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Forum: GC3: Natural Sciences

Issue: The safe disposal of toxic and radioactive waste

Student Officer: Cenker Camcı & Selin Eryiğit

Position: President Chair & Deputy Chair

Introduction



Toxic waste is any kind of unwanted substance that causes harm to the environment and also humans, through various ways of interaction such as inhaling, direct contact or consuming. For example, cleaning products such as ammonia, batteries, motor oils, etc. are all considered as toxic waste and consists chemicals that are harmful to both human body and to the environment.

On the other hand, radioactive waste, as nuclear waste, is the toxic outcome of a nuclear interaction that contains radioactive nuclear materials with no benefitting purposes. As these substances are threatening to both environment and to humans, the disposal of such substances cannot be conducted as if they were ordinary waste. A safe disposal has to be ensured in order to prevent the harmful effects of both toxic and radioactive waste and the damage they are most likely to cause.

These substances can cause many damages if not disposed in a safe and correct way. They require extreme attention during the disposal process after they stop being used as the mistakes and false disposal of such substances can have drastic and irreversible effects. For instance, some radioactive wastes tend to explode over time when they are buried which can cause fatal injuries and significant damages on the surface of Earth. In addition, many toxic and radioactive substances can pollute and dissolve into underground water sources which can poison and affect the growth and also health of many organisms, primarily being the humans and plants.

The harmful effects are not even limited to those that are mentioned above, there are so many long terms effect as such substances pollute the soil too. Once the soil is affected by the toxic waste such as batteries that are buried, the crops that grow on that land also inhabits these chemicals which are later on transferred to animals and humans who consume them as food



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sources. By this way, the toxic qualities these products possess gets transferred through the food chain in ecosystems in which these wastes are disposed in a dangerous and risky method.

Definition of Key Terms

Radioactive Waste: Harmful radioactive substances that remain after energy has been produced in a nuclear reactor.

Toxic Industrial Waste: The hazardous waste that is produced by industrial activities such as factories, mills, industries, and milling operations.

Nuclear fuel: Nuclear substances that can be burned to produce heat or energy

Radionuclide: A radionuclide is an unstable atom which has excess nuclear energy.

Mining: The extraction of valuable substances, geological materials and chemicals from the earth.

Milling: The process of breaking solid and big particles to smaller pieces by crushing, grinding or cutting with a mill (the device that works with electricity).

Glaciation: The process in which land is covered by thick layers of ice, or the effect this process has.

Long-lived ILW and HLW: Radionuclides' time to break down differs depending on what kind of emitters they are. If one radionuclide's half-life is long, it tends to be an alpha or a beta emitter. A long life means that the radionuclide emits less penetrating gamma rays, which makes it easier to handle.

Background Information

1. Types of radioactive waste

Radioactive waste includes any material that is either intrinsically radioactive, or has been contaminated by radioactivity, and that is deemed to have no further use.

Very Low-level Waste (VLLW)



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Low-level Waste (LLW)

Intermediate-level Waste (ILW)

High-level Waste (HLW)

2. Produce of waste: nuclear fuel cycle and the actual burning of the uranium.

3. Waste Storage and Transport

4. Legacy Waste

5. Non-nuclear power waste

Timeline of Major Events

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| July 29, 1957 | The International Atomic Energy Agency (IAEA) is established with the aim of providing assistance on how to use atomic energy to the benefit of human kind as well as the world peace. |
| 1961 | The International Atomic Energy Agency (IAEA) opens a bureau in Austria which allowed the further researches upon the aims of IAEA to be international. |
| 1970s | A method of waste disposal which is so called deep borehole disposal of high level radioactive waste is enhanced. |
| 1972 | The treaty on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter is prepared in a convention and then adopted. |
| 1980 | In Sweden, a referendum was held regarding the dangers and the hard disposal of radioactive waste. It resulted in Swedish citizens voting for the closing of nuclear reactors. They also expressed their will to use more sustainable and environmental friendly energy resources than nuclear reactors. |
| 1997 | The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management is signed under the supervision of IAEA which was the first treaty about the management of nuclear waste on a global scale. |
| 2002 | Nuclear Waste Management Organization (NWMO) is established in Canada. |



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Major Countries and Organizations Involved

Afghanistan:

Over the past 11 years, large quantities of toxic waste were collected in Afghanistan due to the North Atlantic Treaty Organization's presence and operations in the region. This accumulation of toxic waste is so severe that it caused Afghanistan to be ranked as the country with the most amount of hazardous waste in its borders. After realizing the traumatic reality, NATO started an initiative to reduce the amount of hazardous waste in the country, however, this disposal of such waste should be carried out in a safe manner in which humans or the environment do not get affected in a negative way. That is why finding methods of safe disposal of toxic waste will also help Afghanistan get rid of its hazardous waste to provide room for growth and sustainability. As a country that still has room for a lot of development, Afghanistan should be disposing its toxic waste in a safe to ensure the country's sustainability in many fields such as but not limited to environment and health.

Japan:

As a country that has experiences a massive growth and development over the past few decades, Japan still struggles to eliminate hazardous waste in its borders. Japan uses reusing and recycling as the core of their disposal of hazardous waste, however, as the industrialization of Japan occurred in a rapid speed, the methods that they were using to dispose their waste are not complying with today's needs. Japanese constitution sees minimizing the waste generation as the most important aspect of reducing hazardous waste, however, the developed industry and overpopulated cities prevent this idea from being implemented and cause Japan to struggle. In addition to that, the recent Japan-Thailand Economic Partnership Agreement (JTEPA) caused many controversies regarding the disposal of hazardous waste. This agreement allowed Japan to dispose its hazardous waste in Thailand and this caused protests under the slogan "Thailand is not Japan's waste bin". Furthermore, recently, the authorities of Thailand discovered 196 tons of hazardous e-waste in the containers that were shipped from Japan and called upon Japan to take their waste back. Japan agreed to take the containers back and said that they will start legal investigations for the individuals who were responsible for shipping that containers to Thailand.

Greenpeace:



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Greenpeace is an organization that focuses solely on environment and find measures to both protect it as well as raising awareness about it. As the disposal of toxic and radioactive waste possesses a huge threat against the environment, Greenpeace has been an active organization in the issue of safe disposal of such waste. For instance, Greenpeace activists were the ones who started the protests regarding the Japan-Thailand Economic Partnership Agreement (JTEPA). Moreover, Greenpeace called upon Japan to regulate the standards of the treaty and make adjustments regarding the environmental aspect of it. Greenpeace also urged Thailand to withdraw from the agreement and said they should not sign it under these conditions where their environmental entity is in danger.

United Kingdom:

United Kingdom has established a new regulation and an approach towards the safe disposal of nuclear waste. This new method that they are investing in is called a Geological Disposal Facility (GDF). It basically suggests that nuclear waste of a country should be buried kilometers below the ground in a safe facility to eradicate the negative impacts of nuclear waste. This method is seen to be the most efficient long-term solution to the problem at hand by the international community.

Jamaica:

Jamaica is a country that experiences a massive amount of waste production every day, 4010.7 tones of solid waste to be precise. Jamaican government established an organization called National Solid Waste Management Authority (NSWMA) to regulate and find effective ways of disposing solid waste. With such initiative, Jamaican government took a step forward while finding ways to safely dispose toxic waste and this organization can be taken as an example while solving this issue or even implement it to a global scale to ensure the safe disposal of toxic waste not only in Jamaica, but all around the world.

Canada:

Canada, as a country with a high international profile, has been implementing solutions to the problem at hand. Canada established an organization called The Nuclear Waste Management Organization (NWMO) by which they regulated the production of nuclear waste in their borders and found measures for their safe disposal. As a country which expressed its environmental stance, Canada is once again thriving to ensure the well-being of its citizens and the environment. NWMO has been an effective organization and contributed to the waste management of Canada significantly.



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Previous Attempts to Solve the Issue

1. Near Surface Disposal: Disposal at ground level or below ground level (only tens of metres depth). Used for VLLWs, LLWs, and in some countries for ILWs. Usage of vaults and waste containers. Some form of excavation is present, either through drainage, gas venting system or drift. It is implemented in many countries including UK, USA, France, Netherlands, Japan and many more. It carries the risk of being effected by climate change, thus being disrupted.
2. Deep Geological Disposal: Disposal below ground level minimum at 250 meters(at depths between 250m and 1000m for mined repositories, or 2000m to 5000m for boreholes). Used for ILWs, HLWs, and used fuel. It is still investigated in some countries, but also being implemented by many. By a combination of engineered and natural barriers, the de-activated matter is isolated under the ground. It carries little risk because especially deep underwater facilities lack oxygen, which keeps the chemical from mobilizing.

Mined repositories & Deep boreholes

3. Deep Well Injection: For liquid wastes. The wastes are injected into solid rocks which are specifically chosen for their ability to trap the waste, and are deep under the ground.
 - Russia example
 - USA example

Possible Solutions



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Toxic and radioactive waste possess a huge threat to the safety and health of humankind as well as the environment and therefore need to be disposed in a safe manner. First of all, countries should make regulations in their legislations and adjust their policies regarding the production and disposal of radioactive and toxic waste as a base for all the other solution alternatives. Forming organizations with the aim of conducting research and investigations upon the production of toxic and radioactive waste and the ways they are being disposed would also enlighten authorities and scientists while tackling the issue at hand. Conventions and treaties among nations in order to solve the problem of the safe disposal of toxic and radioactive waste is also an important solution to ensure the sustainability and the productivity of the solutions that are found. This also shows the importance of cooperation for this issue as radioactive and toxic waste can expand its effect overseas and over borders, affecting more countries. Moreover, raising awareness is also efficient as public would be informed about dangers of such waste and implement small practices into their daily lives to ensure the safe disposal of household products that are counted as toxic or radioactive waste once they are not used anymore, such as batteries. Establishing a body under every nation's government, just like Canada and Jamaica did, for the purpose of investigating and collecting data regarding the toxic and radioactive waste in that specific country is also an important solution. Finally, designating safe areas for the disposal of toxic and radioactive waste is one of the most significant solutions to this issue. However, the security and the safety of such areas should be ensured and authorities have to make sure that such waste cannot mix into the water sources, soil or air in any way.

Useful Links For Further Research

- IAEA Safety Standards for Disposal of Radioactive Waste
https://www-pub.iaea.org/MTCD/publications/PDF/Pub1449_web.pdf
- Radioactive Waste Management
<http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/radioactive-waste-management.aspx>
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