Study of the used deuterium absorption material disposal

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ABSTRACT

The dryer (ten per unit) are operating to remove tritium in PHWR(Pressurized Heavy Water Reactor).

There are coming out heavy water adsorbent from operating the dryer (95 drums for ten year per unit)

The amount of radioactivity of heavy water adsorbent almost exceed ninety times more than disposal limit-in-itself showed by The Ministry of Science and Technology

It has to be disposed whole radioactive waste products, however there are problems of increase at the expense of their permanent disposal

In this research, We have studied how to remove kinds of nuclear materials and amount of tritium with in heavy water adsorbent

As the result we could develop disposal equipment and apply it.

D20 adsorbent have to contain below Gamma nuclide 0.3Bq/g and tritium 100Bq/g "The Regulation for disposal of the radioactivity wastes "showed by The Ministry of Science and

Technology

There fore.

So as to remove amount of tritium and kinds of nuclear materials (DTO) we needed a equipment.

Also we have studied how to remove effectively radioactivity with in Adsorbent

As cleaning heavy water adsorbent and drying on each condition (temperature for drying and hours for cleaning)

Because there is something to return heavy water adsorbent by removing impurities within adsorbent when it is dried o high temperature.

After operating, we have been applying this research to the way to dispose heavy water adsorbent

Through this we could reduce solid waste products and the expense of permanent disposal of radioactive waste products and also we could contribute nuclear power plant run safely.

According to the result we could keep the best condition ofradiation safety super vision and we could help people believe in safety with Radioactivity wastes control for harmony with Environment.

INTRODUCTION

As you know the tritium charactristic is similar with hydrogen and reacts to oxygen and makes HTO and it exchanges with hydrogen of an organic compound.

Also tritium compounds has large specific gravity and boiling point.

And it has slow reaction time and diffusion time in comparison with H2O.

Hydrogen isotopes make various molecular structure through the photosynthesis and

biological process.

The heavy water reactor creates 3-H and 14-C more than a light-water reactor.

Because it makes use of coolant and moderator.

The tritium is the isotope of hydrogen with one proton and two neutrons, so it has same chemical property but different phycal property.

Tritium emits beta rays only, and has a half of 12.3years. The meximum beta energy is 18keV, and the average beta energy is 5.7keV.

The tritium in the heavy water NPP is created with deuterium in the heavy water, due to operating time of the NPP, tritium concentration in heavy water is continuously rising.

When tritium is out of the human body, the effect is litter. It is emits only beta particles of very low energy. These beta particles cannot even penetrate the outer dead layer of the skin and tritium is therefore an internal hazard only.

We have been considerably effort to deal with so much tritium and other nuclide in heavy water.

Especially, we studied to minimize the radioactive waste and developed the nuclide disposal method as well as tritium in the used deuterium absorption material which was generated solid waste in heavy water steam recover. As a result, this study, development and operating system make that we could dispose non-radioactive waste from radioactive waste.

EXPERIMENT & RESULT

A. 1st experiment of decontamination

1) Term

a) Drying after 1st washing : Drying in 65℃ for 20hours after washing in pure water for

5minutes.

b) Drying after 2nd washing : After 1st washing, drying again in 65℃ 20hours after re washing in pure water for 5minutes.

2) Result of experiment

a) Drying after 1st washing

○ Satisfaction(self-disposal regulation(0.3Bq/g))

Gamma activity has been reduced by 23.0%(0.21Bq/g) over the base activity(0.27Bq/g).

○ Unsatisfaction(self-disposal regulation(100Bq/g))

Tritium activity has been reduced by 96.7%(249Bq/g) over the base activity(7,595Bq/g).

b) Drying after 2nd washing

○ Satisfaction(self-disposal regulation(0.3Bq/g))

Gamma activity has been reduced by 58.7%(0.11Bq/g) over the base activity(0.27Bq/g).

○ Unsatisfaction(self-disposal regulation(100Bq/g))

Tritium activity has been reduced by 97.6%(179Bq/g) over the base activity(7,595Bq/g).

B. 2st experiment of decontamination

1) Term

a) Drying after 1st washing : Drying in 65℃ for 20hours after washing in pure water for 5minutes.

b) Drying after 2nd washing : After 1st washing, drying again in 65℃ 20hours after

rewashing in pure water for 5minutes.

2) Result of experiment

a) Drying after 1st washing

○ Satisfaction(self-disposal regulation(0.3Bq/g))

Gamma activity has been reduced by 95.6%(0.009Bq/g) over the base activity(0.20Bq/g).

○ Unsatisfaction(self-disposal regulation(100Bq/g))

Tritium activity has been reduced by 97.4%(235Bq/g) over the base activity(9,000Bq/g).

b) Drying after 2nd washing

○ Satisfaction(self-disposal regulation(0.3Bq/g))

Gamma activity has been reduced by 100%(BKG) over the base activity(0.20Bq/g).

○ Unsatisfaction(self-disposal regulation(100Bq/g))

Tritium activity has been reduced by 98.8%(105.4Bq/g) over the base activity(9,000Bq/g).

C. 3st experiment of decontamination

1) Term

Heat the sample in 250℃ for 60minute

2) Result of experiment

a) Drying after 1st washing

○ Satisfaction(self-disposal regulation(0.3Bq/g))

Gamma activity has been reduced by 100%(BKG) over the base activity(0.19Bq/g).

○ Unsatisfaction(self-disposal regulation(100Bq/g))

Tritium activity has been reduced by 97.3%(147.4Bq/g) over the base activity(5,426Bq/g).

D. 4st experiment of decontamination

1) Term

a) Drying after 1st washing : Drying in 65℃ for 20hours after washing in pure water for 5minutes.

b) High temperature drying: After 1st washing, drying in 250℃ 60minute.

2) Result of experiment

a) Drying after 1st washing

○ Satisfaction(self-disposal regulation(0.3Bq/g))

Gamma activity has been reduced by 95.6%(0.009Bq/g) over the base activity(0.20Bq/g).

○ Unsatisfaction(self-disposal regulation(100Bq/g))

Tritium activity has been reduced by 97.4%(235Bq/g) over the base activity(9,000Bq/g).

b) Drying after 2nd washing

○ Satisfaction(self-disposal regulation(0.3Bq/g))

Gamma activity has been reduced by 100%(BKG) over the base activity(0.20Bq/g).

○ Satisfaction(self-disposal regulation(100Bq/g))

Tritium activity has been reduced by 99.7%(29Bq/g) over the base activity(9,000Bq/g).

ANALYSIS

We were analyzed tritium in the used deuterium absorption material and gamma rays activity according to each experiment.

Now, this study shows that 4th experiment is satisfaction.

Also we acquired that "Drying for 1 hour after washing in decontamination water for 5 minute" is the best method for removing the radioactive contaminations in the used deuterium absorption material.

And it was entered development of radioactive removing equipment and operating manual.

Conclusion

unit : Bq/g

Experiment	Result of experiment		Limitation		Decision
	Gamma	Tritium	Gamma	Tritium	
1st	0.11	179.0	0.3	100	Unsatisfaction (Ttritium)
2nd	N/D	105.4	0.3	100	Unsatisfaction (Ttritium)
3rd	N/D	147.0	0.3	100	Unsatisfaction (Ttritium)
4th	N/D	29.0	0.3	100	Usatisfaction (Ttritium)

<Graph 1. Decision of self-disposal availability>

CONCLUSION

Up to now, the tritium in the heavy water adsorbent and many kinds of Gama nuclear have been disposed as the radioactive waste.

However. this study can make. them non-radioactive waste. and also show how to

cut down the amount of waste effectively.

We can improve controling skill for and cut down the expense of disposing radioactive waste come from decontaminaton heavy water adsorbent.

We are sure to find out how to dispose the heavy water adsorbent most effectively.

The dryer for the wet radioactive waste is made by this study.

It disposes the wet solid waste into the dried solid waste easily and even the tritium in the waste.

Especially it is convienient and small enough to move to many places.

We can put it on any place for work.

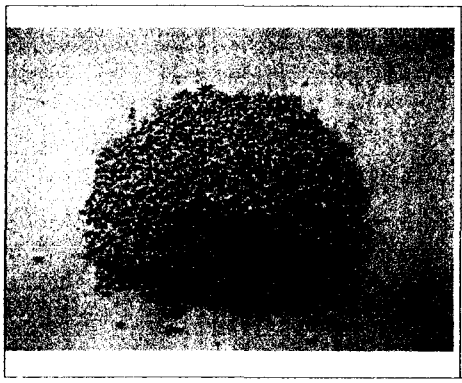
It enables all the solid waste to dry in the proper temperature and the proper hours.

As this result, we can expect to cut down the amount of radioactive waste and to make solid waste become solid well and to remove tritium effectively.

According to places, we can expect that it enables used filters to dry and us to use tools or not for removing tritium and it can cut down the amount of radioactive waste and reuse used resin.

A. deuterium adsorption

1) Photograph



* Main element
: $Na_{12}[(AlO_2)_{12}(SiO)]XH_2O$
* Manufacturing process
: Paste(Clay contains Al & Siiicate)
-extension-cutting-drying-pellet type

Chart 6. Photograph of deuterium absorption material and manufacturing process

2) Crystal structure & enlarged photograph (10,000times)

Chart 7. Crystal structure & enlarged photograph (10,000times)

B. Drying apparatus

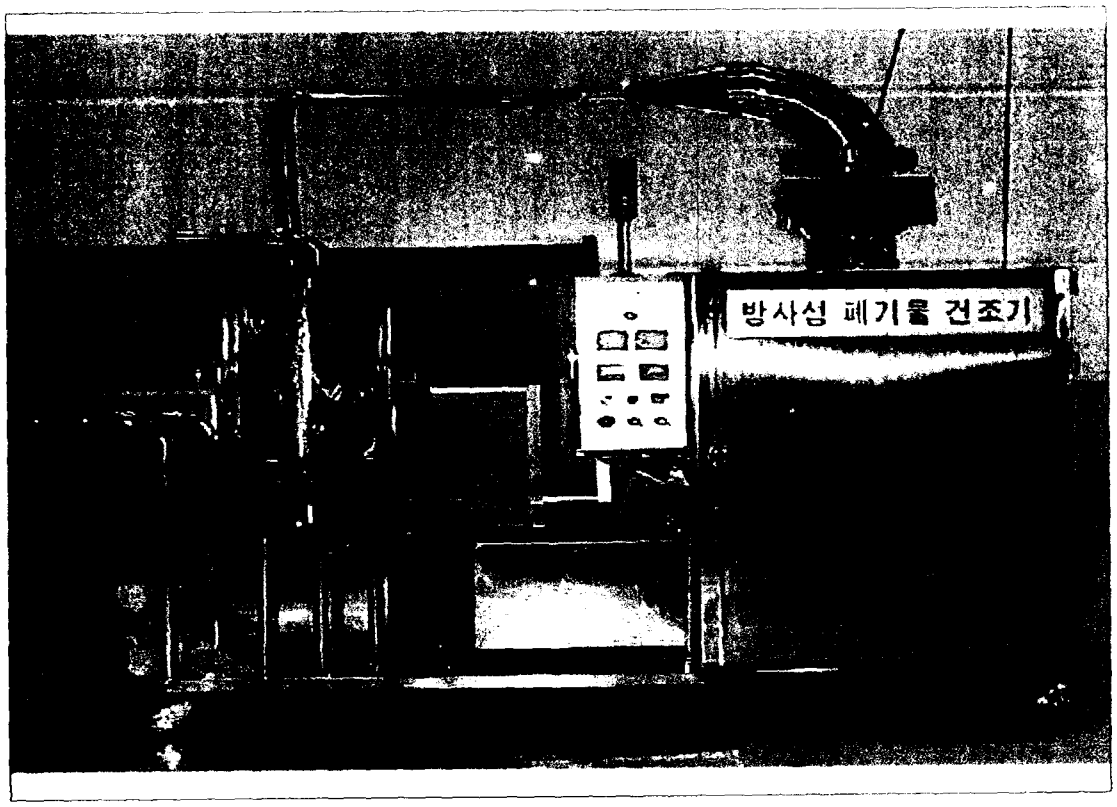


Chart 8. Radioactive waste drying equipment