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SCIENTIFIC FOUNDATIONS FOR OPTIMIZING TECHNOLOGICAL PARAMETERS IN ETHANOL PRODUCTION FROM COMMON REED BIOMASS

Tojimurodova Munisa Mo'min qizi

Mansurov Olim Pardaboyevich

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Abstract. This thesis examines the potential of common reed biomass as a renewable raw material for ethanol production and considers ways to improve the efficiency of the technological process. Common reed contains cellulose and hemicellulose, which can be converted into fermentable sugars through appropriate pretreatment and hydrolysis. The main technological stages include raw material preparation, pretreatment, hydrolysis, fermentation, and ethanol separation. Particular attention is given to optimizing technological parameters, including temperature, processing time, acidity, and fermentation conditions. Improving these parameters may contribute to more efficient biomass conversion and more rational use of local renewable resources [1, 3, 6].

Keywords: common reed, ethanol, biomass, cellulose, hemicellulose, pretreatment, hydrolysis, fermentation, renewable raw materials.

Introduction. The growing demand for energy resources and the need to use raw materials efficiently have increased interest in renewable sources. Plant biomass is a promising resource because it contains organic compounds that can be processed into valuable products, including ethanol. The use of non-food plant materials can also reduce competition between industrial processing and food production.

Common reed is a widespread perennial plant that produces substantial amounts of biomass. Its lignocellulosic structure contains cellulose and hemicellulose, which can serve as sources of fermentable sugars. However, the presence of lignin and the complex structure of plant cell walls make direct conversion difficult. Therefore, selecting suitable pretreatment and hydrolysis methods is essential for improving ethanol production efficiency [2, 4, 6].

Main Section. The production of ethanol from common reed biomass involves several

interconnected technological stages. First, the harvested plant material is cleaned, dried when necessary, and mechanically processed to obtain smaller particles. Reducing particle size can improve contact between the biomass and processing agents.

The next stage is pretreatment. Its purpose is to modify the lignocellulosic structure and increase the accessibility of cellulose and hemicellulose to hydrolytic agents. The choice of pretreatment method depends on the characteristics of the raw material, process costs, and environmental considerations. Excessively intensive treatment may lead to the formation of compounds that inhibit subsequent fermentation. Consequently, the treatment conditions should be selected carefully [2, 4].

During hydrolysis, complex carbohydrates are broken down into simpler sugars. The effectiveness of this stage depends on factors such as temperature, acidity, reaction time, and the selected hydrolysis method. Appropriate control of these parameters can improve sugar recovery and prepare the hydrolysate for fermentation. Research on ethanol production from renewable plant materials provides a scientific basis for investigating such process conditions [1, 3, 6].

Fermentation is another important stage, during which microorganisms convert suitable sugars into ethanol. Its efficiency depends on the sugar composition of the hydrolysate, temperature, acidity, fermentation duration, and the properties of the microorganisms used. Therefore, pretreatment, hydrolysis, and fermentation should not be considered separately; the conditions of each stage influence the performance of the overall process.

To improve the technology, experimental studies can be used to evaluate the effects of individual parameters and their interactions. For example, experiments may compare different pretreatment durations, temperatures, and hydrolysis conditions while measuring sugar yield and the amount of ethanol obtained. The results can help identify operating conditions that provide an appropriate balance between product yield, energy consumption, processing time, and cost [1, 3, 6].

The use of common reed as a local raw material may also contribute to the more

effective utilization of available plant resources. Nevertheless, practical implementation requires an assessment of biomass availability, seasonal variation, collection and transportation costs, water and energy consumption, and the management of processing residues. A comprehensive evaluation of these factors is necessary before selecting a suitable industrial process [4, 5].

Conclusion. Common reed biomass has potential as a renewable raw material for ethanol production because it contains cellulose and hemicellulose that can be converted into fermentable sugars. Improving the technology requires coordinated optimization of pretreatment, hydrolysis, and fermentation conditions. Temperature, processing time, acidity, and other technological parameters should be investigated experimentally to determine their influence on sugar conversion and ethanol yield. Further research should focus on increasing process efficiency, reducing resource consumption, and assessing the economic and environmental feasibility of using locally available common reed biomass [1–6].

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