Stability of Strength and Deformation Characteristics of Expanded Polystyrene (EPS) within the Time of Long-Term Investigation of Creep Strain under Permanent Compressive Loading

Saulius VAITKUS *, **Ivan GNIP, Sigitas VĖJELIS**

Scientific Institute of Thermal Insulation of Vilnius Gediminas Technical University, Linkmenu st. 28, 08217 Vilnius, Lithuania

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The results of investigation of strength ($\sigma_{10\,\%}$, σ_{cr}) and deformability (E) characteristics of expanded polystyrene specimens are presented. The results are based on the short-term compression in the organization of long-term creep study. For the experiments identical specimens stored 5 years at ambient temperature (23 ±2) °C and relative humidity (50 ±5) % as well specimens after removal long-term loading were used. There were established, that difference between experimental values of stress and initial modulus of tested expanded polystyrene specimens with confidence probability P = 90 % (on-sided test) is negligible (random).

Keywords: expanded polystyrene slabs (EPS), short-term compression, aging, long-term compression.

1. INTRODUCTION

Expanded polystyrene (EPS) due to its availability and satisfactory performance characteristics is commonly used in building structures where it is exposed to various kinds of stresses [1 – 3]. Long-term compression is the basic type of stress for foamed plastics used as a heat insulation-construction material. Study of stress and strain characteristics of expanded polystyrene under the conditions of long-term exposure to constant compressive stress is of significant interest. It is a common practice in Europe to state during long-term tests of expanded polystyrene products a level of creep strain for correction for 10, 25 and 50 years [4], accordingly, taking into consideration [5], duration of direct experiment should be 122, 304 and 608 days, respectively. At the same time a power equation (Findley W. N.) is used in [5]. It is recommended to substantiate use of other phenomenological functions, according to [5], on the basis of direct experiment lasting at least 5 years [6].

The authors of the article have performed (5 ÷ 5.4)-year creep tests of expanded polystyrene (EPS) pieces with constantly compressing stress σ_c equal to $(0.25 \div 0.35)\sigma_{10\,\%}$.

According to [7], long keeping of expanded polystyrene under moderate climate conditions does not cause any significant changes in its mechanical properties. [8] gives results of determination of foamed plastics compressive strength after storage for 10 years in a non-heated site in a region with moderately cold climate. In [8] it is pointed out that most foamed plastics (polyurethane foam, foamed epoxy resins, expanded polystyrene) show significant (up to 30 %) increase of compressive strength in 5 years of aging; further strength of these materials are changing less.

It should be noted that information about the degree of stability of strength and strain characteristics of EPS in time are important for predicting their life durability.

To evaluate stability of mechanical properties of expanded polystyrene (EPS) specimens were tested for short-term compression after 5 year storage during a lengthy experiment. Compression under short loading of thermal insulation materials is main object of studies [9, 10]. Compressible strength of thermal insulation materials is often characterized by its density. When density increases twice, compressible strength increases about 4 times [11].

The aim of the present work is to evaluate the degree of stability of strength and strain characteristics of expanded polystyrene (EPS) boards during long-term experiment of creep according to test results of expanded polystyrene specimens by carrying out creep testing without loading specimens stored during a long-term experiment in the same premises and after removal of compressive stress σ_c.

2. INVESTIGATION METHODS

Expanded polystyrene boards were studied (Table 1) of EPS 60 – EPS 250 types with density (14 ÷ 35) kg/m^3, made by different manufacturers using expansion technology – confined foaming of bead-type raw materials (hard granules (0.8 ÷ 2.5) mm of diameter produced by leading European companies “Styrochem” and “BASF”).

As the criterion of evaluation of deformability of boards at constant compressive stress expanded polystyrene creep deformation of specimens in the form of a cube with an edge of 50 mm was used, which was measured using special stands [5, 12] ensuring constancy of applied stress for 2034 days. Each experiment (altogether 15 lots were tested) included results of testing of three specimens of equal density. The direction of compressing stress in respect of the plane of the board from which the specimens were cut was deemed to be perpendicular. The creep deformations were determined

*Corresponding author. Tel.: +370-5-2752485; fax.: +370-5-2752485.
E-mail address: *saulius.vaitkus@vgtu.lt* (S. Vaitkus)

using the method described in [5] with static stress σ_c equal to $(0.25 \div 0.35)\sigma_{10\,\%}$. Error of stabilization of long-term compressive stress did not exceed 1 %, while changes in a creep – 0.005 mm. Loading of specimens and reading the indicators were done in accordance with requirements given in [5].

Table 1. The experimental test results of deformability of expanded polystyrene (EPS) specimens at the long-term fixed compressive stress σ_c^a

Test number	Test data of specimens at compression load						
	Short-term		Long-term				
	ρ, kg/m^3	$\sigma_{10\,\%}$, kPa	$\bar{d}_s$, mm	σ_c, kPa	ε_0, %	$\varepsilon_c(t_n)$, %	t_n, days
1	16.5	84.5	46.8	21.4	0.737	1.082	1829
2	26.6	175	49.0	44.1	0.592	0.704	1829
3	20,8	121	48,3	30,5	0,653	1.018	1829
4	27.1	164	49.2	40.9	0.814	0.544	1829
5	16.5	84.5	48.9	29.9	0.960	2.442	1829
6	26.8	175	49.0	61.6	0.820	1.129	1829
7	20.7	121	48.3	42.6	0.918	1.695	1829
8	27.1	164	49.2	57.3	0.914	1.013	1829
9	35.5	255	49.3	89.3	0.828	0.889	1828
10	30.4	201	50.5	70.5	0.791	0.995	2034
11	33.1	244	48.5	85.6	0.962	1.906	1967
12	27.5	190	49.2	66.5	0.949	1.864	1967
13	21.9	138	48.9	48.6	0.913	1.652	1967
14	18.5	103	48.9	36.5	0.804	3.633	1966
15	14.5	68.6	49.0	24.0	0.744	3.207	1966

[a] Specimens of series numbers 1 – 4 are tested at a static stress $\sigma_c = 0.25\sigma_{10\,\%}$, series numbers 5 – 15 – at $\sigma_c = 0.35\sigma_{10\,\%}$.

Results of study of creep of expanded polystyrene (EPS) boards of 15 lots at long-term compressive stress equal to $(0.25 \div 0.35)\sigma_{10\,\%}$ are given in [6]. From [6] the present work uses values of strain ε_0, arising at the moment of time $t = 60$ s from the beginning of application of loading and creep strain ε_c developing in the course of time at the moment of ending of the direct experiment $\varepsilon_c(t_n)$ (Table 1).

All experiments were conducted inside the premises with air temperature of (23 ±2) °C and relative humidity – (50 ±5) %.

To evaluate stability of strength and strain characteristics of expanded polystyrene within the period of long-term experiments tests were performed for short-term compression of specimens cut from the boards under study. The stress $\sigma_{10\,\%}$, corresponding to 10 % compressive strain, the ultimate (critical) stress σ_{cr}, upon increase of which quasi-linearity of "loading-deformation" diagram is violated, and the initial modulus of elasticity E were chosen as testing parameters.

Initial variables of three experimental test specimens in the form of a cube with an edge of 50 mm are presented in Table 2.

σ_c value was taken on the ground of $\sigma_{10\,\%}$, found in accordance with data of the 1st test for short-term compression of specimens, which was conducted during organization of long-term experiments in order to study of creep of expanded polystyrene (EPS) boards. Specimens of the 2nd test had been stored (stress-free) within the period of performance of long-term experiments inside the same premises. The 3rd test includes specimens of the long-term experiment after removal of the constant compression stress σ_c.

Methods of research of EPS specimens for short-term compression are presented in [13].

3. METHODS OF PROCESSING THE EXPERIMENTAL DATA

Regression analysis of data of short-term compression of specimens was performed with confidence probability $P = 0.90$ upon one-sided criterion. A preliminary check of experimental results "on anomaly" was performed on the assumption of one dimensional measurement system [14].

Linear dependencies are taken in this work that are characterized by simplicity of calculations when using and allow finding quantitative values of variables of strength and allow finding quantitative values of variables of strength and strain of expanded polystyrene boards with satisfactory accuracy:

$$\bar{Y}_x = b_0 + b_1 \cdot X \quad , \qquad (1)$$

where $\bar{Y}_x$ is an average value of a resulting feature (tested variables); X is a component feature, for example, density of expanded polystyrene boards; b_0, b_1 are constant coefficients calculated on the ground of experimental data by the least squared method [14 − 16].

Proportion of variation of the tested variable $\bar{Y}_x$ from variability of controlled input factor X (for example, density, and stress $\sigma_{10\,\%}$) is presented by determination coefficient $R^2_{y\cdot x}$ (squared coefficient of correlation R_{yx}).

Standard deviation S_r is taken as a means of spreading observation data around empirical regression line (absolute value of average measure of evasion of experimental results from regression line, constant for all its segments):

$$S_r = \sqrt{\frac{\sum_{i=1}^{i=n}\left(Y_{x_i} - \bar{Y}_{x_i}\right)^2}{n-m}} \quad , \qquad (2)$$

where $Y_{x_i}, \bar{Y}_{x_i}$ is an actual i value of a resulting feature calculated according to the equation (1); n is a number of experiments (definitions); m is a number of evaluated constant parameters in the empirical equation ($m = 2$ for the linear equation).

Besides a predictive resulting feature in the form of one numerical value (pointwise prediction value $\bar{Y}_{x_i}$), possible variable of error δ, which allows passing to interval prediction with one-sided upper maximum boundary and lower minimum boundary, was also calculated:

$$Y_{x_i}^{predic.} = \bar{Y}_{x_i} \pm \delta \, . \qquad (3)$$

According to [17]

$$\delta = t_{\alpha;f} \cdot S_r \, , \qquad (4).$$

where $t_{\alpha;f}$ is Student's criterion, value of which was chosen for confidence probability $P = 0.90$ (upon one-sided criterion) depending on so-called number of degrees of freedom $f = n - m$ [18].

Table 2. The initial data and results of testing for short-term compression experimental specimens of EPS

Number of experimental specimens[a]	Number of creep tests (Tab. 1 see)	Initial data of specimens			Data of the specimens tested for short-term compression		
		Number of samples	Change of density from-to, kg/m³	$\overline{\rho}^{b} \pm \Delta\rho$, kg/m³	$\overline{\sigma}_{10\%}^{b} \pm \Delta\sigma_{10\%}$, kPa	$\overline{\sigma}_{cr} \pm \Delta\sigma_{cr}$, kPa	$\overline{E} \pm \Delta E$, kPa
1	1; 5	12	16.2 – 17.1	16.6 ±0.2	84.5 ±1.4	61.4 ±1.2	3405 ±140
	2; 6	23	26.5 – 27.1	268 ±1.5	173 ±3.1	136.0 ±2.8	7896 ±194
	3; 7	24	19.8 – 21.7	20.8 ±0.3	122 ±2.0	95.2 ±1.6	5442 ±128
	4; 8	6	25.9 – 27.2	26.5 ±0.6	164 ±5.2	106.0 ±3.5	6514 ±634
	9	16	33.2 – 36.6	35.0 ±0.6	255 ±5.2	190.0 ±4.6	10342 ±364
	10	18	29.8 – 33.8	31.0 ±0.5	206 ±4.7	126.0 ±6.4	9327 ±212
	11	13	32.5 – 35.7	33.9 ±0.6	238 ±6.5	195.0 ±5.6 (6) [c]	10600 ±620 (6)
	12	14	26.1 – 29.2	27.7 ±0.6	185 ±5.3	147.0 ±7.1 (7)	7360 ±333 (7)
	13	9	20.7 – 23.6	22.0 ±0.6	136 ±6.8	107.0 ±34 (3)	5031 ±1182 (3)
	14	7	16.6 – 18.1	17.5 ±0.7	98.3 ±6.0	–	–
	15	7	13.9 – 15.0	14.5 ±0.4	68.6 ±2.5	–	–
2	1; 5	7	14.8 – 16.8	15.7 ±0.6	81.8 ±5.0	52.9 ±3.4	3171 ±221
	3; 7	8	19.2 – 21.4	20.6 ±0.6	127.0 ±5.6	91.9 ±3.0	5540 ±194
	4; 8	9	24.9 – 26.6	25.8 ±0.4	171.0 ±4.4	120.0 ±6.4	7683 ±510
	10	7	29.8 – 31.9	30.9 ±1.1	216.0 ±15.8	160.0 ±13.8	9744 ±775
3	1; 5; 14; 15	11	14.5 – 18.7	16.7 ±1.0	87.6 ±8.6	61.4 ±7.6	3461 ±529
	3; 7; 13	9	20.4 – 22.1	21.1 ±0.4	128.0 ±5.0	93.7 ±5.4	4919 ±456
	2; 6	9	26.4 – 27.6	26.9 ±0.4	181.0 ±2.5	135.0 ±4.3	7347 ±377
	4; 8; 9; 10; 11	15	29.0 – 35.6	32.0 ±1.2	206.0 ±22.1	155.0 ±23.4	8493 ±959

[a] Specimens: 1 – specimens tested at the organization of researches of creep of expanded polystyrene (EPS); 2 – not weighted specimens stored during time of carrying out of the long-term experiment in the same premise; 3 – specimens after removal of compressing stress in 5 years. [b] Average value and its confidential estimation with reliability 0.95. [c] In brackets the quantity of specimens n, according to which is calculated the average value with a confidential estimate (in other cases n 3rd column of the table see).

4. TESTS RESULTS AND DISCUSSION

Diagrams of deformation of expanded polystyrene specimens during compression are presented in Fig. 1. Diagrams of compression are curvilinear. Specific inflection is observed, so it may be conventionally considered that they consist of two segments. Distinguished points define different mechanical conditions of specimens. Dependence of deformation from the stress close to linear is observed in the initial segment. In the second segment a significant deformation increment is observed with low raise of loading. Distinguished points correspond to ultimate (critical) stresses σ_{cr}, upon reaching of which behaviour of macrostructure of expanded polystyrene products changes [11].

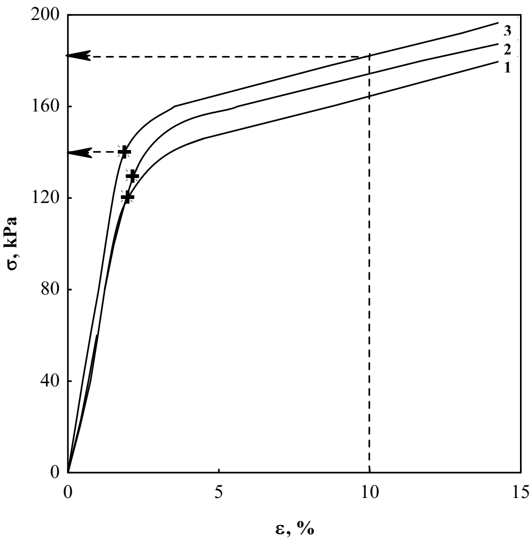

Fig. 1. The variation of relative strains of expanded polystyrene specimens under compression. The numbers on the line - number of experimental specimens in Table 2. Density of specimens, kg/m³: 1, 2 – 25.8; 3 – 26.5. Dots + indicate the experimental values of the ultimate (critical) stress σ_{cr} (see the axis of ordinates)

Results of statistical processing of experimental values of strength and strain characteristics of expanded polystyrene boards' specimens are presented in Tables 3 ÷ 5 (constant coefficients b_0, b_1 of regression equations (5) ÷ (20) of dependence (1), mean square deviations S_r calculated on the ground of experimental data, coefficients of determination $R^2_{y \cdot x}$, and values δ are given to determine one-sided confidence interval of predicted value of

Table 3. The results of statistical data processing of tests of specimens EPS on short-term compression at the experiment organisation on creep testing

Correlated parameters and the number of regression equation [a]	Average value					
	$\sigma_{10\,\%}\rightarrow\rho$ (5)	$\sigma_{cr}\rightarrow\sigma_{10\,\%}$ (6)	$E\rightarrow\sigma_{10\%}$ (7)	$\sigma_{cr}\rightarrow\rho$ (8)	$E\rightarrow\rho$ (9)	$E_4^c\rightarrow\rho$ (10)
Number of testes (estimations)	157	107	123	108	121	44
Parametres of the equations (5) – (10)						
Coefficient b_0	–57.3	–	–	–49.7	–2603	–2793
Coefficient b_1	8.64	0.785	43.9	6.92	379	368
Standard deviation S_r (kPa)	6.99	7.58	632	7.46	639	676
Determination coefficient R^2_{yx}	0.985	0.970	0.928	0.971	0.927	0.929
$\delta^b = t_\alpha \cdot S_r$ (kPa)	9.00	9.78	815	9.62	823	878

[a] Dependence (1). [b] One-sided confidence interval for the predictive assessment of resultant with a confidential probability $P = (1 - \alpha) = 0.90$. [c] The initial modulus of elasticity on initial deformations ε_0 at loading specimens compressive stress σ_c. Value $E_{4(i)} = \sigma_c/\varepsilon_0$, kPa, where i – the number of test on Table 1.

Table 4. The results of statistical data processing of tests for short-term compression of specimens EPS stored in not loaded state during experiment on research of creep of years (t_n = 5 years)

Correlated parameters and the number of regression equation [a]	Average value				
	$\sigma_{10\%}\rightarrow\rho$ (11)	$\sigma_{cr}\rightarrow\sigma_{10\%}$ (12)	$E\rightarrow\sigma_{10\%}$ (13)	$\sigma_{cr}\rightarrow\rho$ (14)	$E\rightarrow\rho$ (15)
Number of testes (estimations)	31	31	31	31	31
Parametres of the equations (11) – (15)					
Coefficient b_0	–55.3	–10,5	–756	–52.6	–3393
Coefficient b_1	8.78	0.784	49.1	6.83	427
Standard deviation S_r (kPa)	6.30	4.33	315	8.20	534
Determination coefficient R^2_{yx}	0.984	0,988	0.984	0.957	0.954
$\delta^b = t_\alpha \cdot S_r$ (kPa)	8.26	5.67	414	10.75	701

[a,b] See Table 3.

characteristics with reliability $P = 0.90$). It is worth mentioning that coefficients of determination of regression equations (5) ÷ (20) of dependence (1) range from 0.883 to 0.988 and upon 90 % reliability degree significantly exceed threshold values (lower boundaries) R^2_{yx} for correspondent values n [19]. Accordingly, given regression equations may be used for prediction of stress values $\sigma_{10\,\%}$ and σ_{cr}, and also of the initial modulus of elasticity E of expanded polystyrene boards during short-term compression. So, value of the coefficient of determination for regression equations (5), (11), (16) testifies that variation of values $\sigma_{10\,\%}$ of expanded polystyrene boards' specimens during short-term compression is 98 % conditioned by change of their density, and only 2 % – by other factors [20] (see coefficients of determination for regression equations (5), (11), (16) in Tables 3 ÷ 5).

Table 5. The results of statistical data processing of tests for short-term compression of specimens EPS after removal of stationary compressing strain σ_c in 5 years

Correlated parameters and the number of regression equation [a]	Average value				
	$\sigma_{10\,\%}\rightarrow\rho$ (16)	$\sigma_{cr}\rightarrow\sigma_{10\,\%}$ (17)	$E\rightarrow\sigma_{10\,\%}$ (18)	$\sigma_{cr}\rightarrow\rho$ (19)	$E\rightarrow\rho$ (20)
Number of testes (estimations)	44	44	44	44	44
Parametres of the equations (16) – (20)					
Coefficient b_0	–62.4	–10.1	–1283	–58.3	–3843
Coefficient b_1	8.92	0.803	50.5	7.10	424
Standard deviation S_r (kPa)	6.53	5.11	792	8.26	939
Determination coefficient R^2_{yx}	0.988	0,988	0.917	0.969	0.883
$\delta^b = t_\alpha \cdot S_r$ (kPa)	8.48	6.64	1031	10.74	1222

[a,b] See Table 3.

Value of the coefficient of determination for regression equations (7), (13), (18) testifies that variation of values of the initial modulus of elasticity E is in average 94 % conditioned by change of their stress $\sigma_{10\,\%}$, and only (2 ÷ 8) % – by other factors (see variables of regression equations (7), (13), (18) in Tables 3 ÷ 5) [20].

Based on results of determination of specimens' density ρ experimental values and regression lines of values $\sigma_{10\,\%}$, σ_{cr} are presented in Fig. 2 and 3.

It can be seen from the Fig. 2 that regression lines 2, 3 are within confidence interval of the regression line 1 (one-sided, with minimal predicted values, and thus pointwise (average) values $\overline{\sigma}_{10\,\%}$ and $\overline{\sigma}_{cr}$ of three experimental tests do not contradict each other, i. e. change of strength variables $\overline{\sigma}_{10\,\%}$ and $\overline{\sigma}_{cr}$ on the basis of tests cannot be considered significant [21]. For instance, values $\overline{\sigma}_{10\%}$ of specimens in the 2nd test with density of 14 kg/m^3 and 38 kg/m^3 (variation interval for tested specimens) only exceed values of specimens in the 1st test in average by 6.1 % and 2.7 %, respectively. $\overline{\sigma}_{10\,\%}$ of specimens in the 3rd test with the same density differs by only (–1.9) % and (+2.1) % in comparison to specimens in the 1st test. Values $\overline{\sigma}_{cr}$ may be directly compared from the Figure 3 or regression equations (8), (14), and (19) presented in Tables 3 ÷ 5.

Based on results of determination of specimens density ρ experimental values and regression lines of value of the initial modulus of elasticity E are presented in Fig. 4. From the Fig. 4 it is worth mentioning that pointwise values $\overline{E}$ of specimens in the 2nd test are covered by a one-sided confidence interval of the regression line 1 with maximum predicted values, and values of the initial modulus of elasticity E of specimens in the 3rd test – a one-sided

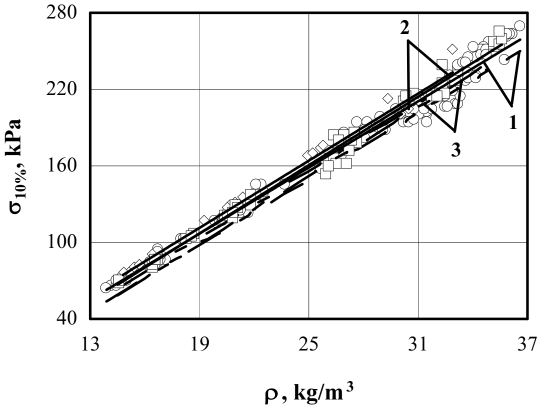

Fig. 2. The empirical regression lines of stress $\overline{\sigma}_{10\,\%}$ of specimens EPS under compression, based on the results obtained in determining their density ρ. Dots – ○; ◊; □ and numbers denote the experimental data for specimens of test series (see Table 2). (—) – denotes the regression lines for mean value $\overline{\sigma}_{10\,\%}$; (---) – is the same for the lower minimal limit of the resultant characteristic $\sigma_{10\,\%}$

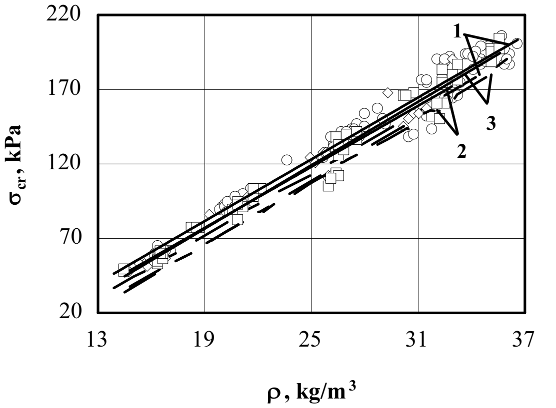

Fig. 3. The empirical regression lines of ultimate (critical) stress $\overline{\sigma}_{cr}$ of specimens EPS under compression, based on the results obtained in determining their density ρ. Dots and lines denote see explanatories to Fig. 2

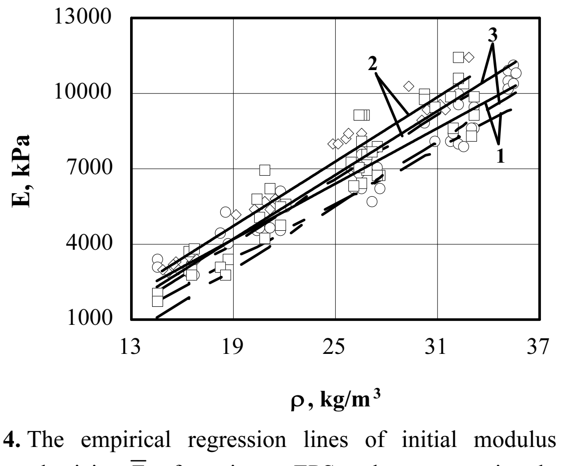

Fig. 4. The empirical regression lines of initial modulus of elasticity $\overline{E}$ of specimens EPS under compression, based on the results obtained in determining their density ρ. Dots and lines denote see explanatories to Fig. 2.

confidence interval of the regression line 1 with minimal predicted values. Thus, pointwise values $\overline{E}$ of specimens from three experimental tests are to be considered non contradictory [21].

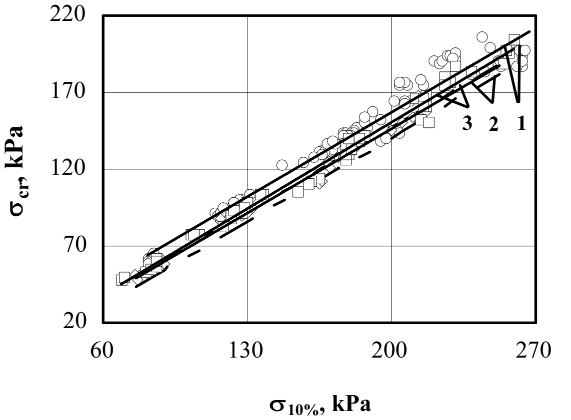

Fig. 5. The empirical regression lines of ultimate (critical) stress $\overline{\sigma}_{cr}$ of specimens EPS under compression, based on the results obtained in determining their stress $\overline{\sigma}_{10\,\%}$. Dots and lines denote see explanatories to Fig. 2

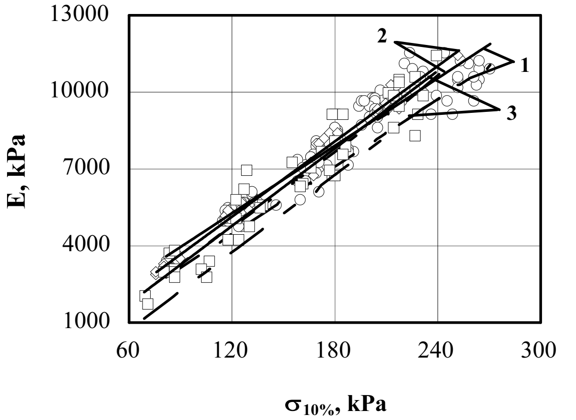

Fig. 6. The empirical regression lines of initial modulus of elasticity $\overline{E}$ of specimens EPS under compression, based on the results obtained in determining their stress $\overline{\sigma}_{10\,\%}$. Dots and lines denote see explanatories to Fig. 2

Based on results of determination of $\overline{\sigma}_{10\,\%}$ (its value according to [4] is the essential variable of strength of expanded polystyrene (EPS) products during compressive strength) of experimental values and regression lines of values σ_{cr} and E are presented in Figs. 5 and 6. For boards of types from EPS 100 to EPS 250 values σ_{cr} of specimens in the 2nd test and values σ_{cr} of specimens in the 3rd test are in average from 13.5 % to 5.4 % and from 10.6 % to 2.8 %, respectively, less in comparison to data of compression tests of specimens in the 1st test. The Fig. 5 illustrates non-contradiction of results σ_{cr} determined by regression equations (6), (12), (17) given in Tables 3 ÷ 5.

In accordance with test results for specimens in the 2nd test values of the initial modulus of elasticity for expanded polystyrene boards of types from EPS 80 to EPS 120 are in average from 9.7 % to 2.5 % less in comparison to test data of specimens in the 1st test; and for expanded polystyrene boards of types from EPS 150 to EPS 250 such values are greater in comparison to test data of specimens in the 1st test. In accordance with test results for specimens in the 3rd experimental test the pointwise value $\overline{E}$ for expanded polystyrene boards of types from EPS 80 to EPS 150 is in average from 21.5 % to 4.4 % less (stays within one-sided confidence interval of the regression line 1), and for boards EPS 200 and EPS 250 is 0.4 and 3.3 greater in comparison to test results of specimens in the 1st test. In case of use of regression for evaluation of prediction values a confidence coefficient is usually taken 90 % (one-sided criterion) [17]. Thus, degree of coincidence of calculation results for pointwise values $\overline{E}$ based on regression equations (7), (13), (18) (see Tables 3 ÷ 5) can be regarded as satisfactory (see Fig. 6).

Pointwise values of the initial modulus of elasticity E received as a result of initial deformation upon loading of specimens in the 3rd experimental test by compressive stress σ_c, which is equal $(0.25 \div 0.35)\sigma_{10\,\%}$ (approximated by a regression equation (10)), calculated by regression equations (9), (15), (20) in Tables 3 ÷ 5, and filled by numerical parameters on the basis of experimental results for each of three experimental tests belong to the field of values of the initial modulus of elasticity E of specimens tested during organization of long-term study, which means that they conventionally satisfy non-contradiction [21], i. e. discrepancy of results E in all mentioned cases cannot be considered significant.

5. CONCLUSIONS

On the basis of performed research empirical equations were given for evaluation of strength ($\sigma_{10\,\%}$, σ_{cr}) and strain (E) characteristics during short-term compression of specimens of expanded polystyrene (EPS) boards with density from 14 kg/m^3 to 35 kg/m^3. For each equation possible variable of error δ is given, which allows passing to interval prediction of stress and strain characteristics of expanded polystyrene boards.

It was shown that at confidence probability $P = 90\ \%$ (one-sided criterion) results of calculation of stress $\sigma_{10\,\%}$, σ_{cr} and the initial modulus of elasticity E according to the results of determination of density ρ of expanded polystyrene specimens tested: carrying out creep testing; stress-free specimens stored during a long-term experiment in the same premises; specimens after removal of compressing stress σ_c in 5 years – are consistent, i. e. discrepancy of their average values is insignificant (random).

Results of calculation by regressive equations (6), (7), (12), (13), (17), (18) of ultimate (critical) stress $\overline{\sigma}_{cr}$ and the initial modulus of elasticity $\overline{E}$ based on experimental values of stress $\sigma_{10\,\%}$ for specimens tested: during a long-term experiment; stress-free specimens stored during a long-term experiment in the same premises; after removal of compressing stress σ_c in 5 years – comply with the requirement of non-contradiction at confidence probability $P = 90\,\%$ (one-sided criterion), i. e. their discrepancy is random.

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