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APPLICATION OF THE KAIZEN METHOD TO REDUCE INDUSTRIAL WASTE AND INTRODUCE SEPARATE COLLECTION.

The Kaizen method, which originated at Toyota factories in post-war Japan, was first aimed at minimizing all types of losses (or in another way: Muda). Unlike expensive solutions, such as the purchase of specialized equipment, Kaizen relies on an untapped resource – the observation and initiative of ordinary employees.

Kaizen is a Japanese concept that suggests continuously but gradually developing a company. "Kai" translates to "change," and "zen" means "good" or "best."[1] This approach implies that in order to increase overall efficiency, all participants in the process – from management to ordinary employees - must work together and contribute to continuous improvement. The basic principles of Kaizen include optimizing work processes, training staff, actively involving each employee, and making decisions based on real data.

The implementation of separate waste collection actually faces a number of difficulties. Firstly, many people simply do not have sufficient knowledge about proper waste sorting: they do not know which types of waste are suitable for recycling and which are not. Secondly, even if there are containers for separate collection, residents sometimes mix waste, which can make subsequent recycling impossible.

Additional difficulties are associated with the inconvenient location and structure of the containers themselves. They can be located far from residential buildings, have narrow openings for garbage or heavy lids, which makes them really difficult to use. In addition, there is a shortage of reception points for certain types of waste, as well as sorting and processing facilities.

Economic factors also pose a barrier: revenues from the sale of recyclables often do not cover the cost of organizing a separate collection. [2]

Kaizen is a comprehensive methodology aimed at continuously improving all aspects of an organization's operations and achieving stable, long-term results in various fields.

First of all, Kaizen helps to improve the quality of products and services. This can be achieved through systematic staff training, the introduction of quality control tools and the establishment of a well-coordinated team.

Productivity growth is an equally important task. It is provided by optimizing work processes, improving the skills of employees and introducing modern technologies and tools.

Another key goal is to reduce costs and production costs. The elimination of redundant stages in production processes and the rational use of resources and labor costs helps to achieve it.

Customer satisfaction is also one of Kaizen's priorities. It directly depends on the reduction of order fulfillment times, consistently high quality of products and services, as well as on the level of customer service.

Considerable attention within the framework of the approach is paid to the motivation of staff and the disclosure of their potential. The involvement of each employee in team work makes it possible to maximize their professional capabilities and strengthens the overall teamwork.

Through continuous improvement of production and products, the company ensures its long-term competitiveness in the market. This helps to quickly adapt to changing market conditions and consumer demands, ensuring stability and long-term benefits.

Finally, Kaizen promotes communication and collaboration within an organization. Teamwork, the exchange of knowledge and experience between employees, as well as increasing their motivation create a good basis for effective interaction at all levels.[3]

The 5S system: This technique includes five stages: Sorting (Seiri) – separating the necessary from the unnecessary; Maintaining order (Seiton) - rationally placing everything necessary; Keeping the workplace clean (Seiso) – maintaining cleanliness; Standardization (Seiketsu) – establishing rules and regulations; Improvement (Shitsuke) – shaping habits of order and constant improvement. The 5S system helps to organize the workspace, minimize losses and reduce waste. The order in the workplace is the foundation for effective work and prevention of losses in the future.[4]

Visual management: This management approach is based on providing information and instructions in a visual and easily understandable form. Its main goal is to make work processes more understandable, transparent and convenient for all participants.[5]

Poka-Yoke (Error Protection): This system is aimed at preventing human errors before they occur or before they can lead to negative consequences. It is also called the "zero error principle".

The purpose of Poka-Yoke is to prevent errors at the earliest stage of their origin. Various mechanisms are used for this purpose: signaling devices, limiters, automatic locks and other means that exclude incorrect actions.

The key principles of the Poka-Yoke system include three interrelated elements. Firstly, the principle of "checking before execution", that is, errors are eliminated at the stage of completing the task, even before they appear. This eliminates the need for a subsequent fix and significantly saves time and resources. Secondly, the principle of "simplicity and reliability": The system should be intuitive and trouble-free in operation. Any employee should easily master its work, and the mechanism should function stably without failures. Complex documentation is not required, as the operation of the system is obvious. Thirdly, the principle of "learning and learnability": the concept assumes the ease of perception of the system by employees. Thanks to the thoughtful logic and clarity of the Poka-Yoke mechanisms, new employees can quickly master the rules of work without lengthy trainings and deep immersion in theory, which reduces the time for adaptation.[6]

The PDCA (Plan-Do-Check-Act) cycle.

The Deming cycle, also known as PDCA, is a management technique aimed at continuous improvement of work processes. Developed by William Deming in the middle of the last century, it is used not to achieve one-time results, but to systematically improve product quality, accelerate task completion, and ensure consistent results. The cycle consists of four interrelated stages:

Planning consists of defining goals, methods, and necessary resources to achieve the desired result that meets the client's expectations.

Execution (Do): Implementation of planned actions, including staff training, in a test or limited amount.

Verification (Check): Data collection and analysis to evaluate the results obtained and compare them with the goals set.

Act: Making adjustments to further improve the process based on the data obtained or consolidating successful solutions by standardizing them. [7]

Analysis of 7 types of losses (Muda) in relation to industrial waste

Type of loss	The classical definition	The Kaizen tool
1. Overproduction	Do more than the client needs.	Implementation of a "pull" system. Do not produce without an order.
2. Marriage	Production of low-quality products.	Poka-yoke (error protection).
3. Expectation	Simple equipment or people.	Flow balancing. Standardization of breaks.
4. Transportation	Excessive movement of materials.	Move the containers closer to the point of formation.
5. Excessive processing	Perform more operations than required.	Review the specifications. Use reusable containers.
6. Stocks	Storage of excess raw materials and supplies.	FIFO (first in, first out). Just-in-time deliveries.
7. Excessive movements	Unergonomic human actions.	Ergonomics of the workplace. The tank is at waist level, with a pedal.

The Gemba Walk role (bypassing a real location)

Gemba Walk is based on the principle of "Genchi Genbutsu" – "go and see". In other words, for a true understanding of the problem, it is necessary to observe the situation personally, rather than relying solely on written reports. [8] The main tasks of Gemba Walk include: collecting evidence on work processes, identifying inefficiencies (for example, unnecessary movements, downtime, duplication of actions, violations of standards), assessing the level of safety, building trust in the team (emphasizing the value of their opinion and work), involving employees in the improvement process (by teaching them to identify problems and propose solutions), monitoring compliance with standards, and fostering a culture of continuous improvement (kaizen) at all levels of the organization.

Quality Circles

Quality circles are voluntary groups of employees from the same department or adjacent areas who meet regularly to identify, analyze, and solve problems of quality, productivity, safety, and other aspects of work.[9] They are one of the key tools of all-general quality management (TQM) and kaizen. Their key principles include voluntary participation, autonomy (the circle chooses its own problems to solve within its competence), regular meetings (usually 1 meeting every 1-2 weeks), democracy (all participants are equal, the leader of the circle is chosen from the participants) and focus on improvements (the goal is not just discussion and observation, but specific and noticeable improvements).

Economics: calculation of ROI from the introduction of Kaizen into waste management

ROI (Return on Investment, or "return on investment") is a metric that allows you to evaluate the effectiveness of investments: It shows whether investments in a project or business development have brought profit and how much they have paid off. With regard to the implementation of the Kaizen methodology in the field of waste management, the ROI calculation makes it possible to analyze the financial returns from optimizing processes.

The ROI calculation formula looks like this:

ROI = ((Return on investment — Cost of investment) / Cost of investments) × 100%.

A positive ROI indicator indicates that the cost of implementing improvements has paid off and generated revenue. It is also important to take into account additional factors when evaluating the results, such as those related to risks, the time frame for project implementation, and the qualitative characteristics of the changes made. To get a more complete and accurate picture, it is necessary to apply improved calculation methods and supplement ROI analysis with other financial and non-financial metrics.[10]

Conclusion

The implementation of Kaizen principles for minimizing industrial waste and organizing separate collection is not just the installation of specialized containers or one-time events. This is a profound transformation of the production culture, where every employee rethinks their attitude to waste, perceiving it not as undesirable, but as a potential resource that can bring economic benefits.

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