

Name of the project:

IRN AP09058149 «Investigation of electro-discharge demolition of reinforced concrete products and solid waste for the development of a mobile complex for their recycling and utilization».

Relevance:

The relevance of the project is due to the growing need for the destruction and utilization of hard concrete and reinforced concrete structures during repair, dismantling and subsequent utilization at the decommissioning of buildings and structures. This is especially true for the objects of the residential and industrial complex of Kazakhstan and in particular the Akmola region during the construction period of the 60s of the last century. Reinforced concrete, which is the main building material of these objects, has practically exhausted its resource. Currently, the only way to eliminate construction waste is to take it to a landfill. From an environmental and economic point of view, this approach cannot be called effective.

Despite significant progress in the field of technology for the destruction of reinforced concrete products, the productivity of destruction remains generally very low, and the cost is high. The main reasons for this are the rapid wear of the destructive tool, the difficulty of transferring a sufficient amount of energy to the bottomhole, and the low efficiency of destruction. Taking this into account, along with the improvement of technology based on mechanical methods of destruction, a search and study of new methods of destruction based on modern achievements of science and technology is underway. One of these methods of destruction include electro-hydraulic and electro-discharge methods.

Aim:

Development of physico-technical foundations of electro-discharge method for destruction of reinforced concrete to increase the efficiency of its utilization and recycling, reduce the environmental load by minimizing the volume of man-made waste and introduction of energy-saving environmentally friendly technologies in the course of dismantling and repairing buildings and structures.

Expected and achieved results:**2021:**

- a literary review of the current state of research in the subject area of the project was carried out, namely the generators used, the parameters of the voltage pulse applied to the sample, the optimal geometry of the electrode system, working fluids, hardware design, prototypes and analogues;
- the phenomenology of the process of electric discharge destruction of reinforced concrete has been developed, monitoring and analysis of the current state of research and achievements in the field of the project will be carried out;
- a phenomenological model of electric discharge destruction of substandard concrete of different grades and composition has been developed.
- a phenomenological model of electric discharge destruction of reinforced concrete has been developed, taking into account the geometry of the reinforcement frame and the depth of the reinforcement;
- data were obtained from measurements of physical and mechanical characteristics and the presence of defects in concrete samples of different grades (B7.5; B 20; B 30), the degree of their cracking, porosity and defectiveness;
- one (1) article or review has been published in a peer-reviewed foreign or domestic publication recommended by COXON;

2022:

- an electronic model of a mobile high-voltage pulse voltage generator has been developed;
- a stochastic-deterministic model of the initiation and development of discharge channels in concrete has been developed, taking into account its properties, the geometry of the reinforcement frame and the geometry of the electrode system;
- a model of shock wave action on concrete has been developed, taking into account the parameters of the discharge circuit of a mobile high-voltage generator and the parameters of the applied voltage pulse;
- a physical and mathematical model of the channel stage of an electric discharge has been developed, taking into account the parameters of a high-voltage generator, physical and mechanical characteristics and natural cracking of concrete;
- 2 (two) articles or reviews have been published in a peer-reviewed foreign or domestic publication recommended by KOKSON;
- a program has been developed for introducing the results of scientific research into the educational process;
- recommendations have been developed on the possibility of using the results of research work in the real sector of the economy;

2023:

- the optimal parameters of the acting voltage pulse have been determined, causing maximum destruction of concrete with minimal energy expended, and the results of a study of the operating modes of the high-voltage voltage pulse generator will be obtained;
- obtained results of numerical modeling of stochastic pre-breakdown processes and shock wave dynamics under electric discharge impact on concrete and reinforced concrete, taking into account the depth of reinforcement depending on the physical and mechanical parameters of the destroyed media, optimal conditions for the destruction of concrete and reinforced concrete structures, taking into account the real parameters of structures;
- proposals and recommendations were developed for the implementation of the results of the research performed; for the disposal of substandard reinforced concrete products and the organization of recycling of building materials (solid metal reinforcement, embedded parts, crushed stone and other components suitable for the manufacture of new concrete and reinforced concrete products);
- the requirements for the high-voltage pulse generator (operating voltage, stored energy, pulse rise time) and the electrode system are determined, recommendations for the assessment and selection of effective operating and energy characteristics of mobile equipment will be developed, a draft Terms of Reference for carrying out experimental design work for the creation of a mobile electric discharge complex will be developed destruction of reinforced concrete;
- 2 (two) articles or reviews have been published in a peer-reviewed foreign or domestic publication recommended by KOKSON;
- 2 (two) articles and (or) reviews have been published in peer-reviewed scientific publications in the scientific direction of the project, indexed in the Science Citation Index Expanded of the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 35 (thirty-five).

Project Manager: Sarsikeyev Yermek Zhaslanovich, PhD. H-index Scopus – 5, Web of Science – 4. Scopus Author ID – 56252099900, Web of Science Researcher ID – I-9900-2016, ORCID [0000-0002-7209-5024](https://orcid.org/0000-0002-7209-5024).

Research team members:

1. Kuznetsova Natalya Sergeevna, performer, Scopus H-index - 6, Web of Science - 4. Scopus Author ID - 56370956000, Scopus link <https://www.scopus.com/authid/detail.uri?>

authorId=56370956000. WoS Researcher ID – N-1494-2014, WoS link <https://app.webofknowledge.com/author/record/3060731>.

2. Akimzhanov Temirbolat Baltabaevich, performer, Scopus H-index 2, WoS H-index 1. Scopus Author ID – 56485979700. WoS Researcher ID – G-4842-2018. Scopus link <https://www.scopus.com/authid/detail.uri?authorId=56485979700>. WoS link <https://app.webofknowledge.com/author/record/19161405>.

3. Suleimenova Gulmira Orazbaevna, performer.

4. Atyaksheva Anastasia Dmitrievna, performer, Scopus Author ID – 57204188484. Scopus link <https://www.scopus.com/authid/detail.uri?authorId=57204188484>.

5. Mehtiev Ruslan Alievich, performer.

6. Sagalbaeva Asem Kairgalievna, performer.

Information for potential users:

The technology for recycling reinforced concrete slabs based on these methods can be built as waste-free, and both the reinforcement cage and the products of concrete destruction can be reused with minimal processing costs.