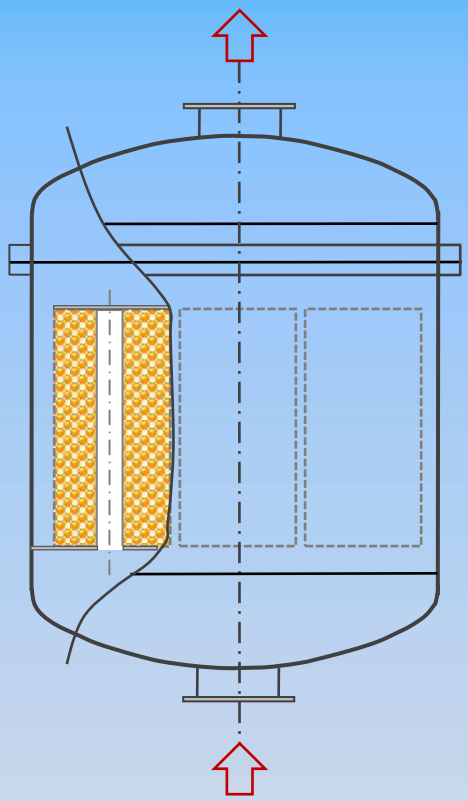
Removal of Radioactive Organic Iodine

AgX Filter



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PREFACE

Since the Fukushima-Daiichi nuclear accident occurred in 2011, Japanese electric companies start to improve safety countermeasures which are taken on the premise that an nuclear accident may happen. Motivation of these countermeasures is to limit the level of radioactive releases into the environment with the objective of protecting on-site operators and residents, and minimizing ground contamination.

Specifically, filtered vent system (FVS) is one of the most important equipment in dealing with the severe nuclear accident. Furthermore, in order to prevent damages by earthquake, tsunami and terrorism, it is useful to design the compact FVS that can be installed underground.

AgX filter can further strengthen safety of FVS. After the Chernobyl disaster, FVS utilizing AgX filters in WET or DRY has been developed in Europe. This type FVS can remove the radioactive organic iodine which is very harmful to the human body.

ISSUES IN FILTERED VENT SYSTEM

1.Conventional WET system cannot effectively remove radioactive organic iodine.

2.When a severe accident occurs, a large amount water vapor will be generated. Due to the condensation of water vapor, the performance degradation of adsorbents like silver-exchanged zeolite is concerned.

3.High hydrogen concentration will be generated. If hydrogen countermeasure is not taken effectively, the combustion or explosion will likely occur.

4.Countermeasures of the anti-earthquake, -tsunami and preventing terrorism activities are necessary. For this reason, the compact design is required.

5.Radioactive organic iodine has a great of influence on human body, and hundreds times toxicity compared to other radioactive substances.

FEATURES OF AgX FILTER

1. AgX filter exhibits excellent adsorption characteristics of radioactive organic iodine even under the harsh conditions like severe nuclear accident.
2. It has been confirmed that High adsorption efficiencies can be kept even if the residence time is as short as 0.16 second. Therefore, it is possible to design a compact filter.
3. High adsorption performance has also been confirmed under the condition that the condensation of water vapor occurs at the start of venting (AgX filter unit operates passively without any power supply).
4. AgX filter unit has the features with seismic qualification and anti-stress.
5. AgX filter has the adsorption effect of hydrogen. It is expected that to prevent hydrogen combustion.
6. Excellent adsorption performance has been proved in gas atmosphere simulated a severe accident.
7. High adsorption performance has been confirmed when AgX filter is long-term exposed in the environment with high humidity.
8. Non-flammability. Secondary disasters such as fire will not occur.

APPLICATIONS OF AgX FILTER

1.As an organic iodine filter subsequent to the filtered vent in WET system.

※ It is possible to change the specification according to processing off-gas volume and conditions.

2. As an organic iodine filter subsequent to the filtered vent in DRY system.

※It is available to change the specification and to take the countermeasure of decay heat according to processing off-gas volume and conditions.

3.As an organic iodine countermeasure filter of the strengthened anti-stress vent in BWR.

4.As a substitute for activated carbon filter in annulus and SGTS.

※ Correspondence of small processing off-gas volume is possible. AgX filter can be designed with smaller volume than that of activated carbon.

5. It can also serve air condition in emergency management room and central control room.

※ Similarly, AgX filter unit shown in item 4 can also be designed and manufactured according to required specification.

REMOVAL CHARACTERISTICS OF ORGANIC IODINE

Table 1 Dependences of absorption efficiency of CH_3I on the temperature of superheated steam. The evaluation was performed by TÜV SÜD.

Bed depth (mm)	Residence time (sec.)	Absorption efficiency (%)				
		99 ºC (DPD* 0 K)	101 ºC (DPD 2 K)	104 ºC (DPD 5 K)	109 ºC (DPD 10 K)	114 ºC (DPD 15 K)
50.8	0.16	99.860	99.922	99.913	99.964	99.990
76.2	0.24	99.988	99.995	99.974	99.990	99.998
101.6	0.32	99.997	99.999	99.989	99.999	99.999

*DPD: Dew Point Distance.
Other test conditions. Radioiodine: CH_3I (I-131); gas comp.: steam/air=95/5 (super heated gas); P=0.98 bar.

Table 2 Relationships between absorption efficiency of CH_3I and bed depth at the high temperature, relative humidity (RH) and pressure. The evaluation was performed by NUCON International Inc.

Bed depth (mm)	Residence time (sec.)	Absorption efficiency of CH_3I (%)
T=130 ºC; RH=95 %; P=399 kPa		
50.8	0.246	99.967
76.2	0.369	> 99.999
101.6	0.492	> 99.999

Other test conditions. Linear velocity (LV)=20 cm/sec.; Radioiodine: CH_3I (I-131).

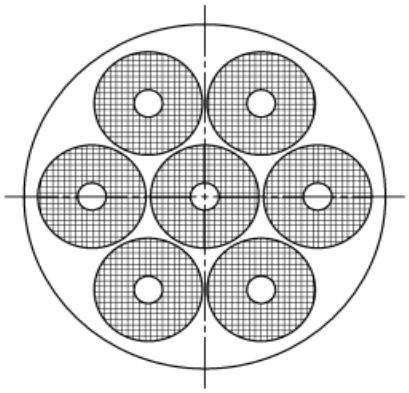
Table 3 Absorption efficiencies of CH_3I on AgX at different temperatures and relative humidity. The evaluation was performed by NUCON International Inc.

Bed depth (mm)	Residence time (sec.)	Absorption efficiency of CH_3I (%)			
		RH 95%			RH 70%
		30 ºC	60 ºC	90 ºC	66 ºC
50.8	0.250	98.738	99.685	99.970	> 99.999
76.2	0.375	99.850	99.950	99.983	> 99.999
101.6	0.500	99.962	99.987	99.995	> 99.999

Other test conditions. P=103 kPa; LV=20.3 cm/sec.; Radioiodine: CH_3I (I-131).

STANDARD SPECIFICATIONS OF AgX FILTER USED IN WET SYSTEM

Flow Rate	25,000 m^3/hr
Max. Operating Pressure	350 kPa
Max. Operating Temperature	200 °C
Max. Pressure Loss	5 kPa
D F	> 100
Applied Standard	JSME, ASME
Seismic Class	S s (Japan Special Criteria)
Material	SUS316L
Mass (Approx.)	15 t



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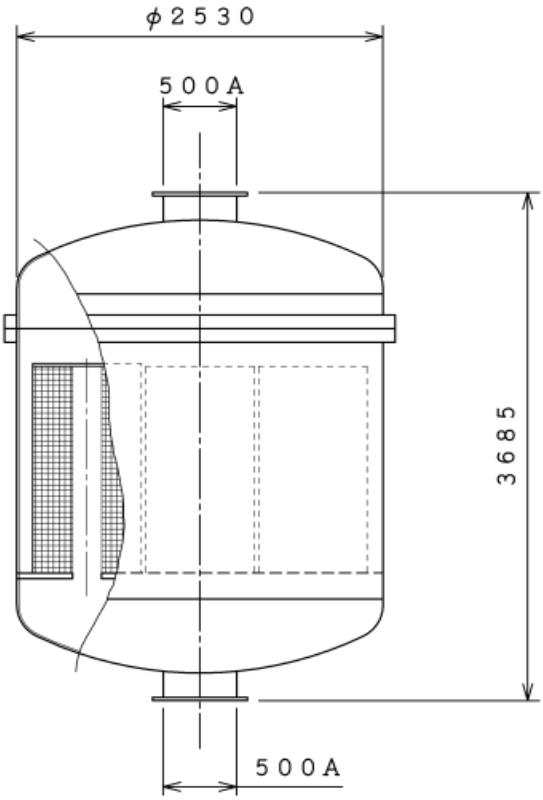

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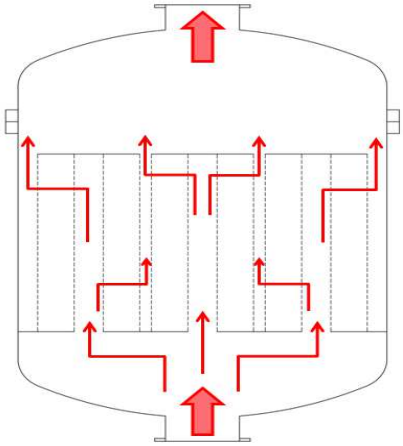

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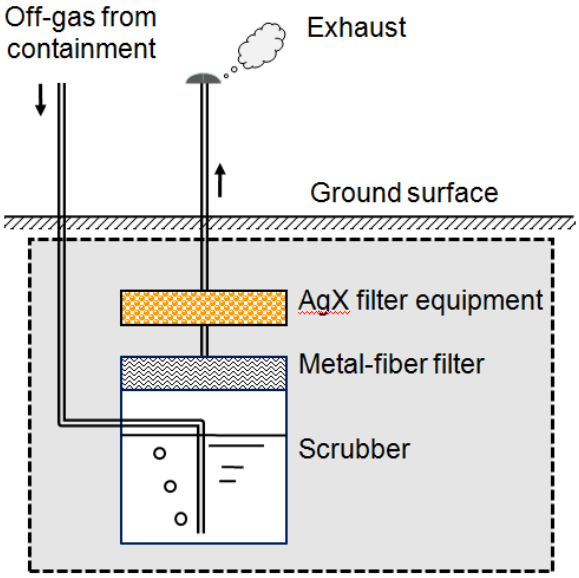

(d)

Fig. 1 Diagram of AgX filter unit and its application. (a) Top view; (b) Front view and dimensions; (c) Flow path; (d) Application to WET-system.

CONTACT INFORMATION

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