OPTIMIZATION OF THE COMPOSITION OF WASHING MATERIALS AND DEVELOPMENT OF TECHNOLOGY FOR NEW BIO-ECOLOGICAL COMPOSITIONS

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Abstract: This scientific study provides a comprehensive analysis of the theoretical and practical foundations for optimizing the composition of washing materials and developing the technology for new bio-ecological compositions. The research examined the environmental problems associated with synthetic detergents, their negative impact on water and soil ecosystems, and the aspects that pose a threat to human health. Based on these findings, the study highlights the challenges of creating biodegradable, low-toxicity, energy-efficient, and highly effective bio-ecological washing compositions. In optimizing the composition of detergents, the synergistic effect between components, pH balance, foaming level, emulsion stability, and biodegradability indicators were evaluated as the primary criteria.

Keywords: Detergents, enzyme technology, surface-active agents, optimization, stabilizers, energy-saving technologies, physicochemical properties, biotechnology, ecological standards.

YUVUVCHI MATERIALLARNING TARKIBINI OPTIMALLASHTIRISH VA YANGI BIOEKOLOGIK KOMPOZITSIYALAR TEXNOLOGIYASINI ISHLAB CHIQISH

Annotatsiya: Mazkur ilmiy tadqiqotda yuvish vositalari tarkibini optimallashtirish hamda yangi bioekologik kompozitsiyalar texnologiyasini ishlab chiqishning nazariy va amaliy asoslari har tomonlama tahlil qilingan. Tadqiqot davomida sintetik yuvish vositalari bilan bog‘liq ekologik muammolar haqida ma’lumotlar , ularning suv va tuproq ekotizimlariga salbiy ta’siri hamda inson salomatligiga xavf tug‘diruvchi jihatlari muhokama qilingan. Tadqiqotlarimiz asosida olingan asosiy tahliliy natijalar shuni ko’rsatdiki, biologik parchalanuvchan, kam zaharli, energiya tejamkor va yuqori samaradorlikka ega bioekologik yuvish kompozitsiyalarini yaratishning bir qator afzalliklari mavjud. Yuvish vositalari tarkibini optimallashtirishda komponentlar o‘rtasidagi sinergetik samara, pH muvozanati, ko‘piklanish darajasi va biologik parchalanish ko‘rsatkichlari asosiy mezonlar sifatida baholandi.

Kalit so‘zlar: Yuvish vositalari, ferment texnologiyasi, sirt-faol moddalar, optimallashtirish, stabilizatorlar, energiya tejovchi texnologiyalar, fizik-kimyoviy xossalar, biotexnologiya, ekologik me’yorlar.

ОПТИМИЗАЦИЯ СОСТАВА МОЮЩИХ СРЕДСТВ И РАЗРАБОТКА ТЕХНОЛОГИИ НОВЫХ БИОЭКОЛОГИЧЕСКИХ КОМПОЗИЦИЙ

Аннотация: В настоящем научном исследовании всесторонне проанализированы теоретические и практические основы оптимизации состава моющих средств и разработки технологии новых биоэкологических композиций. В ходе исследования были изучены экологические проблемы, связанные с синтетическими моющими средствами, их негативное воздействие на водные и почвенные экосистемы, а также аспекты, представляющие угрозу для здоровья человека. На основе полученных результатов освещены актуальные вопросы создания биоразлагаемых, малотоксичных, энергосберегающих и высокоэффективных биоэкологических

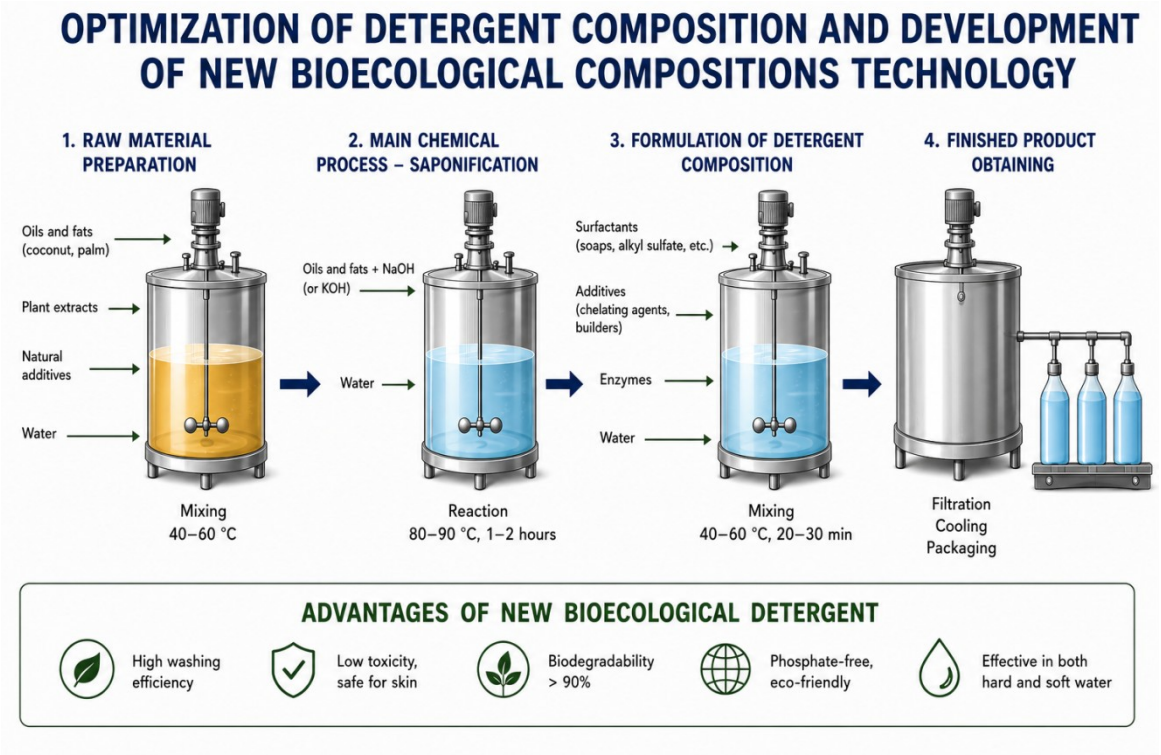
моющих композиций. При оптимизации состава моющих средств в качестве основных критериев были оценены синергетический эффект между компонентами, pH-баланс, степень пенообразования, стабильность эмульсии и показатели биоразлагаемости.

Ключевые слова: Моющие средства, ферментная технология, поверхностно-активные вещества, оптимизация, стабилизаторы, энергосберегающие технологии, физико-химические свойства, биотехнология, экологические нормы.

INTRODUCTION

As a result of the rapid development of the chemical industry, the rising standard of living, and strengthening environmental safety requirements, the issue of improving the composition of detergents has become a pressing scientific and practical area. The presence of phosphates, aggressive surface-active agents, synthetic aromatic compounds, and components that are difficult to biodegrade in traditional synthetic detergents negatively impacts water bodies, soil, and the atmosphere. Therefore, creating bio-ecologically safe, biodegradable, non-harmful to human health, and highly effective washing compositions has become an important direction in modern chemistry and ecology. While the technology for detergents was initially based on simple soap, product efficiency increased significantly with the subsequent emergence of synthetic surface-active agents. However, with the widespread use of synthetic components, environmental problems also intensified. It has been established that bleaching agents, stabilizers, preservatives, and synthetic fragrances cause toxic processes in aquatic ecosystems. In particular, the intensification of eutrophication in water bodies due to phosphates was identified as one of the main sources of environmental problems. At the same time, modern consumers are demanding environmentally friendly, non-allergenic, biologically active, and energy-efficient detergents. This necessitates the development of a new generation of bio-ecological compositions. The use of plant-based surface-active agents, enzymes, natural sorbents, biosurfactants, and microbiologically active components in such compositions is crucial. By conducting scientific research in this area, it is possible not only to enhance environmental safety but also to achieve economic efficiency. The primary function of detergents is to separate impurities from fabric or other surfaces, keep them in a dispersed state, and prevent their redeposition. This process depends on factors such as the composition of the detergent, its physicochemical properties, water hardness, temperature, and mechanical action. During the composition optimization process, the functional role of each component must be thoroughly studied. Bio-ecological washing compositions developed using new technologies have the potential for wide application not only in the household sector but also in the textile industry, food enterprises, medical institutions, and agriculture. Therefore, a comprehensive study of their physicochemical properties, environmental impact, and economic efficiency is an important task. Optimizing the composition of detergents is a complex, multi-factorial process. It involves considering the synergistic effects between components, the critical micelle concentration, pH balance, foaming properties, emulsion stability, and biodegradability. Although these substances increased washing efficiency, they led to negative consequences due to their long-term persistence in the ecosystem. Therefore, there is a growing trend in new bio-ecological formulas to replace phosphates with citrates, zeolites, and biodegradable complexing agents. Enzymatic detergents are of great interest for their ability to break down protein, fat, and starch mixtures. Protease, lipase, amylase, and cellulase enzymes ensure high washing efficiency even at low temperatures. This

serves to reduce energy consumption and lessen the environmental load. Biosurfactants are one of the key components of modern bio-ecological compositions. They are surface-active substances synthesized by microorganisms, possessing high emulsifying capacity, low toxicity, and biodegradability. Rhamnolipids, surfactins, and sophorolipids are among the most promising biosurfactants. The use of nanostructured components in creating new bio-ecological compositions is also a promising direction. Nanozeolites, nanocellulose, and silver nanoparticles enhance the antiseptic and adsorbent properties of detergents. However, it is necessary to thoroughly study their impact on human health. Foaming is perceived by consumers as a critical indicator of detergent quality. However, excessive foam can cause problems in water treatment systems. Therefore, it is important to use controlled foaming systems in bio-ecological compositions. Aromatic substances used in detergents are also an important issue from the standpoint of environmental safety. Using essential oils and natural extracts instead of synthetic fragrances reduces the risk of allergic reactions. Lavender, lemon, eucalyptus, and mint essential oils also possess antibacterial properties.



The degree of biodegradability is one of the primary criteria determining the ecological safety of a detergent. According to modern standards, at least 80 percent of the surfactants in a detergent must be biodegradable. For this reason, plant-based alkyl polyglucosides and amino acid derivatives are widely used in bio-ecological formulas. Encapsulated detergent compositions are also being created based on new technologies. The microencapsulation method increases the stability of enzymes and aromatic substances. This ensures the product's long-term shelf life and functional effectiveness. The use of bio-ecological detergents in industrial enterprises significantly reduces the toxicity of wastewater. The introduction of environmentally friendly washing compositions is particularly important in the textile industry for the protection of water resources. Assessing the toxicological properties of detergents is one of the key stages in creating bio-ecological technologies. Indicators such as skin irritation, allergenicity, mutagenicity, and ecotoxicity are determined using special laboratory methods. Formulas based on natural components are generally considered safer than their synthetic counterparts. Foaming is perceived by consumers as a critical indicator of detergent quality. However, excessive foam can cause problems in water treatment systems.

Therefore, it is important to use controlled foaming systems in bio-ecological compositions. The aromatic substances used in detergents are also an important issue from the point of view of environmental safety. Using essential oils and natural extracts instead of synthetic fragrances reduces the risk of allergic reactions. Lavender, lemon, eucalyptus, and mint essential oils also have antibacterial properties. The degree of biodegradability is considered one of the main criteria determining the environmental safety of a detergent.

Conclusion

In conclusion, optimizing detergent compositions and developing technologies for new bio-ecological formulas are important for ensuring environmental safety, making rational use of resources, and creating effective products that meet modern consumer demands. Research findings have shown that the phosphates, surfactants, and non-biodegradable components in traditional synthetic detergents cause significant harm to environmental systems. Therefore, creating formulations based on biodegradable, low-toxicity, and renewable raw materials is a pressing issue.

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