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**INTELLIGENT MONITORING AND CONTROL SYSTEM FOR
THE PIPE MANUFACTURING PROCESS**

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Abstract. Here one of the new efficient approaches to solving problems of intelligent support of making decisions of a cooperate enterprise scale is analyzed, bearing in mind that the enterprise is oriented towards integration of two interconnected information technologies: a technology of constructing information storages and a technology of intelligent data analysis.

A new conception of the role of informing-controlling systems in controlling and operating pipe manufacturing process is suggested. It broadens a traditional view over information systems just as if it were only an instrument of a computer data analysis. The role of the modern information systems in the manufacturing as an independent scientific and applied direction serving as a connecting link in the triad “raw product – ngingering process – end product” is substantiated. Some problems connected with plantation of the informing-controlling systems in the pipe manufacturing is formulated. It broadens a traditional view over information systems just as if it were only an instrument of a computer data analysis.

Keywords: information system, data analysis, information storages, intelligent decision.

Introduction. A lot of works are devoted to the problem of research, elaboration and plantation of the computer systems in metallurgy. So, in [1] the role of the computer control systems in cast iron production is accentuated. In [2] it is shown that the computer control systems allow to realize not only a current fusion control, but also to conduct an analysis of the technological situations with giving recommendations as to controlling the blast-furnace process in whole. In [3] it is noted that the software environment for conducting a calculating analysis of the most important sides of the blast-furnace process and for conducting an automated search for the optimal conditions of fusion in basic modes of the blast furnace’s

performance.

In [4] a new approach to mathematical modeling of metal turning in section extruding based on the finite elements method is suggested.

In this article, one of the efficient approaches to solving problems of intelligent support of making decisions of a cooperate enterprise scale is analyzed, bearing in mind, that the enterprise is oriented towards integration of two interconnected information technologies: the technology of constructing information storages and the technology of intelligent data analysis. Additionally, in our opinion, the information systems, correspondent mathematical models and processes of their construction, verification and interpretation are the irreplaceable link in the triad “raw product – engineering process – end product” , and they are called to provide integrity of the engineering process and manufacturing. Besides, prospects of a further development of informing-controlling systems, both in pipe manufacturing and in some related researches supporting this direction are examined.

Setting the problem. Upgrading of technics and technologies and a continuous growth of requirements to the quality of the product inspire elaboration of new information systems of intelligent support of making decisions of a cooperative enterprise scale.

One of the approaches to creating systems of a new generation decision support is oriented towards integration of two interconnected information technologies: the technology of constructing information storages (IS) and the technology of intelligent data analysis.

This article is devoted to the peculiarities of elaboration of the information systems of the new type on the example of the controlling processing characteristics of the products rolled by the pipe-rolling plant 140 (PRP-140).

Nowadays, the technology of constructing IS is partially based on the PRP-140 with lengthwise-rolling mills

The substance of the constructing technology of the IS is as follows. The distinctive feature of the engineering process of the pipe manufacturing by the PRP-140 with the lengthwise-rolling mills is in presence of single-type structural elements in the plant line which define the composition and configuration of the

PRP-140. Such a peculiarity allows to create the OIS which contains a varied information as to the performance of the PRP-140 (date, time, fusion number, pipe grades, steel quality etc.). Further on, the data from the OIS are extracted and put into one source – the IS.

The main idea, put into the principle of the IS technology is to conduct the current analysis intermediately on the basis of the operative information systems is inefficient. It is explained by the fact that the data as to the performance of one of the PRP-140 mills do not enable to get a whole and objective picture of the performance of the plant in whole. All the necessary for the analysis data are kept in a single source – the IS. The main peculiarity of the IS data is their availability not only for reading. At the same time, no data modification is made, as it may break integrity of the IS.

Main research material statement. Taking into consideration that the IS contain various information as to the performance of the PRP-140 (date, time, fusion number, pipe grades, steel quality, ingoing size of the round billet, pipe sizes after each mill etc.), the task of the suggested information system is to classify and to process the data for the purpose of resetting the PRP-140 mills' processing characteristics and those of the correspondent forecast.

At the same time, the information system enables to take a lot of measures as to the data processing. So, if necessary, one can follow dynamics of changing the characteristics of each pipe from the circular furnace up to the sizing or reducing mills inclusively. Besides, there appears a possibility to classify the data according to the rolling characteristics (steel quality, ingoing size, round billet size, pipe grades etc.). The latter permits to carry out a number of researches connected with determining dependence of the rolling process results on the ingoing data and current characteristics.

For example, in the process of piercing a lot of one-sized hollow-billets, an elongation ratio shift under each hollow billet's deformation may be observed [5]. A variable pace of work of the piercing mill, preconditioned by essential processing pauses, implies a constant considering of the thermal condition of the plant which influences the total elongation value. The elongation ratio shifts under a lot of hollow billets piercing reach 30% of nominal (table) values. In order to stabilize the

elongation ratio, the operating personnel (supervisor), following his own practical experience and intuition adjusts the mill settings by means of shifting the piercer plug before piercing the next hollow billet. For the purpose of reducing the supervisor's subjective influence, the suggested system chooses the required piercer plug's condition subject to the algorithm elaborated.

In order to estimate the received rolling characteristics, the algorithm uses the dependencies including the peculiarities of the pipe deformation process according to the fundamentals of the pipe manufacturing theory [6]. It should be noticed that among the analyzed characteristics, the principal figures are those of the hollow billets' and pipes' length, the elongation ratios for each mill and the plant in whole, crop values, dead time, unfinished sections number. Let us consider a variant of the suggested IS's functioning.

The suggested IS provides for several functioning modes. A large volume of information in the IS requires a preliminary data retrieval, which is made by means of classifying according to the date, pipe grades, fusion number, lot's number, order's number. Let us consider an example connected with the data processing and analyzing according to the calendar. When switch to the calendar mode, a dialog box appears on the screen for the user to choose the year, month and day, for instance. Subject to the chosen date the IS data retrieval is activated. In the result of processing the information, the total number of records on this issue appears on the screen. Further on, the information as to the functioning of the PRP that day in whole appears on the screen. In this box, numbers of orders for pipe manufacturing, hollow billets sizes, the rolled pipes grades, rolling time etc. are shown.

If necessary, the required information can be printed out and analyzed (press the button "Analyze"). Here the data from the IS are transferred to the Excel environment, where their automatic classification and processing according to the algorithm is given.

The data transfer from the IS to the Excel environment is explained by the fact that the given program product enables to realize the necessary data processing in rather a convenient and obvious manner.

Besides the analytical procedure of information processing, the environment permits to form the required graphical dependencies.

Summary. In the suggested approach, the key role in making decisions as to the control belongs to two technologies: the technology of IS and the technology of the intelligent data analysis. The suggested technologies are an essential component of the engineering process and serve as the connecting link in the triad “raw product – engineering process – end product”.

The practical application of this product permits the operating personnel of the enterprise to control the engineering process, analyze the processes passing in each mill, adjust the PRP mills’ engineering characteristics in the pipe-manufacturing process. The suggested approach influences quite strongly the production’s quality improving and enables to work stably in the thin-walled pipe grades sphere.

The principal approach to task-solving may be used for other rolling mills, such as continuous rolling mills, flattening mills, small-section mills, hot-rolling mills that will help to save the metal and improve the quality of production.

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