Research Group

InfoMine

The community of independent consultants
in geology, mineral resources, mining and metal industry

Review of Railway Wheels Market in the CIS

Moscow
April 2007

Internet: www.infomine.ru
e-mail: info@infomine.ru

Contents

List of Tables

List of Figures

Introduction

The report is devoted to analysis of market of railway wheels in Russia and Ukraine to estimate prospects of their expending and to forecast domestic consumption up to 2009.

The report consists of 76 pages, 36 Tables and 20 figures. It includes 5 sections: review of production technology and grade of the products; analysis and estimation of competitor-producers of railway wheels; analysis of export-import flows; review of domestic and export-import prices on railway wheels; analysis and forecast of domestic consumption.

The research was accomplished mainly by a method of desk studies, with analysis of many information sources, first of all, state official statistics: data of Russian State Committee on Statistics (now Federal Service of State Statistics, or Rosstat), Ukrainian State Committee on Statistics (data on production of the products), Russian domestic railage statistics, data of Russian State Customs Committee and Ukrainian State Customs Committee (foreign trade information). Besides, information directly from companies, involved in this business, as well as database of InfoMine company were applied. Notice that some differences in data on foreign trade transaction are connected with inconsistency of Russian and Ukrainian official customs statistics.

Summarized data were then verified and corrected using a number of telephone interviews with specialists of the companies, involved in the business.

This all allowed to reveal clear picture of market of railway wheels in Russia and Ukraine (competitors, consumers) and its prospects.

1. Production technology and grade of products

1.1.Technology of wheels production

Technology of railway wheels production includes the following processes:

- Steelmaking;
- Steel treating in ladle-furnace and vacuum-degassing facility;
- Bottom casting steel;
- Rolling at wheel-rolling mill;
- Thermic treating wheels;
- Mechanical treating wheels.

Steel for wheels production is produced in Russia and Ukraine in ***open-hearth furnaces*** (at JSC «Vyksa metallurgical plant» and JSC «Nizhnedneprovsky pipe-rolling plant», NDTZ) or ***by BOC method (blast oxygen converter)*** (JSC «Nizhnetagilsky metallurgical combine», NTMK).

At all the three enterprises, steel is subjected to treating in a ladle-furnace and a vacuum-degassing facility that improves considerably properties of steel. In ladle-furnace, steel is blown with argon and refined to decrease sulfur and phosphorus content and to homogenize chemically the steel; then the steel is treated at vacuum-degassing facility to decrease content of gases dissolved in it. These measures provide optimal viscosity, pliability and strength of steel for wheel products, providing high mechanical strength and resistance of the final products.

Steel casting is conducted at JSC «Vyksa metallurgical plant» and JSC «Nizhnedneprovsky pipe-rolling plant» by bottom casting method into open-bottom mold o obtain ingots weighting 3.5-4t, elongated to ratio of above 4 (length/average diameter). The ingots are cut to obtain initial wheel blanks at multi-support cutters.

JSC «Nizhnetagilsky metallurgical combine» produces wheel steel in its converter plant, including 4 160-t converter (BOC), 3 ladle-furnaces and 2 circulation vacuum-degassing facilities, as well as 4 **continuous-billet casters**. Wheel billet (semis) are cast at curvilinear 4-strand concaster (No. 1, commissioned in 1995). Then the billets are cut at Wagner saws to obtain wheel blanks, going then into recuperation heating ring furnace with rotary bottom In this case furnaces 28 and 30m in diameter, with the bottom width of 3 and 4.4m, respectively are used; at each bottom 3-5 blanks are positioned. Then scale removal is conducted.

At the next stage – ***wheel stamping***: initially the blank is treated at press 20MN (to 30% deformation), then at press 50 MN to 60-70% deformation, with following punching of central part of the blank (to provide reaching required thicknesses of wheel parts), and, finally the blank is treated at 100-MN press.

Then ***rolling the wheel*** is conducted at wheel-rolling mill, followed by treating at 35-MN press of double action to provide benching disk, sizing wheel, piercing central nave hole and labeling.

Thermic treating the wheels includes anti-flake annealing, hardening and drawback.

Anti-flake treating wheels is conducted by method of isothermic soaking at 650^{o}C (to remove hydrogen).

In «Vyksa metallurgical plant» and «Nizhnedneprovsky pipe-rolling plant», anti-flake treating is implemented in tunnel furnaces 125m long; at NTMK, the process is conducted in pit furnaces (with use of natural gas as fuel). The anti-flake treating is conducted at 600-670^{o}C for 3 hours.

Then, after hot deforming, cooling the wheels to 400-550^{0}C to form austenite and to complete structural changes in steel, providing hydrogen separation from solid solution in iron, is conducted.

Before hardening, the wheels are heated in ring furnaces up to 800-850^{0}C, and then are hardened for 100-200 seconds. Then the wheels are collected in stacks (6 pieces in each) and are cooled by air for 30-40 minutes.

Then the wheels are subjected to soaking in pit furnaces for at least 2.5 hours at 470-520^{0}C (temperature is set depending on steel chemistry).

After mechanical treating the wheels, they are subjected to inspection, measurements, and tests of mechanical properties (in samples).

1.2. Requirements imposed on grade of railway wheels

Wheels are produced from steel of various grades (Table 1):

1 – coach cars, passenger locomotives, non-motored cars of electric and diesel trains, track machines;

2 and 3 - for freight cars, freight locomotives and car movers.

Wheels from steel of grade, containing 0.63% C maximum, are manufactured to client order for coach cars and non-motored cars of electric and diesel trains.

Steel for wheels is to produce by open-hearth, converter and electric steelmaking rout and to be subjected to ladle-furnace treating by inert gas. The steel may be subjected to vacuum degassing; for such steel, hydrogen content must be below 0.0002%.

Requirements, imposed on chemistry of wheel steel, are shown in Table 1.

Table 1: Chemistry of wheel steel (GOST 10791- 89-(2004))

Steel grade	Chemistry, %					
	C	Mn	Si	V	S	P
					maximum	
1	0.44- 0.52	0.8-1.20	0.4-0.65	0.08-0.15	0.030	0.035
2	0.55-0.65	0.50-0.90	0.22-0.45	maximum 0.10	0.030	0.035
3	0.58-0.67	0.50-0.90	0.22-0.45	0.08-0.15	0.020	0.030

Notes:

1. Carbon content is allowed in range of preciseness ±0,02%.
2. Ni, Cr and Cu content are allowed 0.30% maximum for each; molybdenum content is to be 0.08% maximum.
3. For concast billet, sulfur content is permitted 0.020% maximum.
4. In finished wheels, range of vanadium content fluctuations is permitted ±0.02%.

Mechanical properties, hardness and shock viscosity of wheels, subjected to strengthening thermic treating must meet requirements, presented in Table 2.

Table 2: Mechanical properties, hardness and shock viscosity of wheels, subjected to strengthening thermic treating (GOST 10791- 89-(2004)

Steel grade	Breaking stress $\sigma_в$, N/mm^2 (KgF/mm^2)	Relative elongation δ,%	Relative narrowing ψ,%	Hardness at a depth of 30 cm of rolling surface, HB	Shock viscosity KCU* at samples at temperature 20^{0}C, J/cm^2 (kgF·m/cm^2), minimum	
		minimum			rim	disk
1	880-1080 (90-110)	12	21	248	30 (3.0)	30 (3.0)
2	910-1110 (93-113)	8	14	255	20 (2.0)	20 (2.0)
3	980-1130 (100-150)	8	14	285	16 (1.6)	16 (1.6)

* - shock viscosity KCU is integrated characteristics, including force of crack origination (aO) and force of viscous crack propagation (aP): KCU = aO + aP

Mass of all-rolled wheel to GOST 9036-88 in given in Table 3.

Table 3: Mass of all-rolled wheel (GOST 9036-88)

Diameter of wheel, mm	Diameter of nave hole, mm	Mass *, kg
957	190	391
957	175	398

* To client order, it is allowed to manufacture wheels with thickness 17^{+3} mm (rim) and 24±2 mm (near nave hole), mass 385 kg and 392 kg correspondingly to diameter d.