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Technological Modernity Management in Anti-Corrosion Protection Processes

Renata Stasiak-Betlejewska (0000-0001-8713-237X)
Faculty of Management, Czestochowa University of Technology. Armii Krajowej 19B, 42-200 Czestochowa. Poland. E-mail: renata.stasiak-betlejewska@wz.pcz.pl

Anti-corrsion protection supports structural element quality of the steel structure. Important for the management of corrosion protection is not only the analysis of system incompatibilities in the process, but also the side effects of their treatment. The article presents results of the use ABC method applied to technological machines modernity level management in anti-corrosion protection of steel structures. Research findings enables identifying and analysis of technological modernity level of machines used in the anti-corrosion protection process what is crucial for the final quality of the process and product manufactured in the steel construction production. The paper proves effectiveness of using ABC method in the machines modernity level assessment for ensuring process quality and improvement of the steel construction corrosion ensuring process.

Keywords: technological modernity level, management, machine component, anti-corssion, ABC method

1 Introduction

Machinery and devices are the basis for the functioning of the production system of each company. They decide on the product quality level and the success of the company regarding customer requirements. The right approach is important to the operation of machinery, and their running maintenance. Repair and maintenance service system of machinery and equipment is a component of the operating system of a company. The machines technological modernity level has large impact on the final quality level of the product [1, 10, 11, 12].

The modernity of the production system and its technical resources is an important component of its development [21]. Modern and novelty are not the same thing. Modernity is the result of progressive development, the development of science and technology, and a new object does not always equal the term modern. With regard to technical systems, modernity is defined as a higher degree of meeting the requirements, taking into account the latest achievements and experience in the processes of design, construction, production and operation. Modernity is related and appropriately identified with the concept of quality, because a modern machine is usually associated with high quality workmanship. It is very important to assess the modernity of production resources, which is the starting point for taking action to improve the company's competitiveness on the market [5, 17].

Foucault describes modernity as an attitude rather than a period of history in that it influences forms of relationships both to oneself, i.e. the constitution of ourselves as autonomous subjects, and contemporary reality, which again includes inter alia, forms of knowledge, projects of rationalization of knowledge and practices, and technologies [4].

Technology is a targeted process of performing the needed products or services, implemented in a production system with identified elements and their connections, built to implement this process based on available theoretical and practical knowledge", i.e. technology can be treated as a specific system. In this situation, it becomes reasonable to establish an appropriate (and preferably optimal) method of technology management, just as standards for quality, environment, security, information and other management have been established. Such a system should consist of a number of elements, such as: technology strategy, management and design principles, key processes and their sub-processes, appropriate documentation, records, audits, corrective, preventive and other actions. Particularly important elements include the proper identification of key processes and their sub-processes and the establishment of an optimal method of managing these processes (measuring the technological potential, measuring the level of technology, managing the park of technological machines [14, 15, 16].

According to Feenberg technology made modernity possible [3]. Lowe claims, that management of technology requires knowledge of technology [13]. The decision making is a difficult process because a person taking the decision is responsible for its future effects. Company managers should take a decision on the change of the machine for the newer one since production technology and status of the machinery park affects the final product quality [8, 9]. Most manufacturing companies realizes their technologies, implemented through concrete machinery parts. They differ in terms of importance, the relevance of their selection and the level of their modernity [6, 7].

All operational facilities, including technical facilities, age with varying degrees of intensity [8, 9]. The aging of the technical object is associated with the loss of its value, among others in the context of the development of technology used in a given machine. Hence the important role of diagnostics of technical objects in an enterprise responsible for the quality of the result of production processes.The diagnosis of the technical objects exploitation system serves to increase the efficiency of the diagnosed system [2, 17, 18].

The aim of the article is analysis of technological modernity level of machines used in the corrosion protection process with using ABC method that enables machineds modernity management in the context of the improving of the final product quality in anticorrosion protection process. The method indicated above was supported by the use of the Pareto - Lorenz method, which is based on the established empirical regularity that in nature, technology, human activity, etc., usually 20-30% of the causes determine about 70-80% of effects. [19] The Pareto-Lorenz method, the so-called the ABC method is one of the techniques that enable the definition of activities aimed at improving the level of processes and quality characteristics of material objects. The Pareto-Lorenz method is a technique leading to the identification of the most important features (events, causes) that have the most significant impact on the quality, and thus enabling the determination of activities aimed at improving the quality level of processes. [20]

Research findings have been achieved in the pilot research done in the company dealing with steel construction manufacturing. ABC method was applied as the part of the processes quality improvement project in the company.

2 Methodology

The modernity of machine parts of devices can be classified using the ABC analysis of technology to assess their value and usefulness for the company in the analyzed period. Competitive advantage, expressed in costly leadership or the richness of the product range, may be used as the evaluation criterion. The latter is achieved thanks to the flexibility of devices that allow company to frequently change the type and quality of the product. The ABC analysis of the technology is based on the principle that in each statistical group it is possible to distinguish several of its members, conventionally marked with the letter A, which determine the main part of the results. At the other end of the distribution, there are many members of the group, denoted by the symbol C, with little contribution to the results of its activities. The work, however, cannot be completely ignored. The rest are indirect members of the group, marked with the letter B. The Pareto-Lorenz diagram is used to analyze the quantitative structure of nonconformities/defects, e.g. of a product, and the ABC analysis of technologies concerns the individual components used in the production of the machine and the assessment of their modernity on the five-point Parker scale [1, 7, 8, 10, 16].

One of the ways to analyze the technology portfolio is the ABC technology method. It is a method that allows the level of modernity of machine parts and devices to be assessed. Its essence consists in the categorization of individual parts of strategic components in a given machine or device. The parts are divided into 3 categories [1, 9, 10, 11]:

- A - basic components (fundamental parts of the machine that guarantee the product special attributes),
- B - supporting components (general),
- C - secondary components (they are not subject to the innovative activity of the user, they are of little importance when buying new machines).

Assessment of the levels of modernity is made using the five-point Parker scale where [1, 8, 9, 10]:

- level 1 - means simple parts; they can be made using craft techniques, e.g. machine foundations,
- level 2 - means parts that have been manufactured using technologies known and unchanged for many years, e.g. standard engine cooling system,
- level 3 - parts made with the use of the mastered technology, but requiring technical knowledge, e.g. a standard electric motor,
- level 4 - parts manufactured with the use of modern market technologies, e.g. diagnosis display on the control panel computer,
- level 5 - means parts that are the result of the most modern technologies, patented and available only in this machine.

The use of such categorization makes it possible to rank modernity in terms of the purposefulness of development and investment. This allows you to decide which parts need to be upgraded, replaced and which not. Technologies are not mutually isolated from each other. Thanks to the use of the ABC analysis of technology, it is possible to identify significant technological possibilities of the company.

The ABC analysis of technologies (Pareto-Lorenz diagram) concerns the components used in the production of the machine in the assessment of modernity in the five-point PARKER scale.

Applied scale levels [1]:

- 1 - concerns simple parts that can be made in a simple way,
- 2 - parts manufactured using technologies known for years,
- 3 - parts manufactured with the use of the mastered technology, requiring appropriate technological knowledge,
- 4 - parts manufactured with the use of modern technologies,
- 5 - the most modern technologies present in the machine of a specific company.

Table 1 presents description of machine technical characteristics analyzed in the ABC technology method. All key technological aspects for machines elements have been described.

According to information presented in Table 1 one of the machine elements is construction that includes: structure frame stiffness, vibration level, alignment, table movement precision and guides. The foundation of the machines has some key technological aspectsthat is the object of the modernity level analysis, such as: stiffness, vibration level of the machine and its surroundings. The object of machine modernity level analysis in ABCE technology method for energy supply system that is analysed on its operating within following technological aspects such as: motors, starters, circuit breakers, power factor, spindle and servo automatic drives, transformers, power circuits.

Drive system of the machine is analysed on its modernity level within its technological aspects with regards to: the range and variability of the cutting speed and feed, transmission, clutches, spindles.

Control system of the machine is anlaysed in the aspect of the following aspects: its dialogue with the operator, tool movements, level of precision and safety limits.

The object of the modernity level analysis in ABC technology method concerns also:

- tooling,
- system for handling processed elements and system of supporting functions,
- programming system,
- console.

Mentioned systems are responsible for parameters of the anti-corrossion protection process results.

Tab. 1 *Technical characteristics of the machine [1, 8, 9, 10]*

Machines elements	Key technological aspects
Construction	Structure frame stiffness, vibration level, alignment, table movement precision, guides
The foundation	Stiffness, vibration level of the machine and its surroundings
Energy supply system	Motors, starters, circuit breakers, power factor, spindle and servo automatic drives, transformers, power circuits
Drive system	The range and variability of the cutting speed and feed, transmission, clutches, spindles
Control system	Dialogue with the operator, tool movements, level of precision, safety limits
Tooling	Tool design, tool magazine, automatic tool change, tool wear compensation, tool setting in the machine tool
System for handling processed elements	Size, putting on, fixing, handles
Systems of supporting functions	Coolant, filtering, lubrication, chip removal, heat exchanger for electrical systems, hydraulic and pneumatic systems
Programming system	Data input and collection, types of operations, standard functions and subroutines of the learning device, error correction, display of results
Console	Display of diagnosis on the monitor screen, machine status, location display, graphics

Table 1 describes all technological aspects of machines elements that are the object of the analysis and assessment in ABC technology method.

Some companies specify general requirements for the technology portfolios contained in the devices. Their needs can be related to the technology offered by the vendors as part of the device evaluation to assess the accuracy of such portfolios. Full compliance may mean that the device has been made strictly according to the customer's needs, and the prospective user only needs to consider whether the cost of such a solution is justified. It is a matter of negotiation to reconcile the requirements for technology with the usefulness of the device and its price.

Using the ABC metohd allows for identifying the most important elements of the machines that has influenve on the processes quality and elements that can be causes of problems in the anti-corrosion processes in the steel construction production.

Owing to ABC method, it is possible to thoroughly understand the needs of production process to implement changes in the machines maintenance plan in order to ensure management processes.

3 Research object and research results

The level of machine modernity affects final quality of the finished products. The ABC method allows to evaluate the modernity level of selected production machines in the analyzed enterprise that produces steel constructions. The company has qualified and experienced staff and a professional machine park that guarantee reliability and reliability of products and services, even for the most demanding customers. Employees of the Quality Control Office who perform the weld tests have certificates of competence according to the PN-EN ISO 9712 standard in the field of second degree non-destructive testing: VT, MT, PT, UT issued by the Welding Institute, TÜV Rheinland and the Office of Technical Inspection, as well as certificates confirming the qualifications in in the field of design and supervision over the implementation of anti-corrosion protection on steel structures, issued by the Road and Bridge Research Institute. The policy of the integrated management system was approved by the President of the Management Board of the Company, and then it was disseminated in all organizational units. For the sake of proper dissemination of the integrated management system policy, the Management Board of the company appointed the Manager of the Quality Control Office as the Plenipotentiary for the Integrated Management System, and thus authorized to:

- establishing, implementing and maintaining the processes necessary for the efficient operation of the integrated management system,
- analyzing and presenting all reports on the functioning of the Integrated Management System,
- communication and dissemination of knowledge about IMS throughout the company,
- continuous improvement,
- suspension of processes that may directly affect any non-conformities,
- prompt removal of any non-conformities noticed during audits.

In the research, two strategic machines were selected for the study, which were divided into 3 sub-assemblies and assessed according to the five-point Parker scale.

The analyzed machines, in terms of its technological modernity, are used in the process of anti-corrosion protection of the steel structure. Metal structures are very common and have a wide range of applications in every sector of the economy (e.g. processing industry and construction, agriculture, forestry, fishing, or mining).

The process of protecting the steel structure against corrosion is divided into pre-treatment and proper treatment. The pre-treatment process, which is divided into two stages, includes grinding works, which consist in rounding off all sharp edges, as well as removing chips. The second stage of pre-treatment also includes washing the structure with a detergent to remove dirt and grease. The proper treatment is also divided into two stages and the first one includes abrasive blasting, which is aimed at obtaining the appropriate metal purity class and giving it the appropriate roughness for better paint adhesion and penetration. The second stage of proper processing is the application of paint coatings in accordance with the specification and documentation of a given steel structure.

The elements are blast-cleaned to the Sa 2½ cleanliness class, and then undergo a very detailed visual inspection in accordance with the PN-EN ISO 8502 standard. After passing the inspection, the construction elements are transported to the paint shop. At the beginning, each structure is additionally dedusted, and then, in the first phase of painting, hard-to-reach places as well as welds and narrow edges are prepared with a brush, this procedure is necessary in order to obtain similar coating thickness values. The structure prepared in this way is painted using the hydrodynamic spraying method with an epoxy primer layer, which has good penetrating properties and is supposed to inhibit the corrosion process in the initial phase of corrosion. After drying of the primer layer, its thickness is controlled, which must comply with the specification and is usually 70 μm. There is a possible acceptability of thickness error that may occur and must not be lower than 90% of the established thickness and higher than stated in the product data sheet. The next step is to re-seal hard-to-reach places, welds and narrow edges, and then you can apply an interlayer by hydrodynamic painting, which is also an epoxy paint. After this stage of painting, the quality control of the thickness is also carried out, which must also be in accordance with the specification and is usually 120 µm. The last stage is painting the surface layer - polyurethane, which has very good protective properties against moisture and, what is very important, against UV radiation. It is applied by hydrodynamic painting, but with a slightly smaller thickness 50 µm. Excessive thickening could cause cracking of the topcoat. After the final painting, we carry out thickness checks and visual assessment. As part of the special construction, the declared protection against corrosion, the requirements of the PN-EN ISO 12944-3 standard should be applied. Structures that meet the requirements of this standard can be obtained in relation to all the criteria of their protection and operation.

The research analysis concerning the analysis of technological modernity level of analyzed machines was preceded by an analysis of quality problems that were identified in the analysis of the anti-corrosion protection process in the examined company. The Pareto-Lorenz method was used here, enabling the determination of directions of activities aimed at improving the quality of products. By reducing the level of defective products, you can contribute to improving the management system. The Pareto-Lorenz method allows you to identify the main problems in the process that affect the quality of products, and at the same time indicate the efficiency of the machines. The method is also to show in which direction corrective actions should be taken to obtain the maximum effect, as well as what should be omitted, what should not be focused on, and which causes do not have a significant impact on the occurrence of non-conformities.

Table 2 presents research findings analysis, that was made on the basis of own observations in a company that performs anti-corrosion protection. There were presented nonconformities identified in the anti-corrosion protection of the steel structure in the analyzed enterprise. They are the result of improper operation of the machines involved in the analyzed process. Identified nonconformities have large impact on the final product quality level. As one of the corrective actions recommended by Department responsible for Quality Control is analysis of technological modernity level of machines used in the analyzed process.

One of the frequently repeated nonconformities are: too thin coating (36.32% of nonconformity occurrence share), coating contamination (26.01% of nonconformity occurrence share) and thickening (9.42% of nonconformity occurrence share). Those nonconformities caused from the operating machines used in the anti-corrossion protection processes: Xtreme X70 paint pump and KAESER screw compressor that have been analyzed in the paper with using ABC technology method.

Tab. 2 *Nonconformities in the anti-corrosion protection of the steel structure in the analyzed enterprise*

Symbol	Nonconformity	Frequency of occurence	Noncoformity occurrence share [%]	Accumulated nonconformity occurrence share [%]
N-1	Too thin coating	81	36.32	36.32
N-2	Coating contamination	58	26.01	62.33
N-3	Thickening	21	9.42	71.75
N-4	Dry spray	14	6.28	78.03
N-5	Coating delamination	3	1.35	79.37
N-6	Mechanical damage	20	8.97	88.34
N-7	Stains	13	5.83	94.17
N-8	Fish eyes on the coating	5	2.24	96.41
N-9	Non-drying coating	1	0.45	96.86
N-10	Inappropiate color	7	3.14	100.00
∑		223	100%	

As it was mentioned in the analysis of nonconformities identified in the anti-corrossion protection processes for steel construction elements manufacturing two mostly frequently occured nonconformities have been caused by machines used in the mentioned processes. Those machines are the object of the ABC technology method analysis that is supported by their construction description.

Xtreme X70 paint pump has NXT air motor, modular air valve, integrated air regulation. Graco Xtreme X70: 1 KING 180CC is designed for spraying anti-corrosive materials with the highest parameters of viscosity and density. It is based on the XTREME piston pump driven by the NXT 6500 air motor. This pump is characterized by exceptional durability and the possibility of many years of operation in extreme operating conditions. Graco Xtreme X70: 1 KING 180CC painting unit has a number of advantages and amenities: regulated by the stroke of the lower valve, limited pulsation of the fed material, large piston area, plasma hardened surface, a compact filter structure with replaceable meshes built on the pump body, large volume of material fed to the pump operation cycle, antifreeze engine with lower noise level, monitored amount of flowing medium. Mini alkyd paints, alkyd paints with anti-corrosive pigment, epoxy primer, epoxy primer, epoxy, zinc, zinc silicate. Suitable for the toughest protective coatings and 100% solids (solvent free). It is used for spraying two-component and bituminous-epoxy materials with high viscosity and large pigment grain size, as well as fire-resistant and anti-fouling insulation materials. Figure 1 present elements of the Graco Xtreme X70: 1 KING 180CC paint pump construction.

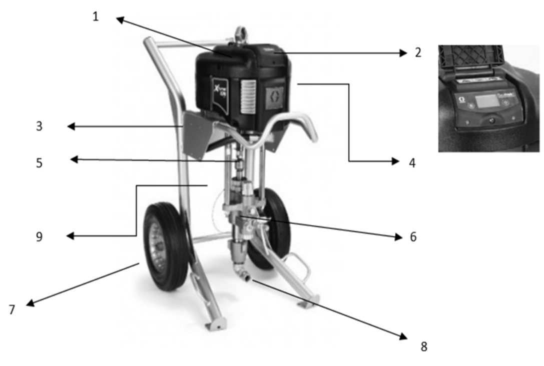

Fig. 1 *Construction of the Graco Xtreme X70: 1 KING 180CC paint pump*

Graco Xtreme X70 paint pump presented on Figure 1 includes following parts: 1-NXT air motor, 2-Data Trak control module, 3-Unit frame, 4-Modular air valve, 5-Sinker, 6-Material pump with built-in filter, 7-Wheels, 8-Material collection system, 9-Quick disconnect system.

The ABC method of technology with a five-point Parker scale was used to assess the modernity of the parts of the selected machine used in the production company. This method divides all parts of of the tested machine into three groups:

- A - these are the parts that are mainly used in a given machine, allowing the product to be assigned specific attributes and of key importance influencing the functioning of the company.
- B - these are less important parts, used in all machines of this type in a specific industry.
- C - these are the least important parts, generally available on the market and generally used in all industries.

All ABC parts and devices are rated on the Parker five-point scale:

- Level 1 - these are simple parts that can be manufactured using basic craftsmanship techniques.
- Level 2 - these are parts that have been manufactured with the use of known and unchanged technologies for many years.
- Level 3 - these are parts that have been manufactured with the use of mastered technology that requires special technical knowledge.
- Level 4 - these are parts manufactured with the use of modern technologies currently available on the market.
- Level 5 - these are parts which are the result of combining several state-of-the-art technologies and are patented and present in a given machine, in a given enterprise.

The ABC analysis of the technology to determine the modernity of parts of individual components was carried out on the example of the Graco Xtreme X70: 1 painting unit. This aggregate is one of the machines used in the company's production process. This process consists in applying paint coatings to selected elements. Painting consists in sucking the applied material into the pump and then spraying it on e.g. a steel structure. To assess the modernity of the Graco Xtreme X70: 1 painting unit in the analyzed enterprise, the ABC technology method with a five-point Parker scale was used. Graco Xtreme X70: 1 paint package parts classification is divided into three categories: Primary (A), Support (B), Secondary (C) and their Parker rating is shown in Table 3.

Tab. 3 *Technological modernity level assessment for the Graco Xtreme X70:1 painting pump*

Machine name, year of production			Graco Xtreme painting pump, 2017
Product name			Paint coated product
Product material type			Epoxy, Polyurethane, Polyvinyl
Year of production			2020
Assessment of technological modernity of machine component parts:			
1. Parts of the base assembly (A):			LEVEL
A	A1	NXT air motor	4
	A2	Modular air valve	3
	A3	Material pump with built-in filter	4
2. Support component parts (B):			LEVEL
B	B1	Data Trak control module	5
	B2	Quick disconnect system	4
	B3	Material collection system	2
	B4	Ram	3
3. Secondary component parts (C):			LEVEL
C	C1	Unit frame	1
	C2	Wheels	2

Based on the characteristics of technological modernity level of the painting aggregate, an analysis of individual groups was made. Interpreting each team, it can be noticed that in group A - basic, 67% of subassemblies reached level 4. Considering the elements from group B - supportive, level 2, 3, 4, 5 obtained 25%, while in group C - secondary, 50% was awarded to the level of 1 and 50% to level 2. Figure 2 presents results of technological modernity level for Graco Xtreme X70: 1 KING 180CC paint pump.

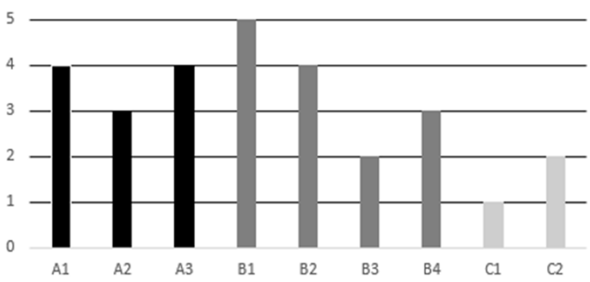

Fig. 2 *Characteristtivs of technological modernity level for Graco Xtreme X70: 1 KING 180CC paint pump*

Research results confirms the high modernity level of analyzed machines (parts A and B), that are used in the anit-corrosion protection processes as parts that ensure appropriate processes quality level. Part of the analyzed machine allow for obtaining appropriate results of the process ensuring specific attributes and of key importance influencing the final quality of anti-corrosion processes results. NXT air motor and material pump with built-in filter, as a base assembly parts, confirms high modernity level (4), that is sufficient for the final quality level of processes that can be done by using those parts. Data Trak control module, as a supportive component part in the analyzed machine, was evaluated on the highest level according to its modernity level (5).

A KAESER screw compressor is another machine used in the production process at company X. A KAESER compressor is designed to generate compressed air and then supply compressed air to the high-pressure tanks used for abrasive blasting (sandblasting). The compressor is operated by one operator. Figure 3 shows a KAESER rotary screw compress.

Fig. 3 *KAESER rotary screw compressor*

The air is drawn in from the surroundings through the air filter, where it is thoroughly cleaned. The air is then compressed in the compressor block. The compressor block is driven by an electric motor. Cooling oil is injected into the screw compressor block. The oil lubricates the moving parts and seals the rotors against each other and against the housing. Such direct cooling in the compression chamber guarantees a low compression end temperature. The cooling oil is separated from the compressed air in the oil separation tank and then cooled in the cooling oil cooler. The cooling oil then flows through the oil filter in a stream and returns to the injection point. The pressure inside the machine maintains the above cooling oil circuit. It is not necessary to use a separate pump. The thermo valve regulates and optimizes the temperature of the cooling oil. The compressed air is separated from the cooling oil in the oil separation tank and then enters the air cooler through the minimum pressure check valve. The minimum pressure check valve maintains the minimum system pressure at all times in order to guarantee an uninterrupted flow of cooling oil through the machine.

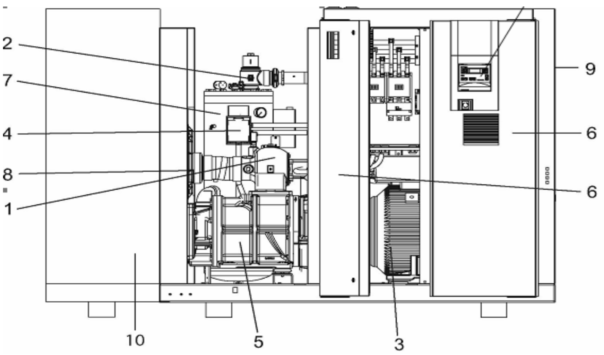

Fig. 4 *Construction of KAESER rotary screw compressor*

The air cooler cools the compressed air to a temperature that is only about 5 K to 10 K higher than the ambient temperature. Most of the moisture is removed from the compressed air at the same time. The machine is equipped with a frequency converter that regulates the speed of the compressor motor depending on the compressed air requirement. The centrifugal separator removes liquid components from the compressed air. The downstream refrigeration dryer separates the condensed liquid from the compressed air. The condensate is drained via a suitable condensate drain. Figure 4 presents construction of the KAESER rotary screw compressor.

KAESER rotary screw compressor includes following parts presented in Figure 4 such as: inlet valve, minimum pressure check valve, compressor motor, oil filter, compressor block, switch cabinet, oil separation tank, air filter, oil/air cooler, cabinet for a refrigeration dryer/frequency converter, sigma control panel.

The assessment of the machine parts technology modernity was carried out on the example of a screw compressor. It is another machine used in the production process of company X. The production process with the use of a compressor consists in supplying compressed air to pressure vessels in order to perform appropriate abrasive blasting and then applying coatings by spraying. As a result of the production process, a product was obtained, properly prepared for spray painting, and then spraying with appropriate paints. To assess the modernity of the screw compressor used in the manufacturing company X, the ABC analysis of the technology with a five-point Parker scale was used. In order to improve the machine, its technological advancement level should be examined.

Categorization is possible thanks to prioritizing technologies in terms of the purposefulness of their development and investing in them, i.e. deciding which technologies to move to a higher level. However, technologies are not mutually isolated from each other, they often create constellations based on sets of scientific principles.

The assessment of technology modernity level of individual components of analyzed compressor is shown in Table 4.

Tab. 4 *Technological modernity level assessment for KAESER Screw Compressor*

Machine name, year of production			KAESER KOMPRESSOREN DSD 238 compressor
Product name			Compressed air
Product material type			Pressure
Year of production			2014
Assessment of technological modernity of machine component parts:			
1. Parts of the base assembly (A):			LEVEL
A	A1	Compressor motor	4
	A2	Compressor block	4
	A3	Sigma control panel	5
2. Support component parts (B):			LEVEL
B	B1	Inlet valve	3
	B2	Minimum pressure check valve	4
	B3	Oil filter	3
	B4	Oil separation tank	4
	B5	Air filter	3
	B6	Oil / air cooler	4
3. Secondary component parts (C):			LEVEL
C	C1	Switch cabinet	2
	C2	Cabinet for the refrigeration dryer	2

Analysis of the technological modernity level with using ABC method for a KAESER screw compressor presented in Table 4, confirms average status of the machines modernity level (3.45). The highest grade was noted for Sigma control panel (5). Three supportive component parts (minimum pressure check valve, oil separation tank and oil/air cooler) noted average grade (4). Majority of machine parts find their position on the fourth level.

Figure 5 presents research resulst analysis for technological modernity level of KAESER rotary screw compressor elements.

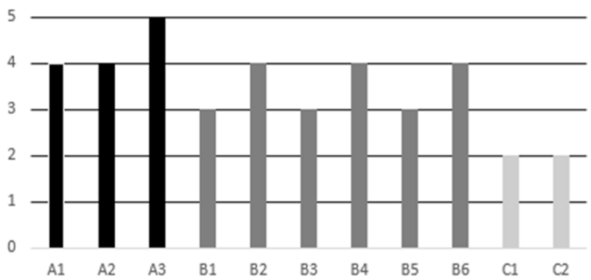

Fig. 5 *Characteristtivs of technological modernity level for KAESER rotary screw compressor*

Based on the characteristics of the modern screw compressor, an analysis of individual groups was made. Interpreting each team, it can be noticed that in group A - basic, 67% of subassemblies received level 4. Considering the elements from group B - supportive, level 3 and 4, they obtained 50%, while in group C noted only grade 2.

4 Conclusion

The article presented results of the ABC method applied to machines modernity level assessment to analyse, assess and identify value and usefulness of the machines used in the anti-corrsion process in the steel construction production process. One of the basic, but important factors is the way and the ability to design a steel structure in such a way that it fulfills its function and at the same time is well prepared for anti-corrosion protection. From this point of view, shape plays a key role in design, because thanks to appropriately designed elements of the structure, it is possible to reduce losses resulting from the corrosion phenomenon. Savings would come not only from corrosion losses due to inadequate shape of the structure, but also from the use of other paint systems.

Analysis of nonconformities in the process of anticorrosion protection identified several problems resulting from the machines exploitation. It required diagnosis of the machines technological modernity level based on ABC method analysis. Requirements for the process of anti-corrosion protection of operation, that the contractor performs inspection of the technical condition and equipment of the device in the process for the performance of the standard quality level of workmanship. The inspection of the application of paint coatings should be carried out in terms of the efficiency of the equipment used and the technique of applying the painting material, as well as compliance with the recommendations regarding the conditions and protection of freshly applied coatings, as well as adherence to the drying and acclimatization time of coatings. When starting the application of coatings, as well as with all changes of equipment and materials, the thickness of the applied layer should be monitored on an ongoing basis by measuring its wet thickness with a painting comb in accordance with PN-EN ISO 2808:2008. The execution and control of works is facilitated by the adoption of different colors for each coating. It is necessary to control the operation of thickening the coating performed after drying the applied coating on the edges, peripheries of openings, gaps, joints, screws.

Considering that one of the applications of machines technological modernity level analysis with using the ABC method is the possibility of ranking modernity in terms of the desirability of machines parts modernity level development and investment, i.e. deciding which parts should be modernized, the machines mentioned require investment in A category parts, which have an impact on the level of quality of the processes responsible for the processes of applying anti-corrosion protection in steel structures used in the construction industry. Technologies, however, are not isolated from each other, they often form constellations based on sets of scientific principles. Always, however, the analysis of the ABC of technology allows you to identify significant technological capabilities of the company.

In order to check the modernity of the two main devices that have a great impact on the blasting and coating process, they were subjected to the ABC method of machine modern technology and subjected to the five-point Parker scale. The research shows that the machines do not differ in terms of technology from those currently used on the market.

As can be seen from the conducted research, the phenomenon of corrosion is very common and it is necessary to constantly strive through the quality management systems to improve the corrosion protection process.

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