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IMPROVING THE QUALITY OF PIPE PRODUCTS DUE TO IMPROVING SURFACE PREPARATION METHODS BEFORE APPLYING THE PROTECTIVE COATING

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The article investigates the issues of improving the quality of pipe products by improving the methods of surface preparation before applying a protective coating. The value of product quality of the production enterprise in the context of pipe production is considered. It is established, that the most important in most situations are specific proposals to improve the quality of pipe products. The quality of pipe products refers to the pipe industry, which worldwide belongs to the industries that are characterized by stable requirements for product quality, its types and range. Naturally, the buyer prefers those manufacturers whose pipe products, other things being equal (price, appearance, prompt delivery, etc.) have increased consumer properties – strength, durability, accuracy, and so on. The main consumers of pipe products – the basic industries – mechanical engineering, automotive, construction, mining, etc. In the near future, ferrous metallurgy products have no competitors and no real substitutes. Requirements for pipe metal products (in terms of mechanical properties, corrosion resistance, absence of defects, etc.) are constantly expanding. One of the most important areas of optimizing the quality of pipe products at the studied enterprise is the proposal to implement an investment project to purchase a plant for cleaning the outer surface of pipes with mechanization. The economic effect of the project implementation and comparison of manufactured pipes with anti-corrosion coating stored in the port and in the conditions of PRS № 2 is considered. Calculations of the project implementation at the enterprise LLC “INTERPIPE NIKO TUBE” were made. The calculations of financial and economic indicators in accordance with the internal requirements of the enterprise in the preparation of such projects for implementation.

ПІДВИЩЕННЯ ЯКОСТІ ТРУБНОЇ ПРОДУКЦІЇ ЗА РАХУНОК ВДОСКОНАЛЕННЯ МЕТОДІВ ПІДГОТОВКИ ПОВЕРХНІ ПЕРЕД НАНЕСЕННЯМ ЗАХИСНОГО ПОКРИТТЯ

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Ключові слова:

захисне покриття,
конкурентоспроможність,
проект, система управління
якістю, трубна продукція,
управління якістю, якість.

У статті досліджуються питання підвищення якості трубної продукції за рахунок вдосконалення методів підготовки поверхні перед нанесенням захисного покриття. Розглянуто значення якості продукції виробничого підприємства в розрізі виробництва труб. Встановлено, що найважливіше значення в більшості ситуацій мають конкретні пропозиції щодо підвищення якості трубної продукції. Якість трубної продукції відноситься до трубної промисловості, яка у світовому масштабі належить до виробничих галузей, які характеризуються стійкими вимогами до якості продукції, її видів і сортamentу. Природно, що покупець віддає перевагу тим виробникам, чия трубна продукція за інших рівних умов (ціна, товарний вигляд, оперативність поставки, та інше) має підвищені споживчі властивості – міцність,

довговічність, точність і тощо. Основні споживачі трубної продукції – базові галузі промисловості – машинобудування, автомобілебудування, будівництво, добувна промисловість та ін. На найближчу перспективу у продукції чорної трубної металургії немає конкурентів і немає реальних заміників. Вимоги до трубної металопродукції (в частині механічних властивостей, корозійної стійкості, відсутності дефектів та ін.) постійно розширюються. Один із найважливіших напрямків оптимізації якості трубної продукції на досліджуваному підприємстві є пропозиція реалізувати інвестиційний проєкт щодо придбання установки очищення зовнішньої поверхні труб з механізацією. Розглянуто економічний ефект від реалізації проєкту і порівняння виготовлених труб з антикорозійним покриттям на зберіганні в порту і в умовах ТПЦ № 2. Здійснено розрахунки впровадження проєкту на підприємстві ТОВ «ІНТЕРПАЙП НІКО ТЬЮБ». Проведено розрахунки фінансово-економічних показників згідно з внутрішніми вимогами даного підприємства при підготовці таких проєктів до впровадження.

Formulation of the problem

The development of market relations in Ukraine is impossible without efficient and stable economic development, which primarily depends on the production of competitive products. This is an indicator of the activity not only of individual enterprises, but also of the country's economy as a whole. One of the most important factors that determine the success of the enterprise and ensure the competitiveness of its products is its high quality, which must meet not only domestic but also international standards. The quality of metallurgical products, without which the existence of mankind is impossible, primarily depends on the quality of raw materials from which it is made. That is why in order to conquer international markets and ensure the appropriate competitiveness of metallurgical products in domestic markets, it is necessary to constantly monitor the improvement of its quality, which is the key to the successful operation of enterprises. Improving product quality is one of the most important areas of intensive development of the country's economy, a source of economic growth, efficiency of social production. In a market economy, the problem of quality is the most important factor in improving living standards, economic, social and environmental security. Quality is a complex concept that describes the effectiveness of all areas of the enterprise, namely: strategy development, production organization, marketing and more. First of all, the level of development of the enterprise and the size of its profit depends, on quality of production. It is fundamentally important for each company to constantly improve the level of quality. The success of individual companies in foreign and domestic markets depends entirely on how well their products meet quality standards. Therefore, ensuring and improving product quality is relevant for all enterprises. The success and efficiency of the enterprise and, as a result, the national economy as a whole depend on the solution of these problems.

Analysis of recent research and publications

General theoretical, methodological and practical issues on the problem of quality management were considered by domestic scientists, as: V.G. Vasilkov [1], S.O. Gutkevich, M.D. Korinko, Y.M. Safonov, D.V. Solokha, L.A. Punchak, O.V. Belyakova [2], O.C. Ivanilov [3], G.I. Kapinos, I.V. Babiy [4], M.M. Parkhomenko [5].

S.O. Gutkevich, M.D. Korinko, Y.M. Safonov, D.V. Solokh, L.A. Punchak, O.V. Belyakova believe that quality is an international category, which has two components: technical, which is formed in the production process and characterizes the technical level of production (reliability), and economic, which is determined by the price and cost of quality assurance (efficiency).

Ivanilov O.S. argues that the economic category of "quality" is a public assessment, characterized by the degree of satisfaction of consumer needs in certain conditions of consumption of a set of properties that are openly expressed or potentially embedded in the product.

Formulation of goals

The purpose of the article is to substantiate the project of improving the quality of pipe products by improving the methods of surface preparation before applying a protective coating on LLC "INTERPIPE NIKO TUBE".

Presentation of the main research material

The main problem of the quality of the ultraviolet coating, and the quality of production of pipes, applied in the pipe rolling shop № 2 (PRS2) of the company LLC "INTERPIPE NIKO TUBE" today, is the unstable adhesion of the coating of the final product. The degree of adhesion is evaluated according to ISO 2409 on a scale from 0 points (best adhesion) to 5 points (no adhesion). In fact, when coating a unprepared surface, a different degree of adhesion is obtained from a score № 1 to a score № 5, depending on the surface condition of a particular batch of pipes. At the same time on parts of pipes, which show at control at factory satisfactory adhesion, in the course of the subsequent short transportation there is a peeling of a covering. The main factors that have a significant impact on the degree of adhesion:

- the presence of oil and grease contaminants on the metal surface (residues lubricating and cooling fluids used in the processing of pipes);
- the presence of dust on the metal surface and more.

To ensure guaranteed coating quality, the metal surface must be prepared. International standards governing the application of coatings consider various methods of

surface preparation, including: abrasive blasting (shot blasting and sandblasting), chemical cleaning, mechanical cleaning, plasma cleaning, etc. The effectiveness of various methods of surface preparation were carried out on the line SELMERS “INTERPIPE NMTZ” in the processing of pipes with a size of 323.8x10.31x11000 mm, brand Gr. B, smelting № 1200716, pipes rolled on 26.02.2020 in PRS2 LLC “INTERPIPE NIKO TUBE”. During the work, two alternative methods of surface cleaning were compared:

- jet alkaline cleaning of high pressure;
- shot blasting.

The evaluation of the results was performed by the following methods:

- the presence of fat and oil contamination - by wetting;
- degree of dust – by the method of adhesive tape according to ISO 8502-3;
- the degree of corrosion damage to the surface – visually by comparison with the scales according to ISO 8501-1;
- the presence of water-soluble salts on the surface – according to ISO 8502-6 and conductometric method according to ISO 8502-9.

Due to the fact, that in the condition after rolling the amount of dust on the pipes exceeds the maximum estimated according to ISO 8502-3 pollution point № 4, to obtain a quantitative assessment, the control method was adapted. Measurement of the amount of dust on the surface of the pipes was performed by repeated sequential gluing of adhesive tape on the same section of the pipe until the

amount of dust adhering to the tape became much less than the original. The number of prints and their appearance assessed the final degree of contamination.

The following project implementation options were considered:

- line for cleaning the outer surface of the pipe with detergents and brushes (pipe washing) with mechanization;
- installation of a shredding line (9 chambers, 18 devices) with mechanization;
- installation of a shot-cleaning line (2 chambers, 4 devices) with mechanization;
- installation of a shredding line (1 chamber, 2 devices) with mechanization.

Implementation of the project involves the purchase and installation of equipment in front of the pipe finishing line in PRS № 2, according to the proposed configuration: purchase of cleaning the outer surface of pipes with mechanization (main (2 chambers, 4 devices) and auxiliary equipment), construction work by the contractor, dismantling, installation work on the project by employees of LLC “INTERPIPE NIKO TUBE”, commissioning and training of personnel by the company-supplier of equipment for cleaning the outer surface of pipes, closing the application of water-soluble varnishes, project implementation aimed at ensuring product quality.

Given the condition of the surface of the pipes before processing on the finishing line in the PRS № 2, the level of adhesion does not guarantee high-quality application of anti-corrosion coating. In the table 1 shows the effect of

Table 1 – Effect of the project

Losses from the transfer of a suitable PR5 during the repair of pipes	Units measurement	2021	2022	2023	2024	2025	2026	Total (2021–2026)
Sorting of pipes at the enterprise with transfer to PR5 (assortment of PRS № 2)	t	330	1321	1321	1321	1321	1321	6 937
The difference in the price of finished products / PR5 (assortment PRS № 2)	\$/t	256	256	256	256	256	256	1 533
Sorting of pipes at the enterprise with transfer to PR5	\$/year	84 405	337 618	337 618	337 618	337 618	337 618	1 77 2495
Sorting of pipes in the port and return at the enterprise with transfer to PR5 (assortment of PRS № 2)	T	95	378	378	378	378	378	1 986
The difference in the price of finished products PR5 (assortment PRS № 2)	\$/t	303	303	303	303	303	303	1815
Sorting of pipes in the port and return at the enterprise with transfer to PR5	\$/year	28 603	114 411	114 411	114 411	114 411	114 411	600 660
Sorting of pipes in the port and their repair in the USA (assortment of PRS № 2)	t	193	772	772	772	772	772	4051
The weighted average cost of repairing pipes in the United States (range PRS № 2)	\$/t	185	185	185	185	185	185	1 108
Sorting pipes in the port and repairing them in the United States	\$/year	35 629	142 514	142 514	142 514	142 514	142 514	748 199
Sorting of pipes in port and their repair in Ukraine (assortment of PRS № 2)	t	151	605	605	605	605	605	3 175
Weighted average cost of pipe repair in Ukraine (assortment of PRS № 2)	\$/t	137	137	137	137	137	137	821
Sorting of pipes in the port and their repair in Ukraine	\$/year	20 697	82 788	82 788	82 788	82 788	82 788	434 637
Total sorted at the enterprise	t/year	330	1 321	1 321	1 321	1 321	1 321	1 321
Total sorted in ports	t/year	439	1 755	1 755	1 755	1 755	1 755	9 211
Together sorted from lack of LFP	t/year	3 076	3 076	3 076	3 076	3 076	3 076	16 148
Total financial losses	t/year	169 333	677 332	677 332	677 332	677 332	677 332	3 555 991

project implementation and comparison of manufactured pipes with anti-corrosion coating stored in the port and in the conditions of PRS № 2. Indicators of financial efficiency of the project are shown in table 2, 3 and pic.1.

Depending on the requirements of standards and orders, the production of pipes in the PRS № 2 is performed in accordance with the standard routes established at the enterprise. Thus the main stream of production passes the basic technological operations: entrance control of receipt of preparation; cutting the workpiece to rolling lengths;

heating the workpiece, flattening the pipes on PRA 350; control of pipes on the Foerster installation; cutting of pipes on Reika TOC; visual and instrumental control of the tightness test; chamfer cutting.

The final processing of export pipes is carried out on the line of finishing of pipes LLC “VNT” on which the following operations are carried out:

- control of conformity of steel grades by spectral method;
- visual control of pipes, selective control of geometrical parameters;

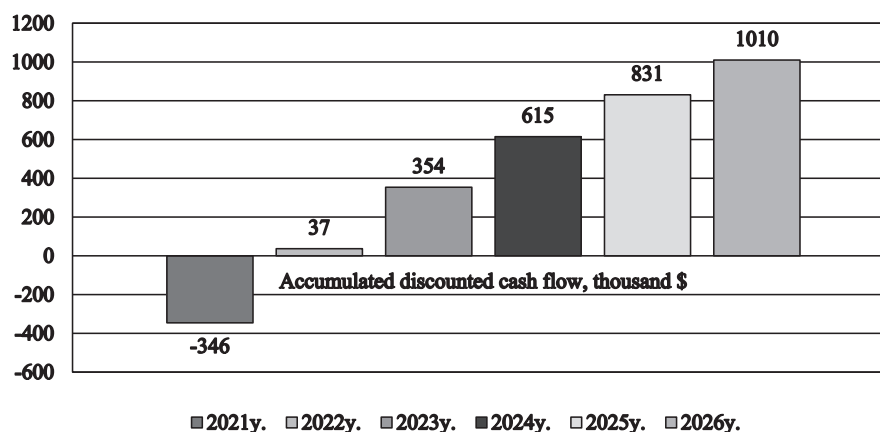
Table 2 – Indicators of financial efficiency of the project

Indicator	2021	Years of project implementation				
		2022	2023	2024	2025	2026
Investments, thousand \$	(468)	–	–	–	–	–
CAPEX	(363)	–	–	–	–	–
HP	(105)	–	–	–	–	–
Total project income, thousand \$	169	677	677	677	677	677
Losses from the production of pipes with poor external coating, thousand \$	169	677	677	677	677	677
Total project costs, thousand \$	(20)	(122)	(122)	(122)	(122)	(122)
The cost of cleaning pipes before painting, thousand \$	(20)	(122)	(122)	(122)	(122)	(122)
Net income before depreciation, interest, incl. and income tax (EBITDA), thousand \$	149	555	555	555	555	555
Depreciation, thousand \$	–	(47)	(47)	(47)	(47)	(47)
Net income before taxes (EBT), thousand \$	149	508	508	508	508	508
Income tax, thousand \$	(27)	(91)	(91)	(91)	(91)	(91)
Net Income, thousand \$	122	417	417	417	417	417
Depreciation, thousand \$	–	47	47	47	47	47
Net cash flow, thousand \$	(346)	464	464	464	464	464
Net discounted cash flow, thousand \$	(346)	383	317	262	216	179
Accumulated discounted cash flow, thousand \$	(346)	37	354	615	831	1010

Table 3 – The main indicators of project effectiveness

Indicator	Value
The cost of capital	21,0%
Investment capital, thousand US dollars	468
NPV, thousand US dollars	1010
PI	3,16
DPP, years	0,9
Internal rate of return (IRR),%	132%

Project effectiveness



Pic. 1. Project effectiveness

- measuring the length and weighing of each pipe;
- marking of pipes;
- heating of pipes;
- application of anti-corrosion coating with UV varnish (if necessary);
- packing and packing of pipes.

As a result of the work and discussion at the enterprise, the optimal configuration of the project of acquisition of the installation of cleaning of an external surface of pipes with mechanization (the main (2 chambers, 4 devices) and auxiliary equipment) was defined.

The installation of new equipment will clean the surface of pipes that need to be covered with UV varnish from rust, peeling scale and dust.

Thus, the following sequence of technological operations in the line of finishing of pipes is offered:

- shot blasting of the outer surface of the pipes (if necessary, to order, which require coating with UV varnish);
- control of conformity of the steel brand by spectral method;
- visual control of pipes, selective control of geometrical parameters;
- measuring the length and weighing of each pipe;
- marking of pipes;
- heating of pipes;
- application of anti-corrosion coating with UV varnish (if necessary);
- packing and packing of pipes.

The technology of processing pipes that do not require the application of UV varnishes, because of the project does not change (crane pipes will be placed on the existing table loading the finish line).

The main purpose of the equipment: preparation of the outer surface of the pipes for the application of UV varnish.

The budget of the project is formed on the basis of the offer of LLC NVF “Tekhvagonmash” (4 devices), thus the choice of the company of the supplier of the equipment will be executed within the limits of the established tender and purchasing procedures of the Company.

Implementation of the project involves the purchase and installation of equipment in the line of finishing of pipes in PRS № 2, according to the proposed configuration:

- purchase of an installation for cleaning the outer surface of pipes with mechanization (main (2 chambers, 4 devices) and auxiliary equipment);
- execution of construction works by the contractor;

- performance of dismantling, installation works on the project by employees of LLC INTERPIPE NIKO TUBE;
- commissioning and training of personnel by the supplier of equipment for cleaning the outer surface of pipes;
- closing the area of application of water-soluble varnishes.

Conclusions

This article considers the problem of the quality of ultraviolet coating of pipes at the company LLC “INTERPIPE NIKO TUBE”. The problem of unstable adhesion of the final product coating causes huge financial losses to the company. Factors that significantly affect the degree of adhesion are the presence of oil and grease contaminants on the metal surface and the presence of dust on the surface. The implementation of the project is proposed, which provides for the purchase and installation of equipment in front of the pipe finishing line in the pipe rolling shop (PRS № 2) LLC “INTERPIPE NIKO TUBE”, according to the proposed configuration: purchase of cleaning the outer surface of pipes with mechanization. The article shows the effect of the project implementation and comparison of manufactured pipes with anti-corrosion coating stored in the port and in the conditions of PRS № 2. As a result of the work and discussion, the optimal configuration of the project was determined at the enterprise, the purchase of the installation of cleaning the outer surface of the pipes with mechanization (main (2 chambers, 4 devices) and auxiliary equipment). Implementation of the project to install new equipment will provide a significant economic effect, reduce future costs and improve the quality of pipes in production, including and provide high-quality cleaning of the surface of pipes that need to be covered with UV varnish, from rust, peeling from scale and dust. The technology of processing pipes that do not require the application of UV varnishes, as a result of the project does not change (crane pipes will be placed on the existing table loading the finish line). The main purpose of the equipment is to prepare the outer surface of the pipes for the application of UV varnish.

First of all, the solution to the problem of improving product quality at the company i, its high image among customers, it is access not only to domestic but also to foreign markets, it is the basis for maximum profit and stable financial position, which determines the prospects for further research.

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