPa),Load(N),Stretching(mm),Module(Mpa).

The mean qualities and standard deviations of evaluated properties were determinate and determined for prolongation of the example of the finish film in maximum power (Fmax). The diagrams have indicated the conduct of the covering films during the tensile stress tests. As a result of the tensile stress testing of different kind of epoxy films under the different temperature conditions, each waterborne epoxy coating film and solvent based epoxy coating films shows different mechanical and physical reactions at each temperature.

1st Group of Samples
30 piece of epoxy film samples were left the oven for 5 weeks in 23 Celsius degrees with 45-55 humidity conditions.

Result of tensile stress of solvent-based epoxy coating material room temperature

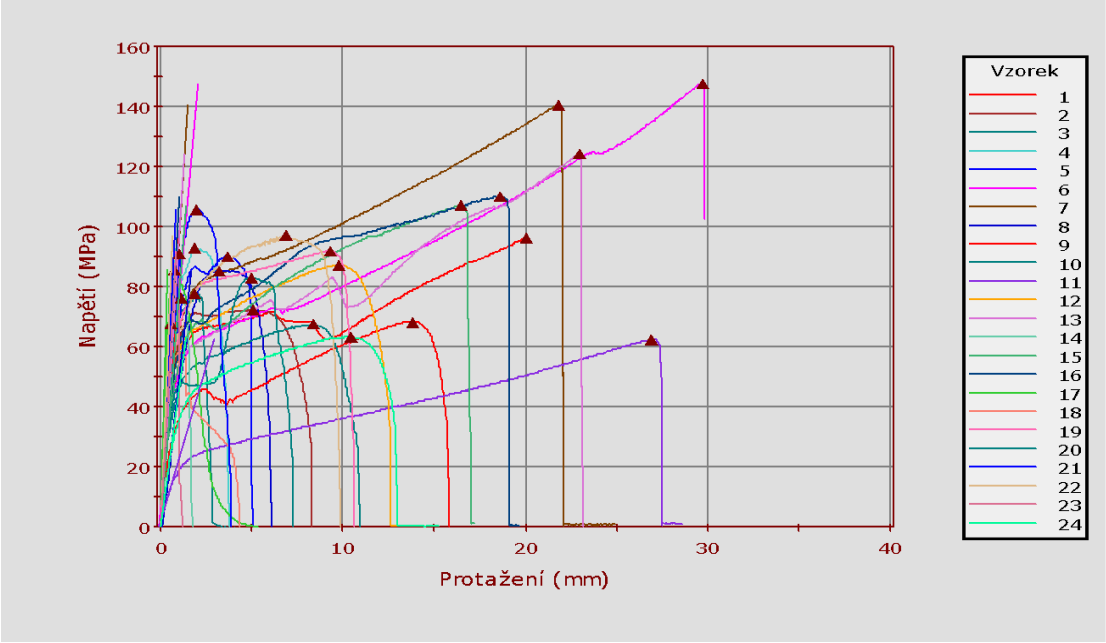

Figure1. Tensile Stress of solvent-based epoxy coating material

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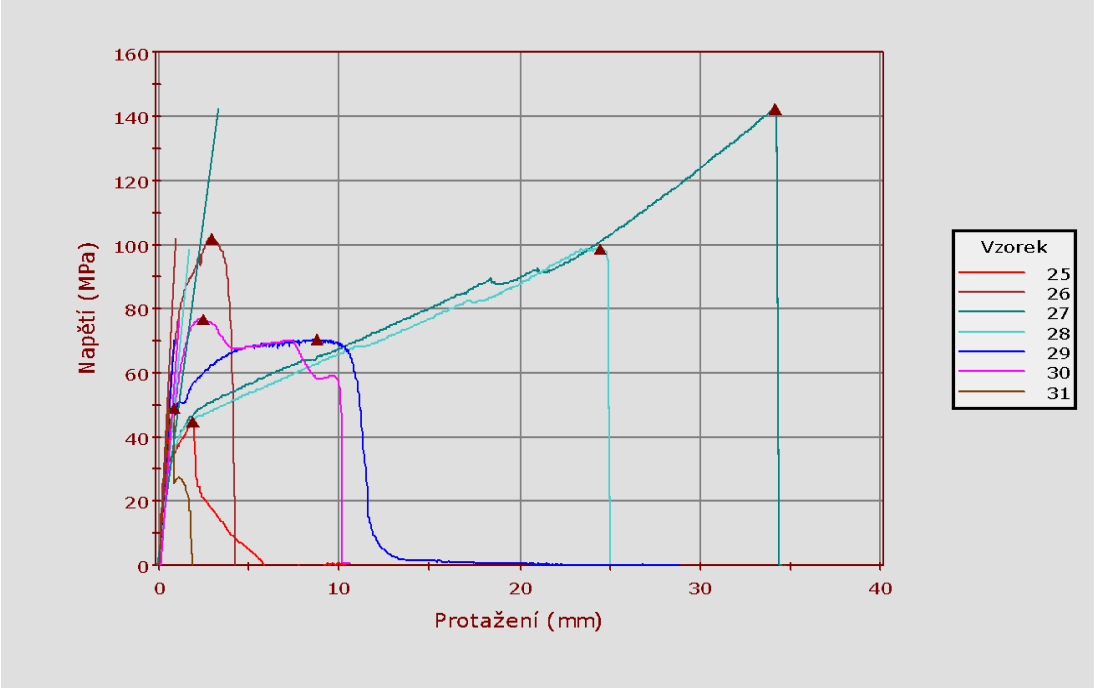

Figure2. Tensile Stress of solvent-based epoxy coating material-2

	Sample label	Tensile stress (kPa)	Load (N)	Stretching (mm)	Module (MPa)	Evaluation
1		96,260	33,691	20,02347	10286,33	
2		72,176	25,261	5,09990	11594,70	
3		77,607	27,162	1,86658	11231,27	
4		92,798	32,479	1,90011	11139,79	
5		89,987	31,495	3,63376	8329,58	
6		147,673	51,686	29,73346	6768,10	
7		140,295	49,103	21,80022	9033,17	
8		85,239	29,834	3,16673	5369,15	
9		68,232	23,881	13,83309	7561,45	
10		67,385	23,585	8,36663	9242,46	
11		62,411	21,844	26,93329	2112,65	
12		87,056	30,470	9,80006	9731,99	
13		124,385	43,535	22,99990	10004,09	
14		76,100	26,635	1,10005	10927,29	
15		106,952	37,433	16,49998	7642,76	
16		110,124	38,543	18,63337	10189,06	
17		85,877	30,057	0,73360	21884,72	
18		67,663	23,682	0,60008	13569,00	
19		91,959	32,186	9,30045	11105,54	
20		83,032	29,061	5,03332	11098,83	
21		105,798	37,029	1,99963	12082,31	
22		96,907	33,918	6,86673	15376,76	
23		90,799	31,780	1,03299	11040,88	
24		63,247	22,136	10,43320	4641,92	
25		44,647	15,627	1,86647	7538,07	
26		101,848	35,647	2,89981	10902,36	
27		142,417	49,846	34,16694	4184,54	
28		98,702	34,546	24,50028	5844,31	
29		70,364	24,627	8,76637	8175,97	
30		76,788	26,876	2,43349	6939,18	
31		48,852	17,098	0,83288	8505,81	

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Diameter		89,470	31,315	10,22119	9485,61	
Maximum		147,673	51,686	34,16694	21884,72	
Minimal		44,647	15,627	0,60008	2112,65	
Standard deviation		25,210	8,824	9,912	3653,55	
Non-uniformity coefficient		28,177	28,177	96,971	38,52	
Median		87,056	30,470	6,86673	9731,99	

Table 1. Results of each samples tensile stress of solvent-based epoxy coating material

Figure3 . Broken solvent-based epoxy coating samples after tensile stress test

Result of Tensile Stress of Water-borne Epoxy Coating Material Room Temperature

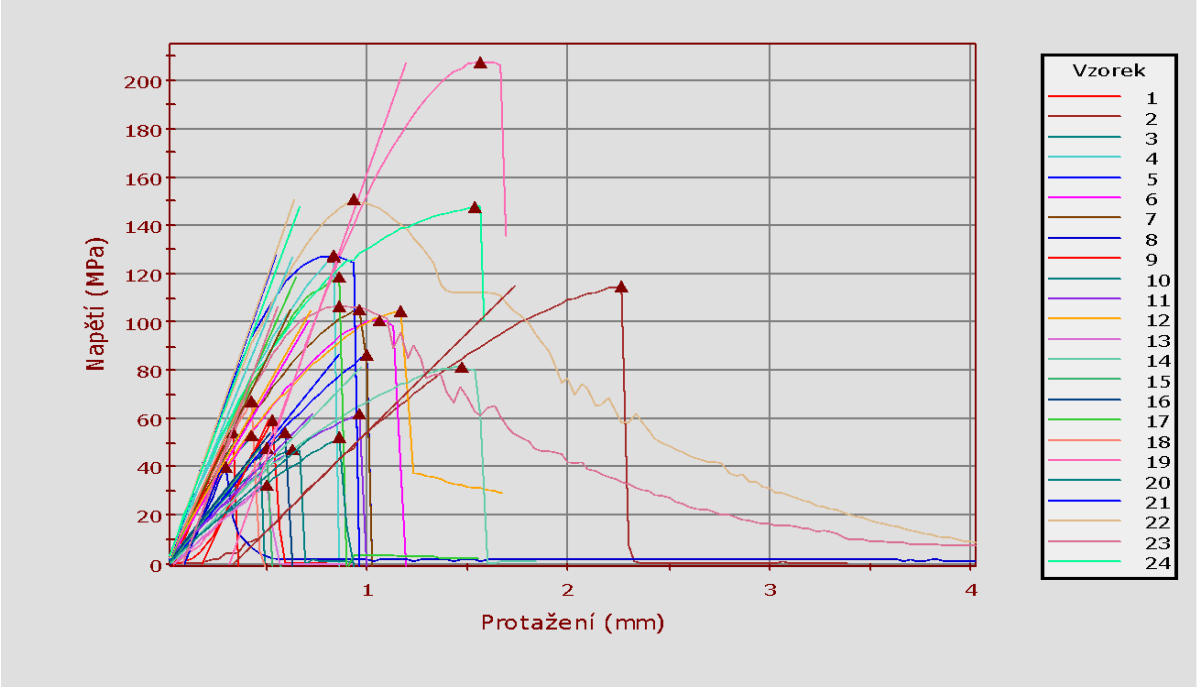

Figure 4. Tensile stress of waterborned epoxy coating material

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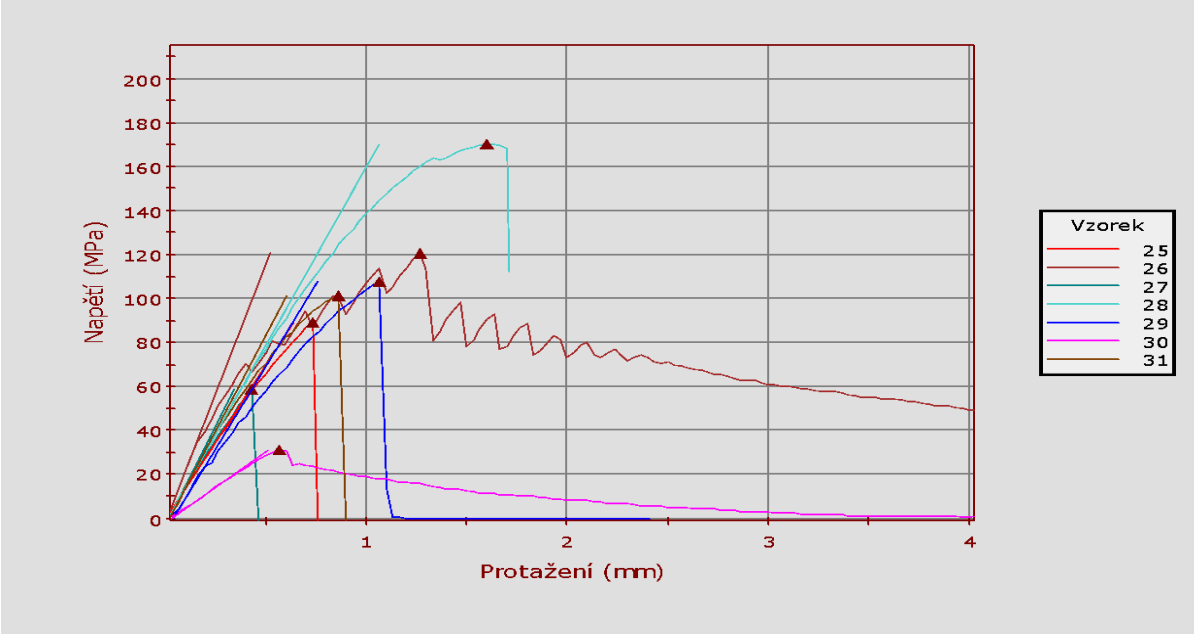

Figure 5. Tensile stress of waterborned epoxy coating material-2

	Sample label	Tensile stress (kPa)	Load (N)	Stretching (mm)	Module (MPa)	Evaluation
1		54,543	19,090	0,33327	20210,53	
2		114,961	40,236	2,26620	8185,07	
3		52,946	18,531	0,43350	14864,04	
4		127,036	44,463	0,83288	20295,64	
5		86,829	30,390	1,00029	10415,41	
6		100,756	35,265	1,06687	14218,18	
7		105,302	36,856	0,96652	17156,04	
8		39,952	13,983	0,29998	21525,13	
9		59,453	20,809	0,53361	17790,15	
10		47,391	16,587	0,63325	10520,75	
11		61,875	21,656	0,96593	8377,20	
12		104,498	36,574	1,16675	14438,67	
13		32,240	11,284	0,49997	7487,26	
14		81,212	28,424	1,46673	8595,19	
15		48,079	16,828	0,50020	10904,64	
16		54,384	19,034	0,59996	10602,79	
17		119,005	41,652	0,86700	18775,71	
18		66,969	23,439	0,43338	18166,49	
19		207,761	72,716	1,56589	23657,02	
20		52,364	18,327	0,86689	7327,24	
21		127,506	44,627	0,83288	23942,73	
22		150,635	52,722	0,93382	24128,29	
23		106,469	37,264	0,86689	22644,25	
24		147,890	51,761	1,53319	22345,91	
25		89,394	31,288	0,73372	14005,28	
26		120,369	42,129	1,26686	23515,12	
27		59,004	20,651	0,43327	17944,50	

28		169,923	59,473	1,59989	16112,11	
29		107,803	37,731	1,06711	15033,95	
30		31,472	11,015	0,56655	6607,03	
31		101,644	35,575	0,86689	17439,39	
Diameter		91,280	31,948	0,90323	15717,15	
Maximum		207,761	72,716	2,26620	24128,29	
Minimal		31,472	11,015	0,29998	6607,03	
Standard deviation		42,871	15,005	0,444	5638,42	
Non-uniformity coefficient		46,967	46,967	49,119	35,87	
Median		89,394	31,288	0,86689	16112,11	

Table 2. Results of each samples tensile stress of water-borned epoxy coating materiál

Figure 6. Broken samples after tensile stress of waterborned epoxy coating material

2nd Group of Samples in the oven

Epoxy films were left in the oven in 50 Celsius degree temperature with %75 humidity and stay over there for 5 weeks.

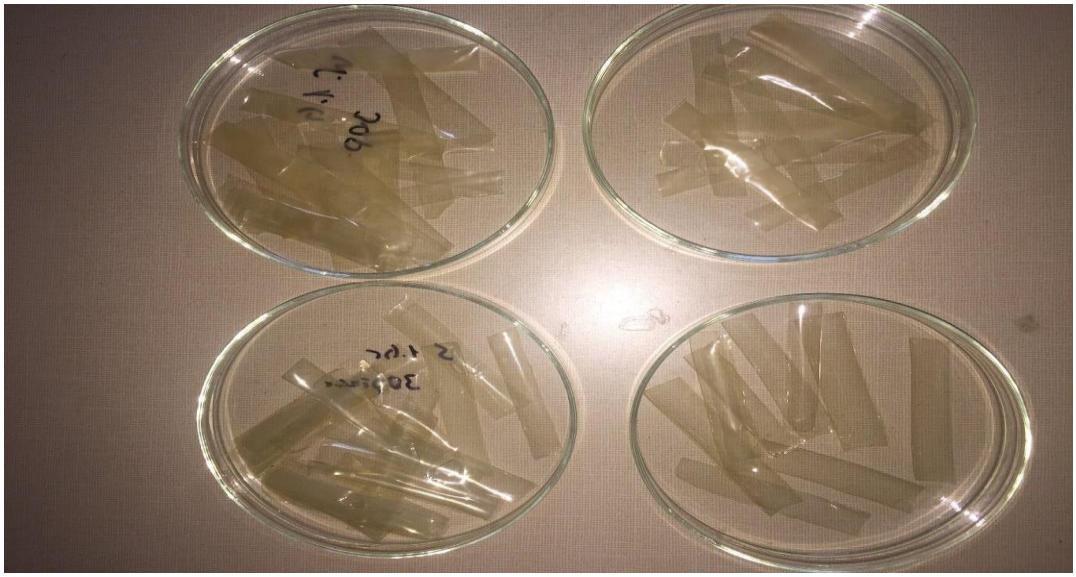

Figure 7 . Coating film samples after oven

Waterborne Epoxy Samples

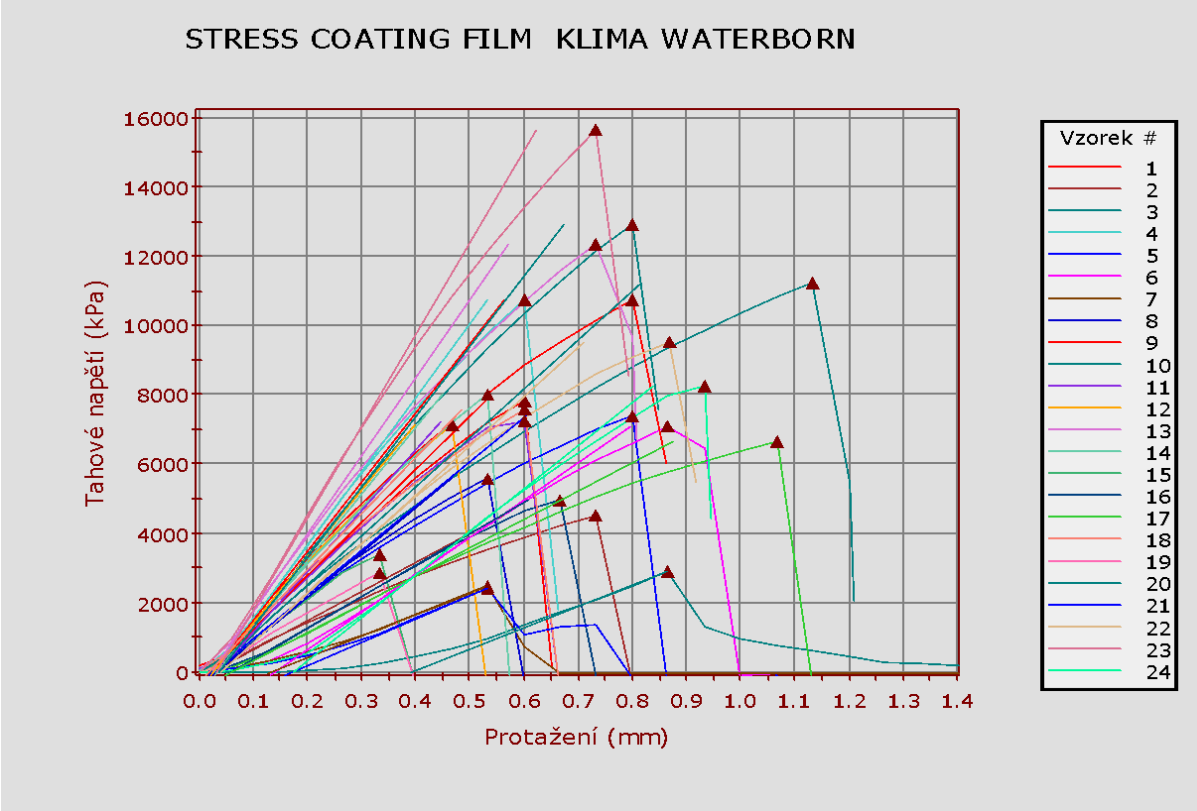

Figure 8. **Tensile stress of waterborned epoxy coating material**

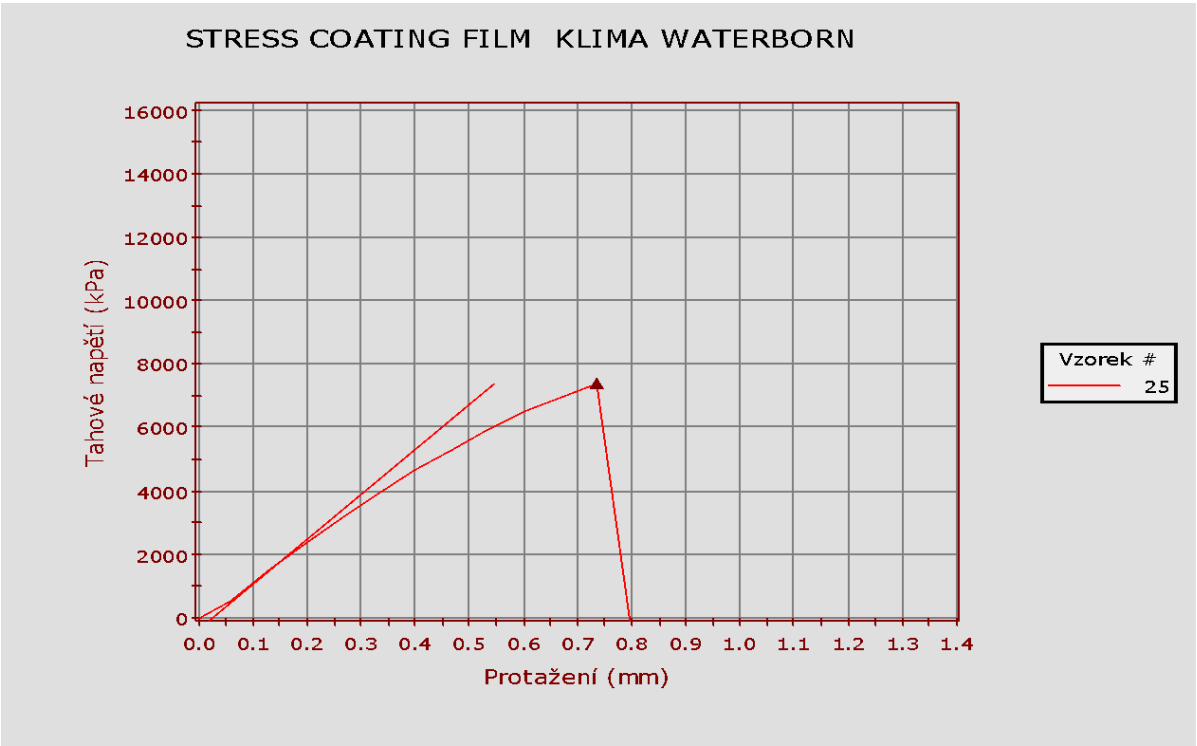

Figure 9. **Tensile stress of waterborned epoxy coating material-2**

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	Sample label	Tensile stress (kPa)	Load (N)	Stretching (mm)	Module (MPa)
1		7827,128	50,876	9236,986	
2		4520,539	29,384	5061,941	
3		11236,982	73,040	8492,581	
4		10720,703	69,685	12797,430	
5		7375,290	47,939	7641,250	
6		7083,098	46,040	6488,511	
7		2449,021	15,919	3758,969	
8		5583,433	36,292	7701,514	
9		10727,081	69,726	11954,637	
10		2898,588	18,841	3663,274	
11		7241,220	47,068	10510,846	
12		7118,898	46,273	11474,498	
13		12330,890	80,151	13512,279	
14		8021,832	52,142	11500,532	
15		3400,636	22,104	-----	
16		4967,514	32,289	5459,800	
17		6644,991	43,192	4902,536	
18		7563,209	49,161	9756,476	
19		2855,433	18,560	-----	
20		12920,496	83,983	12122,500	
21		2434,911	15,827	4076,734	
22		9549,265	62,070	8560,256	
23		15645,075	101,693	15839,518	
24		8240,899	53,566	7421,449	
25		7408,084	48,153	8542,863	
Diameter		7470,609	48,559	8716,408	
Maximum		15645,075	101,693	15839,518	
Minimal		2434,911	15,827	3663,274	
Standard deviation		3474,586	22,585	3381,008	
Non-uniformity coefficient		46,510	46,510	38,789	
Median		7375,290	47,939	8542,863	

Table 3. Results of each samples tensile stress of water-borned epoxy coating materiál

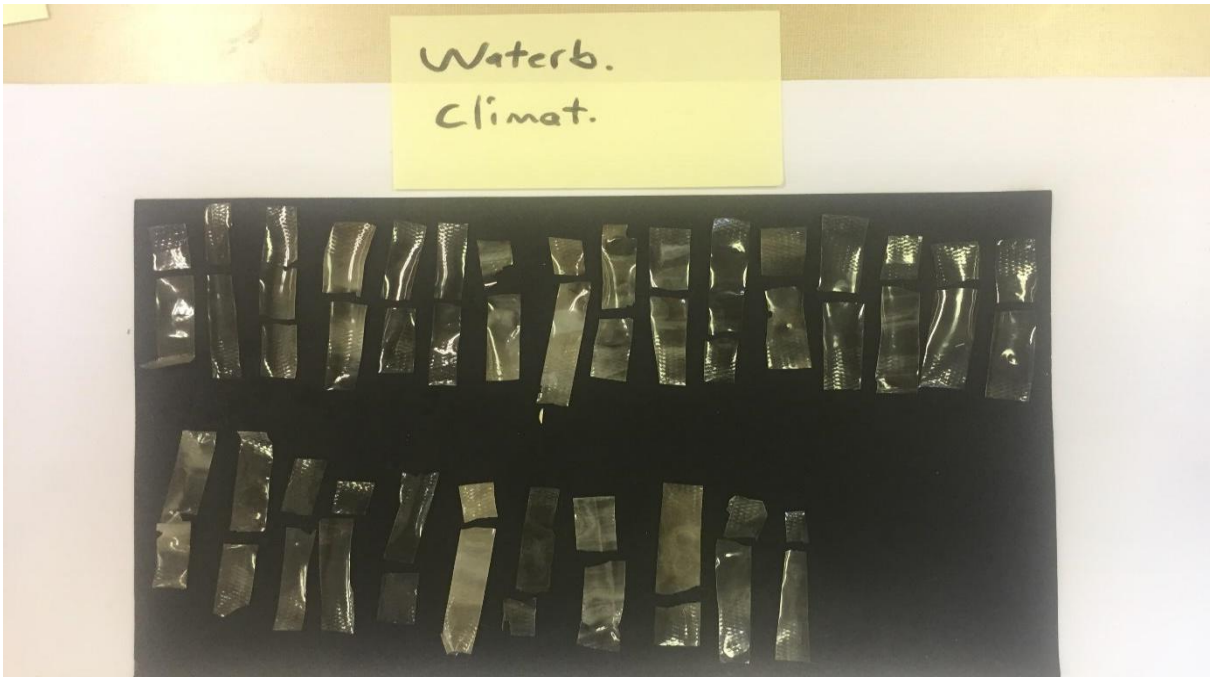

Figure 10. Broken samples after tensile stress of waterborned epoxy coating material

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Solvent Based Epoxy

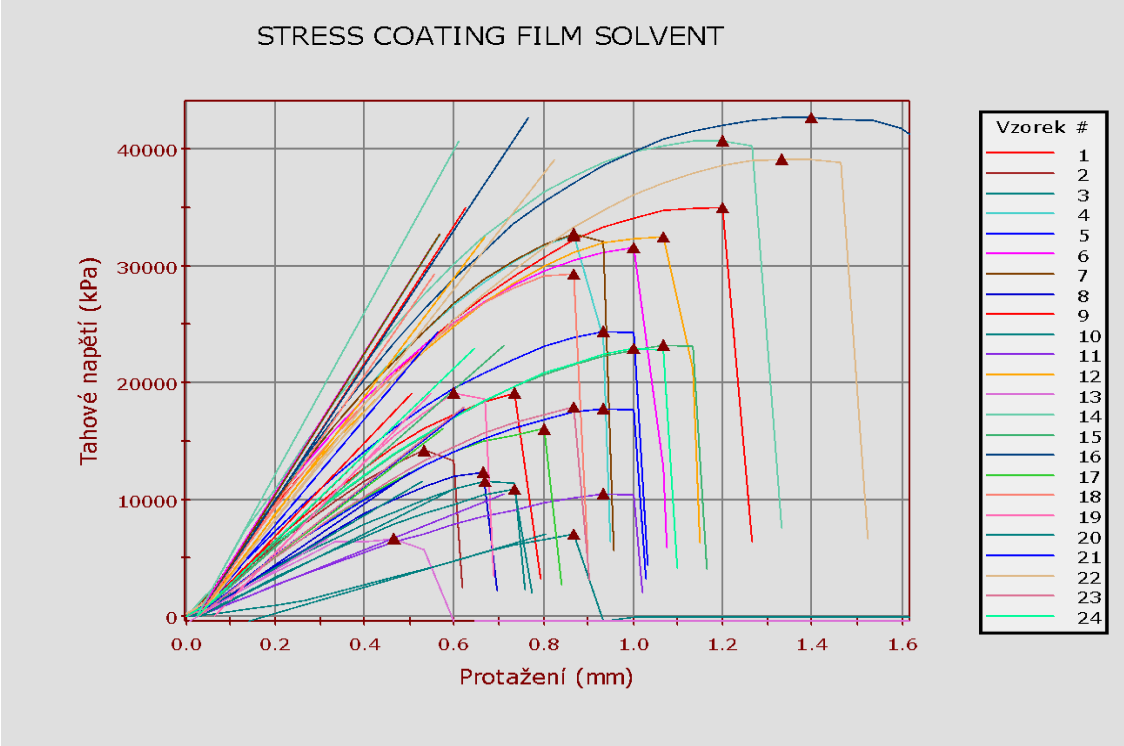

Figure 11. **Tensile stress of solventbased epoxy coating material**

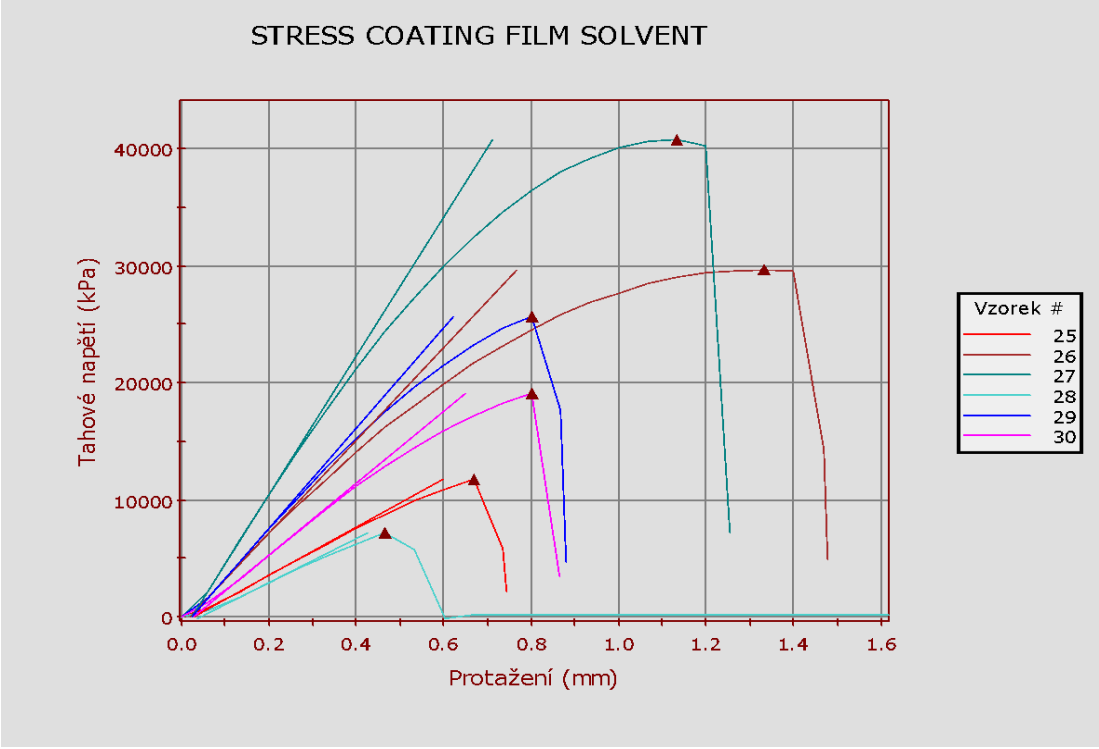

Figure 12. **Tensile stress of solventbased epoxy coating material-2**

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	Sample label	Tensile stress (kPa)	Load (N)	Stretching (mm)	Module (MPa)
1		34981,964	227,383	35206,409	
2		14157,030	92,021	22044,576	
3		11483,232	74,641	13437,797	
4		32635,784	212,133	36170,717	
5		24387,627	158,520	27389,298	
6		31513,157	204,836	36217,084	
7		32703,880	212,575	36310,785	
8		12308,672	80,006	15730,310	
9		19146,391	124,452	24126,820	
10		6975,059	45,338	6690,068	
11		10522,258	68,395	9259,609	
12		32512,081	211,329	30482,114	
13		6590,089	42,836	13691,995	
14		40703,045	264,570	41734,056	
15		23168,337	150,594	20194,733	
16		42719,498	277,677	34796,285	
17		16095,102	104,618	17576,630	
18		29262,180	190,204	33140,356	
19		19074,011	123,981	23531,820	
20		10864,297	70,618	11501,359	
21		17735,924	115,284	17921,942	
22		39137,459	254,393	29580,224	
23		17832,144	115,909	18055,238	
24		22896,858	148,830	22106,332	
25		11727,374	76,228	12365,771	
26		29672,058	192,868	23929,940	
27		40811,962	265,278	35612,912	
28		7091,396	46,094	11050,048	
29		25760,866	167,446	25886,075	
30		19071,556	123,965	18421,720	
Diameter		22784,710	148,101	23472,101	
Maximum		42719,498	277,677	41734,056	
Minimal		6590,089	42,836	6690,068	
Standard deviation		11060,244	71,892	9707,807	
Non-uniformity coefficient		48,542	48,542	41,359	
Median		21021,625	136,641	22819,076	

Table 4 *Results of each samples tensile stress of solventbased epoxy coating materiál*

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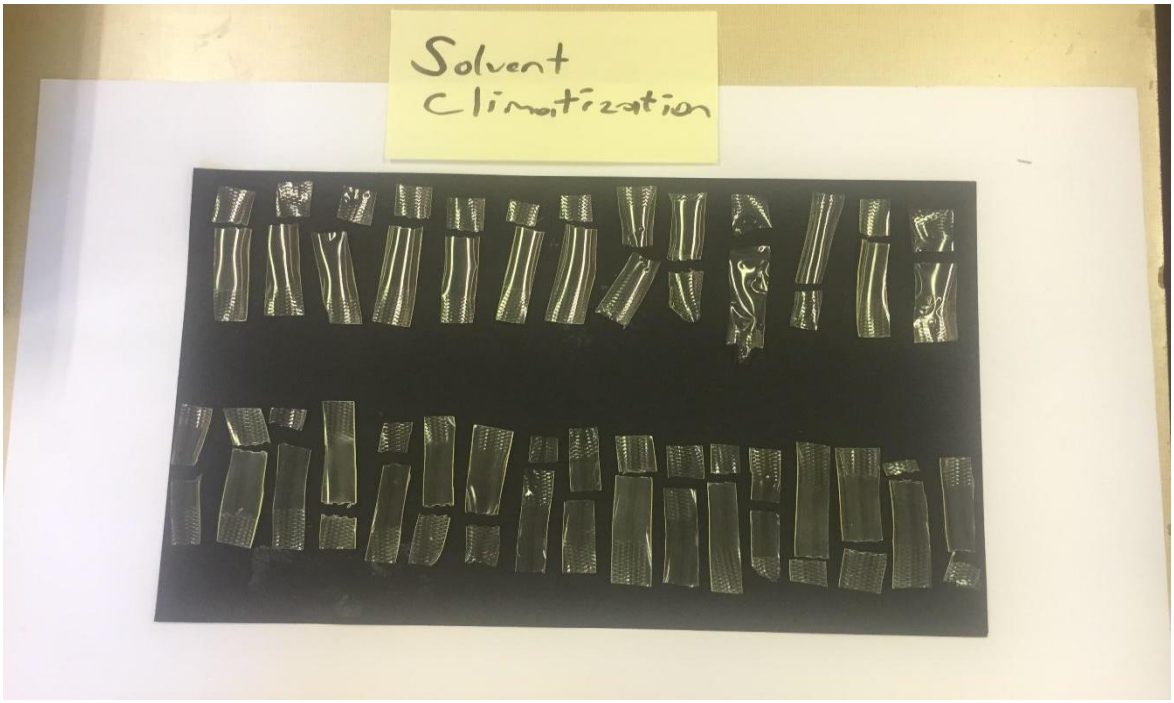

Figure 13. Broken samples after tensile stress of solventbased epoxy coating materiál

3rd Group Frozen Samples

Epoxy films in the freezer in-30 Celsius degree with 0 humidity and stay over there for 5 weeks

Waterborne Epoxy Group

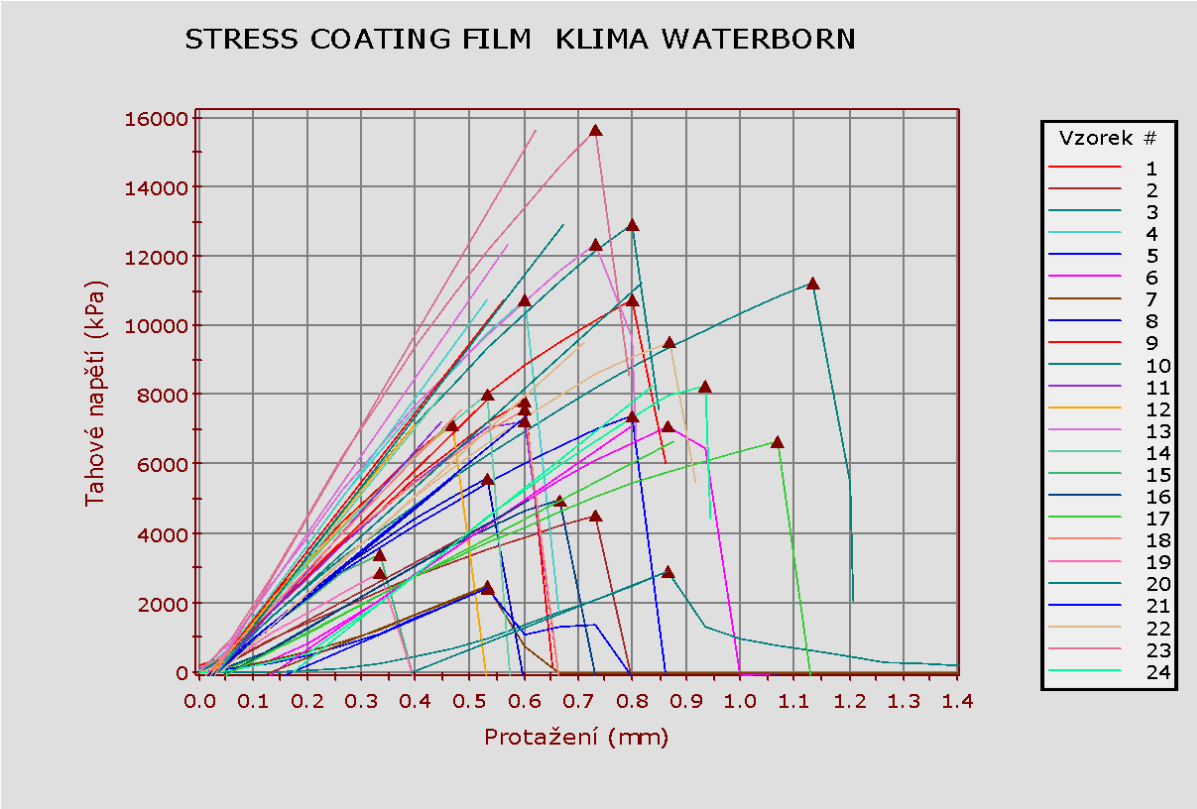

Figure 14. **Tensile stress of waterborne epoxy coating material**

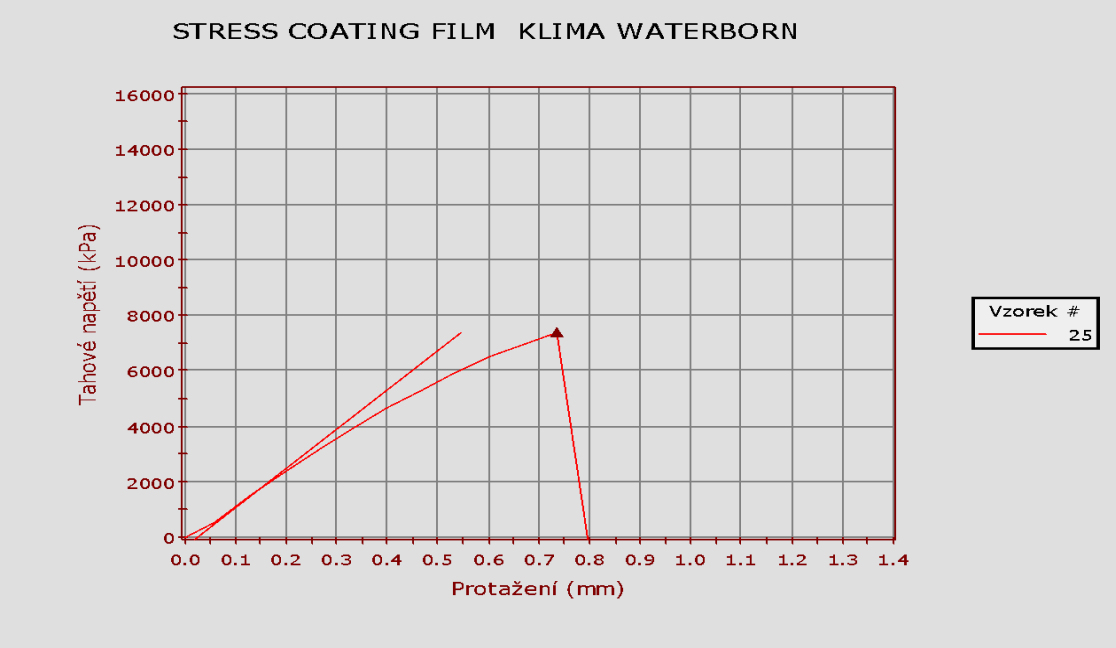

Figure 15. **Tensile stress of waterborne epoxy coating material-2**

	Sample label	Tensile stress (kPa)	Load (N)	Stretching (mm)	Module (MPa)
1		**7827,128**	**50,876**	**9236,986**	
2		**4520,539**	**29,384**	**5061,941**	
3		**11236,982**	**73,040**	**8492,581**	
4		**10720,703**	**69,685**	**12797,430**	
5		**7375,290**	**47,939**	**7641,250**	
6		**7083,098**	**46,040**	**6488,511**	
7		**2449,021**	**15,919**	**3758,969**	
8		**5583,433**	**36,292**	**7701,514**	
9		**10727,081**	**69,726**	**11954,637**	
10		**2898,588**	**18,841**	**3663,274**	
11		**7241,220**	**47,068**	**10510,846**	
12		**7118,898**	**46,273**	**11474,498**	
13		**12330,890**	**80,151**	**13512,279**	
14		**8021,832**	**52,142**	**11500,532**	
15		**3400,636**	**22,104**	**-----**	
16		**4967,514**	**32,289**	**5459,800**	
17		**6644,991**	**43,192**	**4902,536**	
18		**7563,209**	**49,161**	**9756,476**	
19		**2855,433**	**18,560**	**-----**	
20		**12920,496**	**83,983**	**12122,500**	
21		**2434,911**	**15,827**	**4076,734**	
22		**9549,265**	**62,070**	**8560,256**	
23		**15645,075**	**101,693**	**15839,518**	
24		**8240,899**	**53,566**	**7421,449**	
25		**7408,084**	**48,153**	**8542,863**	
Diameter		**7470,609**	**48,559**	**8716,408**	
Maximum		**15645,075**	**101,693**	**15839,518**	
Minimal		**2434,911**	**15,827**	**3663,274**	
Standard deviation		**3474,586**	**22,585**	**3381,008**	
Non-uniformity coefficient		**46,510**	**46,510**	**38,789**	
Median		**7375,290**	**47,939**	**8542,863**	

Table 5. Results of each samples tensile stress of waterborne epoxy coating material

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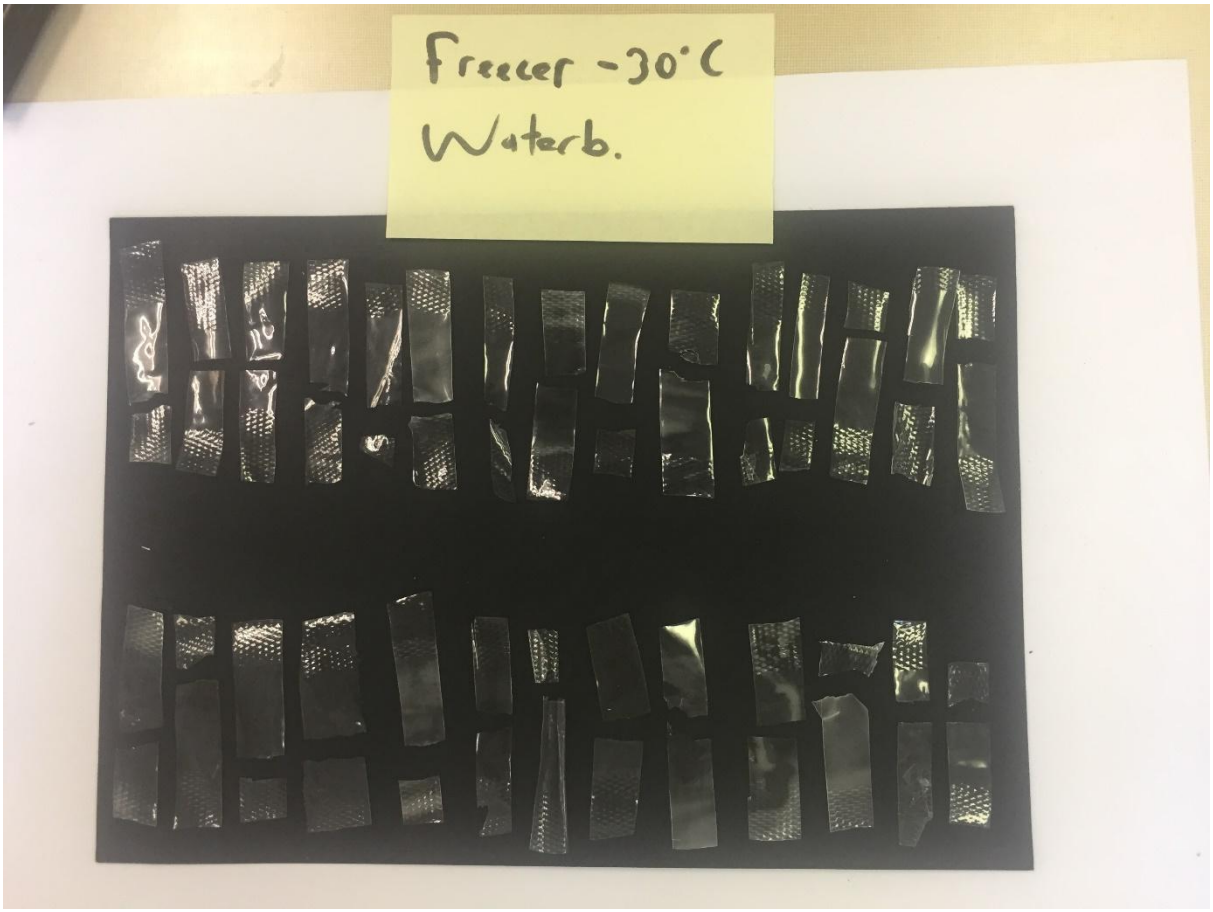

Figure 16. Broken samples after tensile stress of waterborne epoxy coating materiál

Solventbased Epoxy Group

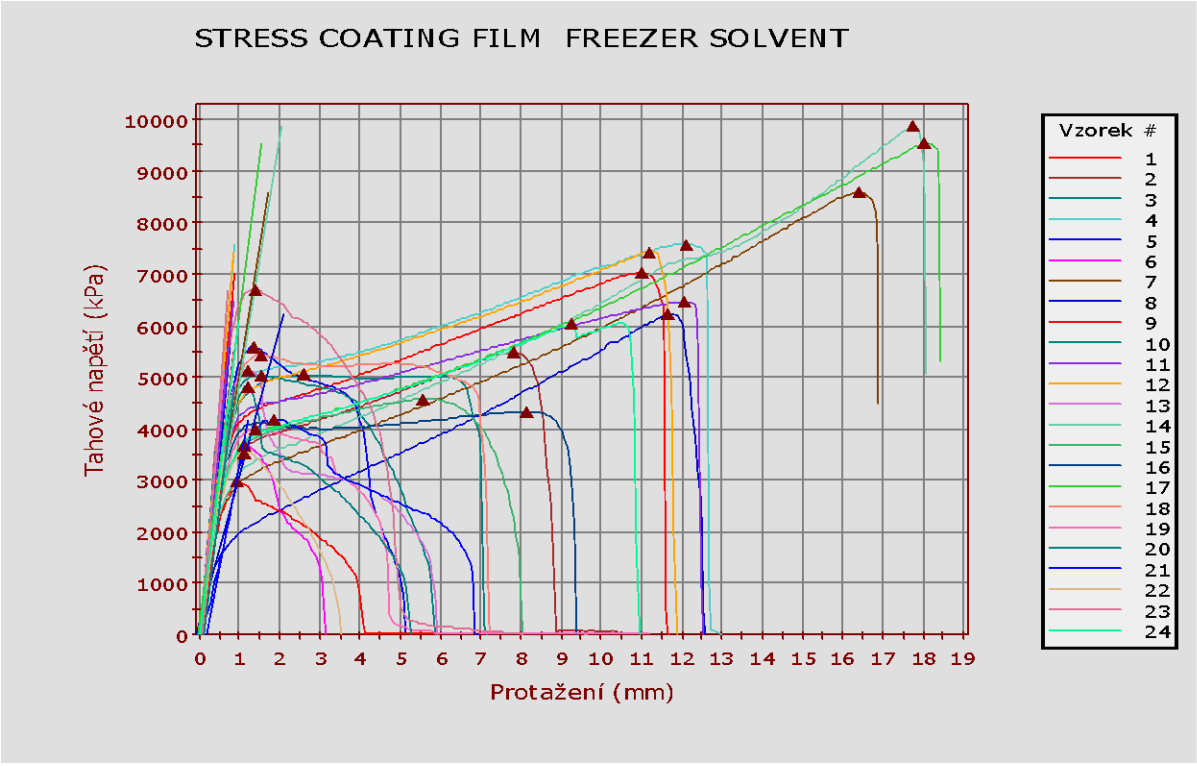

Figure 17. Tensile stress of solventbased epoxy coating material

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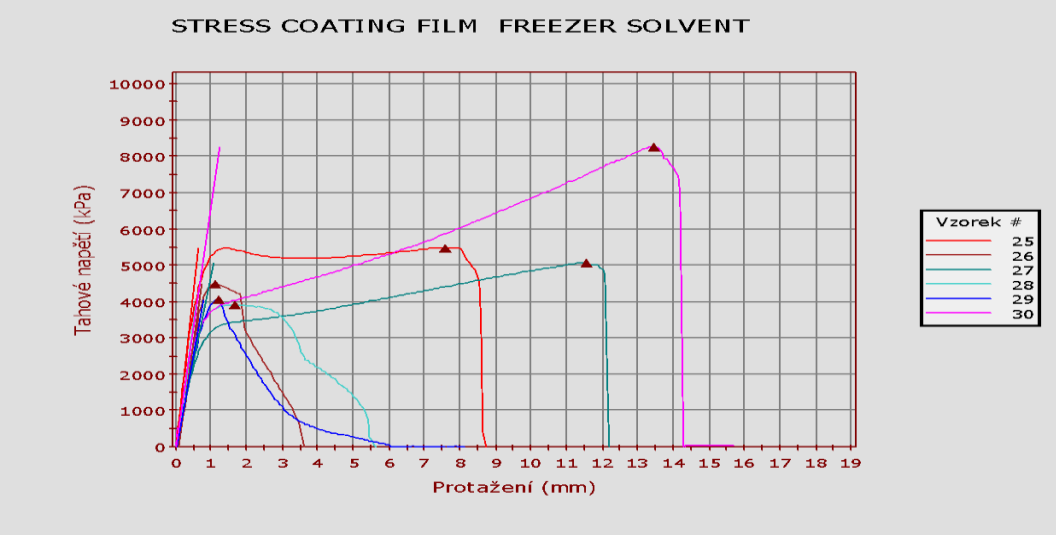

Figure 18. Tensile stress of solventbased epoxy coating material-2

	Sample label	Tensile stress (kPa)	Load (N)	Stretching (mm)	Module (MPa)
1		**7025,320**	**45,665**	**4757,095**	
2		**5483,064**	**35,640**	**3908,973**	
3		**5052,952**	**32,844**	**5753,619**	
4		**7584,824**	**49,301**	**5258,618**	
5		**5583,895**	**36,295**	**4992,802**	
6		**3676,818**	**23,899**	**3525,854**	
7		**8594,821**	**55,866**	**2905,427**	
8		**6224,024**	**40,456**	**1733,108**	
9		**2979,637**	**19,368**	**3589,206**	
10		**5038,280**	**32,749**	**4684,748**	
11		**6462,349**	**42,005**	**4578,452**	
12		**7434,921**	**48,327**	**5333,421**	
13		**5134,811**	**33,376**	**5309,338**	
14		**9896,541**	**64,328**	**2861,735**	
15		**4577,115**	**29,751**	**3610,977**	
16		**4340,875**	**28,216**	**3806,567**	
17		**9536,670**	**61,988**	**3630,132**	
18		**5442,273**	**35,375**	**4106,029**	
19		**3993,152**	**25,955**	**3774,342**	
20		**4831,335**	**31,404**	**3650,754**	
21		**4185,750**	**27,207**	**2474,107**	
22		**3544,387**	**23,039**	**3520,988**	
23		**6702,180**	**43,564**	**6224,898**	
24		**6046,227**	**39,300**	**3764,279**	
25		**5474,922**	**35,587**	**5102,997**	
26		**4472,482**	**29,071**	**4145,407**	
27		**5073,331**	**32,977**	**2885,852**	
28		**3903,123**	**25,370**	**4305,528**	
29		**4043,071**	**26,280**	**3159,049**	
30		**8255,682**	**53,662**	**3966,643**	
Diameter		**5686,494**	**36,962**	**4044,031**	
Maximum		**9896,541**	**64,328**	**6224,898**	
Minimal		**2979,637**	**19,368**	**1733,108**	
Standard deviation		**1780,862**	**11,576**	**1014,451**	
Non-uniformity coefficient		**31,317**	**31,317**	**25,085**	
Median		**5288,542**	**34,376**	**3857,770**	

Table 6. Results of each samples tensile stress of solventbased epoxy coating material

Figure 19. Broken samples after tensile stress of solventbased epoxy coating materiál

4th Group; Epoxy films had 30 cycles of 2 different extreme temperature condition
1 hour +50 Celsius degree at the oven then,
1 hour -30 Celsius degree at the freezer
When this cycle done its counted as a 1 cycle. Samples are waiting at the freezer rest of the time. (weekends and after cycles)
After the samples are going to get tested in Instron 3360 Series Dual Column Table Top Testing System. The testing systems provide pulling test simplicity, performance, and affordability for quality control (QC) labs and production testing.

Waterborne Epoxy Group

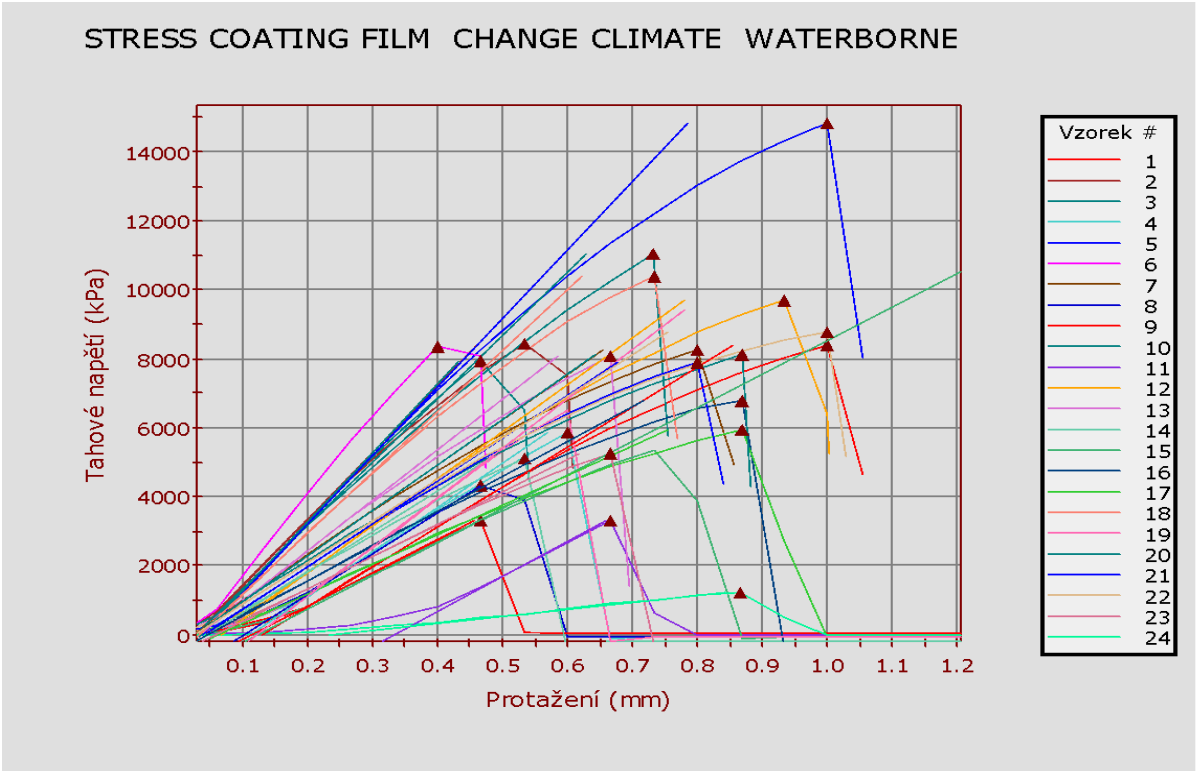

Figure 20. Tensile stress of waterborne epoxy coating material

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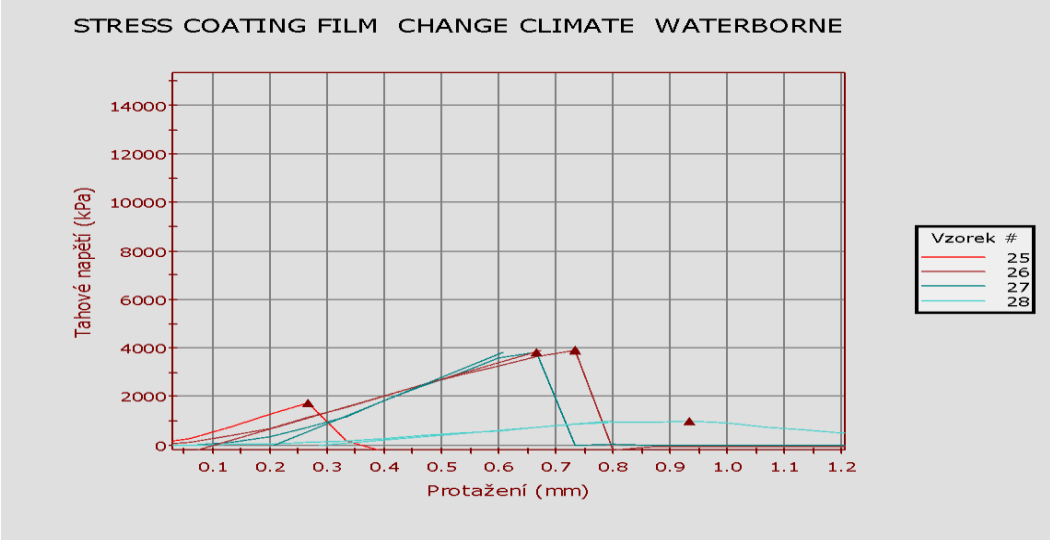

Figure 21. Tensile stress of waterborne epoxy coating material-2

	Sample label	Tensile stress (kPa)	Load (N)	Stretching (mm)	Module (MPa)
1		**8387,760**	**54,520**	**6951,643**	
2		**8428,638**	**54,786**	**11580,047**	
3		**11043,585**	**71,783**	**11012,242**	
4		**5840,105**	**37,961**	**7658,867**	
5		**14829,358**	**96,391**	**11888,103**	
6		**8369,418**	**54,401**	**-----**	
7		**8264,232**	**53,718**	**7835,894**	
8		**4312,650**	**28,032**	**7146,803**	
9		**3335,047**	**21,678**	**5857,160**	
10		**7920,741**	**51,485**	**12005,862**	
11		**3308,039**	**21,502**	**6085,764**	
12		**9673,913**	**62,880**	**8156,065**	
13		**8073,460**	**52,477**	**8758,539**	
14		**5108,990**	**33,208**	**7044,393**	
15		**15744,583**	**102,340**	**5855,966**	
16		**6807,054**	**44,246**	**6071,906**	
17		**5972,428**	**38,821**	**5156,702**	
18		**10402,864**	**67,619**	**10591,010**	
19		**9437,255**	**61,342**	**8618,509**	
20		**8109,626**	**52,713**	**7913,365**	
21		**7897,252**	**51,332**	**7465,296**	
22		**8783,797**	**57,095**	**7226,285**	
23		**5271,956**	**34,268**	**5671,744**	
24		**1260,204**	**8,191**	**1256,000**	
25		**1758,958**	**11,433**	**-----**	
26		**3909,808**	**25,414**	**4124,382**	
27		**3815,324**	**24,800**	**5711,952**	
28		**988,510**	**6,425**	**1174,348**	
Diameter		**7037,698**	**45,745**	**7262,263**	
Maximum		**15744,583**	**102,340**	**12005,862**	
Minimal		**988,510**	**6,425**	**1174,348**	
Standard deviation		**3615,470**	**23,501**	**2776,886**	
Non-uniformity coefficient		**51,373**	**51,373**	**38,237**	
Median		**7908,996**	**51,408**	**7186,544**	

Table 7. Results of each samples tensile stress of waterborne epoxy coating material

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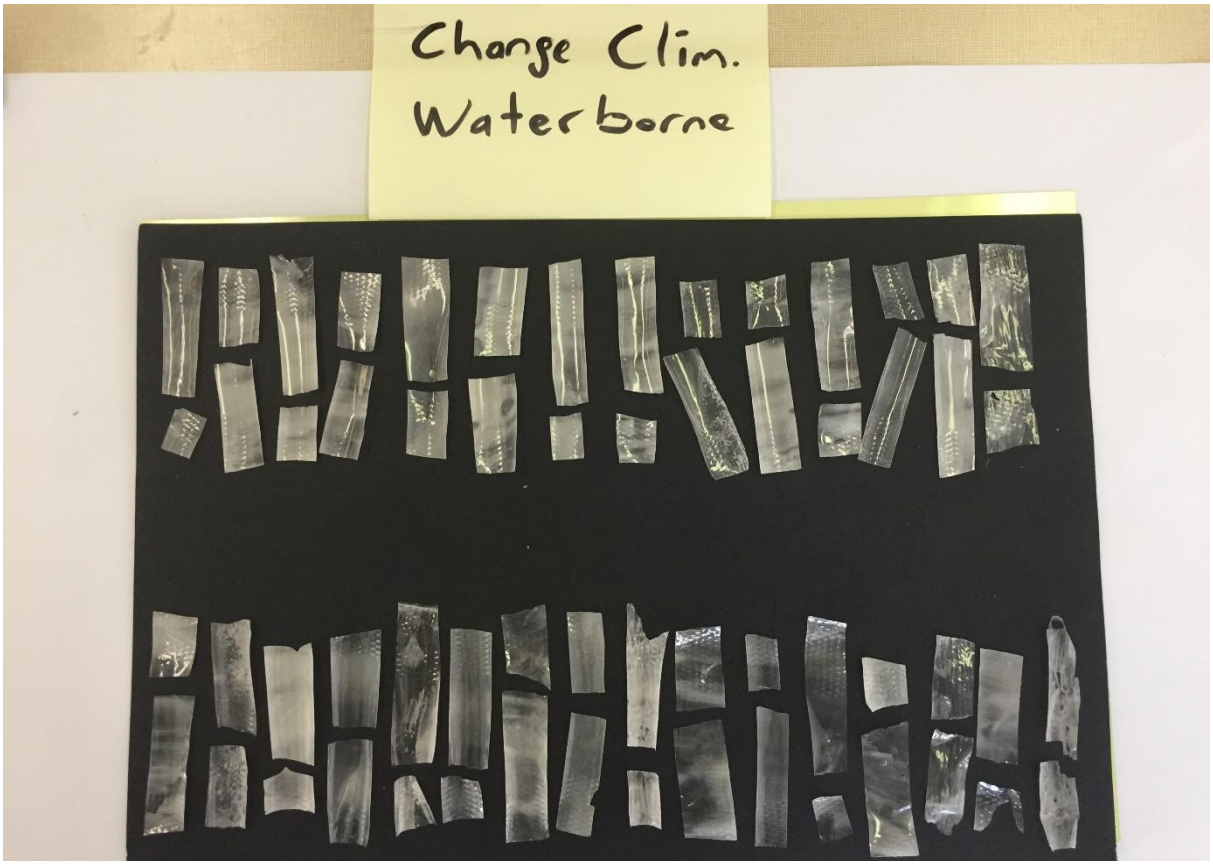

Figure 22. *Broken samples after tensile stress of waterborne epoxy coating material*

Solvent Based Epoxy Group

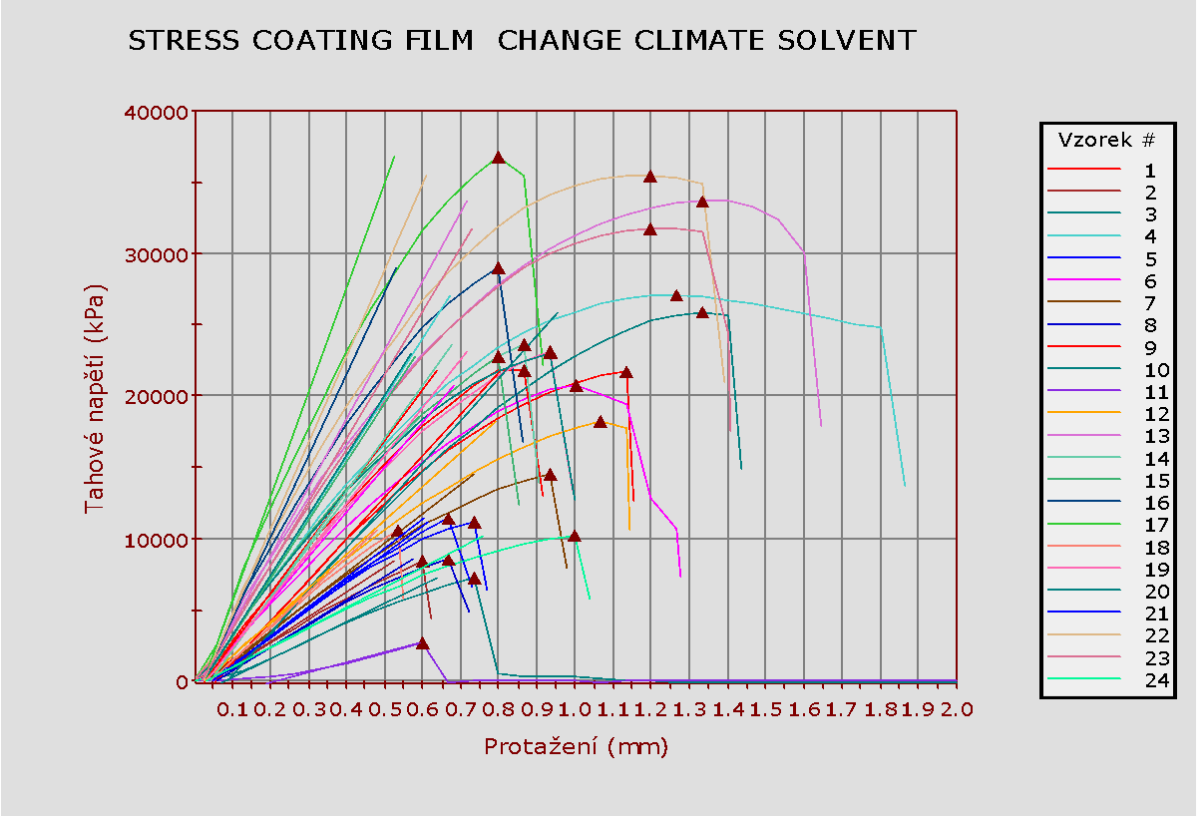

Figure 23. Tensile stress of solventbased epoxy coating material

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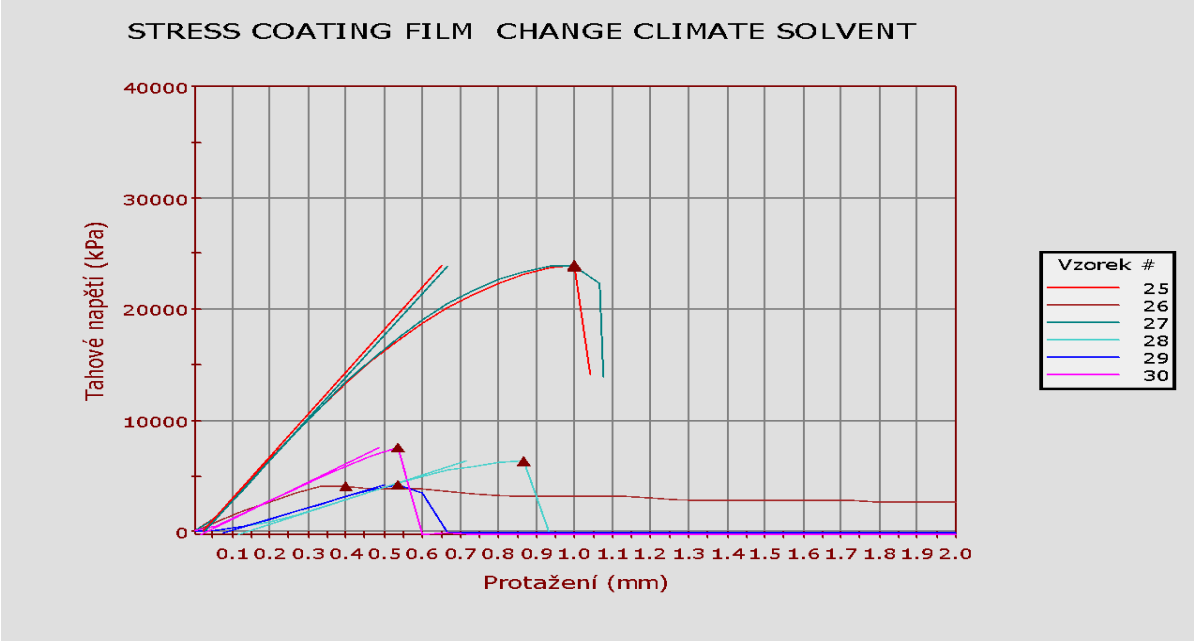

Figure 24. Tensile stress of solventbased epoxy coating material-2

	Sample label	Tensile stress (Pa)	Load (N)	Stretching (mm)	Module (MPa)
1		21710,457	141,118	17446,500	
2		8399,733	54,598	10462,270	
3		7195,377	46,770	7690,755	
4		27110,874	176,221	25185,028	
5		11223,031	72,950	11813,959	
6		20700,449	134,553	18979,830	
7		14523,354	94,402	12473,086	
8		8560,971	55,646	9930,989	
9		21854,742	142,056	21409,051	
10		25871,691	168,166	17862,442	
11		2629,909	17,094	4194,751	
12		18259,434	118,686	14322,794	
13		33706,604	219,093	28853,690	
14		23644,157	153,687	22377,712	
15		22771,948	148,018	24780,101	
16		29003,883	188,525	34304,306	
17		36782,402	239,086	44003,173	
18		10547,039	68,556	14396,885	
19		23128,355	150,334	20245,401	
20		23008,163	149,553	25317,747	
21		11361,113	73,847	12368,798	
22		35511,246	230,823	36366,483	
23		31811,205	206,773	26735,578	
24		10186,968	66,215	8420,341	
25		23988,752	155,927	23025,270	
26		4088,747	26,577	-----	
27		23876,972	155,200	22335,864	
28		6354,845	41,306	6565,374	
29		4221,926	27,443	6088,117	
30		7565,810	49,178	9903,973	
Diameter		18320,005	119,080	18546,906	
Maximum		36782,402	239,086	44003,173	
Minimal		2629,909	17,094	4194,751	
Standard		10090,989	65,591	9770,311	

deviation					
Non-uniformity coefficient		**55,082**	**55,082**	**52,679**	
Median		**21205,453**	**137,835**	**17862,442**	

Table 8. Results of each samples tensile stress of solventbased epoxy coating material

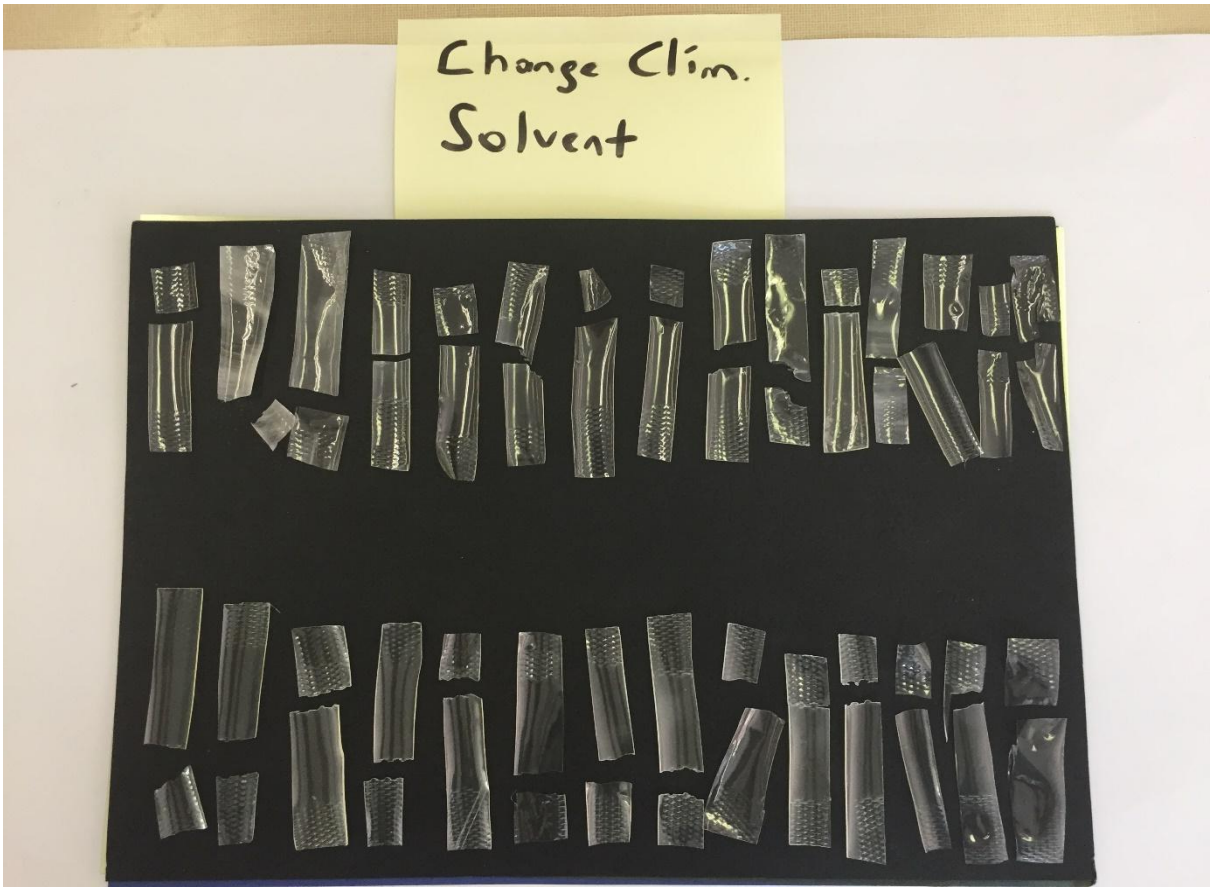

Figure 21. *Broken samples after tensile stress of solvent epoxy coating material*

IV. CONCLUSION

In this study, the most common components in the industry, solvent-based epoxy and water-based epoxy substances, reactions in 4 different climate / temperature environments were investigated.

In different temperature conditions, color changes of water-based epoxy material have been observed. However, the solvent-based epoxy substance did not show any visible color change, which means that the solvent-based epoxy substance has a longer visual life.

Especially, as the temperature rises, water-based epoxies are observed from transparent to yellow. This result has revealed that water-based epoxy materials are not preferred in warm places/conditions. No color change was observed in water-based and solvent-based epoxy when we evaluated in cold weather conditions. However, solvent-based epoxy is physically stronger in cold temperature as well as in other temperature conditions.

Due to the color change and less durability experienced in water-based epoxies, solvent-based epoxies offer advantages in terms of their lifetime. It can also be preferred as an adhesive in the woodworking industry. Because of the visual and physical characteristics, it provides in different temperature conditions, it can be preferred in upper surface treatment

As a result of the values obtained in the experimental studies, the tensile strength of resistance varied according to the material type and different temperature conditions. Regarding the chart It has been observed that the solvent-based epoxy substance at 4 different temperatures is physically stronger than the water-based epoxy substance.

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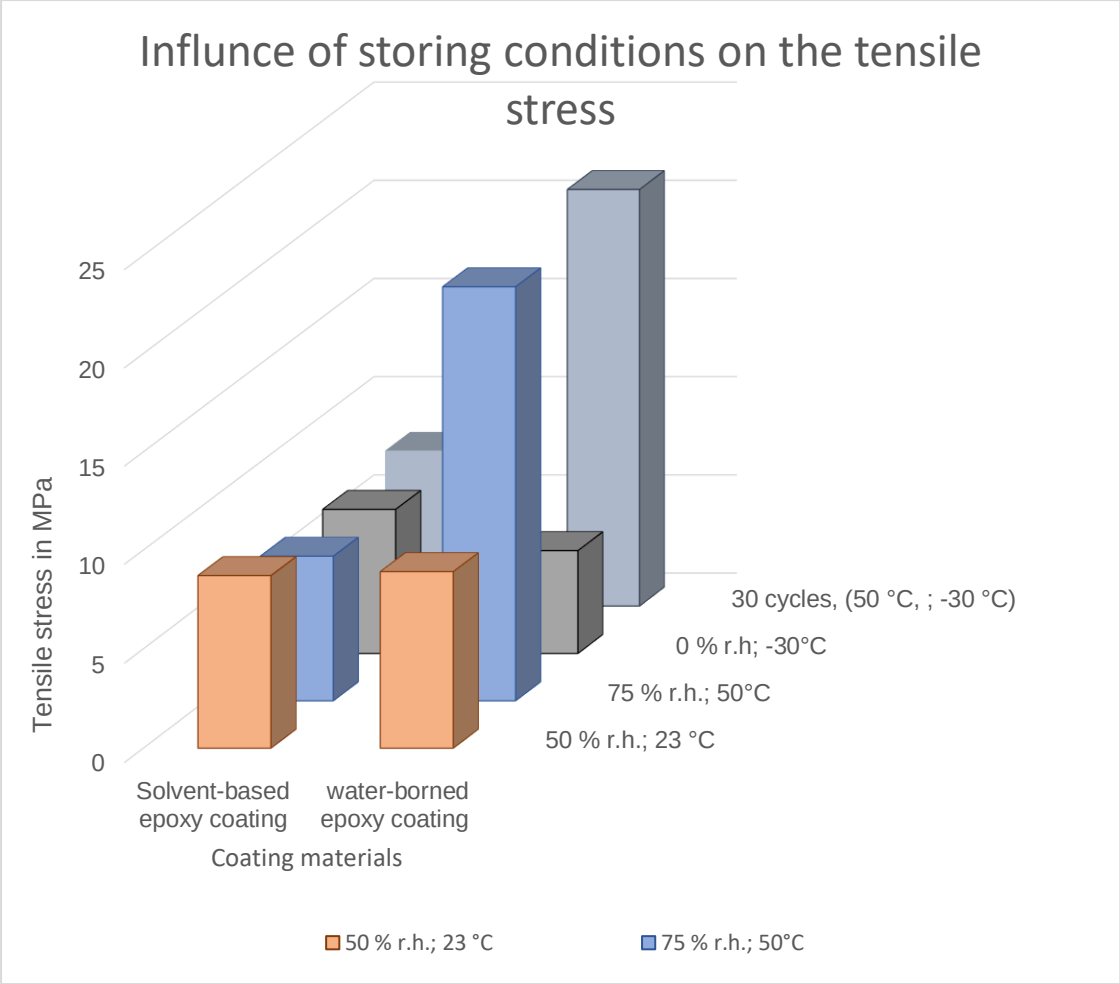

Chart 1. Influnce of storing conditions on the tensile stress

When we compare experimental studies the tensile strength of only solvent-based epoxy coating material we can see the breaking points are changable in under the different temperature conditions.As the results show the most strong breaking point in the 1st colomn group of samples which is room under the temperature 23 Celsius degree which is useful for indoor use. As the chart shows solvent based orange column have very similar value of breaking point which are the weakest breaking points.We can consider under the extreme temperature conditions solvent-based epoxy coating material can break easier than normal coniditions.Result of the solvent-based grey column as expected mixture of extreme and regular temperature conditons.

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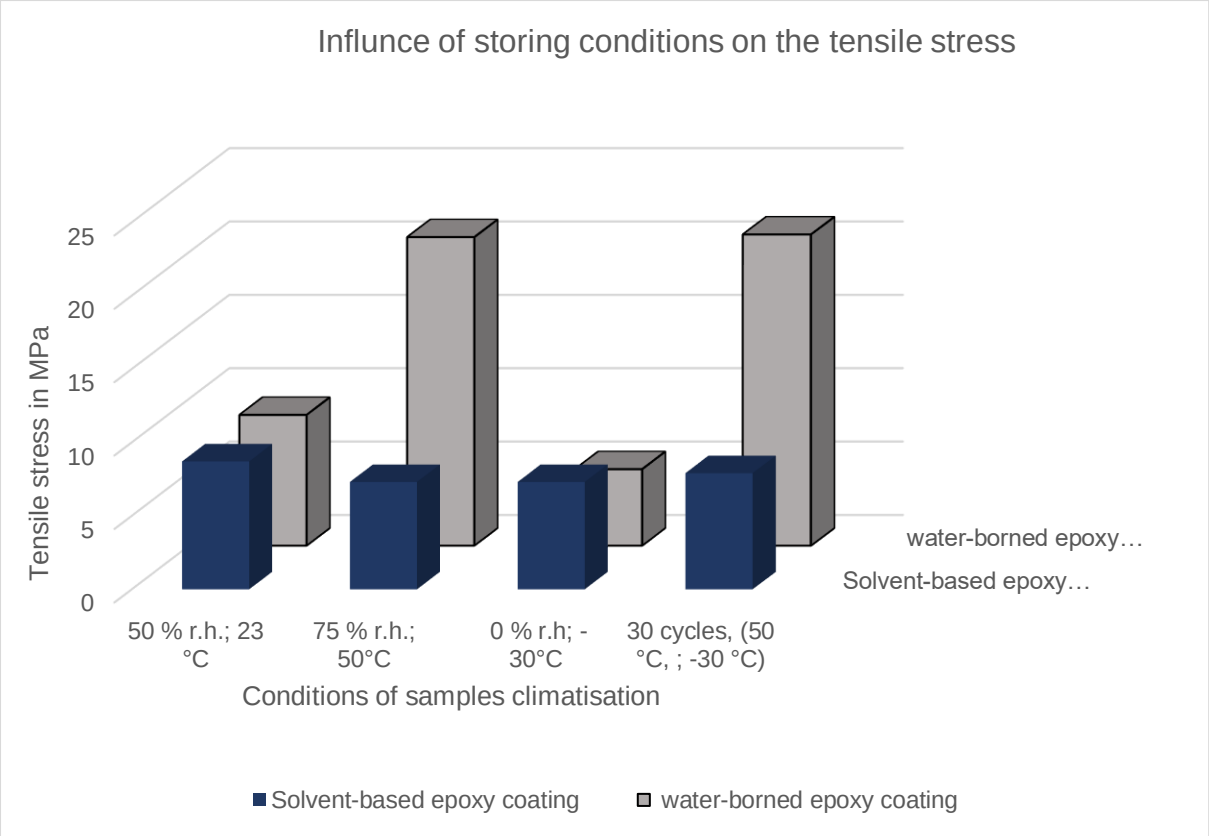

Chart 2. Influnce of storing conditions on the tensile stress

When we compare in the same experimental studies way the tensile strength of the only waterborne epoxy coating material we can see breaking points are changeable under the different temperature conditions.

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