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Nuclear Waste Management

Gagana M B

Bapuji Institute of Engineering and Technology, Davangere, Karnataka, India

ABSTRACT

In recent years waste management has become a huge challenge to the global community. Nuclear waste which has radioactive components is causing a tough challenge to dispose of. In various countries, they have adopted methods like dumping the waste in sealing cans and burying it underground or below the sea bed which is very harmful to the environment and habitats. The radioactive waste has to be treated but without human handling. So we can do it with the help of AIML and data science, where we can program the machinery to carry out the neutralizing process. As there is remains of radiation in the nuclear waste we can use it to form energy resources. Though it's very hard to manage we still haven't found the safest way and the current measures taken to dispose are very uncertain and do not ensure complete safety. Why bury it when we can convert it into some form of energy or useful resource?.

***Corresponding author**

Gagana M B, Bapuji Institute of Engineering and Technology, Davangere, Karnataka, India.

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Abbreviations

LLW: Low-Level Waste
HLW: High-Level Waste
AI: Artificial Intelligence
AIML: Artificial Intelligence and Machine Learning

Introduction

The spent nuclear power of a reactor is the nuclear waste. The generation of the waste has been taking place since from 1960-1970. The world has already seen the destruction and harm caused by radioactive elements. The unstable nature of these elements releases radiation when the disintegration of atoms takes place. The uranium and plutonium were the major elements that were used in creating nuclear power and weapons. The end product of nuclear power generation is nuclear waste which is hazardous and has radiation. The handling of this waste is done in different methods. Mainly the methods of incineration- treating the waste at high temperatures and evaporation techniques. The most widely used method is- sealing the radioactive waste in multi-layered cans or tanks, which are mostly made of lead and also layering it with concrete and burying these cans in a geo-disposable site. These methods are considered to be safer and reliable, on the other hand, some countries like France, Japan, Germany, Belgium and Russia are recycling the used plutonium to generate electricity. The waste is classified into two levels ie., 1) Low and Intermediate levels of waste and 2) High level of waste. The high level of waste is very dangerous and is aqueous in the state and has 99% of the radioactive radiation. It's a challenging task to handle this level of waste and it shouldn't be exposed to living beings and the atmosphere. There are various actions taken to resolve this issue by adopting the methods of deep geological disposals. It is accepted as the safest method of disposal and is implemented.

In recent studies and publications, various discoveries have been made and it is shown that LLW can be transformed and has shown its implementations in the field of medical sciences and technology. As there are a lot of undiscovered components left in the HLW. Instead of disposing of it can it be transformed into some other form of resources? Or can there be any alternative methods of handling this waste?

Methods

Nuclear waste management is a critical aspect of the nuclear energy industry and is essential to ensure the safe handling and disposal of radioactive materials.

The emerging nuclear medicine is gaining lots of demand as there is proof and studies taking place regarding this topic. The LLW are already finding its implementation in this field but the high-level waste composition is much more complex in its structure and there might be many useful things in this aqueous substance. Though it seems impossible to experiment with HLW and analyse it more the current emerging technology makes it possible.

The designing of special safety suits to protect human beings from radiation, temperature and toxic gases produced from nuclear waste. We are currently using the safety suits designed by the Lead but to be in the environment where the handling of nuclear waste is taking place we need advanced safety equipment. The suits have to be experimented with by exposing them to various aspects similar to their working conditions. As lead is also harmful to human beings, there is a need for any other substitute other than lead. Tyvek 10000 and 2000 are currently in use but we need still more advanced to handle HLW. The suits better have GPS and at least some automatic parameter analysing technology.

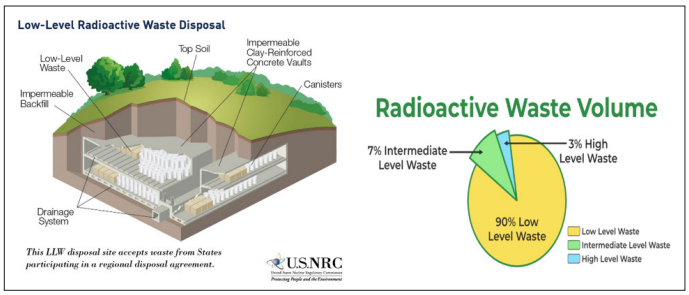
Building of plants to process HLW. The process system is built in the nuclear power plant. This particular unit can be on a small scale or large scale based on the percentage of the HLW produced

in that particular plant. The material which it is built with should be corrosion resistant. We can use some technology that we are already implementing while dealing with volcanos and lava. The material of the bucket and ladle can be used as they are high temperature resistant. Some of the countries are converting used plutonium to generate electricity we can try to implement this technology even in the case of HLW. if we could find ways to generate electricity as a product of HLW, this could be another source of energy. We can take the assistance of AI to monitor various parameters and AIML to manufacture equipment, which can carry out the process of handling with HLW. By this, we can prevent human beings from working in hazardous environments and reduce the risk of getting exposed to radiation.

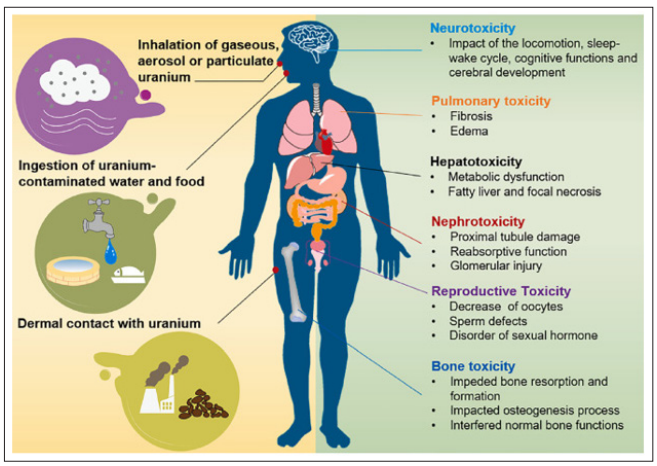
Finding an alternative to generate nuclear energy. We are using uranium and plutonium currently to generate nuclear energy. The mining of the uranium is very hazardous and difficult. We have already seen the deformities it has caused in the workers who have worked in the mining and uranium is not available abundantly everywhere. we can find some other element which is not harmful and doesn't emit radiation. This element has to be sustainable, economical and available abundantly to generate power. It should be a perfect alternative for uranium with no hazardous impacts.

Results

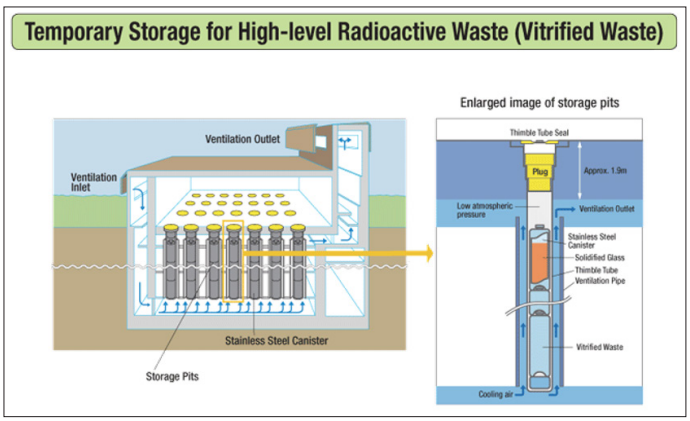
The processing of any material has many processes. The nuclear power plant that can take on HLW should be situated in an isolated and very ideal conditions environment. This particular field of research needs experts in various domains to work together to find the solution. There are still several elements that have not been discovered and this brings forth a speculation of an element in existence that can help us in finding the solution to the issue.



As artificial intelligence is finding its implementation in various fields and technology, it can assist us in dealing with nuclear waste as well and also take on the work that is hazardous for human beings to be involved. We can design the machines in a way where nothing harmful is emitted and gets out of the system to the environment.



Type of uranium	Composition (%)	
	^{235}U	^{238}U
Natural uranium	0.7	99.3
Slightly-enriched uranium	1.0-1.8	≈98.5
Low-enriched uranium	3	97
Weapon-grade uranium (WGU)	93.5	6.5



Discussions

The present generation is in need of a sustainable and reliable form of energy. With ever ever-increasing demand for energy, fossil fuels are unable to fulfil the demand. The pollution caused and as the coal is near to extinction, we need other forms of energy. We are currently using many available forms of energy but we need a high electric power supply with less consumption of resources. When the world was introduced to the energy equation E=mc2, nuclear energy came into existence and we knew that it could fulfil the energy demand. But the result of nuclear energy generation ie., nuclear waste caused huge problems and debates around the world. If we can find the most suggestable method to handle nuclear waste then we can nearly overcome the energy crisis. We can try to convert the nuclear waste into some other form of energy or find an absolute no-harm disposable method. The geological disposable method can only postpone the effects for now but eventually, it will cause problems in future. But why dispose of it when we still have room for converting the waste into something useful? Most of the powerful nations that are producing nuclear energy have the technology to use nuclear energy but there is still no invention about how to handle the waste with a success rate of 100%. In recent days, there has been disposable of nuclear waste water(treated) into water bodies which is very concerning as it may contain toxic materials in it. These incidents indicate that there is a need for better disposal methods of any state of waste that is associated with nuclear energy [1-18].

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