



Integrated method of technological processes estimation in materials engineering

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co-operating with

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ABSTRACT

Purpose: of the presented paper is meant to explain the necessity of implementing the Integrated Quality, Environmental and Occupational Health and Safety Management System and using the proper methods of estimating the technological processes, which takes into account not only the final products but also the environmental influences and occupational health and safety; in this case in the steel wire production.

Design/methodology/approach: applied for the survey has covered the integrated opinion of technological processes based on the quality, environmental and occupational health and safety criterion and using the Integrated Risk Ratio to estimate the risk connected with occurrence of nonconformities, environmental aspects and threats to occupational health and safety in the analyzed processes.

Findings: of the carried out researches are as follows: the realization of quality, environmental and occupational health and safety policy by the integrated methods of technological processes estimation and in accordance with the proposed models results in the improvement of analyzed productive processes of steel wire rod, and in consequence - to their optimization both in the range of view of products' quality and in the aspect of quality of environmental influence and occupational safety.

Practical implications: refers to the application in the steel wire production of the technological model and model of operational control lowering the Integrated Risk Ratio.

Originality/value: of the presented paper has been achieved by application of the new methodology concerning the usage of integrated methods of technological processes estimation, including the Integrated Risk Ratio.

Keywords: Quality management; Environmental management; Occupational health and safety; Process estimation; Integrated risk ratio; Operational control

1. Introduction

Contemporary organization, undertaking competitive fight on the market, has to fulfill not only customers' expectations in the

reference to the quality of delivered products and services, but also the interested sides' requirements connected with minimization or elimination of the negative influences of technological processes on environment as well as workers' requirements connected with occupational health and safety.

For the realization of quality requirements in the aspect of produced articles, environment and occupational health and safety there is a necessity of the system allowing for the proper usage of technical and organizational resources. The system should assure first of all the continuous improvement of all its elements, and by that, increasing the ability to fulfill the determined needs, culturally overtaken, or obligatory ones.

The solution of the above mentioned problems can be the implementation of Integrated Quality, Environmental and Occupational Health and Safety Management System based on the ISO 9001 standard requirements. Usage of the “process approach” allowing for full identification of all the processes, and then usage of the proper methods of estimation based on the quality criterion, also the integrated methods of estimation the technological processes, form grounds for their improvement. The results of conducted research show on these elements of productive process, where only the application of new technological or organizational solutions can assure the minimization or elimination of incompatibilities in Integrated Quality, Environmental and Occupational Health and Safety Management System.

During recent years, development of technical and organizational solutions created conditions of effective processes’ improvement in the area of materials engineering.

Steel, being the main metallic material, is the most popular constructive material. The interaction of mechanical and physico-chemical factors determines the forming of its technological and utility properties. Methods of plastic processing allow for work of 80% of total production. Therefore, because of such a high importance of using the integrated estimation methods especially in the metal industry, the research in the range of steel wire production has been undertaken.

2. Quality of the products as the result of the quality of the productive system

Product, its quality and modernity, being the material, energy or informational result of existence and functioning of productive process, depends directly on its organization in the frames of productive system, which as an organized and designed arrangement of elements, relations between those elements and principles of transforming input factors into output factors fulfilling the customers’ requirements, includes: the transforming

input factors into output factors, production factors, material, energy and informational effects of productive process, process of system management as well as material, energy and informational feedbacks between all elements of the system [1-5].

Analyzing and optimizing the technological process one should first of all specify the aims and criterions of the analyzing and optimizing. That is why taking into account on the output of the process both the intended products and services offered to the clients and products unintended and undesirable for environment and threats to workers, coming into being during the productive process, one can specify basic criterion of optimization. The criterion is always quality connected with the purpose it serves to - production of the products with intended parameters with concurrent minimization of negative influence on environment and workers [6-10].

Technologies, which are the base for the products characterized as “the latest achievements of technique”, very often create the threat for the natural environment; the planned final product is goes together with undesirable products, which are the by-products of the technological process [6-11].

Therefore, for proper definition of quality, on the output of the technological process it should be taken into account both intended products and services offered to clients and products unintended for environment and coming into being during productive process of given technology as well as the results of realization of the process to the health and safety of workers (fig. 1) [6-10,12].

The effect of management of the technological process, based on the quality criterion, should be high effectiveness of the stated aims, not only in the aspect of quality of the final products but also in the range of environment and safety and work hygiene, which ensures high level of effectiveness [6,12-15].

3. Integrated quality, environmental and occupational health and safety management system

R. Kolman defines quality as a “degree of fulfillment of requirements set of which total satisfaction means the accomplishment of relative perfection state”, which is understood as “quality being the result of currently taking place, not extreme, requirements [16]”.

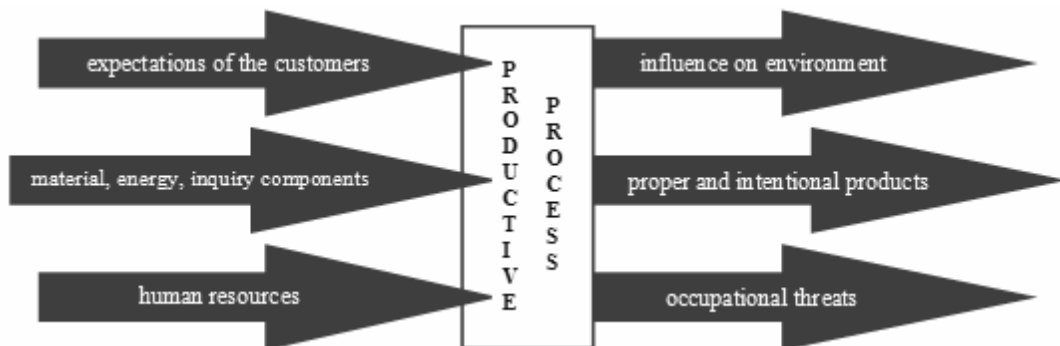


Fig. 1. Productive process with coexistent streams [12]

In the range of the management systems, based on the quality criterion, if the quality becomes the necessary mean in realization of the strategic aims, the concept of quality should be considered mainly in the range of [3,11,17]:

- mechanics (attribution of particular quality properties, characteristic for optimal social usefulness, to the items,
- environment (minimizing the negative influence on environment during the whole life of product cycle,
- workplace safety (aiming at elimination of all the threats for health and life of the workers by creating the living and working conditions improving the physical and emotional safety, and at the same time increasing the level of culture),
- economy and law (nation of law).

Management based on the quality criterion is possible solely by management of processes in range of Quality Management System because only the proper organization of the production process is able to ensure its high efficacy and effectiveness [2,6,13-15,17,18].

Management system, defined as “set of simultaneously connected or commonly influential elements used to establish the policy and aims, and to gain these aims” in the range of chosen management systems, including the quality, environmental and occupational health and safety system, covers [27]:

- planning “directed towards aims setting [...] and describing the operational processes and connected with them resources necessary to gaining these aims [...]”
- controlling “directed towards fulfilling the requirements [...]”
- ensuring „directed towards ensuring of the requirements [...] to be fulfilled”
- improvement “directed towards increase of the ability to fulfilling the requirements [...]”.

Management based on the quality criterion connected with the desired products (items, services) offered to the client, undesired products creating the threat to the natural environment and to the work safe of the workers, is reflected in [26-28]:

- quality management systems based on the requirements described by the PN-EN ISO standards, 9000 series,
- environmental management systems based on the requirements described by the PN-EN ISO standards, 14000 series,
- occupational health safety management systems based on the requirements described by the PN-N standards, 18000 series.

Requirements concerning the process, product or service are usually different from the requirements which most of the producers must fulfill in the range of environment protection and the safety and hygiene of work. It derives from the fact of concentration of the quality management systems on gaining the economical benefits, as well on ensuring the clients full satisfaction. However, the increase of the ecological awareness in the society, as well as the knowledge of safety among the workers, and the competitive fight on the market, cause more frequent consideration of the environmental and safety aspects in the range of the management systems [3,19-21].

At the same time, the fact of existence of numerous common points in the organizational and operational structure of well-functioning Quality Management System, Environmental Management System, as well as in the Occupational Health and Safety Management System, seems to be obvious. In the mentioned management systems the basic aim is prevention

against the failures and threats, as well as the proper economical and ecological strategies. In each of these systems steering with the process is realized as the operational control, in each of these systems may occur incompatibilities accompanied by corrective and preventive procedures, the records are run, and supervised, and the problem of estimating these systems is coincidental, too [3,4,19,22-25].

In every case the same conception of management, being in accordance with the cycle of constant quality improvement - presented in the Deming's Circle, was applied, and covering planning, implementing and functioning, checking and corrective performances, check-up and constant improvement (fig. 2) [26-28].

Defined, measurable and proved aims have been realized mostly in the range of the independently functioning systems. However, currently, one of the possibilities of reconciling these contradictory businesses of the company and its workers, and at the same time, taking into account the problems connected with the environment protection, is the integration of the Quality Management System with the Environmental and Occupational Health and Safety Management System (fig. 3) [3,10,29].

As the most useful way of integrating the Quality Management System with the Environment Management System and Occupational Health and Safety Management System, the simultaneous implementation of both mentioned above systems based on the PN ISO 9001:2000 norm is indicated [3,4,31,32].

Such an adjustment brings the measurable benefits for the outsider customers as well as for the organization itself; system covering aspects of both systems is easier to implement, increases the capacity of the process, improves the workers' productivity, which at the same time reduces the costs, shortens the certification process and increases its value [31,32].

According to the standard “for an organization to function effectively, it has to identify and manage numerous linked activities. An activity using resources and managed in order to enable the transformation of inputs into outputs, can be considered as a process. Often the output from one process directly forms the input to the next [27]”. Such a “process approach” by [3,4,6,13,14,31,33,34]:

- defining and analyzing of the necessary processes to gain the quality aims,
- choice of proper methods of efficiency and effectiveness of the processes,
- estimating of the processes' efficiency and effectiveness level, has an crucial mining for both: single processes and for the system of processes.

The standard mentioned above defines the process as “each activity or the set of activities, in which the resources for altering inputs into outputs is used”. Integrated Management System, based on the quality criterion, covering [3,4,7-10,19,35]:

- products and services intended, offered to the clients - output of the process,
- potential threats of health and life of the workers,
- resources (energy, raw materials) - input of the process,
- products and services unintended and undesirable for environment, and appearing during the manufacturing process - output of the process, is nothing else than the system of connected with each other and simultaneously influential processes.

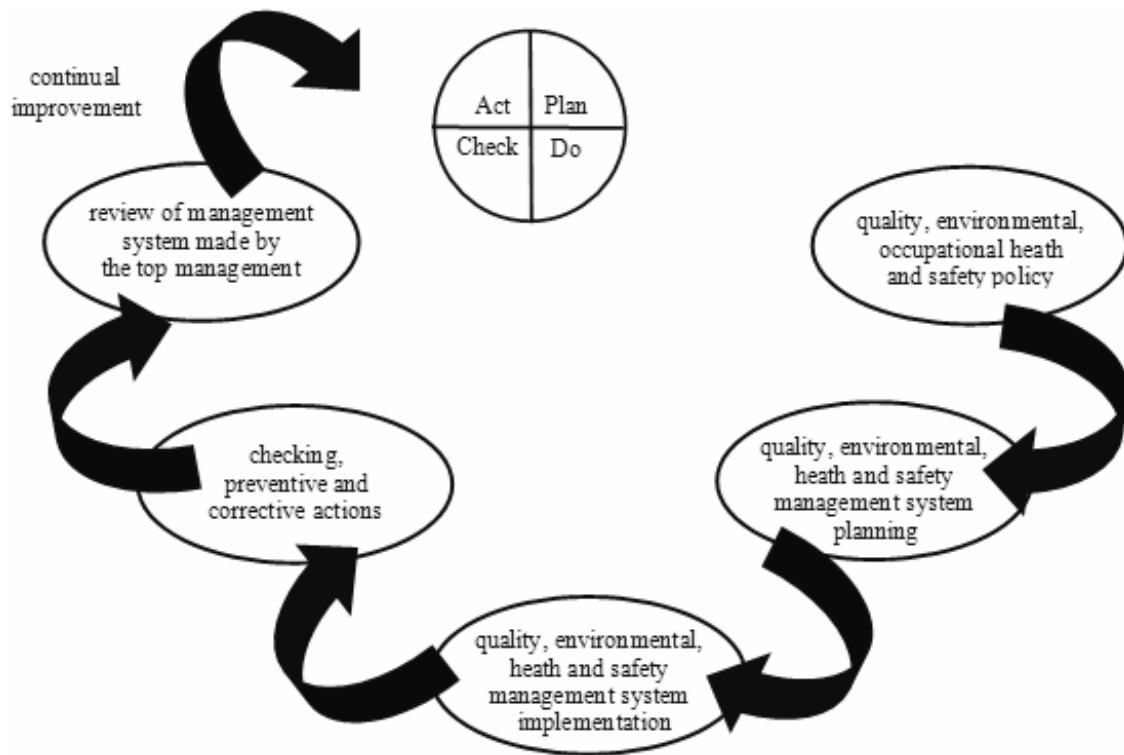


Fig. 2. Conception of Quality Management System, Environmental Management System and Occupational Health and Safety Management System based on Edward Deming's cycle [26-28]

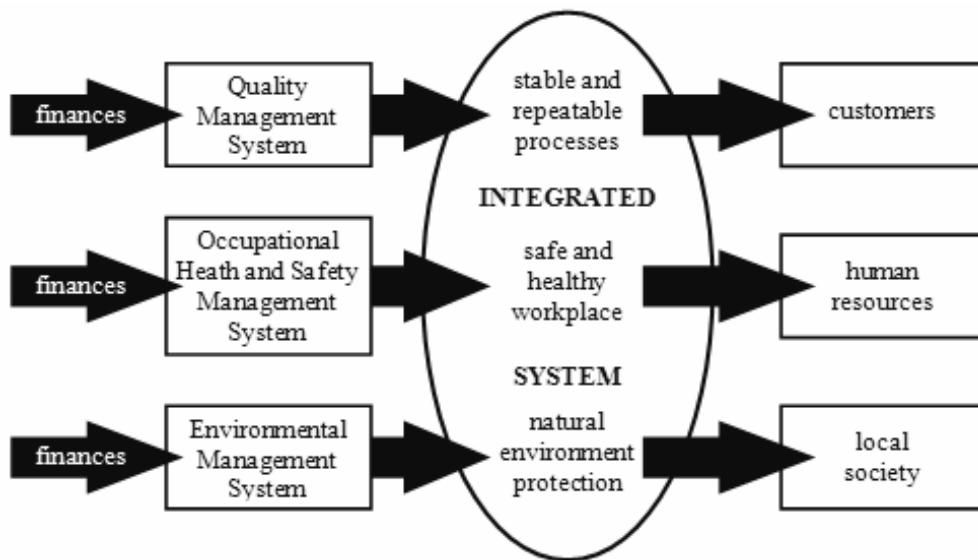


Fig. 3. Pattern of influences of Integrated Quality, Environmental and Occupational Health and Safety Management System [3,29,30]

The implemented system of management of processes, based on the ISO 9001:2000 standard, enables for the early detection of the processes' threats in the range of the quality of

the products, environmental and safety, by fulfilling the requirements of PN-EN ISO 9001, PN-EN ISO 14001 and PN-N-18001 standards [26-28].

4. Elaboration of the integrated method of technological processes estimation

The more information connected with the subject of the process is gathered and the more profound their analyzes, the more complete the process is and the bigger chance for its optimization. The base of the constant improvement is the problem of incompatibility between the aim of the process and the starting-point data of this process.

Identification, and next, the proper estimation of the processes which have the highest meaning in case of reaching the required quality in broad meaning, are the basis for their improvement.

In the range of quality management one of the most applied method of examination and estimation is the expert method Failure Mode and Effect Analysis enabling the elimination of the potential problems occurring in the process by elimination of the sources of their origin.

First stage of the analyzes covers defining the structure of the system and its particular functions.

Second stage it is an analyzes of nonconformity. Possible defects are elements of the system, which do not fulfill or fulfill in a wrong way their functions. Potential reasons of nonconformity are ill-functioning elements of the lower line, and the potential results of the defects are ill-functioning elements of the higher line. Accordingly to the ISO standards series 9000 these nonconformity are called: "the non-fulfillment of a requirement", and the defect means non-fulfillment of a requirement related to an intended or specified use [30].

Third stage deals with the estimation of the nonconformity meaning. It is based on the three basic questions:

- what is the probability of occurring the cause of the nonconformity,
- what is the probability of detecting the cause of the nonconformity,
- how severe can be the nonconformity.

The answer to the stated questions is:

- the approximate number of occurrence presents the estimation of the probability of occurring the cause of the nonconformity and is defined together with considering all applied preventive actions,
- the approximate number of detecting presents the estimation of the probability of detecting the caused of nonconformity and is defined together with taking into account all applied detecting actions,
- the approximate number of importance presents the estimation of the importance of the nonconformity occurrence and is defined for the particular system,

and the final evaluation of the coefficient of the risk level presenting the level of risk probability connected with nonconformity occurrence.

Stage three covers the range of meaningful nonconformities and the optimization. The high level of risk proving the threat of appearance of the particular incompatibility in the process points at the necessity of taking up the correcting and preventing optimizing steps.

In the scope of the environmental system PN-EN ISO 14004 standard suggests the environmental aspects identification aiming at estimating the previous, current and the further, both positive

and negative, influence of the company's activities on the environment.

Stage one deals with the choice of company's activity, its product or service, which will be analyzed.

Stage two is the identification of the environmental aspect of the chosen activities, products or services; environmental aspect it is "the element of the organization's activity, its products or services, which may interact with the environment [28]."

Stage three covers the identification of the current and the probable environmental influences connected with the identified environmental aspects; the influence on the environment it is "each change in the environment, both useful and the not-beneficial one, which fully or partially caused by the activities of the organization, its products or services [28]."

Stage four it is the estimation of the identified environmental influences meaning. The estimation considers the influence scale, harmfulness of the influence, probability of its appearance and the duration time.

Occupational Health and Safety Management System based on the guidelines of the PN-N-18002 standard, suggests the occupational risk estimation. It aims at identification of the threats appearing at the work places as well as to defining the occupational risk involved [29].

Stage one it is collecting the crucial information for the occupational risk estimation. At that point the information concerning the company location, applied technologies and technological appliances, localization of the work position, used appliances and means of work, harmful and troublesome factors at the work place, usage of the protective minces, is gathered.

Stage two concerns the identification of the occupational safety and health threats, together with their effects; "threat it is the condition of the environment which might cause the accident or the illness [26]."

Stage three covers the defining of the occupational risk and is based on the two crucial questions:

- what is the probability of threat occurrence,
- how severe can be the consequence of the threat presence.

While estimating the probability of the harmful effect of the threats occurrence, the frequency, time of risk exposure, probability of the threat evoking event occurrence and possibility of the losses avoidance is revised.

Stage four it is defining the risk acceptance. It is the final stage of the occupational risk estimation and it aims at pointing of the risk acceptance. Risk acceptance is calculated directly on the base of its estimation.

The need of integrated opinion of the studied models of technological processes implicated the necessity of creation of Integrated Risk Ratio of processes considering, besides the gravity and difficulty of realization of set technological parameters, also the risk coefficient linked to the occurrence in the process potential nonconformities, significant environmental aspects and threats to occupational health and safety.

The integrated analyzes of the technological process takes into account common algorithm of the estimation of the sources of nonconformities, environmental aspects, as well as the threats of the work safety, and it covers:

- defining the structure of the system and its individual functions,
- characteristics of the nonconformities, environmental aspects, and the threats to occupational health and safety,

- estimating of the nonconformities, environmental aspects and the threats to occupational health and safety; estimating of the incompatibilities' meaningfulness was based on the three main questions:
 - what is the probability of occurrence of the nonconformity, environmental aspect, threat to occupational health and safety?
 - what is the probability of detecting the incompatibility, environmental aspect, threat to occupational health and safety?
 - how harmful can the result of nonconformity, environmental aspect, threat to occupational health and safety be; together with the estimation of the priority number of occurrence of the source of the nonconformity, environmental aspect, threat to occupational health and safety?
- choosing of the nonconformities, meaningful aspects and safety threats.

The answer to the above presented is defining the preference number of occurrence of nonconformity cause/environmental aspect/threat to occupational health and safety, the preference number of detection of the nonconformity cause/environmental aspect/threat to occupational health and safety as well as the preference number of nonconformity/ environmental impact/after-effect of threat to occupational health and safety importance, and the final calculation - the qualification of coefficient of the risk level expressed in scale $1 \div 1000$.

The usage of created coefficient allowed choosing the processes evoking the particular threat for environment and occupational health and safety, and suggesting the solutions of eliminating or minimizing the negative impact of the analyzed processes on environment and occupational health and safety with simultaneous maintenance of the set product parameters.

5. Application of the analyzed research methodology in the analyzes of the technology of steel wire manufacturing

Having the direct impact on the development of numerous branches of industry, transport, building industry and everyday life, rope wires and ropes undergo the development process in the range of technology and economy of their manufacturing [36,37].

Steel ropes are the bearer element of high or low complexity, which basic element are steel wires. Changeable and extremely harsh environmental conditions, to which the steel ropes are exposed to, are the reason of the limited material fatigue durability of their construction, caused mainly by the material fatigue of the coordinating, wearing off and changing the geometry wires [37].

Resulting from the above mentioned increase of the demand for high durability and corrosion-proof wires and ropes creates the necessity of constant thorough research in the range of quality of the zinc-plated wires.

The manufacturing process is, however, troublesome for both: environment and the workers. The results of possible failures connected with the process and the threats to the health and life of

workers are hard to predict. Therefore, the works on devising the methods of new generation technologies, in the range of wire manufacturing or applying the proper control methods aiming at minimization or full elimination of the threats, are so crucial.

In order to make the research more effective in reaching the aims, not only in the scope of their properties but also in the area of minimizing the negative influence of their manufacturing both: on the environment and the safety of workers, in work the attempt of integrated analyzes of steel zinc-patted wire (designed for ropes) manufacturing, has been undertaken. The research has been carried out in the company being the national producer of ropes and wires.

The led research cover the technological processes of the zinc-plated wire production made of steel species C66D, realized in the company being the national producer of wires and steel ropes. The analyzed technological process of the steel zinc-plated wire covered:

- superficial processing of wire rod, including: digestion in sulphuric acid, rinsing, making a $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ coat, drying,
- plastic processing, including: sharpening the endings of wire rod, welding the endings of wire rod, drawing in the low temperatures,
- thermal processing - patenting,
- superficial processing, including: digestion, rinsing, making a ZnCl coat, drying, fire zinging,
- plastic processing being the drawing of the zinc-plated semi-manufactured product.

The realized processes have been estimated accordingly with the previously taken methodology of the integrated estimation. Comparison of the estimation integrated rate has been presented in the table 1.

Table 1. The comparison of the Integrated Risk Ratio of the studied processes of plastic, thermal and superficial processing

kind of process	Σ TPI	Σ TPD	Σ QRL	Σ ERL	Σ TRL	IRR
superficial processing	1902	24	1008	1348	1320	993
plastic processing	606	10	736	20	80	79
thermal processing	1270	5	222	520	414	294
zinc-plating	2506	46	617	1042	760	697
finishing superficial processing	810	3	77	-	80	42

where the symbols mean:

- IRR - Integrated Risk Ratio taking into account products' quality, environmental and occupational health and safety aspects,
- TPI - index of the importance of individual technological parameters in the realization of quality, environmental and occupational health and safety aims
- TPD - index of difficulty of realization of individual technological parameters,
- QRL - index of the risk level of analyzed incompatibility,
- ERL - index of the risk level of analyzed environmental aspect,
- TRL - index of the risk level of analyzed threats to occupational health and safety

According to the comparison shown on the chart 1, it can be stated that:

- the smallest coefficients of risk characterize the processes of plastic processing of naked wires and semi-manufactured zinc-plated articles,
- the highest coefficients of risk characterize the processes of preparation of wire rod surface to the plastic processing and preparation of naked wires to the putting of protective coats, as well as the processes of thermal processing.

Therefore, the processes of preparation of wire rod surface as well as naked wires surface to the plastic processing and zinc-plating have been classified as the ones which leave no possibility of simultaneous realization of quality, environmental and occupational health and safety aims.

In the revised scope it has been worked out then and applied the model of operational control and mechanical removing of cinder.

The operational control included within the frame of the Integrated Quality, Environmental, Occupational Health and Safety and technological processes Management Systems covered:

- identification of legal requirements in aspect of quality of produced articles, environmental aspects and threats to occupational health and safety,
- identification of operational criterions, it means - identification of technological parameters of process,
- identification of potential nonconformities, environmental aspects and threats to occupational health and safety,
- qualification of risk connected with presence of the potential nonconformities, environmental aspects and threats to occupational health and safety,
- qualification of the Integrated Risk Ratio,
- qualification of operational criterions, it means - qualification of technological parameters of process which increase can be connected with loss of stability of process,
- qualification of operational profiles, it means - qualification of the supervised technological parameters of process enabling the operational control,
- operational monitoring including the control of key profiles.

The suggested technological solution was a mechanical cleaning of the wire rod surface using, for instance, the fluid - stream method, which working mechanism relies on bombarding with the abrasive grains the surface which is being cleaned.

While choosing the method of removing the cinder from the wire rod surface one should consider the possibility of its applying depending on the quantity of oxides, which covers the wire rod before plastic processing, so depending on time and the place of the wire rod storing before attempt to its removing and resulting the loss of mass of wire rod resulting from the increase of rust quantity.

Application of the mechanical method of cinder from the wire rod surface, which is to be exposed to the plastic processing, in practice, reduces almost completely the problem of:

- occurrence of the incompatibilities in the process and resulting from the chemical effect of the sulphuric acid,
- occurrence of important environmental aspects such as after-etching sewages and washings, after-neutralizing sediments and the risk of the industrial failure, connected with presence of the mentioned environmental aspects,
- occurrence of meaningful threats for the health safety and the life of the workers resulting from direct contact with the strong corrosives.

Possibilities of the optima solutions suggested in the range of the realized technology of steel rods manufacturing have been estimated accordingly with the previously taken methodology, which enabled to specify the model solutions which reduces the Integrated Risk Ratio in high degree in reference to all activities aiming at reaching the product's conformity together with the specified requirements being in accordance to the set quality, environmental, and work safety and hygiene criteria.

For estimating the possibilities of realization of the set quality and environmental aims, taking into consideration the risk connected with the occurrence of potential incompatibilities, important environmental aspects and threats to occupational health and safety, the Integrated Risk Ratio for the realized technological processes (table 1), technological processes steered operationally the technology taking into account application of the mechanical removing of the cinder (table 2) and the technology taking into account application of the mechanical removing of the cinder (table 3).

Table 2.

The comparison of the Integrated Risk Ratio studied processes of plastic, thermal and superficial processing controlled operationally

kind of process	Σ TPI	Σ TPD	Σ QRL	Σ ERL	Σ TRL	IRR
superficial processing	1902	24	839	368	720	520
plastic processing	606	10	322	19	64	38
thermal processing	1270	5	104	70	280	115
zinc-plating	2506	46	281	339	512	326
finishing superficial processing	810	3	44	-	64	29

Table 3.

The comparison of the Integrated Risk Ratio studied processes of chemical and mechanical superficial processing

kind of process	Σ TPI	Σ TPD	Σ QRL	Σ ERL	Σ TRL	IRR
chemical superficial processing	1902	24	1008	1348	1320	993
mechanical superficial processing	306	7	212	70	318	51

The results of research proved the thesis, that the realization of quality, environmental and occupational health and safety policy based on the proposed technological model and operational control mode, leads to improvement of the analyzed steel wire productive processes, and consequently - to their optimization both in case of the finished articles quality, in the aspect of quality of influence on environment and workers' safety, based on the formalized Integrated Quality, Environmental and Occupational Health and Safety Management System.

The mentioned above have been compared - fig.4.

The legitimacy of implementing the suggested model solutions is therefore approved by the predicted considerable lowering of the Integrated Risk Ratio in case of the processes steered operationally and in the processes of technological model (fig. 4).

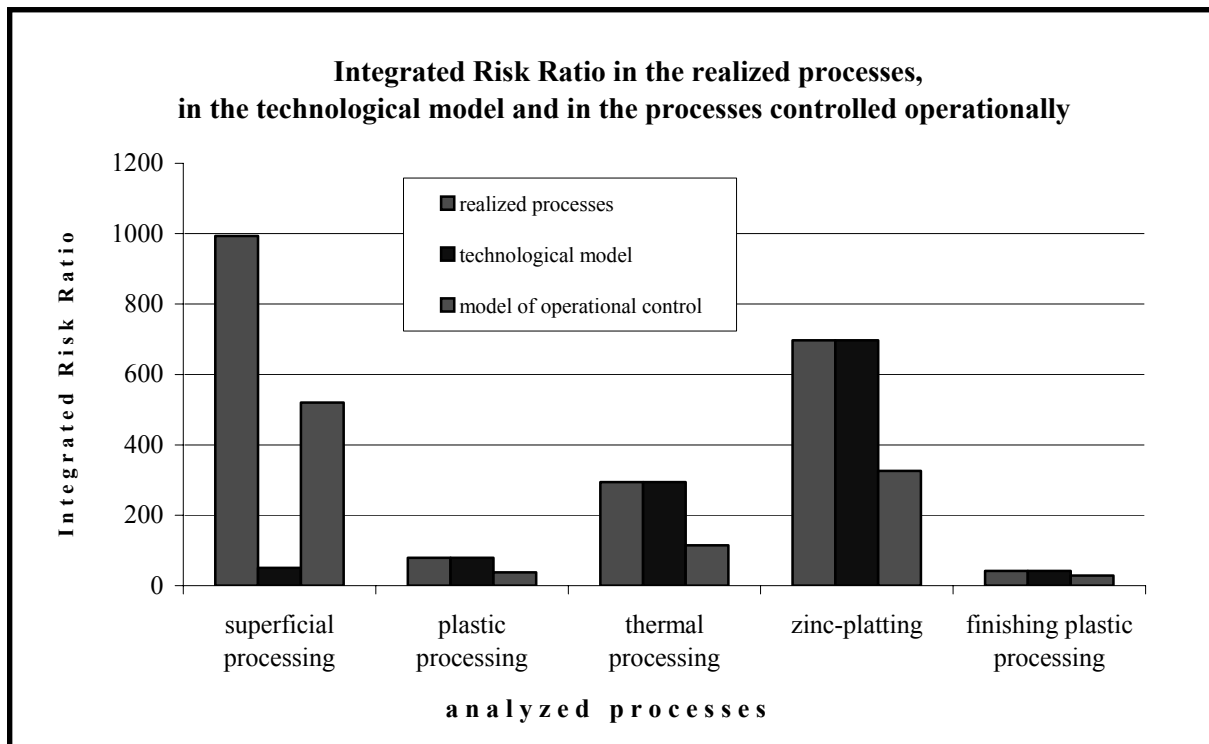


Fig. 4. The comparison of the Integrated Risk Ratio in the realized processes, in the processes of technological model and in the processes with operational control

6. Summary

Fulfilling the requirements and the expectations of the clients in reference to the quality of the products and services, minimization or elimination of the negative influence of the productive processes on the natural environment, together with ensuring the safety and hygiene of work to the workers, is possible exclusively by improving all the technical, technological and organizational aspects in the organization.

Starting point of all improving actions is full identification of all processes in the organization, and next, their analyzing in the range of the Integrated Quality, Environmental, Occupational Health and Management System. The base for this analyzes is choosing the method of examination and estimation of the processes, mainly the technological ones.

In the work presented, the analyzes of the realized processes of the steel wire manufacturing together with using integrated methods of examining and estimating based on the quality criterion and the Integrated Risk Ratio, has been made.

Among all analyzed processes, the process of preparing the wire rod surface to the plastic processing as connected with the numerous potential nonconformities, the environmental aspects and threats to occupational health and safety of high probability of occurrence and low level of detection, high occupational risk, therefore, with the high Integrated Risk Ratio, have been pointed.

In this range, the possibilities of applying other technological and organizational solutions have been revised:

- preventing from occurrence of significant incompatibilities such as: after-etching fragility, after-etching corrosion, and the not-fully-etched areas,
- minimizing, at the same time, water usage for the industrial aims, usage and emission of the sulphuric acid, amount of contamination in the sewages drained to the municipal canalization, amount of after-neutralizing sediments, and lowering the risk of industrial failure occurrence,
- minimizing or eliminating the probability of occurrence of significant threats to the health safety and life of workers which causes direct contact with the strong corrosives.

In the range of interest can be listed: model of operational control and the mechanical preparation of the surfaces, which have been analyzed again accordingly with the methodology taken.

Findings of the research have confirmed the thesis which stated that realization of the quality, environmental and occupational health and safety aims, is possible exclusively after complete identification of all processes in the organization, and next, after their analyzing with using the integrated method of their estimation.

In case of analyzed processes of steel wire manufacturing, they guarantee optimization from the point of view of the final products, in the aspect of quality of the influence on natural environment, as well as in the range of the risk connected with the occupational health and safety.

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