



INNOVATIVE TECHNIQUE FOR COMPLEX CLEANING BEACHES FROM HEAVY, RARE METALS, RADIOACTIVE MINERALS, BITUMEN, POLYMERIC MATERIALS AND MICROPLASTIC INCLUDING

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The paper presents an innovative technology for the complex cleaning of beaches from heavy and rare metals, radioactive minerals, bitumen, polymeric materials and microplastics.

Before talking about the technology itself, let us recall that the longest border in the world is the border of land and sea, or the so-called coastline of the oceans. Its total length, according to data published in the works of various authors, ranges from 777 to 504 thousand km. Separate parts of this coastline have a different origin, structure, history of development and dynamics. The most common type of shores are accumulative shores, which make up approximately 28.4%, or about 200 thousand km, of the total length of the shores of the World Ocean. It can be reasonably assumed that at least 100 thousand km. of the total length of the coasts of the Ocean, are represented by beaches, the width of which can vary widely, but on average, according to very preliminary estimates, is about 70 m.

As you can see, beaches occupy significant areas of the coasts of the World Ocean, and are generally recognized as important tourist and recreational areas. Although there is no general estimate of the annual number of people visiting the beaches, it can be confidently stated that more than two billion inhabitants of our planet use the services of the beaches every year.

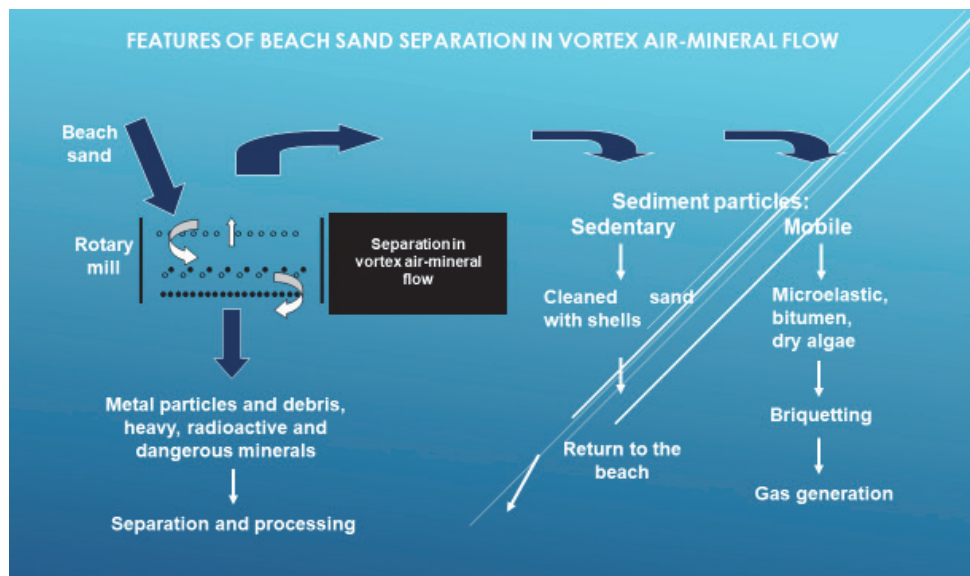
Unfortunately, many beaches that are in demand and popular among people are heavily polluted for various reasons. And beach pollution is increasing every year.

As a result of active hydrodynamic processes in the coastal areas of the sea and on the beaches, as well as in river alluvium and on river beaches, a significant amount of heavy and radioactive minerals, industrial dust particles of metals, plastics, including particles of microplastics, various polymers, bitumen and other potentially hazardous pollutants accumulate substances. Contaminated sand worsens the condition of recreational areas, the quality of fish, mussels, oysters and other hydrobionts used by people for food.

As the world and our experience in studying marine coastal accumulative forms, including beaches, shows, accumulative bodies composed of sandy sediments of various sizes are most polluted.

Therefore, cleaning sandy beaches from various pollutants is an urgent practical task today. To effectively solve this problem, it was necessary to develop an innovative technology that includes high-performance equipment.

On the Figure is a technological scheme of components beach sand separation in a vortex air-mineral flow.



Figure

Thus, the goal of our research was to create an effective technology and equipment for the complex cleaning of sandy beaches from almost all major types of pollution.

As an object of research and testing in the process of developing this beach cleaning technology, the authors used the beach sands of the Black and Azov Seas, as well as modern sandy alluvium of the Danube, Dnieper, Southern Bug and a number of other large and small rivers of Ukraine.

The innovative beach sand cleaning technology developed by the authors makes it possible to isolate various types and fractions of pollutants from polluted sands. These can be both small harmful natural and man-made formations, as well as larger man-made particles, including fragments of grenades, mines and fragments of other weapons.

The **figure** shows a technological scheme for cleaning beach sand from pollution.

Later, under laboratory conditions, ferrous and non-ferrous metals, plastic, synthetics and bitumen, heavy minerals: ilmenite, zircon, almandine and others were isolated from beach sands and river sediments.

It is important that the technological equipment can be installed on a small mobile platform. This allows the cleaning of the beach and the collection of harmful components more fast and safely.

Further, under stationary conditions, microplastics, bitumen and algae are used for gas formation, and the joint product of heavy metals and minerals is separated into separate concentrates and can also be disposed of or used both in the production of various materials and for other purposes.

Conclusions.

- Modern bottom sediments and beach sands are often very polluted and dangerous for both people and hydrobionts, that live on the beaches and in adjacent coastal zones of the shelf.



- The authors have developed an innovative technology for cleaning beaches, in particular, from small dangerous natural and man-made particles, including radioactive minerals, fragments of grenades, mines and other weapons.

- This technology has been tested in laboratory conditions.

- Using this technology, ferrous and non-ferrous metals, plastic, synthetics and bitumen, heavy minerals: ilmenite, zircon, almandine and others have been isolated from beach sands and river sediments in laboratory conditions using this technology.

- Cleaned sand returns to the beach

- Equipment can be installed on a small mobile platform for fast and safe collection of harmful components on the beach.

- Further, in stationary conditions, microplastics, bitumen and algae can be used for gas-producing installations, and the joint product of heavy metals and minerals is separated into separate concentrates and can also be used to produce various materials, substances or disposed of.