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Environmental Risk Management Based On Management System Requirements

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Abstract: This article presents scientific and practical recommendations for identifying aspects, assessing their significance levels, and reducing negative impacts by creating an environmental risk management organization standard in the production processes of plastic and rubber components for the automotive industry. During the study, an environmental profile for plastic, rubber, and dyeing workshops was formed based on the requirements of the international ISO 14001 standard.
Keywords: ISO 14001, environmental aspect, environmental impact, automotive industry, waste disposal, monitoring, environmental management, Uz-Metertech Co.

Introduction. In the current era of rapidly developing technology, protecting the environment and preventing serious damage to the environment is one of the most important tasks of humanity [1]. Numerous studies and works are being conducted worldwide to minimize the negative impact of manufacturing enterprises on nature. To reduce the environmental impact of industrial zones, systematic risk management is as important as addressing the root causes of these problems. Environmental risk management serves not only to protect nature but also to achieve economic efficiency through resource conservation [2].

Since the UN conference in Rio de Janeiro in 1952, an increasing number of enterprises have undertaken a number of obligations to eliminate or reduce negative environmental impacts associated with their activities. Several opportunities will open up through the implementation of the requirements of the international ISO 14001 standard at manufacturing enterprises. At the same time, the enterprise can raise its market position [3].

Global market demands favor environmentally friendly products. Statistical analysis shows that since the early 1990s, 94% of the US population has been in favor of purchasing environmentally friendly products. 90% of the population is ready to pay more for such products [4].

Several problems hinder the implementation of environmental management.

Infrastructure shortages - lack of adequate infrastructure, unreliable policies, ineffective environmental legislation, as well as limited financial and human resources - are among the main challenges in implementing environmental management systems in developing countries [5].

Financial constraints - According to the findings of the World Health Organization and the Water Supply and Sanitation Cooperation Council, 25% of developing countries lack access to sanitation services. These figures reach 82% in rural areas [6].

Institutional problems - in developing countries, environmental legislation is outdated, there is a lack of interagency linkage, and responsibilities are overlapping or distributed in contradiction to each other, making it difficult to identify an executive body for these powers.

Method. In the study, the "List of Environmental Aspects" of the vehicle component supplier for 2026 was used as the primary source. The following methods were used to determine the ecological aspects [7,8]:

Process map: Stages from raw material input to finished product output.

Input-output analysis: Energy and water consumption, as well as the amount of waste generated [9].

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Result. In the study, a specially developed organization standard (STP) was used as the primary source for identifying and assessing environmental aspects. The following combined formula was used for the quantitative assessment of the environmental risk level (R) [10]:

$$R = A \times B \times C$$

Where:

A - scale of environmental impact (from 1 to 5 points);

B - severity of impact (from 1 to 5 points);

C - is the probability of occurrence (from 1 to 5 points).

Table 1

Score	A – Scale of Impact	B – Severity of Impact	C – Probability of Occurrence
1	Localized: Limited to a single workplace or equipment.	Negligible: Almost no environmental impact.	Very rare: Once a year or less.
2	Limited: Within a workshop or department area.	Low: Short-term and easily recoverable impact.	Rare: Once a month or quarter.
3	Moderate: Covers the entire enterprise area.	Moderate: Noticeable but controlled environmental impact.	Occasional: Once a week.
4	Extensive: Risk of spreading beyond the enterprise (to nearby areas).	High: Potential deviation from regulatory standards.	Frequent: Daily or every shift.
5	Global: Serious impact on a region or ecosystem.	Critical: Legal violations and irreversible damage.	Continuous: Occurs constantly during production.

Aspects that score \mathbit{R}\geq\mathbf{30}\ points as a result of the calculation are considered Important Environmental Aspects, and monitoring is established for them using the Smart L-Card.

Using the combined formula, the risk points in each workshop were calculated and based on the following diagram:

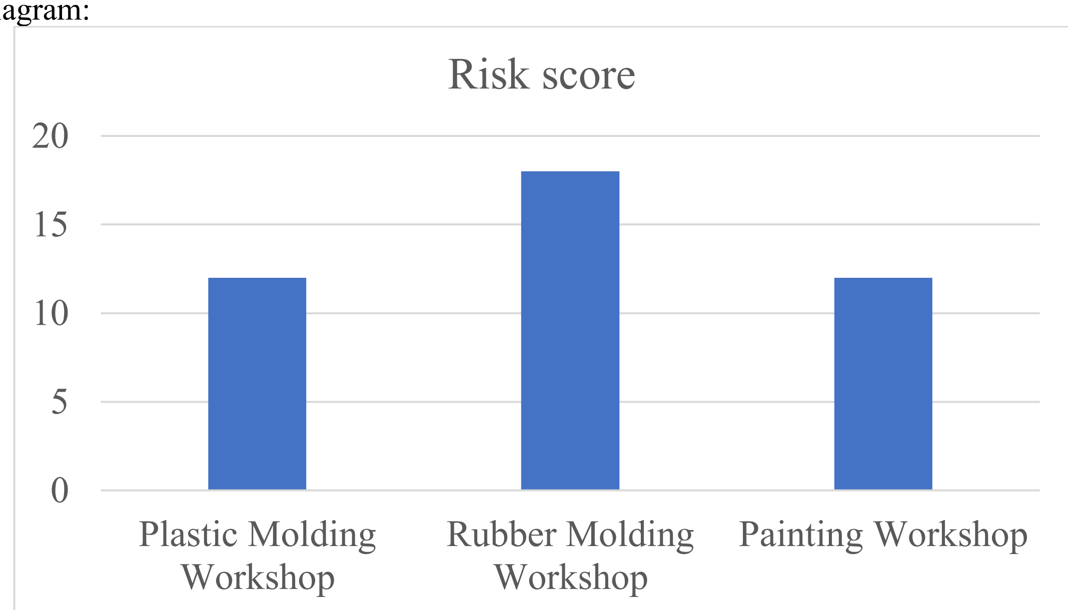

Fig 1. Risk score

Using this methodology, an ecological profile of the enterprise's plastic casting, rubber casting, and painting workshops was formed.

Analysis conducted based on the organization's standard shows that environmental risks are distributed differently across production workshops:

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1. Plastic foundry: Solid plastic waste and high electricity consumption were identified as key aspects. Here, it is proposed to send 100% of waste for recycling in accordance with the principles of the "circular economy."

2. Rubber foundry: Highly hazardous for the release of odorous substances and heat into the atmosphere.

3. Paint shop: The highest point of environmental hazard. Volatile organic compounds (VOC) and solvent vapors released into the atmosphere are identified as significant aspects.

Below are suggestions for eliminating and controlling the most significant environmental aspects in the enterprise's 3 workshops:

In the plastic foundry, the concept of Recycling refers not just to throwing waste away, but to reintegrating it back into the production cycle. Based on the "Circular Economy" principle, the following specific technical recommendations can be provided for this process:

It is recommended to recycle technological waste generated during the plastic casting process (spills, casting channels, waste products) in the workshop itself without going far.

Install small-sized crushers next to each Thermoplast Automatic (TPA). Through this, "hot" waste is immediately crushed and added to the main raw material (granule) in a specific ratio.

The physicochemical properties of the processed material may differ slightly from the primary granule. Apply an 80/20 or 70/30 ratio to avoid damaging product quality (80% fresh granules, 20% crushed waste). This not only eliminates 100% of waste but also reduces the cost of raw materials by 15-20%.

Instead of traditional monitoring, it is recommended to monitor the processing results using a digital system, specifically the Smart L-card. Unlike traditional checklists, the smart L-card uses sensors (IoT) to transmit data to the server in real time without human intervention and automatically activates the 3D-RCA module in case of deviations.

Below are the differences between the traditional L-Card and the proposed Smart L-Card.

Table 2

Characteristics	Traditional L-Card	Smart L-Card (Proposed)
Data Entry	Manual (high human factor influence)	Automatic (via sensors)
Response Speed	Analyzed at the end of the day	Real-time monitoring
Risk Identification	Recording only	Automatic alerts (alarm system)
Analysis Method	Statistical (retrospective)	Predictive (predictive analysis)

The second big problem in the plastic foundry is electricity consumption. To eliminate this problem, it is necessary to use energy-saving inverter equipment instead of energy-intensive equipment.

It is a good idea to recycle junk and reduce the negative impact on the environment. However, preventing the appearance of defective products is the most optimal option. If the amount of waste in the workshop exceeds 3%, the 3D-RCA model triggers the analysis if it is reported via the Smart L-Card. This model identifies a problem through a 3-dimensional cause:

1. Is the technical mold cooling system functional?
2. Organizational - has the raw material moisture level been checked?
3. Human factor - was the pouring mode (pressure/temperature) correctly selected by the operator?

Through these three factors, the root cause of the defective product arises. This processing serves as the basis for creating a raw material cycle within the enterprise, thereby preventing soil pollution, expenses for purchasing new raw materials, and payments for delivering waste to specialized organizations.

To eliminate volatile organic compounds (VOCs) and specific odors released during the rubber firing process, the RTO (Regenerative Thermal Oxidizing) system can be activated. This method is considered the most effective, as it burns toxic substances at high temperatures and converts them into harmless carbon dioxide and water vapor. The air purification level can be increased to 95-98%. The disadvantage of RTOs is their relatively high cost. If it is not possible to install this system, it is possible to clean the air by installing special charcoal filters in the local exhaust ventilation.

A large amount of constant heat is released in the rubber casting shop. This heat can be converted into useful energy by installing recuperators in the ventilation system without releasing it outside.

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By coating the open parts of the press molds with special heat-insulating materials, it is possible to reduce the temperature in the workshop to 3-5 degrees and save energy.

The paint shop is considered the "ecological center" of the enterprise, where volatile organic compounds can cause serious harm not only to nature but also to human health.

For the dyeing shop, it is also recommended to burn off odors by installing an RTO device. Alternatively, using water-based paints instead of solvent-based paints also reduces the amount of harmful substances in the air.

Conclusion. In this workshop, to transition the problem from an invisible state to a controlled one, it is necessary to install Smart L-Card sensors at critical points of the line, thereby reducing the amount of harmful substances in the air and finding the root cause of the problem using a 3D-RCA model when the amount exceeds the norm.

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