APPROVED
Dean of Engineering-Physical Faculty, Doctor of technical sciences, member-correspondent of NAS of Ukraine
(signature) Loboda P.I.
June 27, 2014
Seal: National Technical University “Kyiv Polytechnic Institute”, Engineering-Physical Faculty

PROTOCOL No. 007
of spectral analysis of samples of substances (carbon) extracted from the cylinder of the piston system of the ЧМЕ3 engine

Kiev

1. Basis for tests: The letter No. 16/04 of 16.04.2014
LLC Scientific-Production Firm “Eko-Avto-Titan”

2. Place of tests: Engineering-Physical Faculty of NTUU (KPI).

2. Period of tests: 22-23. 2014

4. Purpose of tests: Assessment of the composition of substances contained in the carbon, extracted from the cylinder of the piston group of the locomotive ЧМЕ3 No. 4378, on which the catalyzer КТ-14Д was installed from 25.05.2012 to 12.02.2014, and the cylinder carbon of the piston group of the locomotive ЧМЕ3 No. 2505, which operated without the catalyzer.

5. Devices for researches. The determination of the chemical composition was carried out on the analyzer of the elemental composition EXPERT 3L, by the direct measurement of the mass fraction (concentration) of chemical elements in the sample by the method of nondestructive energy-dispersive X-ray fluorescence analysis (EDRFA) without the use of standards.

Range of measurements of chemical elements:
from magnesium (12 Mg) to uranium (92U)

5. The researches results are summoned in the Table.

Conclusions: The chemical composition of combustion products with application of the catalyzer КТ-14Д does not differ from the chemical composition of combustion products extracted from the parts of those which worked without the use of the catalyzer.

Expert (signature) Biba E.G.

Comparative Characteristics of

The Results of Definition of the chemical composition of formed carbon from the piston group the cylinder of the locomotive ЧМЕ3 performed in the laboratory "Center of Electronic Microscopy" (CEM) EphF of NTU "KPI"

The determination of the chemical composition was carried out on the analyzer of the elemental composition EXPERT 3L, by the direct measurement of the mass fraction (concentration) of chemical elements in the sample by the method of nondestructive energy-dispersive X-ray fluorescence analysis (EDRFA) without the use of standards

Range of measurements of chemical elements:

from magnesium (12 Mg) to uranium (92U)

	ЧМЕ3 No. 2505		**ЧМЕ3 No. 4378**					
	Piston		**Piston**					
Element	**1**	**2**	**1**	**2**	**3**	**4**	**5**	**6**
14Si	-	-	0.205	-			-	-
15 P	5.503	4.604	4.525	5.474	5.339	3.363	5.015	5.642
16 S	28.340	29.171	30.694	30.163	27.459	21.843	29.035	29.521
20 Ca	50.284	53.474	48.202	51.106	52.657	54.965	51.464	51.262
22 Ti	-	0.159	-	-	-	0.121	-	-
24 Gr	0.101	0.056	0.096	0.061	0.071	0.086	0.048	0.063
25 Mn	0.107	0.028	0.137	0.039	0.048	-	0.043	0.052
26 Fe	5.327	3.265	8.451	3.615	4.279	6.925	4.620	4.796
28 Ni	0.048	0.031	0.054	0.015	0.007	-	0.010	0.012
29 Cu	0.311	0.176	0.342	0.218	0.203	0.257	0.251	0.200
30 Zn	8.318	8.492	5.693	7.088	7.437	9.649	7.255	6.733
31 Ga	-	-	0.013	-	-	-	-	-
38 Sr	0.026	0.036	0.023	0.034	0.042	0.059	0.039	0.038
50 Sn	0.020	0.025	0.020	0.028	0.026	0.047	0.038	0.035
82 Pb	1.614	0.483	1.479	2.106	2.021	2.200	2.152	1.551

(signature) Byba E.G.