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Interdisciplinary Study of the Impact of Environmental Trends and Sustainability Requirements on the Strategic Evolution of the Cosmetics Industry — From Packaging Ecodesign and Green Chemistry to the Transformation of Supply Chains, Marketing Practices, and Regulatory Compliance — With an Econometric Assessment of Market Dynamics and Consumer Preferences

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Abstract

The article presents a comprehensive interdisciplinary analysis of the strategic transformation of the global cosmetics industry against the backdrop of intensifying environmental trends and the sustainable development agenda. The aim of the study is to reconstruct and systematize the causal relationships between environmental drivers and corporate responses at all stages of the value chain, from design to models of consumer behavior. Methodologically, the work relies on a systematic review of academic publications, content analysis of the corporate reporting of leading companies, and examination of industry analytical materials. The results obtained register a paradigmatic shift: a transition from reactive regulatory compliance to the proactive embedding of sustainability principles into the core of business strategy. Within the study, it is demonstrated that the principles of green chemistry and ecodesign are redefining R&D processes and packaging solutions, the imperatives of transparency and accountability are reshaping global supply chains, and shifts in consumer preferences are setting a new market dynamic. A conceptual framework describing this systemic transition is presented, and the hypothesis is empirically confirmed that sustainability serves as a key catalyst for innovation, a source of competitive advantages, and a factor in the long-term capitalization of the industry. The findings presented in the study will be of interest to strategists of cosmetics companies, representatives of regulatory authorities, the academic community, and market analysts working in the field of sustainable development.

Keywords: *Sustainable Development, Cosmetics Industry, Green Chemistry, Ecodesign, Life Cycle Assessment, Sustainable Supply Chains, Consumer Behavior, Corporate Social Responsibility, Regulatory Policy, Strategic Management.*

INTRODUCTION

The contemporary cosmetic industry has reached an inflection point, experiencing synchronous pressure from two interrelated vectors: the accelerating dynamics of demand and the tightening sustainability agenda. The sector continues to scale up: by estimates, the aggregate market size will exceed 380 billion USD by 2027 [1]. The export value of Indonesian cosmetic products in 2024 reached USD 335,95 billion USD [2]. Concurrently, within the expanding market a qualitative reorientation of consumer preferences is taking place [3]. The green/clean cosmetics segment is expanding at an accelerated pace: the global market for organic personal care products is projected to grow at an average annual rate of 6,64% through 2032 [2]. These metrics reflect a transformation of societal expectations: 81% of consumers worldwide expect businesses to take an active role in improving the state of the environment [3, 4], and 62% pay more attention to sustainability issues than two years ago [2].

The scientific problem lies in the absence of an integrated

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interdisciplinary perspective on the ongoing transformation of the industry. The existing body of academic work is fragmented: some studies focus on green chemistry, others — on sustainable packaging, the ethics of supply chains, or consumer behavioral patterns. Meanwhile, a systemic picture of the interrelatedness of these elements and their combined effect, which shapes a new strategic paradigm of the industry, has not yet been articulated. This gap hampers the formation of a comprehensive vision necessary both for theoretical conceptualization and for making effective managerial and regulatory decisions.

The objective of the research is to conduct a comprehensive interdisciplinary analysis of the strategic evolution of the cosmetics industry, identifying causal relationships between environmental drivers and corporate responses at all stages of the value chain.

The scientific novelty lies in the synthesis of previously fragmented areas—technology, operations management, marketing, and strategy—into a single conceptual model that explains the systemic nature of transformational processes in the industry.

The author's hypothesis is that the cosmetics industry is making a strategic shift from a model based predominantly on regulatory compliance to the integration of sustainability principles as a key driver of innovation and a source of sustainable competitive advantage.

MATERIALS AND METHODS

To achieve the stated objective and test the hypothesis, a qualitative, multicomponent research strategy was employed, combining a systematic literature review, content analysis of corporate and industry documentation, and synthesis of case studies. The source base was formed on the basis of strict criteria of academic validity and industry relevance and was structured into three types.

1. Academic publications: the theoretical foundation was provided by peer-reviewed articles from high-impact journals. These materials offered an in-depth understanding of the fundamental concepts of green chemistry, life cycle assessment (LCA), sustainable supply chain management, and consumer psychology.
2. Corporate sustainability reports: to analyze practices, annual and integrated reports of leading global producers of cosmetics and raw materials in recent years were examined, including L'Oréal, Amorepacific, Davines Group, KOSÉ, Mandom, BASF, and Givaudan. The documents served as primary sources of data on corporate goals, strategies, implemented initiatives, and key performance indicators (KPI) in the field of sustainability.
3. Industry analytical reports: for the quantitative assessment of market dynamics and consumer trends, materials from leading consulting and research organizations such as Brand Finance, KPMG, and NielsenIQ were used, providing up-to-date statistical information on market sizes, growth rates, and determinants of consumer choice. Systematic data processing was carried out through thematic coding and cross-type synthesis of information, which made it possible to identify recurring patterns, key trends, and interrelations among various aspects of the industry's transformation

RESULTS AND DISCUSSION

The transformation of the cosmetics industry begins at the deepest level — the level of design and selection of materials for formulations and containers. The driving force behind this shift comprises two interrelated paradigms: green chemistry in formulation development and ecodesign in packaging engineering.

The integration of green chemistry principles is becoming a foundational research framework for the development of new compositions. The twelve principles provide a normative and methodological framework for constructing safer and environmentally higher-quality products [9]. Practical implementation is expressed, in particular, in substituting petrochemical components with renewable feedstock streams, for example, using bio-based 1,2-pentanediol obtained from sugarcane bagasse and corn cobs [23]. Equally prioritized are pathways aimed at creating biodegradable ingredients that do not exhibit persistence in the environment, and at the systematic reduction of the use and generation of hazardous substances at all stages of the technological cycle [22].

A critically important step is the transition from declarative adherence to these principles to their operationalization through rigorous metrics. Large companies are introducing comprehensive internal tools that embed sustainability criteria directly into R&D workflows. An illustrative example is the Green Score methodology developed by The Estée Lauder Companies [8]: each ingredient receives a quantitative assessment along three dimensions — impact on human health, condition of ecosystems, and environmental impact. This shifts formulators' choices into the realm of verifiable data, turning sustainability from an abstraction into a controllable and optimizable parameter. A comparable logic is demonstrated by the L'Oréal Sustainable Product Optimization Tool (SPOT), based on full life cycle assessment (LCA) and calculating a single integrated sustainability index that combines environmental and social indicators [25]. Thus, the industry is making a transition from a qualitative philosophy to quantitatively oriented engineering of sustainable innovations.

Packaging ecodesign, coupled with life cycle assessment

(LCA), comes to the forefront due to the high visibility of packaging waste and its substantial contribution to the product's overall environmental footprint [26]. The sector is progressively reorienting toward the principles of the circular economy, using ecodesign as the operational mechanism. Three strategies form the core of professional discourse: reuse, recycling, and dematerialization. A detailed LCA analysis of plastic cosmetic packaging (Table 1) reveals multilayered and often counterintuitive trade-offs among these trajectories [11].

Table 1. Comparative LCA analysis of packaging ecodesign strategies (compiled by the author based on [11, 25, 26]).

Packaging design strategy	Change in carbon footprint (CO_2e)	Change in human health impact	Change in ecosystem impact	Key finding
V1: Baseline reusable model (3 uses)	0%	0%	0%	Original standard
V1A: Dematerialization (-7%), 1 use	+39% (worsening)	+39% (worsening)	+39% (worsening)	Loss of reusability outweighs the benefit of weight reduction
V2: Dematerialization (-17%), 1 use	+180% (worsening)	+180% (worsening)	+180% (worsening)	Radical weight reduction led to single-use and significant deterioration of metrics
V1(c): Baseline reusable + plastic recycling	-13%	-13%	-13%	Recycling provides a moderate improvement for an already efficient reusable model
V3(c): Single-use + full recycling + without aluminum	-70%	-70%	-70%	Best result, but only with 100% recycling and removal of the high-impact material

Data in Table 1 indicate that reuse provides an environmental gain that substantially exceeds the effect of dematerialization (by 171%) [11]. At the same time, a detailed breakdown shows the critical role of material choice: excluding a compact yet high-impact component—for example, an aluminum tray—can reduce the product's aggregate footprint by as much as 70%, however such an effect is achievable only with guaranteed 100% recycling of the remaining single-use packaging. This reveals the LCA imperative: universal solutions do not exist; simplifying heuristics such as less plastic is always better can distort the picture. Optimal solutions require a systemic, full-life-cycle analysis that accounts not only for design choices but also for consumer behavior (practices of reuse and proper disposal) and the state of infrastructure (collection and recycling systems) [25]. To institutionalize scientifically grounded choices, industry initiatives are being deployed, in particular the Sustainable Packaging Initiative for CosmEtics (SPICE).

The imperatives of sustainable development are initiating a radical reconfiguration of the operational foundation of the cosmetics industry—its global supply chains. The priority lens is shifting from traditional metrics (costs, speed, operational efficiency) to the triad of sustainability, transparency, and shared responsibility.

At the core of this transformation is green supply chain management (Green Supply Chain Management, GSCM). Its logic is the end-to-end integration of environmental criteria at all stages of the operational cycle: from green procurement of raw materials and materials, eco-design, and manufacturing to green distribution and reverse logistics (waste and returns management). The objective function of GSCM is to minimize the cumulative impact of a product over its entire life cycle. Particular attention is paid to emissions (Scope 3) that arise in the value chain outside the company's direct control (for example, at raw-material suppliers or during transportation), yet constitute a substantial share of its carbon footprint.

In contemporary conditions, supplier selection ceases to be an operational procurement procedure and transforms into a key element of corporate strategy. The Cosmetics Sustainable Supplier Selection (C-SSS) model for the cosmetics industry represents a holistic methodology for ranking suppliers based on a balanced set of criteria [10]. To the traditional economic indicators (cost, quality stability) is added a broad range of environmental (e.g., ISO 14001 certification, implementation of circularity principles, traceability of raw material flows) and social metrics (e.g., Fair Trade certification, working conditions, respect for the rights of local communities). As a result, the very notion of a reliable supplier is redefined: from a seller of materials to a partner in risk management and a co-creator of brand value. A supplier with adverse social or environmental practices becomes a direct source of reputational threats for a cosmetics brand, which makes sustainable supplier selection a strategic task of paramount importance.

Achieving sustainability in complex, multi-tier supply chains is impossible without close collaboration and full traceability of flows. Leading companies consistently

cascade sustainability requirements to first-, second-, and subsequent-tier suppliers, stimulating interorganizational learning and the replication of best practices. Empirical studies show that the greatest sustainability spillover is provided by partnerships based on a high level of trust, interdependence, and goal alignment [7]. This includes engagement with small farming operations and local communities to ensure ethical sourcing and the creation of shared value. Thus, sustainability ceases to be perceived as a property of an individual firm and emerges as an emergent quality of the entire supply network; competitive advantage is increasingly determined by a company's ability to orchestrate this network for sustainable outcomes.

The driving force behind the transformation of the cosmetics industry is the market, namely rapidly changing consumer values and preferences. An analysis of market dynamics and consumer psychology simultaneously reveals significant opportunities and serious challenges for industry participants.

Although the aggregate share of green cosmetics still remains below 15% of the entire industry, its outpacing growth rates indicate a profound redistribution of market value in favor of sustainable solutions [3]. This economic imperative is becoming a key driver for corporate investment in sustainable innovation.

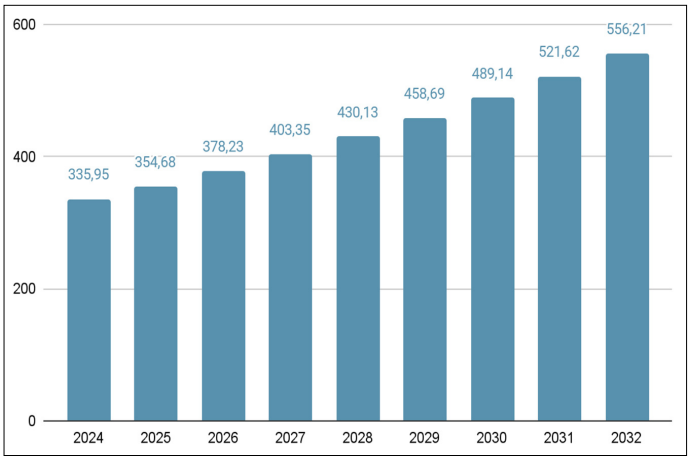

Fig. 1. Dynamics and growth forecast of the global green cosmetics market (2024–2032) in billion USD (compiled by the author based on [2]).

The consumer intention to purchase a green product is the result of a complex interplay of psychographic determinants. Empirical evidence indicates the leading role of the following factors:

Green perceived quality and value (Green Perceived Quality & Value): the likelihood of purchase increases substantially when the consumer is convinced that the green product is not inferior in functional characteristics and reliability to traditional alternatives and simultaneously provides additional ethical and environmental benefits [2].

Green trust and brand image (Green Trust & Brand Image): in the context of information noise and widespread greenwashing, trust becomes a key resource. Consistent transparent communication, supported by certifications and verifiable evidence, shapes a resilient green brand image that serves as a significant predictor of purchase intention [5].

Environmental and health-preserving awareness: growing concern about potentially hazardous chemical components in cosmetics and their environmental consequences serves as a fundamental motivator for the shift to green alternatives.

The totality of these factors indicates that competitive dynamics are shifting from the level of the individual product (we have a natural ingredient) to the level of the brand (we are trusted on matters of sustainability).

The principal challenge for the industry remains the gap between stated attitude and actual behavior (Attitude–Behavior Gap): numerous studies record that a significant share of consumers who display positive attitudes toward sustainable goods do not in fact make corresponding purchases.

Barriers such as: higher price, limited availability at points of sale, and distrust fueled by greenwashing (manipulative attribution of environmental properties to a product) block the conversion of positive attitudes into actual purchases. This gap is not an isolated marketing mismatch, but a key field of strategic competition for the entire industry. Those companies that manage to reduce the stated obstacles—make sustainable consumption intuitively simple, economically accessible, and trustworthy—will be able to monetize substantial latent demand and secure leading positions in the coming decade.

The synergy of technological innovations, transformation of operating models, and market reconfigurations leads to a deep recalibration at the top, strategic level of corporate governance. Sustainable development is ceasing to be a peripheral function of corporate social responsibility (CSR) and is becoming the core of business strategy.

The movement is accelerating under the influence of regulatory frameworks. Macro-regional initiatives such as the European Green Deal, and targeted regulatory acts—the Ecodesign for Sustainable Products Regulation (ESPR) and the REACH Regulation—are shaping the new rules of the game. These requirements prescribe that manufacturers adopt a full life-cycle perspective, increase the circularity of materials, and ensure information transparency [12]. As a result, the bar for mandatory compliance is steadily rising: what previously belonged to voluntary sustainability practices is today increasingly becoming the norm (for example, recyclable packaging, emissions reporting). Consequently, mere rule-following is losing the status of

competitive advantage and turning into the price of entry to the market, whereas the basis of differentiation becomes the ability to go beyond the regulatory minimum through innovation, radical transparency, and brand authenticity.

Analysis of the corporate strategies of leading companies in the industry shows that they are already operating within the logic of a new paradigm. Non-financial reporting demonstrates the proactive embedding of sustainability into the core of the business model [13, 14]. Sustainability is interpreted not as a cost center but as a source of value growth. This shift manifests at several levels:

- Mission and vision: Companies are reformulating their fundamental purpose. Thus, Mandom declares the ambition to be a human-oriented company [14], KOSÉ to create beauty in a sustainable world [15], and Davines Group sets the task to decouple business growth from the consumption of natural resources [16].
- Investments and innovation: Significant resources are directed to R&D for the development of sustainable formulations and packaging solutions, as well as to projects for the decarbonization of supply chains and production processes [16, 17].
- Brand value: Recognition of the direct link between the perceived sustainability of a brand and its financial valuation is strengthening. The Brand Finance Sustainability Perceptions Index empirically confirms this thesis, demonstrating that billions of dollars of brand value depend on convincing and credible actions in the field of sustainable development. Thereby, sustainability finally moves from the category of a hygiene factor to the class of critically important intangible assets [20].

The features of integrating the principles of green chemistry into the cosmetics industry will be described in Table 2 below.

Table 2. Integration of green chemistry principles in the cosmetics industry: from theory to practice (compiled by the author based on [8, 9, 22, 23, 24]).

Green chemistry principle	Practical application in the cosmetics industry
Use of renewable feedstocks	Production of 1,2-pentanediol from biomass (corn cobs, bagasse) instead of petroleum-derived feedstocks.
Design for degradation	Development and use of biodegradable polymers and surfactants in rinse-off products to reduce persistence in aquatic ecosystems.
Design of safer chemicals	Application of quantitative methodologies (e.g., Green Score) to screen ingredients by toxicity metrics and select safer alternatives at early stages of development.
Waste prevention	Optimization of chemical syntheses to increase the yield of the target product (atom economy) and minimize by-products and waste.
Energy-efficient design	Conducting syntheses at ambient temperature and pressure; using catalysts to reduce the energy requirements of reactions.

Technological, operational, market, and strategic components, being interrelated, converge into a holistic architecture of systemic transformation, visualized as a conceptual model (Fig. 2).

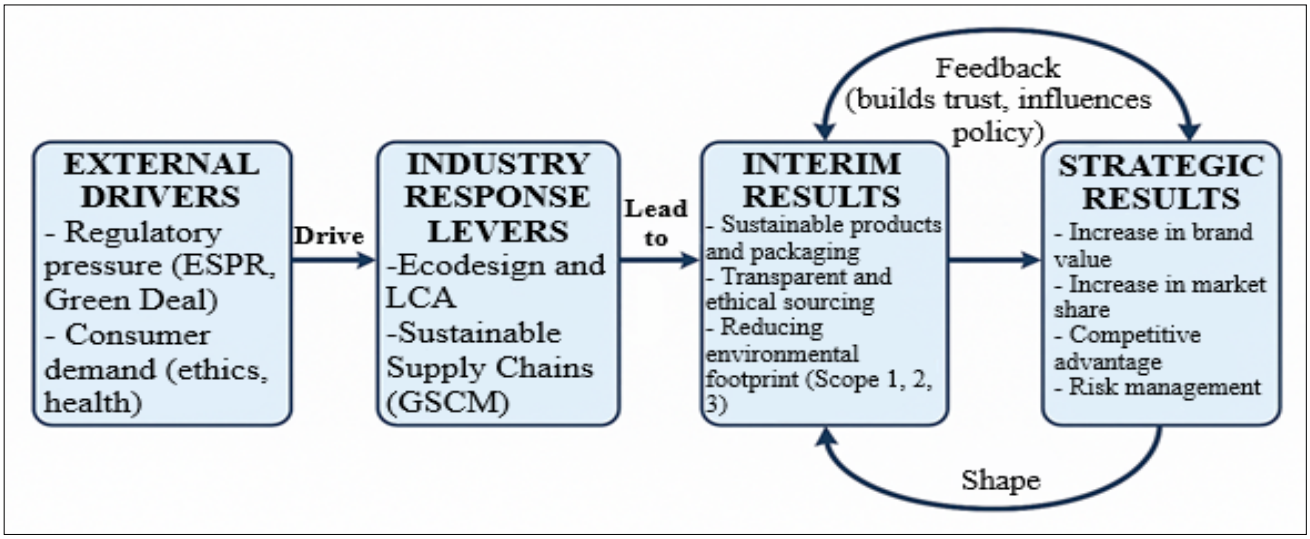

Fig.2. Conceptual model of systemic transformation of the cosmetics industry (compiled by the author based on [6, 18, 19, 21]).

This model captures the completed transformation of sustainability: from a secondary CSR practice it has become the central mechanism of value creation in the contemporary cosmetics industry. Its operation simultaneously catalyzes innovation in R&D, transforms operational activity toward greater efficiency and sustainability, opens new market niches, builds consumer loyalty and, ultimately, directly increases the measurable value of the brand. When a single principle organizes innovation, operations, marketing, and finance end-to-end, it ceases to be a trend and acquires the status of a new strategic paradigm.

CONCLUSION

A comprehensive interdisciplinary analysis demonstrates that the cosmetics market has entered a phase of deep structural transformation driven by the sustainable development agenda. The results obtained show that the changes are not point-specific but systemic in nature and permeate the entire business architecture, from molecular design and materials science solutions to the configuration of global supply chains and corporate strategy. A tight coupling is observed between technological innovations (green chemistry, ecodesign principles), operational practices (GSCM, prioritization of sustainable suppliers), market shifts (expansion of the green segment, revaluation of consumer values), and the strategic repositioning of industry leaders. This confirms the initial hypothesis that the industry has transitioned from reactive compliance with regulatory requirements to the proactive integration of sustainability as a fundamental driver of innovation and a source of competitive advantages. Sustainability has ceased to be a cost item or an element of PR and has become the core of long-term value creation, determining R&D trajectories, improving operational performance, shaping market positioning, and influencing brand capitalization. Promising avenues for further research may include:

1. Longitudinal quantitative studies identifying the correlation between the degree of sustainability integration and companies' long-term financial indicators.
2. A deeper cross-cultural analysis of consumer behavior to capture the regional specifics of the perception of green cosmetics and the barriers to its consumption.
3. An assessment of the potential of new technologies — artificial intelligence for optimizing formulations and blockchain for ensuring traceability in supply chains — in accelerating the transition to sustainable practices.

REFERENCES

1. Alviri H., Lynes J., Habib K. Beyond green chemistry: a comprehensive review of how sustainability has been integrated into cosmetic research //Global Sustainability. – 2025. – pp. 1-52.
2. Cosmetics Market Size, Share & Industry Analysis, By Category (Haircare, Skincare, Makeup, and Others), By Gender (Men and Women), By Distribution Channel (Specialty Stores, Hypermarket/Supermarket, Online Channels, and Others), and Regional Forecast, 2025-2032 [Electronic resource]. - Access mode: https://www.fortunebusinessinsights.com/cosmetics-market-102614 (date of access: 30.08.2025).
3. Sharma R., Singh P., Sharma A. Unleashing green beauty crusade: role of influencer relational characteristics, product perceptions, and warm glow //Journal of Electronic Commerce Research. – 2024. – Vol. 25 (4). – pp. 223-241.
4. Haryono A. T., Lestari S. P. Exploration of factors that influence sustainable consumption behavior (empirical study of skin care clean beauty consumers in Semarang city) //Jurnal Info Sains: Informatika dan Sains. – 2024. – Vol. 14 (1). – pp. 931-942.
5. Putri N. A. A., Hussein A. S., Ismail T. Unpacking Consumer Behavioral Intentions in Sustainable Cosmetics: The Role of Green Brand Love and Trust. – 2025. https://doi.org/10.37641/jimkes.v13i5.3665.
6. Pelizza G., Molteni P. A framework for investigating innovation and institutional change: the case of sustainability. – 2021. - pp.1-13.
7. Dominoni C., Vallgren T. The Spillover of Sustainability in Multi-Tier Supply Chains: A study of the role of SMEs, Partnership and Inter-Organizational Learning. – 2024. - pp. 27-57.
8. Eckelman M. J. et al. Applying green chemistry to raw material selection and product formulation at The Estée Lauder Companies //Green Chemistry. – 2022. – Vol. 24 (6). – pp. 2397-2408.
9. Luengo G. S. et al. Physico-chemical challenges on the self-assembly of natural and bio-based ingredients on hair surfaces: towards sustainable haircare formulations //Green Chemistry. – 2023. – Vol. 25 (20). – pp. 7863-7882.
10. Acerbi F. et al. Enhancing the cosmetics industry sustainability through a renewed sustainable supplier selection model //Production & Manufacturing Research. – 2023. – Vol. 11 (1). - pp.1-5.
11. Gatt I. J., Refalo P. Reusability and recyclability of plastic cosmetic packaging: A life cycle assessment //Resources, Conservation & Recycling Advances. – 2022. – Vol. 15. https://doi.org/10.1016/j.rcradv.2022.200098.
12. SUSTAINABILITY REPORT - Fine Foods [Electronic resource]. - Access mode: https://www.finefoods.it/wp-content/uploads/2023/04/Fine-Foods-DNF-eng.pdf (date of access: 15.08.2025).

13. 2022 Amorepacific Group Sustainability Report [Electronic resource]. - Access mode: https://www.apgroup.com/int/en/commitments/sustainability/sustainability-reports/__icsFiles/afieldfile/2023/08/02/APG_2022_SR(ENG).pdf (date of access: 15.08.2025).
14. Mandom Report 2024 [Electronic resource]. - Access mode: https://www.mandom.co.jp/en/ir/pdf/2024_mandom_report.pdf (date of access: 15.08.2025).
15. KOSÉ REPORT 2024 [Electronic resource]. - Access mode: https://corp.kose.co.jp/ja/sustainability/report/report2024/pdf/report2024-all_en.pdf (date of access: 15.08.2025).
16. SUSTAINABILITY REPORT 2024 - Storyblok [Electronic resource]. - Access mode: https://a.storyblok.com/f/114531/x/ea87e186e0/en-rapporto-di-sostenibilita-2024.pdf (date of access: 15.08.2025).
17. BASF Report 2024_EN [Electronic resource]. - Access mode: https://www.basf.com/dam/jcr:a0caf160-c019-40b1-a4ea-eaedb29b0685/basf/www/global/documents/en/investor-relations/calendar-and-publications/reports/2025/BASF_Report_2024.pdf (date of access: 18.08.2025).
18. 2024 Integrated Report on economic and ESG performance - Givaudan [Electronic resource]. - Access mode: https://www.givaudan.com/sites/givaudanweb.int/files/2025-01/giv-2024-integrated-report_0.pdf (date of access: 20.08.2025).
19. Semi-annual Report on the Consumer & Retail Sector in China - KPMG agentic corporate services [Electronic resource]. - Access mode: https://assets.kpmg.com/content/dam/kpmg/cn/pdf/en/2025/02/consumer-and-retail-industry-analysis-2024-h2.pdf (date of access: 22.08.2025).
20. The report on the value of sustainability perceptions to the world's leading brands March 2024 - Brandirectory [Electronic resource]. - Access mode: https://static.brandirectory.com/reports/brand-finance-sustainability-perceptions-index-2024-full-report-3.pdf (date of access: 23.08.2025).
21. The integration of green chemistry principles in basic chemistry learning to support achievement of sustainable development goal - Dialnet [Electronic resource]. - Access mode: https://dialnet.unirioja.es/descarga/articulo/8791864.pdf (date of access: 23.08.2025).
22. Franca C. C. V., Ueno H. M. Green cosmetics: perspectives and challenges in the context of green chemistry // Desenvolvimento e Meio Ambiente. – 2020. – Vol. 53. https://doi.org/10.5380/DMA.V53I0.62322.
23. Biomass to COSMETIC Sustainable Multifunctional Ingredients and Solutions. - Minasolve [Electronic resource]. - Access mode: https://minasolve.com/wp-content/uploads/2018/03/MINSO_BOOK2017_A4_REV2_SCREEN.pdf (date of access: 25.08.2025).
24. Hitce J. et al. UN sustainable development goals: How can sustainable/green chemistry contribute? Green chemistry as a source of sustainable innovations in the cosmetic industry //Current Opinion in Green and Sustainable Chemistry. – 2018. – Vol. 13. – pp. 164-169. https://doi.org/10.1016/j.cogsc.2018.06.019.
25. L'Haridon J. et al. SPOT: a strategic life-cycle-assessment-based methodology and tool for cosmetic product eco-design //Sustainability. – 2023. – Vol. 15 (19). https://doi.org/10.3390/su151914321.
26. Simboli A. et al. Product ecodesign: an application of Bio-Based materials in the personal care packaging industry //Circular Economy and Sustainability. – 2024. – Vol. 4 (4). – pp. 2427-2448.