ECOLOGY. HUMAN. SOCIETY.

XXVI International Scientific and Practical Conference

dedicated to the 40th anniversary of the Chornobyl Nuclear Power Plant accident

June 25–26, 2026,
Kyiv, Ukraine

ФАПІЕ

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We invite you to take part in the
XXVI International Scientific and Practical Conference

«Ecology. Human. Society»,

dedicated to the 40th anniversary of the Chornobyl Nuclear Power Plant accident

which will be held online on June 25–26, 2026
at the National Technical University of Ukraine
“Igor Sikorsky Kyiv Polytechnic Institute”

Conference Topics

Section 1. General Ecology

- population ecology
- biogeocoenosis ecology
- urban ecology
- biological aspects of flora and fauna and restoration of biodiversity
- biological and biochemical methods of ecological monitoring, bioindication
- medical ecology and public health
- biological methods of sewage treatment, waste disposal and soil remediation

Section 2. Technical Ecology

- technologies of alternative energy
- alternative fuels
- chemical and physico-chemical methods of environmental monitoring
- methods and technologies for water treatment and reclamation
- closed water management industrial technologies
- methods and technologies of recovery, recycling and disposal of gas emissions
- methods and technologies of purification and reclamation of soils
- methods and technologies of recycling and solid waste management

Section 3. Sustainable Development Strategy in the Context of Environmental Safety

- environmental aspects of sustainable development
- environmental indicators of sustainable development
- mathematical modeling methods in the field of environment and natural resources
- problems of environmental education
- environmental law
- environmental audit
- governance in the field of environment and natural resources
- environmental economics

Features of participation in the conference

- Languages of publication: **Ukrainian and English** (*for school pupils and undergraduate students*); **English** for all other categories of conference participants**.**
- The publication must clearly present the relevance of the topic, the purpose, scientific novelty, and essence of the research, as well as appropriate conclusions and a list of references used. **Review publications** must contain the relevance of the topic, the purpose of the literature review, and conclusions including the author's recommendations regarding prospects for further applied research on the given topic.
- Submissions undergo plagiarism screening and screening for improper use of generative artificial intelligence tools using StrikePlagiarism software, as well as a single-blind peer review procedure.
- Published materials receive a **DOI**. The conference website is indexed in **Crossref** and **Scilit**. Publications are available in **OpenAIRE, Google Scholar, Fatcat,** and **OpenAlex**.

Rules for submitting applications

Before preparing materials for publication, please read the general conference requirements, submission formatting rules, and the sample format for materials carefully. Please note that applications are accepted in electronic form only via the conference platform (access via link; registration on the website is required).

Professional development

In accordance with the *Resolution of the Cabinet of Ministers of Ukraine dated 21.08.2019 No. 800 "On Approval of the Procedure for Professional Development of Pedagogical and Academic Staff"* and pursuant to *Order of the Dean of the Faculty of Automation, Industrial and Ecological Engineering of Igor Sikorsky KPI No. 59 dated 19.03.2026*, conference participants receive a certificate of professional development under the program:
"Environmental Safety and Sustainable Development: Presentation of Thematic Research Results and Scientific Communication"
with a volume of **6 academic hours (0.2 ECTS credits)** for one day of participation in the Conference, under the following conditions:

- registration and participation in Conference events;
- presentation of a report (including online or recorded) according to the Conference program;
- submission of the report materials to the Conference proceedings with confirmation of their acceptance for publication.

Organizational fees

The Conference applies an article processing charge (APC) model to ensure open access and high-quality technical preparation. We do not charge a fee for manuscript consideration or the work of reviewers.
Amount of the organizational fee – **50 EURO.**

The organizational fee is paid only after the participant receives confirmation from the Organizing Committee of admission to participate in the conference. Bank details for wire transfer of the organizational fee will be communicated to participants in the relevant invitation letters. A copy of the receipt or payment order confirming payment of the organizational fee must be sent to the Organizing Committee before the start of the conference.

The Organizing Committee provides for the possibility of full or partial exemption from payment of the organizational fee. Full or partial exemption may be granted upon a reasoned request, which is considered individually by the Organizing Committee, taking into account the authors' financial circumstances, availability of institutional support, and other relevant factors. The decision on granting an exemption or discount is made by the Organizing Committee. The Organizing Committee reserves the right to publish manuscripts free of charge on its own initiative.

Important dates

- submission of applications for participation in the conference and conference papers — **until June 1, 2026;**
- payment of organizational fees — **until June 20, 2026**.

Main requirements for formatting conference papers

- **length of materials:** 2–6 A4 pages (excluding the page with bibliography in the other working language of the conference, different from the submission language; see the sample formatting of materials);
- **abstract:** no more than 3000 characters including spaces. Recommended structure: background / methods / results / conclusions;
- **keywords:** no more than 10;
- **font:** Times New Roman, 12 pt, line spacing 1.0;
- **margins:** top – 25 mm, bottom – 30 mm, left – 25 mm, right – 15 mm;
- **file format:** .doc (MS Word);
- **paragraph indent:** 0.6;
- figures, charts, and diagrams must be inserted into the document as graphic objects;
- formulas must be formatted in **MathType Equation Editor**.

Bibliographic information shall be placed as follows:

At the top of the first page, aligned left, the following shall be placed in sequence:

- TITLE OF THE PAPER — in capital letters, bold, 14 pt;
- First name and SURNAME of the author(s) — in bold (the surname of the corresponding author is marked with *);
- name of the institution;
- postal address of the institution in italics;
- *e-mail address of the corresponding author.

On a separate page, bibliographic information, abstract, and keywords are provided in another official language of the conference, as well as the **ORCID code** (participants who do not have this identifier must obtain it free of charge via the link).

Sections of the manuscript:

- Introduction
- Analysis of literary/data sources and problem statement
- Purpose and objectives of the study
- Materials and research methods
- Research results
- Discussion of results
- Declarations regarding conflicts of interest, funding, data availability, and use of generative artificial intelligence tools
- Conclusions

Formatting references to literature sources

- Bibliography and in-text references must be formatted in a single internationally recognized citation style. We recommend that authors use the **APA standard**.
- Descriptions of literature sources must contain full bibliographic data and DOI and/or URL and access date (if available).
- If the list of references contains sources with titles in Cyrillic, in the “References” section on the conference website they must be provided in Latin transliteration.
- The list of references must contain **at least three sources**.

Contact information

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THERMODYNAMIC PREDICTION FOR CREATION OF NOVEL ENVIRONMENT BIOTECHNOLOGIES

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ABSTRACT

This study describes the creation of a universal biotechnology based on thermodynamic prediction, which enables rapid and efficient fermentation of environmentally hazardous waste, as well as the neutralization of toxic metals, radionuclides and xenobiotics with the simultaneous production of a number of commercially valuable products. A module with an optimized design has been developed for fast and effective fermentation of solid and liquid organic waste with simultaneous precipitation of metals.

Keywords: *thermodynamic prediction, anaerobic treatment, organic waste, toxic metals, radionuclides, xenobiotics, environmental biotechnologies.*

INTRODUCTION

Landfills and industrial enterprises are the main sources of severe environmental pollution of the biosphere with a wide range of toxicants [1]. These are four classes of solid and liquid organic pollutants, toxic metals, radionuclides and xenobiotics [2]. Conventional technologies are often inadequate for the effective treatment and detoxification of such waste, resulting in severe environmental contamination [3]. Therefore, the development of novel and effective waste management technologies is imperative.

The objective of this study was to develop and validate a universal biotechnology based on thermodynamic prediction for the complex treatment of four major classes of hazardous waste (multicomponent solid waste, soluble metal compounds and radionuclides as well as xenobiotics) and their conversion into valuable products (energy carriers such as hydrogen and methane, food grade carbon dioxide, metal concentrate and purified water).

MATERIALS AND METHODS

Strategic approach has been created that allows obtaining valuable products from all four classes of toxicants. This biotechnology is based on thermodynamic calculations to determine the optimal conditions for the fermentation of organic waste with concurrent of energy carriers' production, and also the most efficient mechanisms of microbial detoxification of soluble toxic compounds. For thermodynamic prediction we applied Pourbaix diagrams – graphical presentation of "Eh-pH" thermodynamic equilibrium state of compound-electrolyte system [4]. A foundational principle of

this approach is that microbial catabolism is thermodynamically confined to the water stability zone. Our calculations identified the optimal reductive conditions at the lower boundary of this zone, corresponding to Eh = -414 mV at a neutral pH of 7.0 (Figure 1).

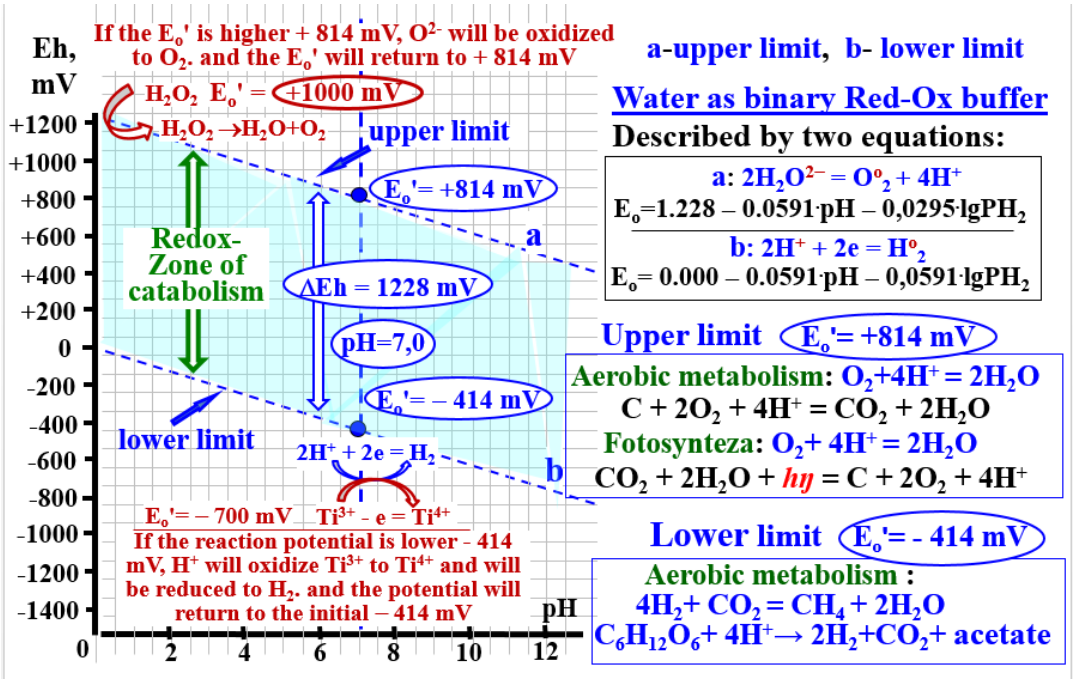

Figure 1. Thermodynamic calculations: optimal conditions for the fermentation of organic waste with concurrent of energy carriers production, and also the most efficient mechanisms of microbial detoxification of soluble toxic compounds. - pH = 7.0 and Eh = - 414 mV

For experimental validation, we designed and constructed a laboratory-scale, direct-flow installation (module) made of transparent acrylic glass (Figure 2). The primary model substrates under investigation are three types of solid waste: sugar beets, potatoes, and fallen leaves. To optimize and accelerate fermentation, we applied granular microbial preparation developed by us [5].

RESULTS AND DISCUSSION

Under regulated microbial metabolism in a direct-flow module, rapid and efficient waste degradation was achieved. The duration of waste degradation was very short, ranging from 3 to 8 days, and the degradation coefficients (Kd), representing the weight reduction multiples, were highly significant, ranging from 96 to 530 (Figure 3). In the aerobic sections of the module, the content of soluble compounds consistently decreased. Their concentration reduced from 5500 to 300 mg/L, and the degradation coefficient was 18. Thus, in the continuous flow mode, rapid and efficient degradation of solid waste was achieved - in the anaerobic sections, while soluble waste was effectively degraded in the aerobic sections.

In the upper part, high-potential conditions (+400 to +500 mV) are formed due to the presence of chromates. However, reductants from the low-potential zone (–280 mV) rapidly reduce chromates in the middle zone (Figure 4) [6]. The high reductase activity of the anaerobic microbiome resulted in a rapid precipitation of chromium, observed as the formation of insoluble

$Cr(OH)_3$ Finally, burning of dry biomass, coated with $Cr(OH)_3$, produces a valuable product, abrasive – crystalline Cr_2O_3.

There are three dominant pathways of detoxification: reductive precipitation, precipitation due to pH shift in alkaline zone, accumulation in cells due to stereochemical analogy of macroelements and radionuclides [7]. By combining these three pathways, the granulated preparation extracted almost 100% of U, P and Am from the effluent. Finally dry radioactive granules are safely disposed of by incineration, reducing their weight by 20 times.

The most effective pathway of xenobiotics detoxification – is their reductive degradation, i.e. their use by microorganisms as electrons acceptors. The reduction of unsaturated bonds of the aromatic ring leads to its destabilization, and further degradation to final non-toxic products [8].

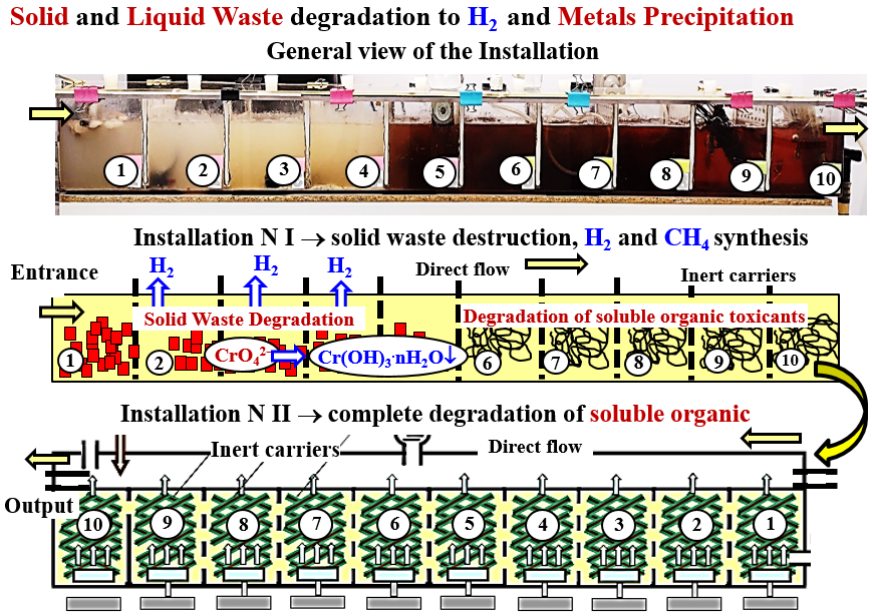

Figure 2. Simplest direct flow bioreactor – without any devices for mechanical mixing

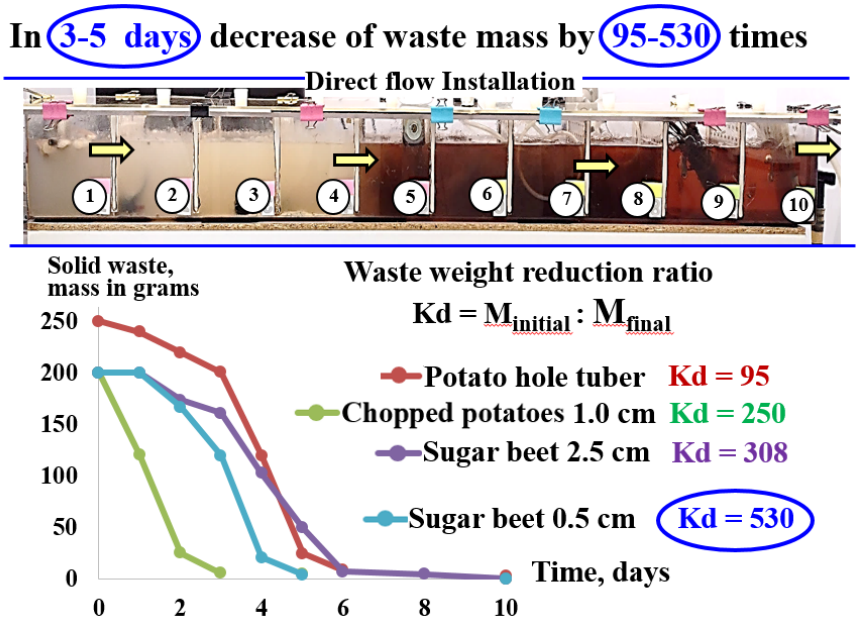

Figure 3. Fast and effective degradation of solid waste in module (direct flow installation)

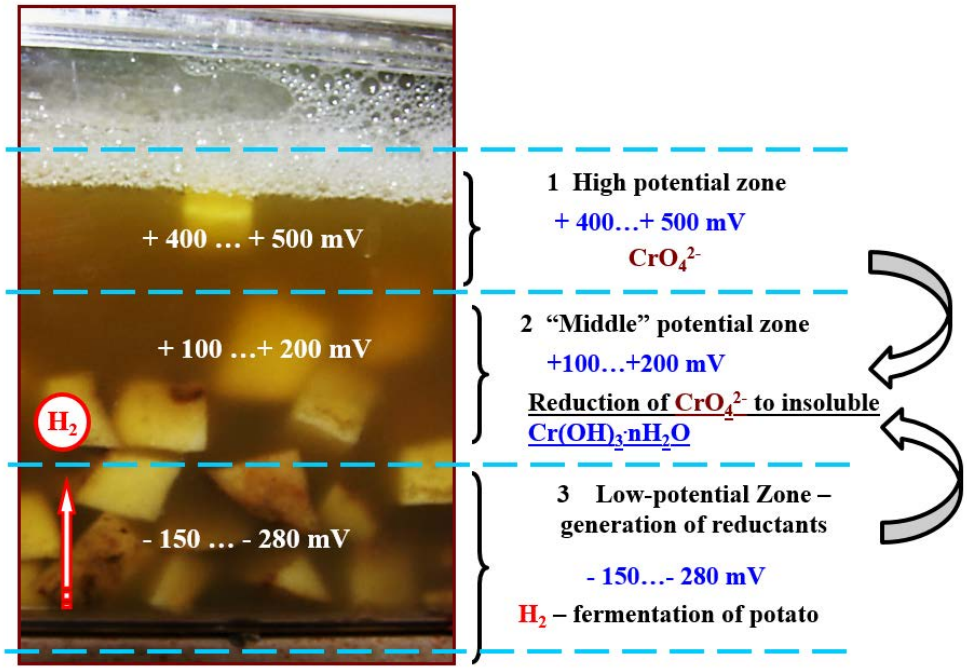

Figure 4. Stereometric distribution of redox-potential in heterophase system and chromate reduction

Based on the thermodynamic analysis (Figure 1), reactor configuration (Figure 2), degradation kinetics (Figure 3), and redox zonation (Figure 4), the integrated characteristics of the proposed biotechnology are summarized in Table 1.

Table 1. Integrated thermodynamic conditions, reactor operation, and biodegradation performance of the proposed waste treatment biotechnology

Component / Process Stage	**Conditions / Parameters**	**Observed Processes**	**Result / Output**
Thermodynamic framework (Eh–pH system)	pH = 7.0; Eh range: +814 mV to –414 mV	Water stability zone defines limits of microbial metabolism; optimal reductive conditions at Eh = –414 mV	Defines optimal conditions for fermentation and detoxification
Upper redox zone (aerobic)	+400 to +500 mV	Presence of chromates (CrO_4^{2-}); oxidative conditions	Formation of oxidized species
Middle redox zone	+100 to +200 mV	Reduction of CrO_4^{2-} to insoluble $Cr(OH)_3$	Detoxification of chromium compounds
Lower redox zone (anaerobic)	–150 to –280 mV (optimal down to –414 mV)	Fermentation of organic waste; generation of reductants (H_2)	Creation of reducing environment for detoxification
Direct-flow installation (Module I)	Continuous flow; anaerobic + aerobic zones	Solid waste degradation; synthesis of H_2 and CH_4; initial detoxification of soluble compounds	Rapid decomposition of solid waste and gas production

Component / Process Stage	Conditions / Parameters	Observed Processes	Result / Output
Direct-flow installation (Module II)	Aerobic conditions	Complete degradation of soluble organic compounds	Purified effluent
Solid waste degradation kinetics	Time: 3–5 days	Rapid mass reduction depending on substrate type	Kd = 95–530 (weight reduction multiple)
Soluble compounds removal	From 5500 to 300 mg/L	Aerobic biodegradation	Kd ≈ 18
Metal detoxification mechanisms	Reductive + alkaline + bioaccumulation	Precipitation of metals (e.g., $Cr(OH)_3$)	Formation of stable metal compounds (e.g., Cr_2O_3 after incineration)
Radionuclide removal	Combined mechanisms	Extraction of U, P, Am	≈100% removal; volume reduction ×20 after incineration
Xenobiotics degradation	Reductive conditions	Microbial reduction of aromatic compounds	Conversion to non-toxic products
Final products	—	Integrated process	H_2, CH_4, CO_2, purified water, metal concentrates

CONCLUSIONS

Thus, thermodynamic prediction allows distinguishing effective pathways of solving environmental problems requiring effective solution in the world scale. It is a promising method for development universal effective biotechnologies for processing of a wide range of ecologically hazardous wastes: solid and liquid organics, metals, radionuclides and xenobiotics. All toxic waste can be converted into useful products – hydrogen, methane, concentrate of valuable metals, etc. The theoretical bases of environmental biotechnologies developed by us are promising for their industrial implementation to prevent pollution of environment with four types of hazardous waste and bioremediation of contaminated ecosystems.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study, as well as the results reported in this paper.

FUNDING

The study was conducted without financial support.

DATA AVAILABILITY

The manuscript does not have associated data.

USE OF ARTIFICIAL INTELLIGENCE

The authors confirm that they did not use artificial intelligence technologies in the preparation of this work.

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ТЕРМОДИНАМІЧНЕ ПРОГНОЗУВАННЯ ДЛЯ СТВОРЕННЯ НОВИХ ЕКОЛОГІЧНИХ БІОТЕХНОЛОГІЙ.

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Анотація

Робота описує створення на основі термодинамічних розрахунків універсальної біотехнології, яка забезпечує швидке та ефективне зброджування екологічно небезпечних відходів, а також знешкодження токсичних металів, радіонуклідів та ксенобіотиків з одночасним отриманням ряду комерційно цінних продуктів. Розроблено модуль з оптимізованою конструкцією для швидкого та ефективного зброджування твердих та рідких органічних відходів з одночасним осадженням металів.

Ключові слова: термодинамічне прогнозування, анаеробне очищення, органічні відходи, токсичні метали, радіонукліди, ксенобіотики, природоохоронні біотехнології.