Scientific and production association
RUSPROMREMONT

Scientific and technical association
NVC

RVS Technology

Results of basic researches on Russian railways

RVS Technology was developed in the 1990's by a group of scientific employees in St. Petersburg.

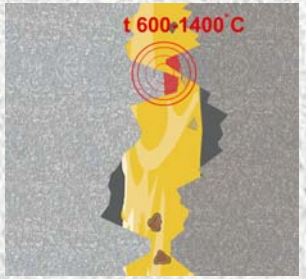
RVC Technology enables repair of worn units and mechanisms without their disassembly during their regular operation

RVS Technology enables selective indemnification of deterioration of friction and contact zones of machine parts due to formation of new ceramic-metal surfaces in these places

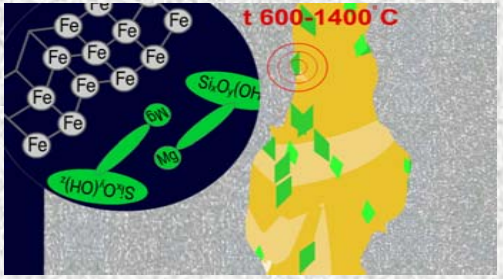
RVS Technology considerably decreases repair expenses

The basic stages of formation of a ceramic-metal blanket

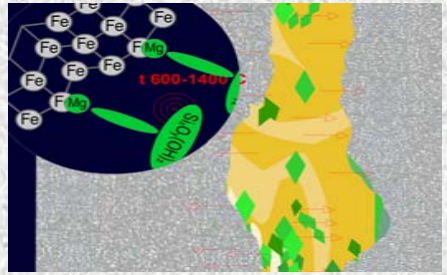
Allocation of energy at deformations of metal and demolition of RVS particles



Breaking molecular communications in chemical connections of material structure

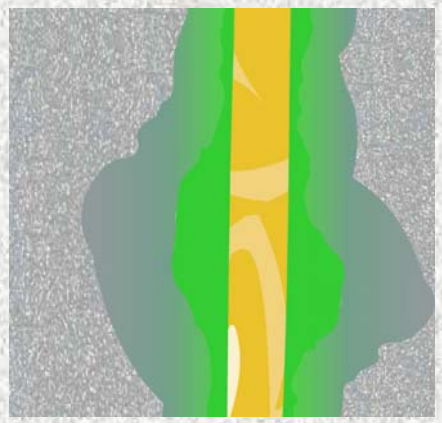


Formation of new communications



Growth of crystals and formation of ceramic-metal surface structure

End of forming ceramic-metal surface structure



<u>Characteristics of a ceramic-metal surface structure</u>

First of all, it is a method of restoring the worn surfaces till the sizes optimizing gaps in the friction pairs (from micrometers up to tenths of millimeters). Furthermore, the reformed surfaces possess unique characteristics:

- Micro hardness till 65 to 72 units on Rockwell scale C depending on the steel type (the usual average increase of the micro hardness for some carbonaceous steels is up to 80 %)

- Increased contact spot by up to 90 %

- Friction coefficient 0.01 to 0.005 (for steel-to-steel pairs the coefficient of dry friction is usually accepted to equal 0.25 to 0.15)

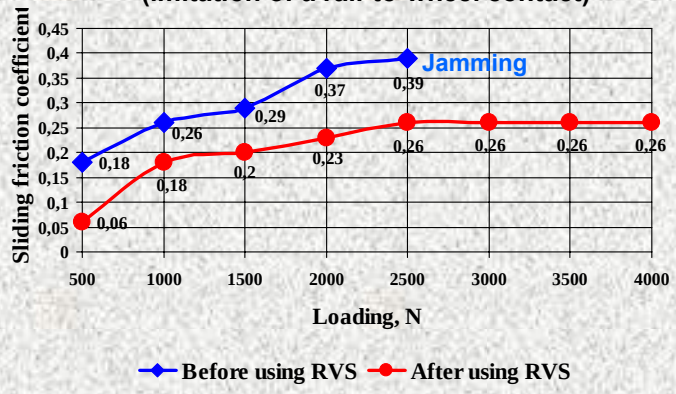
- Destruction temperature of 1700 ° C to 2000 ° C .

The average parameters of technical and economic efficiency from using the RVS Technology are more than are convincing: economy of the electric power increased by 10 % to 20 %; fuel economy consumption decreased by 10 % to 20 %; lubricant consumption decreased down to a half or a third of the original; decreased noise and vibrating parameters; doubled or more prolonged maintenance intervals; decreased operational expenses.

The RVS Technology is approved to be used in many industries on enormous quantities of mechanisms from household sewing machines up to complex hydraulic systems. In the Chita region, efficiency tests of the RVS Technology were carried out on the Transbaikalian railway, the various agricultural enterprises of the region, motor transport, mechanisms of industrial mountain-chemical association Priargunsk. Everywhere – without exceptions – treating the equipment with the RVS Technology has given high technical and economic efficiency.

Decrease in wear speed in a rail-to-wheel friction system

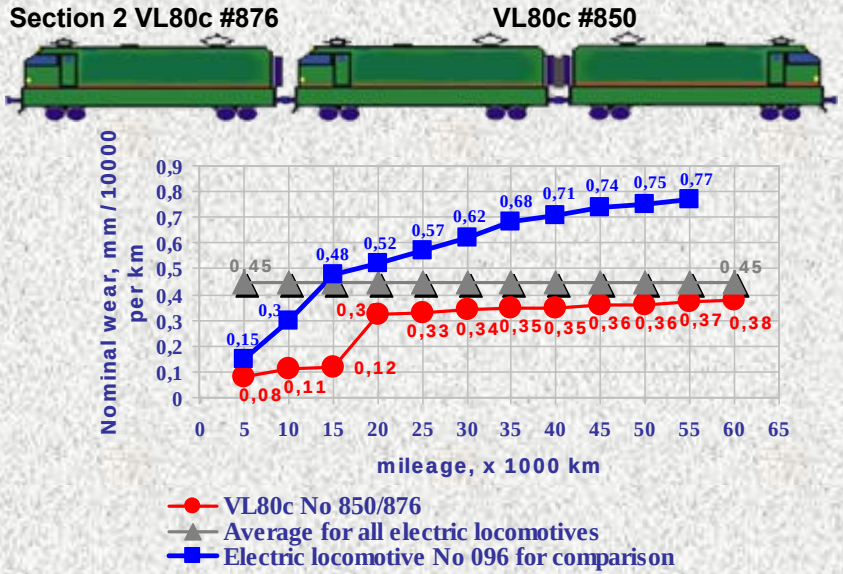
Laboratory researches of steel-to-steel friction pair in conditions of oil starvation (imitation of a rail-to-wheel contact)



As an experiment, a friction machine DM-29M of the Machine Part Department of the Transbaikalian Railway Institute was used. Sample materials to be used in the experiment were chosen to show a variety of hardnesses, which takes place in real conditions of rail-to-wheel contacts. The inner part of a sliding bearing and the shaft were made of steel with the hardnesses of HRC 30 and HRC 35. The tests were carried out in conditions of oil starvation in order to imitate the conditions of boundary friction. The quantity of loading cycles was $4 \cdot 10^4$. In order to gain reliability for the research results, a series of 6 experiments was carried out with a subsequent averaging of the measured figures.

An analysis of the research showed that the sliding friction coefficient decreased, as a result of using RVS Technology in a steel-to-steel friction pair, on the average by 66 %. It is necessary to emphasize that, in the case of using similar samples but not treated with RVS Technology, the materials of the bearing and the shaft seize with each other at the loading of 2500 N, whereas no seizure took place with the treated samples even at the loading of 4000 N.

Researches of hard lubricating rods with 5 % of RVS Technology compound



For carrying out the tests, a laboratory car TEVL 79798 was used.

For toughening the test conditions, a groups of wagons with the total mass of at least 6,000 tons was selected for the route of Chita – Khabarovsk – Karymskaya – Khabarovsk – Chita with the total mileage of 10,000 km. Every time that the personnel was replaced, the hardness and the wear rate of the wheel flanges of the locomotive were measured.

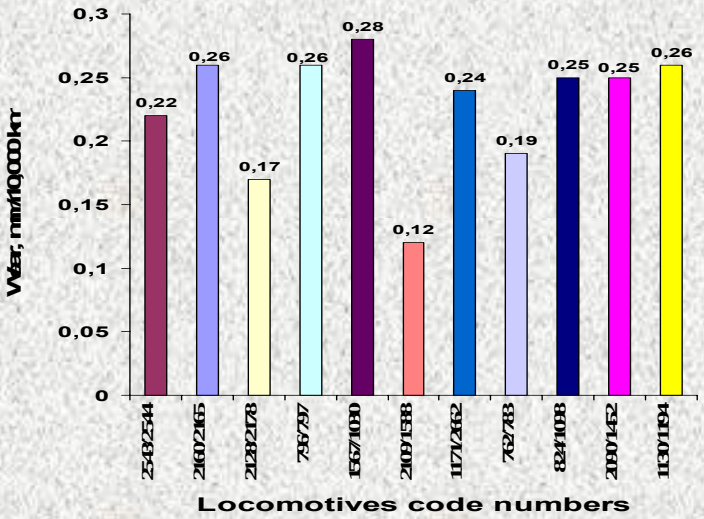
The dynamics of the formation of a ceramic-metal surface structure was measured by an indirect method on the basis of the change of the hardness of the surface of the wheel flanges. The micro hardness was measured with the portable measuring instrument HNL–11A with a shock device of type C for measurements on the Vicker scale (HV).

The dynamics of the wear of the wheel flanges was measured by a direct method by using a pattern for thickness measurement of the wheel flange.

In order to be able to make a comparative analysis on the wear speed of the wheel flanges, the locomotives were run for a mileage of 60,000 km without installing the RVS Technology rods.

As it appears from the schedules, the efficiency of using hard lubricating rods is at its highest at the mileage of 15,000 km.

Industrial tests of hard lubricating rods



The rods were installed in the locomotive depot of the Chita station on the front wheel pairs of the VL80c locomotives with an additional section. The locomotive then operated east of Chita with the total mass of the wagons of approximately 6,000 tons. The rods were replaced after a mileage of 25,000 km in order to measuring the useful life of the rolling surfaces of the wheels by the criterion of the wear of the flanges.

The received results coincide with the calculated values received as a result of an experimental trip of the electric locomotive VL80c No 850/876.

The nominal wear resulting from the usage of the RVS Technology rods decreased by almost 50 % in comparison with traditional technologies of protecting wheel flanges in three-section locomotives.

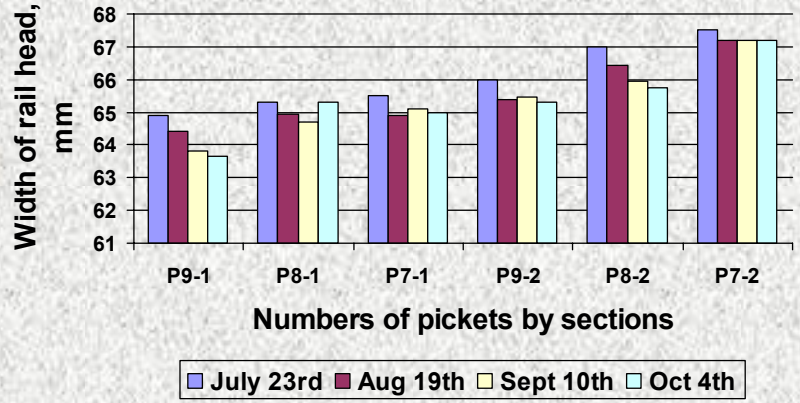
Thus, using RVS Technology for protecting locomotive wheel flanges is economical for the railways.

It is necessary to note that, when using RVS Technology, the wheels of the twelve wheel pairs are protected. The hard lubricating rods do not have any influence on the wagon wheels following the locomotive.

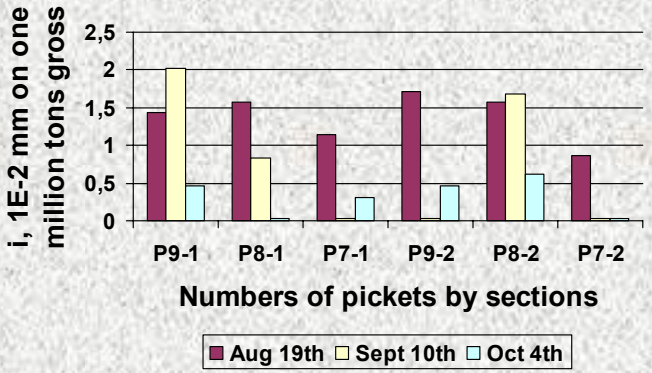
Due to the facts mentioned above, in our opinion, this technology should be used on railway sections where it is impossible to use standard systems, and lubrication systems with RVS Technology compound in the grease should be used for complex wear protection of main locomotives, wagons, and rails.

Tests of lubricating rails with grease containing 1 % of RVS Technology compound

Rail wear in curves



Rail wear intensity in curves



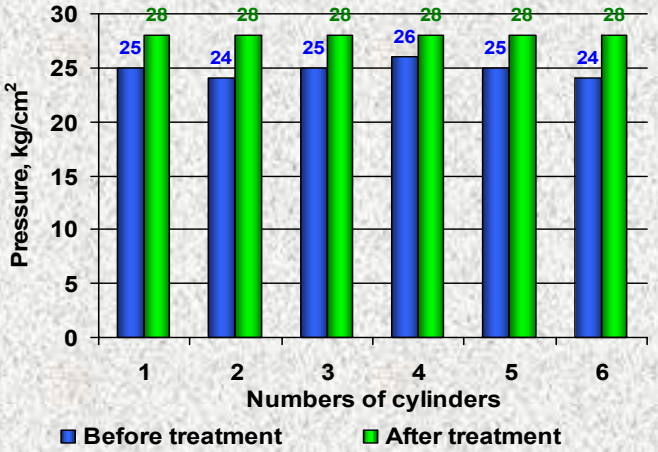
In order to study the influence of RVS Technology on the lateral rail surfaces, the rails on the curves situated on the 6,183rd kilometer and the ends of the switches No 221, 223, 225, 229, 243, 251, and 253 situated in the Chita station No 1 territory. From June 23rd till August 19th, the rails of the curves were not lubricated in order to get wear speed figures without using the RVS Technology. Similar results were received from the switch ends.

An analysis of the received results showed that the intensity of the lateral wear of rails in the curves can be lowered by 63 to 73 %, and the intensity of the wear of the switch ends by over 83 %.

Tests of RVS Technology on diesel engines and gearboxes of railway equipment

Four-stroke diesel engine of a shunting diesel locomotive TEM-2 No 1028

Compression pressure by cylinders



RVS technology was used on the parts of the cylinders and pistons, the crank mechanism, the valve mechanism, fuel feeding equipment, and the revolution regulating system. The measurements were made with the regular equipment of the department of rheostat tests with using a computer-based control devise.

A comparison of the average values of the parameters:

Compression pressure in cylinders was 24.8 kg/cm^2; became 28.0 kg/cm^2

The maximum combustion pressure was 47.3 kg/cm^2; became 58.6 kg/cm^2

Oil pressure was 2.5 kg/cm^2; became 2.8 kg/cm^2

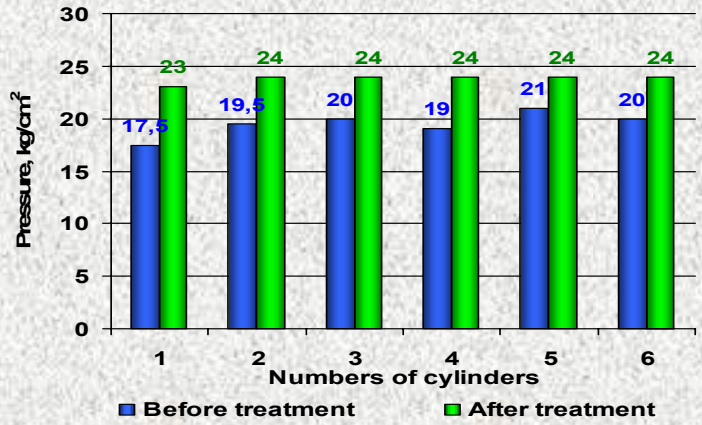
Turbo compressor pressure was 0.5 kg/cm^2; became 0.75 kg/cm^2

Nominal fuel consumption was 7.3 kg/hour; became 6.375 kg/hour

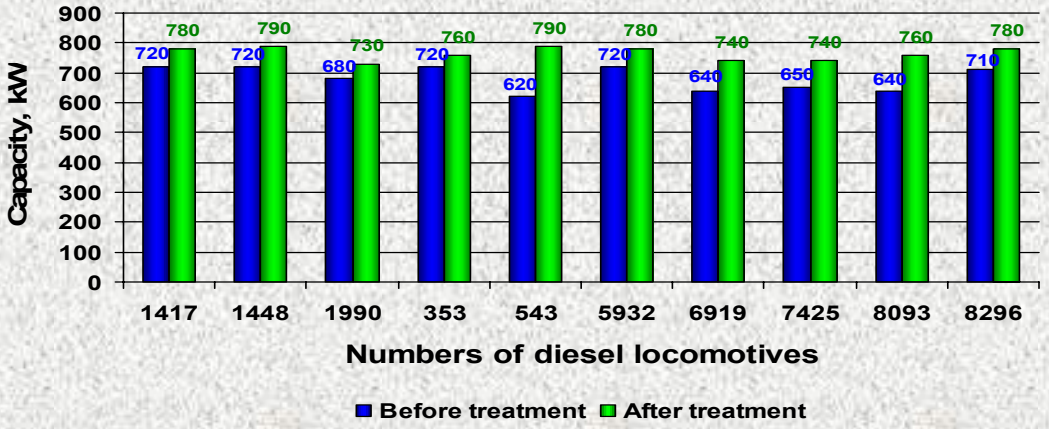
As a result of the treatment the parameters of the diesel engine began to correspond to the values recommended by the manufacturer.

Industrial tests of four-stroke diesel engines of shunting diesel locomotives

Compression pressure of diesel locomotive No 543



Change of effective power of shunting diesel locomotives



A control check of the fuel consumption of the diesel locomotive No 543 showed its decrease by 29 % from 245 g/kWh down to 172 g/kWh.

A calculation of the economic efficiency based on the results of the industrial tests of RVS Technology and those on diesel engines of shunting locomotives shows that it is possible to decrease the operation costs significantly.

Tests of RVS Technology on two-stroke diesel engines of main diesel locomotives

Results of rheostat tests on the diesel engine 14D40 of the diesel locomotive 3M62 No 0088

Date	Para-meter	Section A		Section B		Section C	
		Pos. 0	Pos. 15	Pos. 0	Pos. 15	Pos. 0	Pos. 15
Sept. 2nd, 1999 Before using RVS	n_{tc}	3000	13740	3210	16020	2700	13170
	G_f	23.4		26.0		24.62	
	g_e		228		216		217
	P_{tc}		0.8		0.85		0.8
Sept. 2nd, 1999 After using RVS	n_{tc}	***3350***	***14220***	***3330***	***16170***	***3300***	***14205***
	G_f	***22.04***		***20.12***		***22.01***	
	g_e		***221***		***212***		***204***
	P_{tc}		***0.85***		***0.85***		***0.82***
Nov. 29th, 1999	N_{tc}			***3630***	***16180***		
	G_f			***19.6***			
	g_e				***181***		
	P_{tc}				***0,9***		
Mar. 28th, 2000	N_{tc}	***3360***	***15700***	***3650***	***16230***	***3290***	***16890***
	G_f	***21.77***		***19.9***		***19.74***	
	g_e		***209***		***189***		***196***
	P_{tc}		***0.88***		***0.9***		***0.88***

Research of the technology was carried out on the 14D40 diesel engines of the diesel locomotive 3M62 0088 and the diesel engines 10D100 of the diesel locomotive 2TE10M No 2579 at the locomotive depot Borzia.

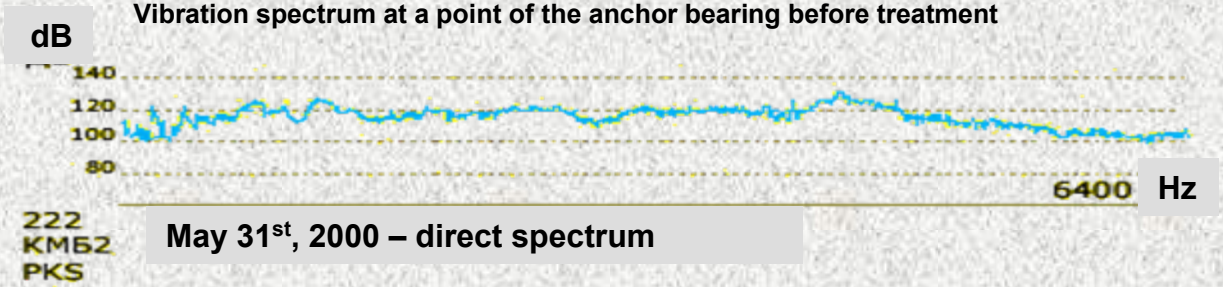
An analysis of the results of the rheostat tests carried out on the diesel engines 14D40 showed that, due to the decrease of friction in the shaft-to-sliding bearing pair of turbo compressors, the revolutions of the driving wheel increased by 28 % (position 15) on the section C. On the section B, the revolutions increased by 13 % (position 0), on the position 15 the revolutions increased insignificantly as they corresponded to the manufacturer's values even before the treatment. The fuel consumption parameters decrease by 4 % on the average immediately after the treatment (during 2 to 4 hours of running-in). After 6 months of operation of the diesel engines and after controlling the nominal fuel consumption, it appeared to have decreased by 10 % on the average by the three sections.

An analysis of the results of the useful life tests of the 10D100 diesel engines showed that during the period operation of 14 months **no seizures of pistons and cylinders, ring damages** were revealed and **no bearing parts were replaced**. A comparative analysis of crankshaft gap measurements showed that the gaps had been optimized, and **there was practically no wear detectable in the bearings** (when measurement accuracy taken into account). The parameters of the gases of the diesel engines and the physical and chemical parameters of the engine oil correspond to the technical conditions.

Industrial tests are being conducted on the 2TE10 locomotives No 4162, 4202, 4698, 5076, 4876, 4883, 4929, 4690, 4776, and 4812, as well as on the 3TЭ10 locomotives No 0059, 1376, 1424, and 0145. During the treatment procedures power of all the diesel engines without exception has increased (on the average by 120 kW). After the first 3 months of operation, during the control of the technical state of the friction pairs of the diesel engines even no traces of their wear were revealed.

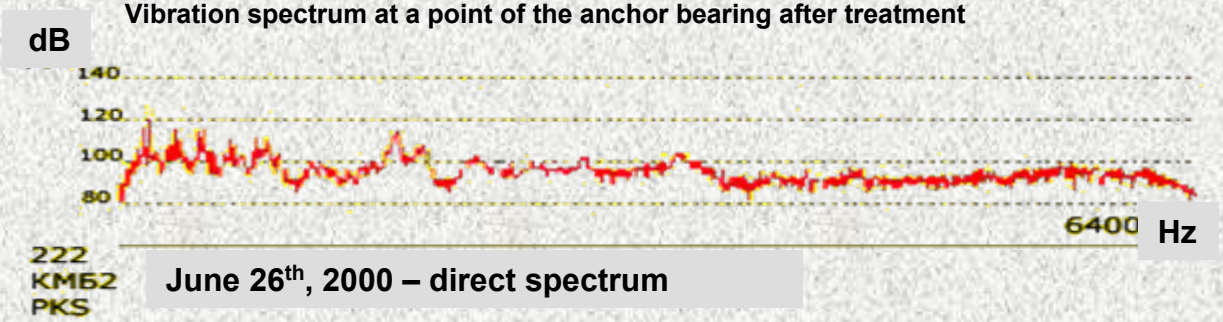
Researches of RVS Technology on traction gearboxes of shunting diesel locomotive TEM-2 No 222

Vibration spectrum at a point of the anchor bearing before treatment



May 31st, 2000 – direct spectrum

Vibration spectrum at a point of the anchor bearing after treatment



June 26th, 2000 – direct spectrum

The research on the influence of RVS Technology treatment on tooth gearing was carried out on the wheel-and-motor blocks of the second and the fifth wheel pairs of the shunting diesel locomotive TEM2A No 222. The treatment of the tooth gearing was carried out three times along with control of the tooth geometry and vibration parameters by using the diagnostic device Prognoz. After the third treatment and running-in during operation, the oil from the treated blocks was drained out. **Subsequently, the locomotive operated without oil in the gearboxes of the second and the fifth wheel pairs.** The thickness of certain teeth and the vibration characteristics were measured with certain intervals. When the teeth were visually checked, one could notice that the contact surfaces have a characteristic matte color with a very high degree of cleanliness. The thickness of the teeth increased by 0.2 mm on the average. The vibration intensity in a direct spectrum decreased by 12 units on the average. The vibration intensity on an envelope spectrum decreased by 20 units on the average. **The useful life of a ceramic-metal surface structure was 10 months of continuous operation without oil in the gearboxes.**