



Analysis of the wire rod superficial processing based on the quality criterion

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ABSTRACT

Purpose: Purpose of the presented paper aimed at showing the connection between the usage of practically well-chosen methods of investigation and opinion of quality and applying the modern technical, technological or organisational solutions, in this case in the technological processes of preparation the wire rod surface to the plastic processing.

Design/methodology/approach: Methodology used for the research has covered the proper integrated expert methods of technological processes' analysis and opinion, also the integrated opinion of technological processes using the Integrated Risk Ratio.

Findings: Findings of the carried out researches are as follows: the realisation of quality and environmental policy based on the proposed model leads to the improvement of analysed productive processes of steel wire rod, and in consequence - to their optimisation both from the point of view of products' quality and in the aspect of quality of environmental influence.

Practical implications: Practical implication can refer to the replacement of chemical etching of wire rod by applying of the technology, taking into account the method of mechanical removing of cinder.

Originality/value: Originality of the presented paper belongs to the new methodology comprising the usage of integrated opinion of technological processes, including the Integrated Risk Ratio.

Keywords: Quality Management; Environmental Management; Technological process analysis; Integrated Risk Ratio

1. Introduction

The increasing expectations of the customers are the cause of more and more innovative solutions not only in range of the quality management, but more and more often these are social requirements connected with the minimisation of enterprise's influence on environment.

That is why the proper solution seems to be the reconciliation of the conflicting enterprise's businesses and environmental requirements in the frames of Integrated Quality and Environmental Management System in the strength of the norms ISO of series 9000 coherent with the norms ISO of series 14000.

The improvement based on the quality criterion with regard to recipients' needs and expectations by the formation of the profile of article or service in such a way, that the imposed customers' requirements could be realised in the largest degree with usage of accessible technical resources and technological processes causes the necessity of applying in the frames of Integrated Quality and Environmental Management System the proper tools and methods of quality.

The usage of practically well-chosen methods of investigation and opinion of quality, according to "the model of perfection" including the identification and analysis of processes as well as creating the aims and undertaking the optimising workings, states the starting point to apply the modern technical,

technological or organisational solutions, also in the technological processes of preparation the wire rod surface to plastic processing.

2. Integrated Environmental and Quality Management System

„The total quality”, being not only the advantage of the final product or service, but also causing no threats for environment, in practice, requires searching solutions that will permit on reconciliation the conflicting organisation’s businesses with legal regulations as well as internal requirements of environmental protection. Such a solution makes up the integration of Quality Management System with Environmental Management System - fig. 1 [1-11].

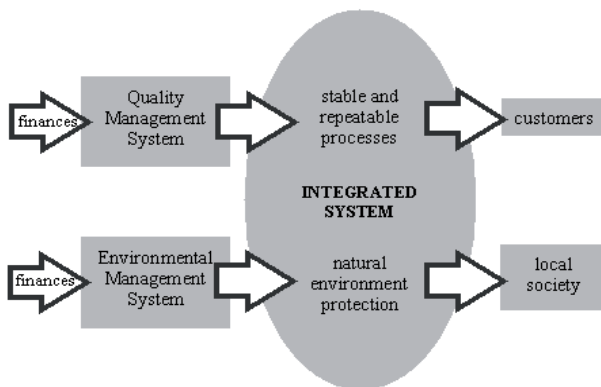


Fig. 1. Pattern of influences of Integrated Quality and Environmental Management System [7]

The conception of quality and environmental management, created on the base of the Edward W. Deming’s quality philosophy, is identical in both above-mentioned management systems, and its main point is prevention of formation the defects and threats as well as the suitable economical and ecological strategies [2-4,7].

In such a situation the integration of analysed management systems seems to be natural; not only in the relation to the resources, processes, aims and procedures, but also in the meaning of the documentation based on the norms connected with individual subsystems [2,4,7].

In reference to PN-EN ISO 9000 norm, “for organisations to function effectively, they have to identify and manage numerous interrelated and interacting processes” [13].

Such a „process approach” by [14]:

- defining and analysis of processes indispensable to achieving the quality aims,
- choice of proper methods of measurement processes effectiveness and efficiency,
- estimation of the effectiveness and efficiency processes’ degree,

has a fundamental meaning both for individual processes, as well as for system of processes, so - from the point of view of technology (fig. 2) [9].

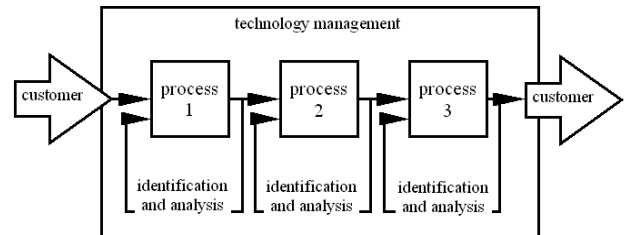


Fig. 2. Pattern of identification and analysis of processes based on the “process approach” in the technology management [9]

The above mentioned problems relate to the question of technology and technological processes management, as well as to the analysed processes of etching the steel wire rod [1,4-6].

The correct course of plastic processing of wire rod, first of all requires its good blank state, especially the good quality of surface of devoid cinder. In many cases wire rod delivered from foundries to wire institutions is covered with the layer of cinder with different thickness and composition. In relationship to the above mentioned before accession to the plastic processing the circles of wire rod are subjected to surface processing; the most often by way of treating with acids solutions [1,4-6].

It creates the necessity of introduction to the managements process of technology of wire additional interventions, first of all the management of the quality of etched wire rod and quality of etching processes, which aim is to obtain the best technological and economic parameters of the process and, as the effect, semi-manufactured products to plastic processing [1,4-6,12].

So the coexistence of the Quality Management System together with Environmental Management System becomes the necessity [1-7].

3. Own research

Conducted investigations included technological process of superficial processing of wire rod species C66D, which has been realised in the company being the national manufacturer of wires and steel ropes [1].

The application of treating the wire rod with solution of sulphuric acid is based on the chemical reaction of iron oxides making up the cinder with acid. This process is accelerated by giving off hydrogen, which by causing tearing cinder off the mould, facilitates access of acid to the cinder layers being in its vicinity.

However to make the surface of etched wire rod well prepared to the plastic processing, and the structure of mould would not undergo the change as a result of influence of acid, the course of process, its parameters are subject to continuous supervision and control defined in the instructions provided for etching process.

Simultaneously the indispensable problem accompanying the etching process is the formation of large quantities of used sulphuric acid, causing the particular danger for natural environment.

Therefore, it shows that the requirements related to the etching process of wire rod are most often different from requirements, which particular organisation has to fulfill in the range of environmental protection.

Due to the above mentioned, the quality control of technological process states the serious question not only from the point of view of the prevention of passing to the external and internal recipients products with a quality unfulfilling requirements, but first of all in the reference to the applied methods of investigations, opinion and optimisation of technological process. These methods, applied on different stages of production, permit on quality formation, and the same - the realisation of the set up qualitative aims.

To the most popular methods of quality investigations and opinion, beside the widely used statistical methods, belong the expert methods, containing: the Quality Function Deployment as well as Failure Mode and Effect Analysis.

Every stage of the course of the analysis included planning and preparation, analysis of potential defects as well as causes and results of these defects, and qualification of risk accompanying the defect pronouncement.

Failure Mode and Effect Analysis of the process included:

- the qualification of system structure and individual functions; for common identification of neuralgic points in product formation in the case of defects analysis, and in the case of opinion of environmental influence - environmental aspects, the algorithm of opinion of defects and environmental aspects compatible with Failure Mode and Effect Analysis as well as "Environmental Aspects and Impacts Analysis", can be accepted,
- the analysis of nonconformities and environmental aspects; nonconformity is "the non-fulfilment of a requirement [13]", environmental aspect is "element of an organisation's activities, products or services that can interact with the environment [15]", and environment impact is "any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services [15]",
- the opinion of importance of nonconformities and environmental aspects; the opinion of importance of nonconformity was based on three elementary questions: what is the probability of pronouncement of nonconformity/environmental aspect, what is the probability of detection of nonconformity/the environmental aspect, how painful the after-effect of nonconformity/environmental aspect can be as well as the qualification of preference number of pronouncement of cause of nonconformity/environmental aspect,
- the choice of significant nonconformity and aspect; the high coefficient of risk level shown the necessity of undertaking the optimising corrective and preventive action.

The need of integrated opinion of the studied models of technological processes implicated the necessity of creation of Integrated Risk Ratio of processes taking into account, besides the importance and difficulty of realisation of set technological

parameters, also the risk coefficient connected with occurrence in the process potential nonconformities and significant environmental aspects.

The usage of created coefficient permitted to make a choice of processes creating the particular threat for environment and proposing the solutions of eliminating or minimalising the negative influence of analysed processes on environment with simultaneous maintenance of the set product parameters.

The variants of optimising solutions proposed in the frames of realised technology of the steel wires productions were opinioned according to the received methodology, what gave the possibility to specify the model solutions reducing the Integrated Risk Ratio.

The conducted analysis has shown clearly, that the processes of preparation the surface of wire rod to the plastic processing characterise with moderated difficulty of realisation the set technological parameters and moderated probability of occurrence of the potential nonconformities in the process, among which the largest importance has the occurrence of the after etching fragility, after etching pittings as well as the presence of unetched places. The company of high coefficient of risk level results with high probability as well as potential results of their pronouncements in the form of lack of possibility of usage in farther processing as well as damaging the machine park.

From the point of view of environmental influence the realised technological process is connected with practically hundred-percent probability of the occurrence of the environmental aspects with very high importance, what is accompanied by the high risk coefficients. It is connected with inscription in the process the presence of after etching sewages, after rinsing sewages, after neutralisation sediment as well as the coexisting with them risk of pronouncement of industrial breakdown.

The process of chemical preparation of wire rod surface to the plastic processing was classified to particularly difficult and burdensome processes in realisation on the basis of investigations in support of criterion of possibility of article formation with desirable stamina, plastic and technological properties as well as from the point of view of the importance of environmental aspects appearing in the process.

Taking into account the observed from several years in Poland growth of waste of water for industrial aims (67% of the total usage), the intensifying process of pollution of overground and underground waters as well as growing quantity of stored wastes, the solutions called "the end of pipe solutions" seem to be the barrier in initiation, and what is more - in certification of Integrated Quality and Environmental Management System.

Therefore, it seems to be well-founded to apply the technology taking into account the method of mechanical removing of cinder permitting on the decrease of:

- waste of water for the industrial aims,
 - waste and emission of sulphuric acid,
 - load of pollution in sewage accompanied to municipal sewages system,
 - the quantity of after production wastes by the partial or total elimination of after neutralisation sediment,
- the possible risk of pronouncement of industrial breakdown connected with the processes, in which the sulphuric acid is present.

4. Conclusions

In the time of competitive fight on market only the continuous improvement of all processes in the organisation is able to assure the winner's position. The upgrade should concern all technical, technological and organisational aspects both in reference to quality of the manufactured products and the influence on the environment.

The awareness, that together with the realisation of well ordered and simultaneously innovative workings in the range of realisation of manager function in the organisation, based on data assembling and their analysis, the advantage of process improvement in support about quality criterion will be increasing, should be essential stimulus to undertake the activity, assuring the fulfillment of recipients' expectations.

In the investigation the test of analysis of wire rod surface preparation processes to the plastic processing has been undertaken, and for that aim, both Failure Mode and Effect Analysis and "Environmental Aspects and Impacts Analysis", were used. Integrated Risk Ratio worked out on their basis, was used in opinion of realised technological processes.

On its basis the superficial processing preparing the wire rod surface to plastic processing was qualified as connected with considerable number of potential environmental aspects and nonconformities with large probability of occurrence and small probability of detection, and so - with high level of Integrated Risk Ratio.

Taking into account the special difficulty of auxiliary operations of preparation material to plastic processing for realisation of qualitative and environmental aims, the possibility of using different methods preventing the significant nonconformities in the form of after etching fragility, after etching pittings as well as unetched places and minimalising simultaneously the waste of water on industrial aims, the waste and emission of sulphuric acid, load of pollution in sewages accompanied to municipal sewage system, the quantity of stored after neutralisation sediment as well as reducing the risk of pronouncement of industrial breakdown was considered.

The proposed model of process was subjected to the renewed analysis. The results of investigations have confirmed the thesis, that the realisation of quality and environmental policy based on the proposed model leads to the improvement of analysed productive processes of steel wire rod, and in consequence - to their optimisation both from the point of view of products' quality and in the aspect of quality of environmental influence.

References

- [1] T. Karkoszka, Modeling of the chosen processes the steel wire technology with regard to quality policy and environmental protection, Doctoral dissertation, Gliwice, 2004.
- [2] T. Karkoszka, M. Roszak, Quality and environmental aspects in the technological process management, Polish Conference on: Projecting & Managing of the realisation of the production. Chosen subjects, 5th-7th of May, 2005, Zielona Góra, 63-68 (in Polish).
- [3] L.A. Dobrzański, Materials science and metallography. Engineering materials and the basis of material projecting, WNT, Warszawa, 2002 (in Polish).
- [4] D. Szewieczek, T. Karkoszka, The analysis of a technological process based on quality and environmental criterion, The Scientific Conference on Materials, Mechanical and Manufacturing Engineering and Technology MMME'2005, Worldwide Congress on Materials and Manufacturing Engineering and Technology COMMENT'2005, 16th - 19th of May, 2005, Gliwice - Wisła, 285-288.
- [5] D. Szewieczek, St. Tkaczyk, T. Karkoszka, QFD analysis as a manner of quality assurance in the technological process, The 12th International Scientific Conference on Achievements in Mechanical and Materials Engineering AMME'2003, Gliwice - Wisła, 919-922.
- [6] St. Tkaczyk, T. Karkoszka, Superficial processing in the aspect of integrated management systems, International Conference on: Integrated Management Systems - quality, environment, safety, technology, Szczyrk 2002, 461-469 (in Polish).
- [7] St. Tkaczyk, T. Karkoszka, Integration of the management systems based on the quality criterion in technological processes, International Conference on: Integrated Management Systems - quality, environment, safety, technology, Szczyrk 2001, 373-379 (in Polish).
- [8] J. Michalska, The usage of the Balanced Scorecard of the estimation of the enterprise's effectiveness, Journal of Materials Processing Technology 162-163 (Elsevier), 751-758.
- [9] M. Roszak, St. Tkaczyk, Chosen aspects of evaluation of productive processes on the example of productive chains of sections type V29, Journal of Materials Processing Technology 162-163 (Elsevier), 770-777.
- [10] B. Krupińska, D. Szewieczek, The attempt of evaluation of the chosen technological gear wheel process on the basis of its efficiency operation, The Scientific Conference on Materials, Mechanical and Manufacturing Engineering and Technology MMME'2005, Worldwide Congress on Materials and Manufacturing Engineering and Technology COMMENT'2005, 16th - 19th of May, 2005, Gliwice - Wisła, 363-370.
- [11] D. Szewieczek, St. Tkaczyk, B. Wojtaszek, Measurement and control of the technological process by means of the analysis of its efficiency, The 12th International Scientific Conference on Achievements in Mechanical and Materials Engineering AMME'2003, Gliwice - Zakopane, 2003.
- [12] P. Lowe, Chapman H., The Management of Technology. Perception and opportunities, Chapman&Hall, London, 1995.
- [13] PN-EN ISO 9000. Quality management systems. Fundamentals and vocabulary, PKN, Warszawa, 2001.
- [14] PN-EN ISO 9001. Quality management systems. Requirements, PKN, Warszawa, 2001.
- [15] PN-EN ISO 14001. Environmental management systems. Specification with guidance for use, PKN, Warszawa, 2005.