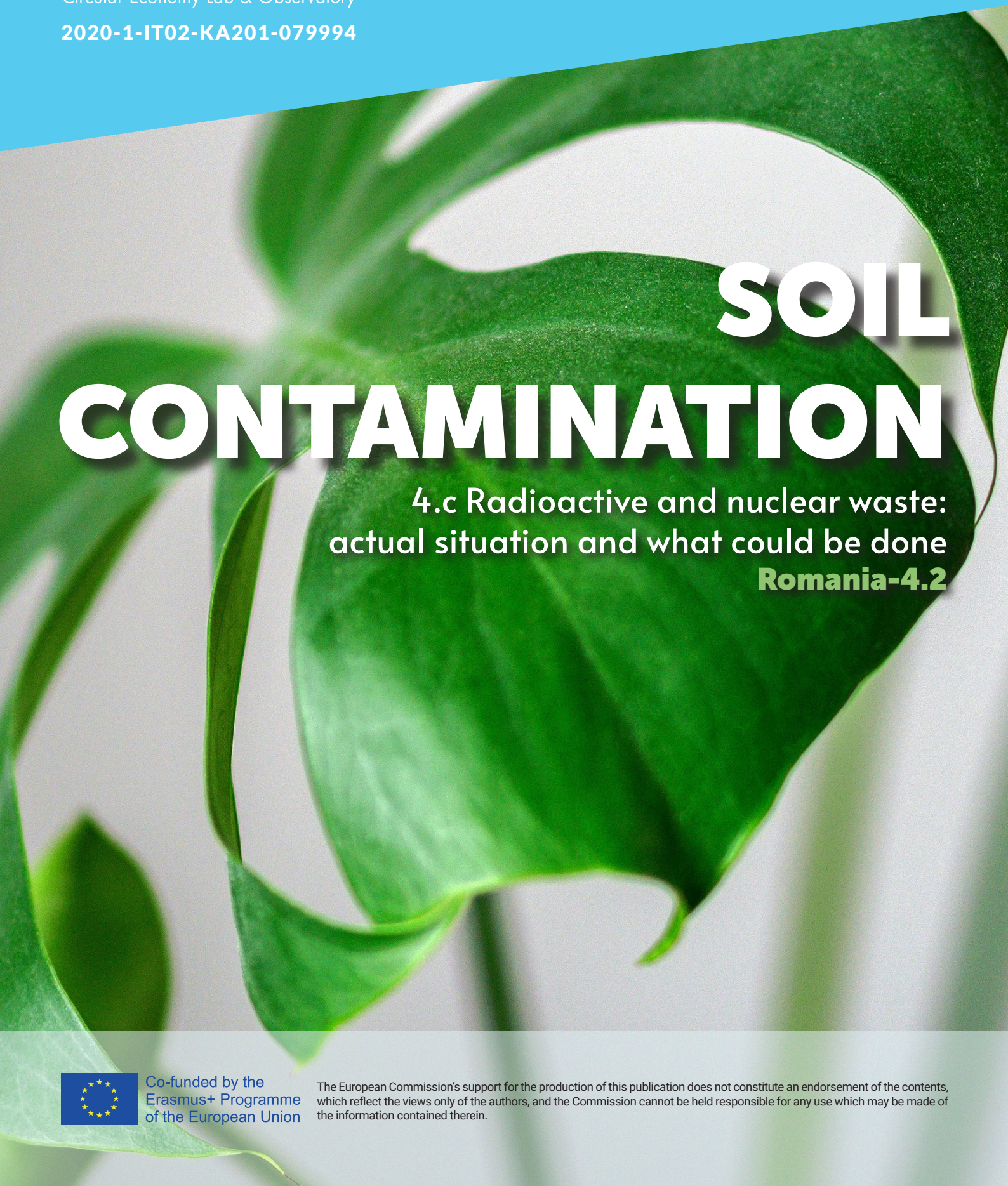
Circular Economy Lab & Observatory

2020-1-IT02-KA201-079994



SOIL CONTAMINATION

4.c Radioactive and nuclear waste: actual situation and what could be done

Romania-4.2

Co-funded by the Erasmus+ Programme of the European Union

SOIL CONTAMINATION

4.c Radioactive and nuclear waste: actual situation and what could be done

Romania-4.2

INTRODUCTION

First of all we need to discuss the difference between the word "nuclear" and "radioactive" "Nuclear" refers to the atom's nucleus. Despite the fact that one example of a nuclear process is radioactive decay, it is not always related to radioactivity.

Nuclear magnetic resonance (NMR, utilized in MRIs), for instance, manipulates the magnetic moments of atomic nuclei without causing radioactive decay. In general, "nuclear chemistry" or "nuclear technology" refers to operations like radioactivity, nuclear fission, and nuclear fusion that alter the makeup or structure of nuclei.

When a nuclear fuel nucleus splits in half in a reactor, nuclear energy is released. The smaller nuclei that are left over, referred to as fission products, are the main element of nuclear waste. The fuel that was placed into the reactor, which is normally made up of assemblies of cylindrical metal rods encasing fuel pellets, is exactly what nuclear waste appears like from the outside.

The components aren't exactly the same, though, because nuclear reactions have already a place. Nuclear waste is composed of elements from the periodic table, including isotopes of iron, zinc, germanium, zirconium, silver, and iodine, just like everything else. For any particular fission event, the two fission product elements are always different, yet the average composition remains the same as billions upon billions of atoms split.

https://pixabay.com/photos/pxclimateaction-nuclear-waste-4168906/

CiELO Circular Economy Lab & Observatory
Co-funded by the Erasmus+ Programme of the European Union
2020-1-IT02-KA201-079994

In essence, you receive the wide range of items displayed below. Typically, solid ceramic pellets that are piled into metal tubes serve as the nuclear fuel that is loaded into commercial reactors. Radioactive waste is produced by a variety of processes, including nuclear research, nuclear energy production, rare-earth mining, and the reprocessing of nuclear weapons.

https://pixabay.com/illustrations/man-face-fear-danger-grunge-art-429641/

Problem's description

Large stockpiles of waste at various levels have accumulated over the course of the 80 or so years that nuclear power has been used, during which time more than 450 commercial reactors, numerous experimental stations, and tens of thousands of nuclear warheads have been constructed.

Only 0.2% to 3.0% of waste, depending on the country, is high-level waste. Approximately 7% more by volume is classified as intermediate waste and is made up of materials like reactor core graphite and reactor component parts. This is likewise extremely risky, but because it doesn't produce much heat, it can be kept in specialized canisters.

Large amounts of garbage classified as low- and very low-level make up the remainder. This includes all radioactive waste generated during the operation and decommissioning of nuclear facilities, including scrap metal, paper, plastic, and building materials.

The general consensus is that there are approximately 22,000 cubic meters of solid high-level waste that have accumulated in temporary storage but have not yet been disposed of (moved to permanent storage) in 14 western countries, as well as undetermined amounts in China, Russia, and at military facilities. Approximately 3.5 million cubic meters of low-level waste and an additional 460,000 cubic meters of intermediate waste are being stored.

https://pixabay.com/photos/coal-fired-power-station-499908/

CiELO Circular Economy Lab & Observatory
Co-funded by the Erasmus+ Programme of the European Union
2020-1-IT02-KA201-079994

According to the WNA, active civil reactors produce around 34,000 cubic meters of new high-level and intermediate waste annually. Disposal of nuclear waste is frequently mentioned as one of the main drawbacks by those opposed to the use of nuclear energy and production of radioactive waste. In fact, nuclear reactor wastes that are extremely hazardous can be radioactive for tens of thousands of years.

The management of nuclear waste is a critical component of the nuclear energy equation. Both facilities that produce nuclear weapons as well as residual fuel from nuclear power reactors are sources of this. No matter where it came from, this hazardous trash contains extremely dangerous substances like pellets of plutonium and uranium.

These extremely radioactive substances continue to be highly harmful for tens of thousands of years, endangering people, freshwater sources, agricultural land, and fisheries. It is imperative that they be carefully and irrevocably disposed of as a result.

More than 250,000 tons of highly dangerous nuclear waste have amassed and been dispersed over 14 nations since the 1950s, when the first commercial nuclear power plants began operating. Most often, idle nuclear power facilities are used to gather and store the highly radioactive material.

A significant number of radioactive isotopes were released into the atmosphere as a result of two of the largest nuclear accidents in history, the Fukushima nuclear disaster (2011) and the Chernobyl disaster (1986), with devastating effects on both humans and the environment. These catastrophes sparked worries about the handling and disposal of nuclear waste, prompting governments to look for less dangerous substitutes.

https://pixabay.com/photos/nuclear-waste-radioactive-waste-1471361/

High-level waste, or radioactive waste from nuclear reactors, is a massive backlog that requires safe and long-term disposal. At a time when the industry is positioning itself as crucial to addressing the climate problem and ensuring energy security in a shifting geopolitical scenario, this poses a significant hurdle and hinders general acceptance of the energy source.

CiELO Circular Economy Lab & Observatory
Co-funded by the Erasmus+ Programme of the European Union
2020-1-IT02-KA201-079994

Possible solutions

There have been numerous attempts to reduce the amount of nuclear waste, but the majority of these have been abandoned due to their unfeasibility, high cost, or ecological unacceptability. They consist of launching it into space, enclosing it in artificial rock, burying it in ice sheets, disposing of it on the most remote islands in the globe, and lowering it to the bottom of the deepest oceanic trenches. Here are a few possible solutions.

After the atoms in the pellet fracture apart to release their stored energy, the pellets in the tubes emerge as radioactive trash. Nuclear waste can be reprocessed to extract more usable material. This process is currently being used at the Hanford Site in Washington state, but the breeder reactors would need to be refueled with uranium every 12-15 years.

Vitrification is one method that scientists have developed to more permanently store liquid nuclear waste. Through this procedure, the dangerous substance is changed into glass, an immovable solid that is easier to control. Glass is extremely durable and not only stops the release of hazardous species into the environment, but it also offers some protection against the release of radioactivity.

India, France, the UK, and other nations have been vitrifying liquid waste from the creation of weapons and recycled fuel for years, and they still do. For over 20 years, workers at Savannah River in the US have vitrified garbage associated with weaponry.

And although the US does not currently recycle fuel, it did so in the 1960s and 1970s in the West Valley Demonstration Project, a project located close to Buffalo, New York. Vitrifying high-level trash produced 275 glass canisters, which are currently being held there while they wait to be permanently disposed of in a repository.

https://pixabay.com/photos/nuclear-waste-radioactive-waste-1471361/

Due to its lingering radioactivity, HLW (high-level waste) will eventually need to be properly disposed of. International scientific agreement on deep geological repositories and technological proof point to HLW disposal that is both secure and environmentally responsible.

In other nations, like Finland and Sweden, such programs are far along. The Waste Isolation Pilot Plant, a deep geological waste repository, is already operational in the United States for the disposal of transuranic waste (long-lived ILW contaminated with military materials such as plutonium).

CiELO Circular Economy Lab & Observatory
Co-funded by the Erasmus+ Programme of the European Union
2020-1-IT02-KA201-079994

A dozen European nations have already developed plans for deep geological storage for their spent fuel, which appears to be one of the finest solutions so far. Their ambitions, though, have run into political obstacles. The idea by Finland to bury its 2,300 tons of high-level trash in an underground hardrock mine is the first and only example of this kind to date that has been successful.

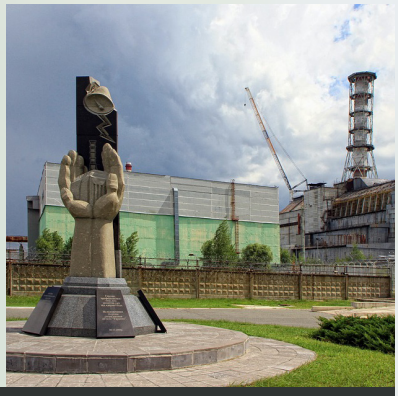
https://pixabay.com/photos/industry-energy-power-supply-5588157/

Conclusions

Radioactive nuclear waste contains very hazardous elements such as plutonium and the uranium fuel pellets. These substances must be carefully and permanently disposed of because they may be exceedingly dangerous for tens of thousands of years.

Because of the risks associated with radioactive waste, many individuals are opposed to nuclear energy even though accidents are extremely unlikely to happen. Nuclear power is one of the most expensive and time-consuming energy sources.

The construction of nuclear power plants is extremely expensive and takes a very lengthy period compared to other forms of renewable energy infrastructure, sometimes even more than ten years. Although nuclear power facilities are costly to develop, they are relatively inexpensive to operate. Nuclear energy has a wide range of benefits and drawbacks, and the debate over whether to keep using this technology or look for alternatives will undoubtedly rage on for years to come.



https://pixabay.com/photos/monument-chernobyl-ukraine-npp-1062297/

Although nuclear power has the potential to be a very deadly weapon, the likelihood of a nuclear war is very low. Even though there have only been a few of historic nuclear mishaps, they are known for their terrible effects and the potentially fatal ripple effects they caused (or almost sparked). But it's crucial to keep in mind that fossil fuels like coal and oil pose a considerably greater danger and silently kill millions of people each year all around the world.

https://pixabay.com/photos/nuclear-power-energy-electricity-4021417/

CiELO Circular Economy Lab & Observatory
Co-funded by the Erasmus+ Programme of the European Union
2020-1-IT02-KA201-079994

BIBLIOGRAPHY

[1] https://cen.acs.org/environment/pollution/nuclear-waste-pilesscientists-seek-best/
[2] https://earth.org/nuclear-waste-disposal/
[3] https://www.theguardian.com/environment/2019/aug/01/what-should-we-do-with-radioactive-nuclear-waste
[4] https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/radioactive-wastes-myths-and-realities.aspx

GROUP

Mihail Bidașcă, Gavriil Bidașcă,
Trif Dragoș, Kusztra Szabolcs.

CiELO Circular Economy Lab & Observatory
2020-1-IT02-KA201-079994
Co-funded by the Erasmus+ Programme of the European Union