

The role of quality control operations in a process of plastic forming

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ABSTRACT

Purpose: The aim of this paper is present the role of quality control operations in such a complex manufacturing process like plastic forming. Nowadays classical manufacturing process management is replaced with total quality management philosophy.

Design/methodology/approach: The presented results base on the investigations conducted in manufacturing plants of heavy industry. Next the results of researches have been compared with requirements of quality standards.

Findings: Results obtained in the work point the importance of a system of continuous quality monitoring and of quality control operations. Moreover the improvement in quality management is directly related with the corporate image.

Research limitations/implications: The presented results base on the analysis of manufacturing processes of steel mills and are considered with the process of plastic forming and related processes. It must be stated that some technological parameters are confidential.

Practical implications: The practical implication of the work is considered with the proposal of a scheme of quality control operations in a manufacturing process of plastic forming. This scheme could be used as a remark showing the proper manufacturing process planning.

Originality/value: The work presents the analysis of manufacturing processes for heavy industry according the quality assessment what is rather a lateral problem in quality analysis.

Keywords: Quality assessment

1. Introduction

The analysis of quality problems of heavy industry is rather conducted according the ISO 9000 standards. But the problem should be considered with the process planning of heavy industry. The name: heavy industry manufacturing processes include different manufacturing processes like metallurgy, plastic forming or cutting [1, 2, 3, 4]. This specific situation changes some elements of quality assessment process.

The quality assessment process typically is considered with the series-scale production system, where it is possible to introduce the whole idea of continuous improvement [5, 6]. But in a heavy industry the problems of quality assessment are different.

They are strongly related with the technology of a manufacturing process [7]. The quality level is related with the type of technological operation, its parameters and its monitoring.

2. Scheme of a forming process

The process of plastic forming could be divided into four main stages (Figure 1). The first one includes all preprocessing operations. They are following the process of technological process preparing. The stage two includes the process of plastic forming. In the stage three the heat treatment is conducted. Finally the stage four includes all closing operations.

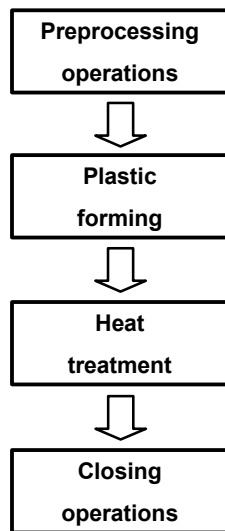


Fig. 1. Scheme of operations of plastic forming [8]

As it was stated above the technological process is preceded by the process of technical documentation preparing. This documentation consists of: list of technical requirements, technical drawings, and technological sheet and operation sheets.

2.1. Preprocessing operations

The scheme of preprocessing operations is presented on Figure 2. Preprocessing operations are mainly related with the process of cutting of a raw material. Views of exemplary preprocessing operations are presented on Figure 3.

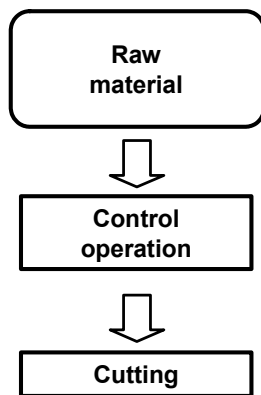


Fig. 2. Preprocessing operations

The quality control operation is placed at the beginning of the preprocessing operations. It is considered with the fact that raw material could be of wrong mechanical or chemical characteristics and it is easy to eliminate it at this stage of a manufacturing process. The cost of elimination is the lowest at that phase of the manufacturing process.



Fig. 3. Cutting operation

2.2. Plastic forms operations

Plastic forming operations are the main operations of the analyzed technological process (Figure 4). This stage consists of four main operations [8, 9, 10]. The first one is heating. The raw material before plastic forming must be plasticized to decrease the forces of forming. Next it is processed. After the process of plastic forming each element is marked. It helps to control its characteristics. Then it is cooled. Figures 5 and 6 present exemplary processes of plastic forming.

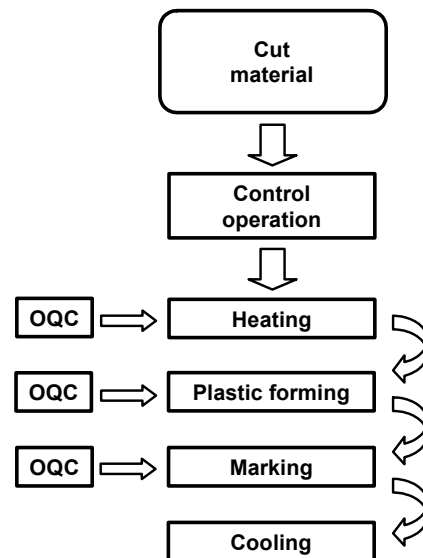


Fig. 4. Plastic forming operations

At this stage it is possible to point two types of control operations. The first one is the general control operations consider with checking the cut material. This control operation is conducted by a quality controller (like in the preprocessing

operations). The other type of quality control operations are these marked as OQC (operation quality control). These operations are conducted by operator of particular technological operations. They are part of the system of a total quality management in a heavy industry.

They are also the example of a participatory system of manufacturing management. In this approach operators are interested in controlling the quality of half-products because they have a role of inner clients of other operations. They could refuse to process the material that does not fulfill all requirements.



Fig. 5. Rolling operation



Fig. 6. Pressure welding operation

2.3. Heat treatment operations

The process of heat treatment (Figure 7) is conducted after the process of plastic forming. It mainly consists of next operations: normalizing, stress relief annealing and toughening [11, 12, 13]. The annealing operations are conducted to eliminate the unequal decomposition of chemical elements, grains or stresses. The toughening operation is conducted to change the parameters of the

produces element. It could be increased the elasticity or hardness of an element. Figure 8 presents an automatic stand for normalizing.

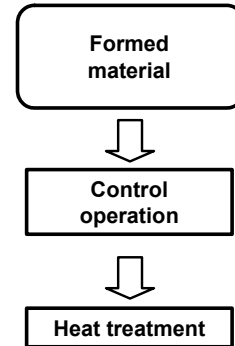


Fig. 7. Heat treatment operations

In this stage there is only a general quality control operation conducted by a quality controller. The formed material is checked and then the quality controller decides about the next operation (heat treatment or repairing or eliminating).

The formed material could be repaired on the machining department. But it is possible only when the dimensions are larger than required. In other cases the element is eliminated.

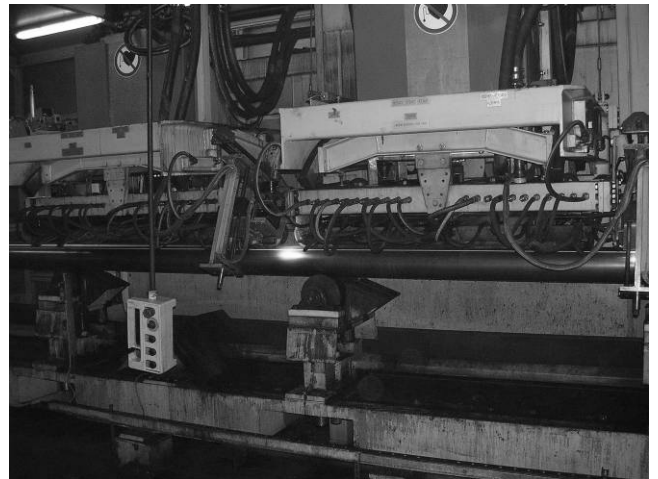


Fig. 8. Automatic normalizing

2.4. Closing operations

The fourth stage includes closing operations (Figure 9). The first closing operation is finishing. During this operation elements are machined. Basic machining operations are: chamfering, drilling, threading, milling or reaming.

At this stage there are two main control operations. The first one takes place at the beginning of the stage to check the element parameters after the heat treatment operation [14]. During this operation the controller checks the hardness and other macroscopic parameters. The ultrasound tests are also conducted (Figure 10)

present an automatic stand for such an inspection). The quality acceptance operation is conducted by the quality department to qualify the element for dispatching. It is also possible to conduct client quality control (CQC) during dispatching.

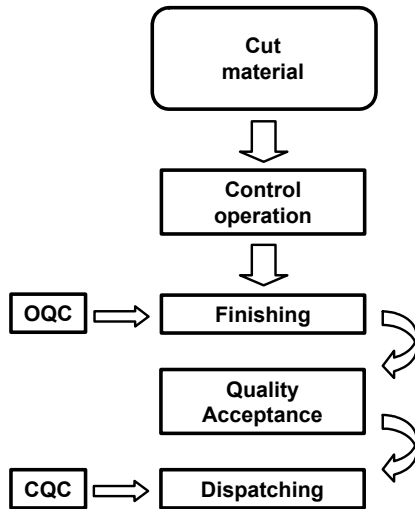


Fig. 9. Closing operations



Fig. 10. Ultrasound automatic inspection

3. Conclusions

Presented analysis of quality operation allows showing three main types of these operations: general one conducted by quality controllers, operation ones conducted by process operators and client quality operation. These operations are conducted in a process manner to introduce the system of continuous improvement [15]. They are also automatic [16].

References

- [1] J. Adamczyk, Manufacturing of mass-scale products from structural micro-alloyed steels in integrated production lines, *Journal of Achievements in Materials and Manufacturing Engineering* 20 (2007) 399-402.
- [2] S. Topolska, D. Szewieczek, The visualization of manufacturing process of pipes welding, *Journal of Achievements in Materials and Manufacturing Engineering* 20 (2007) 575-578.
- [3] S. Topolska, Analysis of the technological process of rings of train wheels, *Journal of Achievements in Materials and Manufacturing Engineering* 17 (2006) 405-408.
- [4] T. Haga, H. Watari, S. Kumai, High speed roll casting of Mg alloy strip by a vertical type twin roll caster, *Journal of Achievements in Materials and Manufacturing Engineering* 15 (2006) 186-192.
- [5] J. Oakland, *Total Quality Management*, Oxford Press, Oxford 1994.
- [6] J. Juran, A. Godfrey, *Juran's quality handbook*, McGraw-Hill Publishing Corporation, New York 2000.
- [7] A. Gzielo, J. Koszkuł, D. Kwiatkowski, M. Pietrzak, H. Świerczyński, Quality control system for the process of continuous casting of steel, *Journal of Achievements in Materials and Manufacturing Engineering* 17 (2006) 333-336.
- [8] M. Blicharski, *Material Engineering. Steel*, WNT, Warsaw 2004 (in Polish).
- [9] T. Karpiński, *Production Engineering*, WNT, Warsaw 2004 (in Polish).
- [10] S. Rusz, The Influence of Technological Parameters on the Rotary Pressing Process, *Proceedings of the 9th International Scientific Conference "Achievements in Mechanical and Materials Engineering" AMME'2000 Gliwice-Zakopane, 2000*, 475-478.
- [11] E. Roźniata, J. Pacyna, Effect of annealing on mechanical properties of ledeburitic cast steel, *Journal of Achievements in Materials and Manufacturing Engineering* 20 (2007) 187-190.
- [12] T. Rzychoń, J. Michalska, A. Kiełbus, Effect of heat treatment on corrosion resistance of WE54 alloy, *Journal of Achievements in Materials and Manufacturing Engineering* 20 (2007) 191-194.
- [13] L.A. Dobrzański, *Metal Engineering Materials*, WNT, Warsaw 2004 (in Polish).
- [14] S. Topolska, Characteristic Defects of Metallic Coatings Obtained in the Metallization Process, *Proceedings of the 13th International Scientific Conference "Achievements in Mechanical and Materials Engineering" AMME'2005 Gliwice-Wisła, 2005*, 675-680.
- [15] A. Gwiazda, Quality tools in a process of technical project management, *Journal of Achievements in Materials and Manufacturing Engineering* 18 (2006) 439-442.
- [16] L.A. Dobrzański, M. Krupiński, J. Sokołowski, Methodology of automatic quality control of aluminum casting, *Journal of Achievements in Materials and Manufacturing Engineering* 20 (2007) 69-78.