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INFLUENCE OF THE CHEMICAL COMPOUND AND HEAT TREATMENT ON DAMPING PROPERTIES OF STEELS

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In work results of experiment new developed damping alloys DAZ-3, DAZ-4, DAZ-5 are offered. Microstructures and damping properties multiple alloyed damping alloys are offered.

Keywords: metallurgy, chemical and damping properties of alloys, annealing, tempering, a microstructure.

Introduction. At the industrial enterprises (ferrous metallurgy, machine-building, transport, etc.) the percentage share of noise shock provenance is very high (table 1).

Table 1. **Levels of sound capacity of the metallurgical equipment**

The equipment name	Compound frequencies of octave strips of Hz								Level of sound capacity, dBA	Total duration of influence for change, h
	63	125	250	500	1000	2000	4000	8000		
Admissible levels of sound pressure on workplaces	95	87	82	78	75	73	71	69	80	>4
Hammer crusher CR-10	106	108	107	106	102	98	95	87	108	>4
Crusher four felling	111	115	114	112	110	108	101	94	115	>4
Inertial roar coking	112	111	106	109	109	107	103	96	115	<4
The lamellar conveyor	106	104	101	99	100	99	92	91	104	<4
Feeder – a roar Electrovibrating design of «Mehanobr»	103	104	104	108	111	115	95	101	114	>4
Hammer malleability V, (0=5 ton)	110	113	96	114	110	109	107	101	115	>4
Bluiming 1300: Machine of igneous clean out	104	109	110	116	116	116	117	114	123	>4
Pipe procurements camp 900/750: Metal transportation	99	112	113	109	104	96	81	72	112	>4
Working cage 750	95	104	102	98	96	90	79	72	105	>4

Sound insulation and sound absorption though have received wide diffusion in practice of struggle against noise and vibration, however the basic lack of these methods is increase in dimensions working zones that complicates access to knots of isolating object, violate a compactness condition, as fire danger raises, worsens sanitation a workplace condition (a dust, a moisture, etc.).

The rigidity increase leads to undesirable increase of weight of the equipment. Extinguisher fluctuations (shock-absorbers, dampers) become complicated a machine design and essentially raise expenses for operation. The rational arrangement of the equipment can conduce to considerable decrease in noise, but in operating shops this method will demand considerable material inputs.

Use of nonmetallic materials (rubber, plastic, polyethylene, a plastic covering) is complicated because of low bending qualities, especially at heats.

Alloys with raised with damping properties and sufficient a complex of physicomechanical characteristics it is possible recommended for manufacturing of details and the knots working in a mode of impact.

Reduction of speed of rotation of the mechanism and force of blow not always probably because of requirements of technological process.

Carrying out of experiment and results of work. With application of a method of mathematical planning experiment alloys on an iron basis, alloyed by carbon, silicon, nickel, chrome, vanadium, niobium, by molybdenum, the titan, aluminium, a pine forest, cerium, calcium, lanthanum (table 2 have been melted.).

One of research problems was reception maximum damper at minimum alloyed.

On fig. 1 the microstructure of alloy DAZ-3 is presented. Damping properties of this alloy L_A = = 83,6 dBA, V_c = 700 dBA/c, $\delta = 3\text{-}10^{-2}$. The alloy is multiple alloyed (1,5 % Mn; 1,0 % Ni; 1,5 % Cr; 1,5 % V; 0,5 % Nb; 0,5 % Mb; 0,5 % Ti; 1,0 % A1; 0,5 % B; 0,5 % Cu).

Table 2. **Chemical compound principal developed alloys**

Marks of the alloys	Chemical compound, %													
	C	Si	Mn	Ni	Cr	V	Nb	Mo	Ti	A1	B	Ce	Ca	La
DAZ-3	–	0,50	1,50	1,00	1,50	1,50	0,500	0,50	0,50	1,0	0,50	0,05	–	0,005
DAZ-4	0,06	0,34	2,04	0,30	1,92	0,21	0,500	1,07	0,15	1,0	0,50	0,70	1,500	1,500
DAZ-5	0,39	0,40	0,80	0,80	0,20	0,80	0,80	0,80	0,15	0,8	–	1,00	–	–

Footnote: 1. DAZ - 3, 4, 5 – damping alloy by Zhumadilova; 2. Metal basis of alloys is iron.

From fig. 1 it is visible that in a cast condition the structure represents ferrite with pearlite. Full annaeling the cast sample leads crush grains, since. There was a recrystallization. Production new grain. Because of crushing ferrite-pearlite grains work decrease damping properties. After tempering (having heated up to Ac + 50 °C, in oil) the alloy structure represents cooling martensite.

To alloyed this alloy manganese (1,5 %), nickel (1,0 %), chrome (1,5 %) have provided high values of speed of attenuation of a sound and logarithmic decrement. But sound generation (L_A) this alloy very high – 83,6 dBA that says that alloyed manganese, nickel, chrome, vanadium, in the chosen proportions does not give a guarantee receipt a quiet alloy.

Alloy DAZ-4 (fig. 2) contains insignificant quantity alloyed elements (Si, Ni, V, Nb, Ti,), thus 2,04 % Mn; 1,92 % Cr; 1,07 % Mo; 1,0 % A1; 1,5 % Ca; 1,5 % La. Such structure has provided must low value L_A (72,1 dBA) and average values Vc and δ. Low value of sound generation is caused by presence of nonmetallic inclusions of the large sizes.

The alloy structure in a cast condition represents ferrite with ledeburit eutectic. To alloyed promoted occurrence pearlite.

In annealed a condition grain was crushed, basically prevailed ferrite.

After tempering – structure martensite. Structures of alloys DAZ-3 and DAZ-4 are very similar, but sound generation very strongly differs. The fundamental reason is the maintenance of nonmetallic inclusions. In percentage terms nonmetallic inclusions at alloy DAZ-3 ($3{,}943\cdot10^{-2}$), at alloy DAZ-4 ($12{,}326\cdot10^{-2}$) nonmetallic inclusions of very large sizes prevail.

Alloy DAZ-5 (0,4 % C; 2,89 % Cr; 1,0 % A1; 1,0 % Ca; 1,5 % La; 0,5 % Cu) are characterised rather high damping by properties: La = 79,6 dBA, Vc = 666 dBA/c, δ = 0,026. This results from the fact that though the general maintenance of nonmetallic inclusions not the highest ($3{,}436\cdot10^{-2}$), however presence of large formations provided high dissipation sound energy.

а

б

в

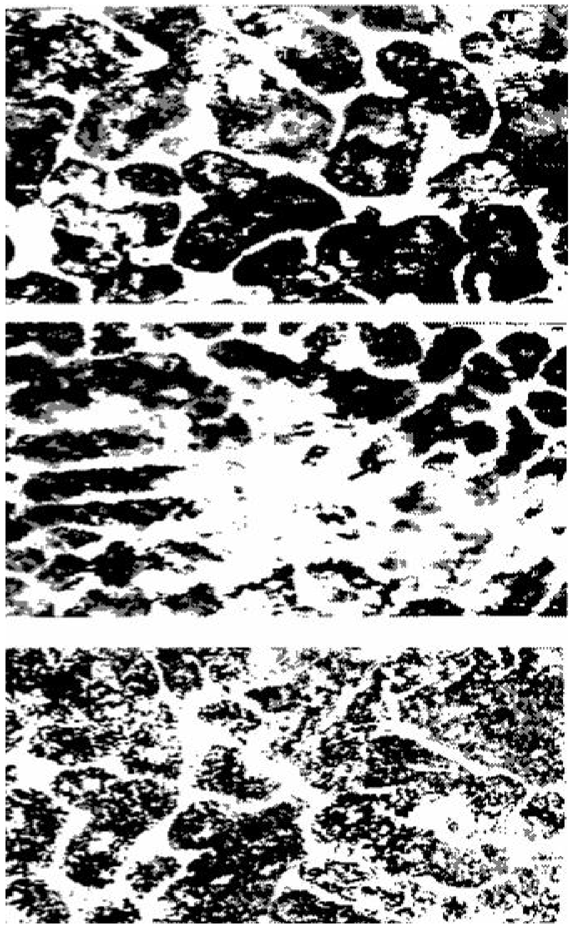

Fig. 1. A microstructure of alloy DAZ-3 in cast (*a*), annealed (*b*) and tempered (*c*) conditions x250

The alloy microstructure is presented on fig. 3. Annealing has lowered Vc from – that the structure (very small structure) has turned out high dispersion. Tempering has sharply raised Vc and δ because of formation martensite structures.

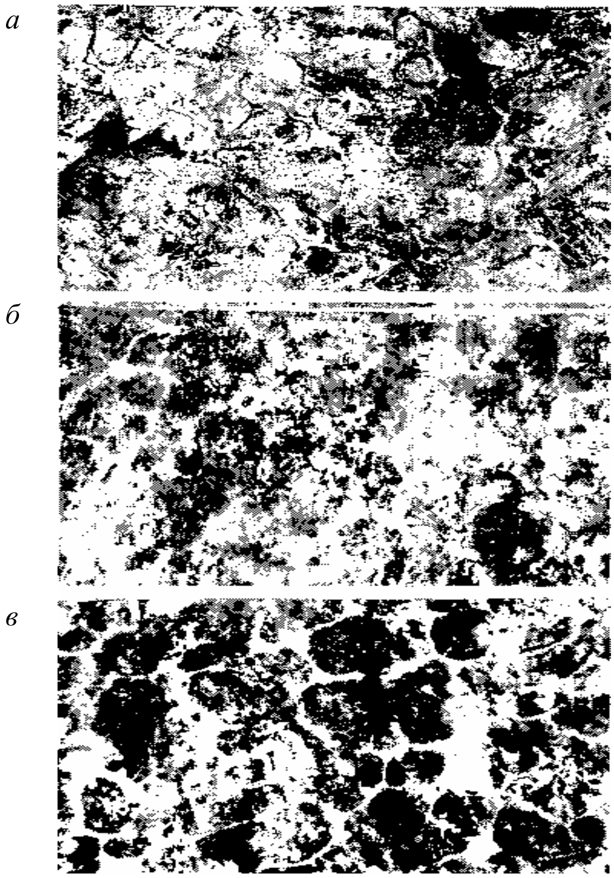

Fig. 2. A microstructure of alloy DAZ-4 in cast (*a*), annealed (*b*) and tempered (*c*) conditions x250

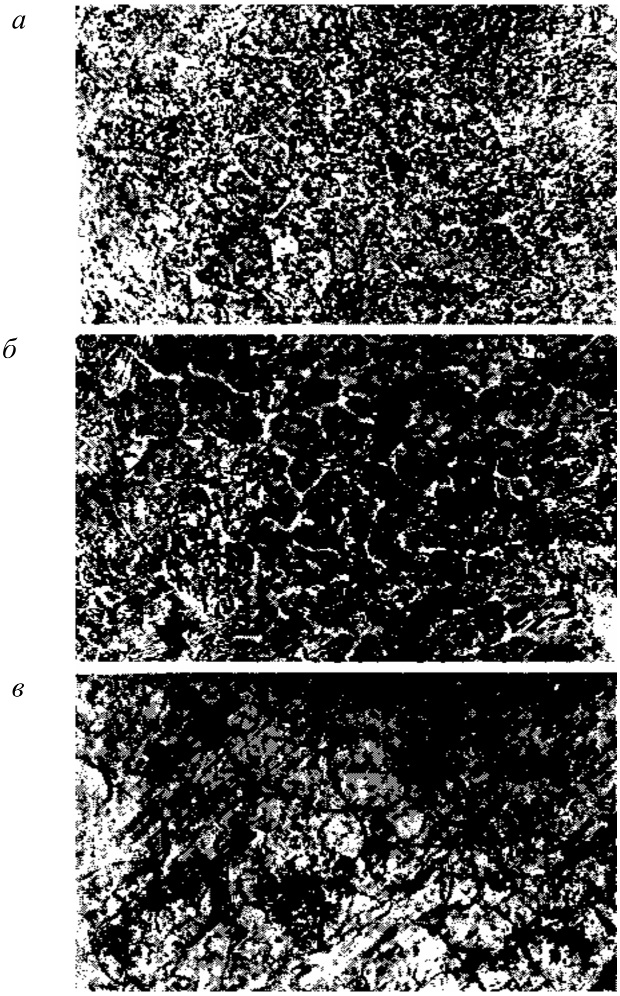

Fig. 3. A microstructure of alloy DAZ-5 in cast (*a*), annealed (*b*) and tempered (*c*) conditions x250

Table 3. **The factors of the regress characterizing influence of alloying elements on logarithmic decrement of fluctuations of developed alloys.**

Model fitting results for: K.Y1(δ) – logarithmic decrement

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-0,011372	0,018534	-0,6136	0,5663
K. N	0,000143	0,000171	0,8353	0,4416
K. C (carbon)	0,055952	0,025633	2,1828	0,0808
K. SI (silicon)	-0,023597	0,016682	-1,4145	0,2163
K. MN (manganese)	-0,011255	0,006533	-1,7227	0,1456
K. NI (nickel)	0,029173	0,015278	1,9095	0,1145
K. CR (chrome)	0,006341	0,004576	1,3855	0,2245
K. V (vanadium)	-0,01267	0,010311	-1,2288	0,2738
K. NB (niobium)	-0,022029	0,00906	-2,4316	0,0593
K. MO (molybdenum)	-0,004712	0,00475	-0,9921	0,3667
K. TI (titanium)	0,061426	0,018982	3,2360	0,0231
K. AL (aluminium)	-0,026482	0,014046	-1,8853	0,1181
K. B (forest)	0,074041	0,018638	3,9727	0,0106

R- SQ (ADJ.) = 0,6519 SE = 0,008222 MAE = 0,003384 DurbWat = 1,967
Previous1y: 0,1451 0,012884 0,009542 2,24521

observations fitted. forecast (s) computed for 0 missing va1. of dep. var.

The regress equation: Y_1= - 0,01 + 0,05 C - 0,02 Si - 0,01 Mn + 0,02 Ni + +0,01 Cr - 0,01 V - 0,02 Nb - 0,004 Mo + 0,06 Ti - 0,02 A1 + 0,07 B.

Results of the table show that in ascending order the greatest influence on growth δ renders a pine forest (k = 0,074041), the titan (k = 0,0061426), carbon (k = 0,055952), nickel (k = 0,023597), niobium (k =-0,022029), manganese (k =-0,011255).

Conclusion.

1. Thermal processing makes essential impact on damping properties of alloys. Tempering raises damping characteristics that, certainly, is connected with formation martensite structures. Formation during training of other phases (because of insufficient speed of cooling) – martensite. Reduces damping properties of alloys. Annealing, providing growth of grains, raises dampering. Annealing, not leading to grain growth, and resign imperfections of structure – reduces dampering.

2. The big role in dissipation sound energy at blow is played by nonmetallic inclusions, thus influence the form and dimensions these inclusions.

3. Rough the structure formed in cast developed alloys, provides the raised attenuation of fluctuations.

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Резюме

Жаңадан жасалған ДСЖ-3, ДСЖ-4, ДСЖ-5 демп-ферлі қорытпаларының тәжірибелік жұмыстарының нәтижелері ұсынылған. Күрделі легірленген демпферлі қорытпалардың микроқұрылымы мен демпферлік қасиеттері келтірілген.

Түйінді сөздер: металлургия, қорытпалардың химиялық және демпферлік құрамы, жұмсарту, шынықтыру, микроқұрылым.

Резюме

В работе предложены результаты эксперимента новых разработанных демпфирующих сплавов ДСЖ-3, ДСЖ-4, ДСЖ-5. Предложены микроструктуры и демпфирующие свойства сложнолегированных демпфирующих сплавов.

Ключевые слова: металлургия, химические и демпфирующие свойства сплавов, отжиг, закалка, микроструктура.

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