THE QUALITY ASSURANCE IN THE ROLLING INDUSTRY – METHODS, APPROACHES AND TENDENCIES

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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.

Key words: gerotor quality assurance, rolls manufacturing, laboratory research, mathematical modeling

1. SHORT REVIEW OF THE ROLLS MANUFACTURING

Rolls are the most important means of hot– and cold–forming bulk products in the ferrous industries. The concept and introduction of rolling mills made the forming of large quantities of metal economically feasible. Rolling mill construction and the art of rolling experienced a sharp growth when production of steel in molten form began and, along with improvements in roll materials, have remained closely connected with the development of the steel industry.

From the standpoint of materials, the above line–up of rolls for hot–rolling remained unchanged although advancing metallurgical and material developments improved the quality significantly. Roll producers learned how to improve the cast–steel rolls by suitable heat treatment and to adapt cast–iron rolls to specific applications by properly balanced charges and further advances in modeling techniques.

Alloying additions for cast–iron rolls probably first came into consideration for rolling sheet, where improvements in the surface of the hot–rolled product were especially necessary. Roll producers learned how to improve the cast–steel rolls by suitable heat treatment and to adapt cast–iron rolls to specific applications by properly balanced charges and further advances in modeling techniques.

Alloying additions for cast–iron rolls probably first came into consideration for rolling sheet, where improvements in the surface of the hot–rolled product were especially necessary. Subsequently it was found possible to increase the performance of shape rolls also by alloying. The innovations in rolling mills placed unprecedented requirements on rolls and users demanded better surface quality on the rolled products, which were often high–strength and therefore difficultly workable steels. Thus, the rollers insisted on longer roll life. Further improvements in the existing types of rolls were made and new roll materials were developed. Today, the roller has available a number of roll types but it is not always simple to select the best one.

The rolls must present high exploitation qualities, which are determined from the hardness, resistance and high temperature stability. These qualities guarantee the high resistances at wear in the dried friction conditions and the unexpected temperature variation stability in the rolling operation. In addition, they assure the resistance at the thermal fatigue, (because the rolls are heated at the contact with the laminate), high resistance at the thermal shock stress, and the bending strain resistance. Also, the rolls must assure the clamping of materials, as well as the high quality of the laminate surface.
Quality of rolls is determined through hardness and through wear resistance, last index having a special importance for all modern rolling mills with a growth production. Of major importance for the rolls exploitation is not merely growth resistance, but also the ability to oppose to different types of wear. Thus, rolling mill rolls considerable influence the specific production and the qualitative level of laminates, reason for which they are given a special attention, in manufacturing, as well as in usage. These requirements can not be completely fulfilled, compelling to the granting of priorities depending on the type of laminates, therefore to compromises. At large, the problem is reduced to the correct material choice, eased by the rich available experience in the current conditions of manufactured and burdened, in the same time, by the large diversity of material used.

Although the manufacture of rolls 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.

To the selection of materials is considered the type of rolling mill, the sizes of rolls (in specially this diameter), the speeds of lamination, the stands from the train of lamination for which is achieved rolls, the working temperature in the lamination process, the module of cooling during work, the size caliber, the pressure on rolls, the rolled material hardness, etc.

The choice of material for rolls is the operation which takes into consideration the own solicitations of the lamination process afferent to the type of rolled products, and the features of different materials considerate optimum in the fabrication of different typo-dimensions of rolls.

2. METHODS, APPROACHES AND TENDENCIES

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 proposal 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.

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 (Fig. 3), 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 (Fig. 4) and mathematical interpretation of the technological processes.

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 (Fig. 5).

The terms “quality assurance” and “quality control” are often used interchangeably to refer to ways of ensuring the quality of a service or product. The terms, however, have different meanings.
Assurance: The act of giving confidence, the state of being certain or the act of making certain.

Quality Assurance: The planned and systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled.

Control: An evaluation to indicate needed corrective responses; the act of guiding a process in which variability is attributable to a constant system of chance causes.

Quality Control: The observation techniques and activities used to fulfill requirements for quality.

In the rolling industry, the quality of the product (of the rolls, in this case) 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)"."
3. 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.

4. QUALITY OF ROLLS ASSURED BY THE MODELLING OF MANUFACTURING DATA

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 mathematically modeling results, described through a number of multi-component equations determined for the spaces with 3 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 research 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 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.

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.

5. 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.

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 solicitation 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.

For this reason, to analyze the metallurgical processes is used, mainly, the statistical fundamental methods that permit to draw 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.

For this point of view is applied the mathematical modeling, which is achieved starting from the differentiation on rolls component parts, taking into consideration the industrial data, as well as the national standards regulations, which recommends the hardness, for different chemical compositions. The optimum solution is determined through some mathematical restrictions to the input values that the mathematical modeling is started.

The realization of a mathematical model starting from industrial data, gathered at the rolls hardness measurement, and at the national standards regulations, which recommends the hardness, for different chemical compositions, also determines the degree of originality of the suggested project. The determination of the equations of regression hyperplanes, which describe the mathematical dependency between the chemical composition and the hardness, the determination of the multi-component relations and the realization of the graphic interfaces for the representations variation areas of the cast–irons chemical composition, completes this area of preoccupations within a processing mathematical of modelling and optimization. Through the original aimed elements mentioned above, the suggested research allows the enunciation of new approaches in the area afferent to the theme.
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