
INCREASING THE ROLLING-MILL ROLLS QUALITY - IN SOME MULTIDISCIPLINARY RESEARCH

■ **Abstract:**

Quality assurance is the activity of providing evidence needed to establish quality in work, and that activities that require good quality are being performed effectively. All those planned or systematic actions necessary to provide enough confidence that a product or service will satisfy the given requirements for quality. Quality assurance covers all activities from design, development, production, installation, servicing and documentation. It includes the regulation of the quality of raw materials, assemblies, products and components, services related to production, and management, production, and inspection processes.

Our approaches the issue of quality assurance of the rolling mills rolls, from the viewpoint of the quality of materials, which feature can cause duration and safety in exploitation. The experimented durability research, as well as the optimization of the manufacturing technology, allows the conclusion of direct results for the rolls. The beneficiaries of these results are the unit in which the rolls are manufactured, as well as the unit that exploits them. The technological manufacturing process of the rolling mills rolls, as well as the quality of material used in manufacturing them, can have a different influence upon the quality and the safety in the exploitation.

■ **Keywords:**

quality assurance, cast-iron rolls, manufacturing, laboratory research, mathematical modeling

■ **INTRODUCTORY NOTES**

Roll makers always ask about rolling conditions and the necessity to choose the right grade of roll material and roll users always ask about the mechanical and physical properties of roll material. Sometimes they feed these figures into their rolling model, but sometimes they also need them for unknown reasons. This information is very rarely useful for selecting the right supplier. Roll makers and roll users frequently have to discuss experiences, performance results, and special requirements of the mill. Roll failure problems can be solved by good co-operation. In engineering and manufacturing, quality control and quality engineering are involved in developing systems to ensure products or services are designed and

produced to meet or exceed customer requirements. These systems are often developed in conjunction with other business and engineering disciplines using a cross-functional approach. By collecting data from samples at various points within the process, variations in the process that may affect the quality of the end product can be detected and corrected, thus reducing waste as well as the likelihood that problems will be passed on to the customer.

Quality assurance covers all activities from design, development, production, installation, servicing and documentation. It includes the regulation of the quality of raw materials, assemblies, products and components, services related to production and inspection processes.

Production logistics is the term used for describing logistic processes within an industry. Also, the purpose of production logistics is to ensure that each equipment and technologies is being fed with the right product in the right quantity and quality at the right point in time. What materials, products, or information come into the activity? What materials, products, or information flow out of the activity? Quality engineers use the D-M-A-I-C model (define, measure, analyze, improve, and control) to document processes before beginning process improvement. If processes are documented, another series of logical questions apply: Are the processes being followed? Are they within acceptable control and performance parameters? Are they outdated? Can they be improved? Those are the questions which determine the correlations between the logistics process and the quality assurance.

■ **QUALITY ASSURANCE IN THE ROLL INDUSTRY**

The manufacture of rolls (see Figure 1) is in continuously perfecting, the requirements for superior quality rolls are not yet completely satisfied, in many cases, the absence of quality rolls preventing the realization of quality laminates or the realization of productivities of which rolling mills are capable. Basic properties of rolls and properties of the material are two totally different sides of a problem and very often this difference is ignored. However, when we start to discuss about the rolls mechanical properties, we have to analyze the rolls material or the roll-properties.

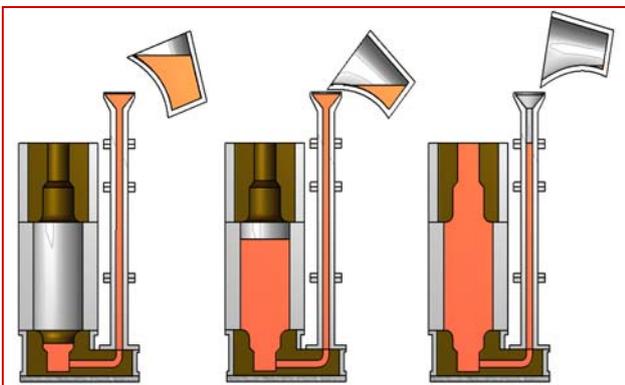


Figure 1. Casting technology of the iron rolls

The technological manufacturing process of the rolling mills rolls, as well as the quality of material used in manufacturing them, can have

a different influence upon the quality and the safety in the exploitation. Our approaches the issue of quality assurance of the rolling mills rolls, from the viewpoint of the quality of materials, which feature can cause duration and safety in exploitation. The quality assurance research fields can be defined through the general research area, through the different experiments effectuated in the laboratories, and, also, through the modern calculation programs, optimization technologies and the better capitalization of the manufacturing data (see Figure 2).

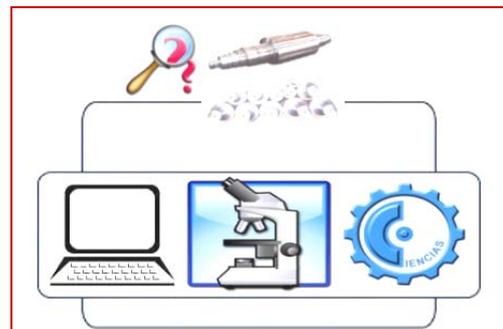


Figure 2. Quality assurance research fields



Figure 3. Quality assurance in rolling industry

In the rolling industry, the quality of the rolls is in directly accordance with the quality of technologies (defined by the casting equipments, materials, applied procedures, etc), and also, by the quality of the manufacturing process (charging, melting, inoculation, ladle treatment, casting, cleaning, etc), which are presented in Figure 3.

■ **QUALITY OF ROLLS ASSURED BY MODELLING OF MANUFACTURING**

Industrial engineering is also operations management, systems engineering, production engineering, manufacturing engineering or manufacturing systems engineering, where as most engineering disciplines apply skills to very

specific areas, industrial engineering is applied in every industry. Industrial engineers typically use computer simulation, especially discrete event simulation, for system analysis and evaluation. The computer is used to generate a numerical model of reality for the purposes of describing complex interaction among components of a system.

Starting from the principle of modeling process, used as necessary basic instrument, both in phase of conception, as well as in the industrial technologies analysis, is determined the optimum regimes of the cast rolls, from the view from chemical composition, as one as the most important parameters of disturbance of the manufacturing process. The enunciation of some mathematical modeling results, described through a number of multicomponent equations determined for the spaces with 3 the and 4 dimensions, as well as the generation of some regression surfaces, of some curves of levels, of the volumes of variation, of the lines of outlines of the volumes of variation of surfaces and the areas of variation of these, can be represented and interpreted by technologists and can be considerate diagrams of correlation between the analyzed variables. From this point of view the project is inscribes in context of scientific capitalization of the process and the industrial technologies optimizations, on the way of the analysis and the mathematical experiment. The quality assurance through the modeling phenomenon is presented in Figure 4.

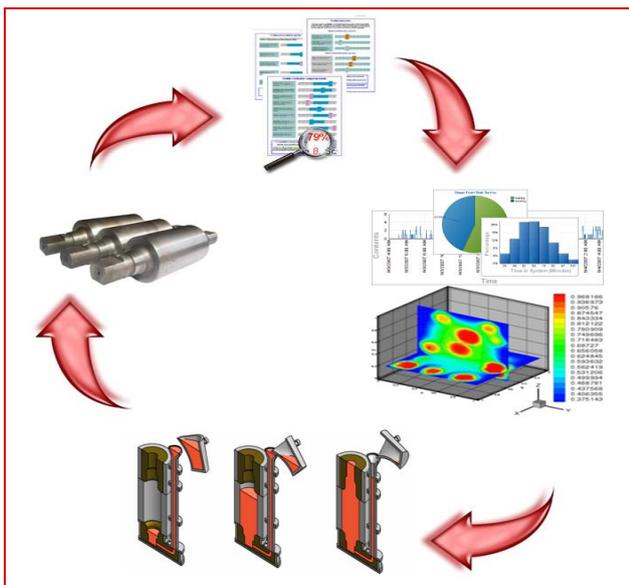


Figure 4. Quality assurance through the modeling phenomenon

The character of the metallurgical processes optimization is influenced by the complex peculiarities of these, which take place into a great number of variables (parameters) that operates independently or cumulate.

For this reason, to analyze the metallurgical processes is used, mainly, the statistical fundamental methods that permit to drawn conclusions, from the observed values, about the repartition of the frequencies of various parameters, about their interaction, about verification validity of certain premises, and about the research of the dependencies among different parameters. However, the statistical methods of the metallurgical process analyses do not solve a series of aspects regarding the mode of establish the decisions for the management of the process. Thereof, parallel with the statistical methods it was developed optimization methods.

The optimization of any technological process has, as a base, a mathematical model. The search for the best solution, for the truth, requests either to find, on the way of a study, definitive truths, or of relative valid truths, valid only in certain conditions, and which, in relation with the definitive truths, include implications and errors.

■ QUALITY OF ROLLS ASSURED BY THE LABORATORY EXPERIMENTS

The researches of durability in the exploitation of cast from cast-iron rolls, constitute a scientifically novelty, and experimentally define an important chapter from the thermal fatigue of the organs of machines in the movement of rotation, in variable temperature mediums. Hot rolling mills rolls work the in the variable compound solicitations, due to lamination process and which repeated to regular intervals of time.

All these phenomena, which are more or less emphases depending on the type and typical of rolling mills, are not taking into consideration in the classic calculus of rolls. If the study of the rolls resistance is extended upon their durability, we must consider the whole complex of tensions with mechanic-thermal influences.

The research on durability in exploitation of hot rolling mills rolls assures relevant conditions for the appropriation of the research methods of the thermal regimes that are submitted the rolls or

other organs of machines, that works in constant (symmetrical) or variables (asymmetrical) thermal sollicitation conditions.

The recommendations for the increase of the duration of exploitation and remove of the damages through the accidental rupture of rolls from the stands of lamination, the attenuation of rolls thermal fatigue, the avoiding of thermal shock and their rational exploitation are actuality issues that must be continuously researched.

In this trend is situated the research of the thermal fatigue phenomena, materialized in technical reports, whose beneficiary is the unit in which the rolls are exploited, as well as through scientific papers, that can develop the framework of scientific research. These researches results lead to direct conclusions about the cast-iron rolls, and permit their comparison with date about steel rolls, area studied thoroughly researched of specialists. The quality assurance through the laboratory and industrial experiments is presented in Figure 5.

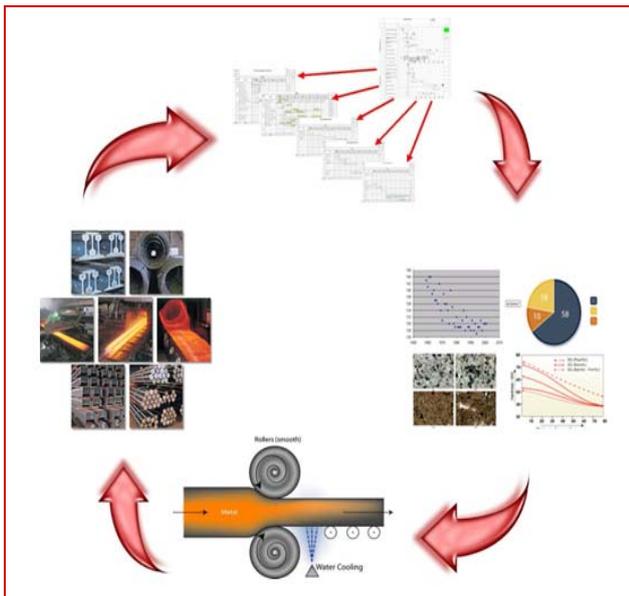


Figure 5. Quality assurance through the laboratory and industrial experiments

The work is of practical immediate utility, inscribing itself in the context of technical capitalization of the manufacturing technologies and of exploitation of cast-iron rolling mill rolls, for which exists an attentive preoccupation both from foundry sectors, as well as from lamination sectors, having as determinate aim the quality assurance and increase the durability in exploitation.

CONCLUSION

The aim of the propose research is to answer to as many questions possible regarding the quality of rolls. In this sense, durability in exploitation is extremely current, both for immediate practice, and for the scientific research attributed to the cast-iron. Also, the realization of optimum chemical compositions of the cast-iron can constitute a technical efficient way to assure the exploitation properties, the material from which the rolling mills rolls are manufactured having an important role in this sense.

In these sense, our researches propose, on aside, to analyze the durability in industrial exploitation of rolling mills rolls – analysis materialized from prism of the laboratory experiment (see Figure 4), and on another side, the optimization of manufacturing technology of the cast rolls, especially those from cast-iron – using electronic calculus technique as the modeling phenomenon (see Figure 5) and mathematical interpretation of the technological processes.

The research on durability in exploitation of hot rolling mills rolls assures relevant conditions for the appropriation of the research methods of the thermal regimes that are submitted the rolls or other organs of machines, that works in constant (symmetrical) or variables (asymmetrical) thermal sollicitation conditions. Also, it can be emphasized the thermal shock, phenomenon that constitutes a permanent danger, which leads to rupture, specific to rolling mills rolls.

On another hand, the realization of an optimal chemical composition can constitute a technical efficient mode to assure the exploitation properties, the material from which the rolling mills rolls are manufactured having an important role in this sense. From this point of view is applied the mathematical modeling, witch is achieved starting from the differentiation on rolls component parts, taking into consideration the industrial data obtained from the hardness on rolls, as well as the national standards reglementations, which recommends the hardness, for different chemical compositions.

Through its nature, the quality assurance in the rolls manufacturing is a research with interdisciplinary character. It approaches, on aside, the technical area of manufacturing and

exploitation of rolls, both in theory and practice, and on the other hand, the areas of the statistical mathematic analysis, of the algorithms and the numerical calculus methods, as well as the mathematical molding and optimization area, applied to a product so simple from point of view of the geometry, but so complex, as structure, property and characteristics ensued, as the rolling mills rolls are.

These results are immediate practical utility both the cast-iron rolling mills cylinders manufacturing industry, and the rolling sectors. In this sense, these researches results can be used in the collective framework of the foundries and the rolling mills sectors, for assurances quality of rolls as far back as phase of production, as well as in exploitation these, what lead to, inevitably, to the assurance quality of produced laminates.

Through the original aimed elements mentioned above, the suggested researches allow the enunciation of new approaches in the area afferent to the theme. The best way for roll makers to achieve better rolls is to ensure that better materials and improved manufacturing processes are used and that roll users take account of rolling conditions and improved rolling processes. When we start to discuss about the rolls mechanical properties, we have to analyze the rolls material or the roll-properties. In conclusion, the rolls quality problems can be solved by good co-operation between the rolls manufacturers and roll users.

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