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HYDROGEN WEAR OF RAILWAY WHEELS AND SPECIAL TECHNOLOGY OF PROTECTION

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Summary: *Wear-resistance problems of the wheel-rail friction pair on the railroad transport are considered. Results of researches of influence of the lubricants applied on a railway transportation, and also a moisture and other hydrogen materials on deterioration of wheels and rails of a railway transportation are resulted. It is established, that hydrogen deterioration is one of the reasons for low wear resistance of applied constructional materials. It is considered, developed by the author, that the special antifriction machining technology (SAMT) of wheels and a rail of the railway transportation, allowing in some times to lower their deterioration. To increase antiscuff and antiwear properties of the wheel-rail friction pair the SAMT is proposed. This technology is a variant of the finish antifriction abrasiveless machining of frictioning surfaces. Results of tests of the developed technology on a number of railways of Russia and Europe are presented.*

HUDROGEN ABSORPTION OF WHEELSET ROLLING SURFACE

The analysis of external environments and nature of deterioration of wheelset surface, has allowed to install, that one of the reasons of intensive deterioration of crests wheelset surface having chopped off of a circle of a rolling, are the processes, characteristic of the phenomen of hudrogen deterioration of metals – opened and registered by a group of Russian scientists, led by professor D. N. Garkunov. It is confirmed by the appearance of the worn surfaces (as oblong hitches, depth from 100 nm up to 10 μm (Figure), or large having chopped off and by chopping off, length up to 20 mm and depth 10 mm), seasonal prevalence of deterioration (more intensive in winter and the autumnal – vernal period), and also special researches of Institute of phusical chemistry of the Academy of Sciences of Russia, contents, which have revealed magnification, of hydrogen in surface layers is stipulated by decomposing hudrogenous of environments (lubrication, water, snow etc.).

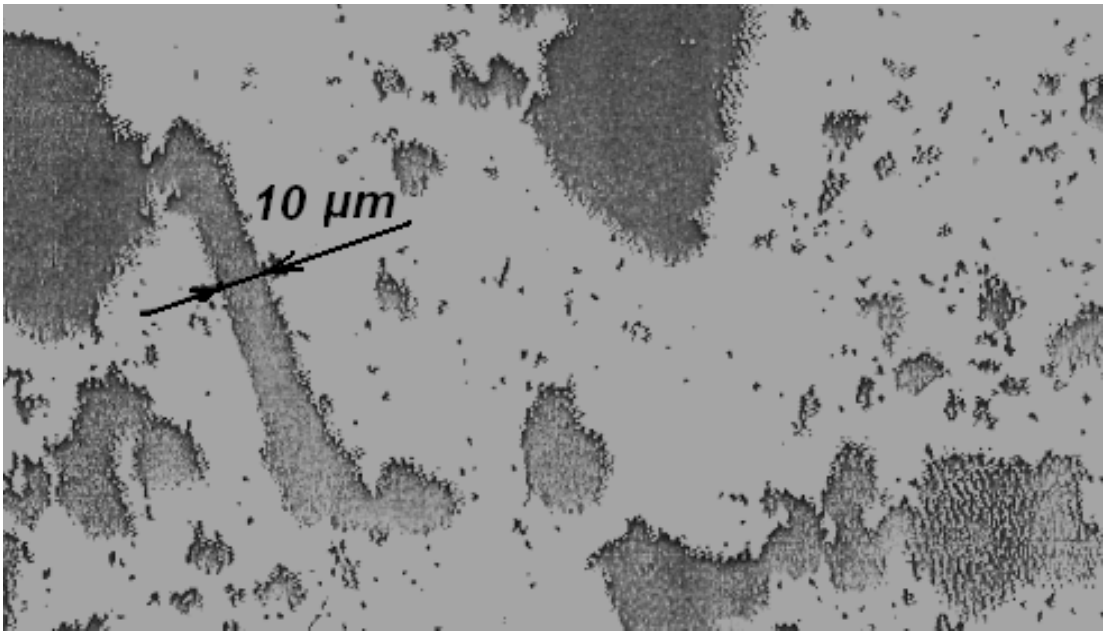

Figure: Appearance of particles of deterioration at hydrogen wear process of metals (x 500)

On friction surfaces rolling wheelset**.** The atomic hydrogen, freely diffusing in microimperfections etc., calls deleting of Carboneum of steel, translating it in plastic state. Other negative consequences are marked also: 'diesel effect" – formation of methane and its detonating at dynamic loads, formation of connections of hydrogen with phosphorous etc. All this reduces in change of pattern of surface layers, generation of microfactures, having chopped off and destructive wear wheelset rolling surface [1].

SPECIAL ANTIFRICTION MACHINING TECHNOLOGY (SAMT)

Having defined one of the principal causes of intensive wear process of a surface of a rolling and crests of railway wheels, the highly effective and cheap method of their protection against hydrogen wear process is offered.

The technique is called special antifriction machining technology (SAMT) of the wheelset surface and consists of the abrasion of coverage of ductile metals on job surfaces wheel [2,3].

The technique special antifriction machining technology has the following essential virtues.

1. It has slashed probabilities cracks initiation and possible further growth of flaws on a surface of a rolling and crest of a sprocket, owing to origin on it of ductile composite pattern fractionally absorbing periodic mechanical voltages (microshocks) and defending a material of a sprocket from a penetration of hydrogen in the zone of contact with the rail.

2. There is no highly temperature effect on surface patterns of metal wheel as against other methods of a heightening of endurance (different aspects of quenching and flash-off, building-up welding of special coverage etc.). The favorable effect on the unmachined wheel and rail cloth, in particular deleting of fissures and particle carrying of ductile copper coverage is carried out.

3. Opportunity broad of introduction of technique special antifriction mechanical treatment of the wheelset surface in compressed periods, owing to relative ease of an applied equipment and low cost of consumables.

4. Cost of handling of one wheel is100 US dollars (according to the prices from the beginning of 2008).

TESTING SAMT SURFACES OF A ROLLING OF WHEEL PAIRS

1. Passenger trains (№ 64 Moscow – Leninogorsk and № 1 Moscow – Vladivostok "Russia" of the Moscow railway – MRW) in bulk 50 wheel pairs (w/p):

– The run before rejection in 175 000…240 000 km is ensured, that more than in 3 times exceeds run of wheel pairs after a customary resharpening on the data routes.

2. Freight cars with load on an axis more than 27 tons on an axis (Experimental ring of the All-Russia research institute of a railway transport – Cherbinka) in bulk 12 w/p:

– Decrease of wearing of ridges of wheel pairs on 38, 9 %;

– Half of wheel pairs at run of 140 000 km. At all had no wearing of ridges.

3. Electrosection ("Locomotive depot of a name Ilicha" – MRW in bulk 24 w/p:

– Capability of maintenance of run up to 200 000 km without resharpening;

– The treated wheel pairs were scrapped on hire, that provides minimum removal of a stuff at a reduction resharpening.

4. Locomotives TME-3 ("Riga locomotive" Latvian railway) in bulk 7 w/p:

– Decrease of wearing of ridges to 4 times.

5. Braking and service life tests ("S-Bahn Berlin Gmbh" (Berlin, FRG) with engaging the specialists – explorers of the corporation "Fb Fahrzeige"):

–Deteriorations have not shown of the braking characteristics in conditions of four different kinds of inhibition, both on dry and on a wet rail;

– The tests are finished in August, 2000 on run 392 000 km and could be prolonged further.

6. Special researches (Institute of physical chemistry of the Russian academy of sciences):

– The obtained outcomes are provided at the expense of a decrease of the contents of hydrogen in surface layers of a wheel pair and rails, after application of technology SAMT (Table), in 40 and more time (with 453…480 up to 0,54...0,75 sm^3 of hydrogen in 100 g of metal).

Table: Results of research of samples on the maintenance of hydrogen

Thickness (depth) of research, mm	Weight, g	Concentration of hydrogen, sm^3 of hydrogen in 100 g of metal
In usual conditions		
3,2...2,8	2,33…3,26	1,50…1,77
2,2...1,8	0,51…0,55	2,45…2,65
1,0...0,8	0,17…0,19	5,0...6,10
0,01	0,005	453,0…480,0
After application of technology SAMT		
3,0...0,8	3,0...0,20	0,54…0,75

CONCLUSIONS

1. Possible sources of hydrogen in a pair of friction “sprocket – rail”:

– Moisture by rain, snow, dew etc;

– Hydrocarbon lubricants (oil, lubrications, fuel etc.);

– Different hydrogen-containing connections from transported freights.

2. Gear of hydrogenous deterioration:

– Destruction of hydrocarbon mediums up to atomic hydrogen;

– Diffusion of atomic hydrogen into the depth of friction surfaces;

– Decarbonization of a friction surface ($C + 2H_2 = CH_4$);

– Growth of microvolumes;

- Formation and growth of microfissures;

– “Diesel effect” (explosive combustion of methane in pores of metal

$CH_4 + 2O_2 = CO_2 + 2H_2O$);

– Caving, conches, craters.

3. Methods of protection from hydrogenous deterioration:

– Grinding a rail cloth and resharpening of wheel pairs;

– Decrease of usage of lubricants;

– Anodic protection;

– Deposition of copper covers (spraying, detonation and other);

– Special antifriction machine treatment (SAMT).

4. The obtained experimental and industrial data uniquely convinces of expediency of applying for lowering process saturation of a material wheel of a railway transportation of special antifriction mechanical treatment of the wheelset rolling surface.

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