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Safe Storage of Zeolite Adsorbents used for Treatment of Accident-generated Water at Fukushima Daiichi Power Station

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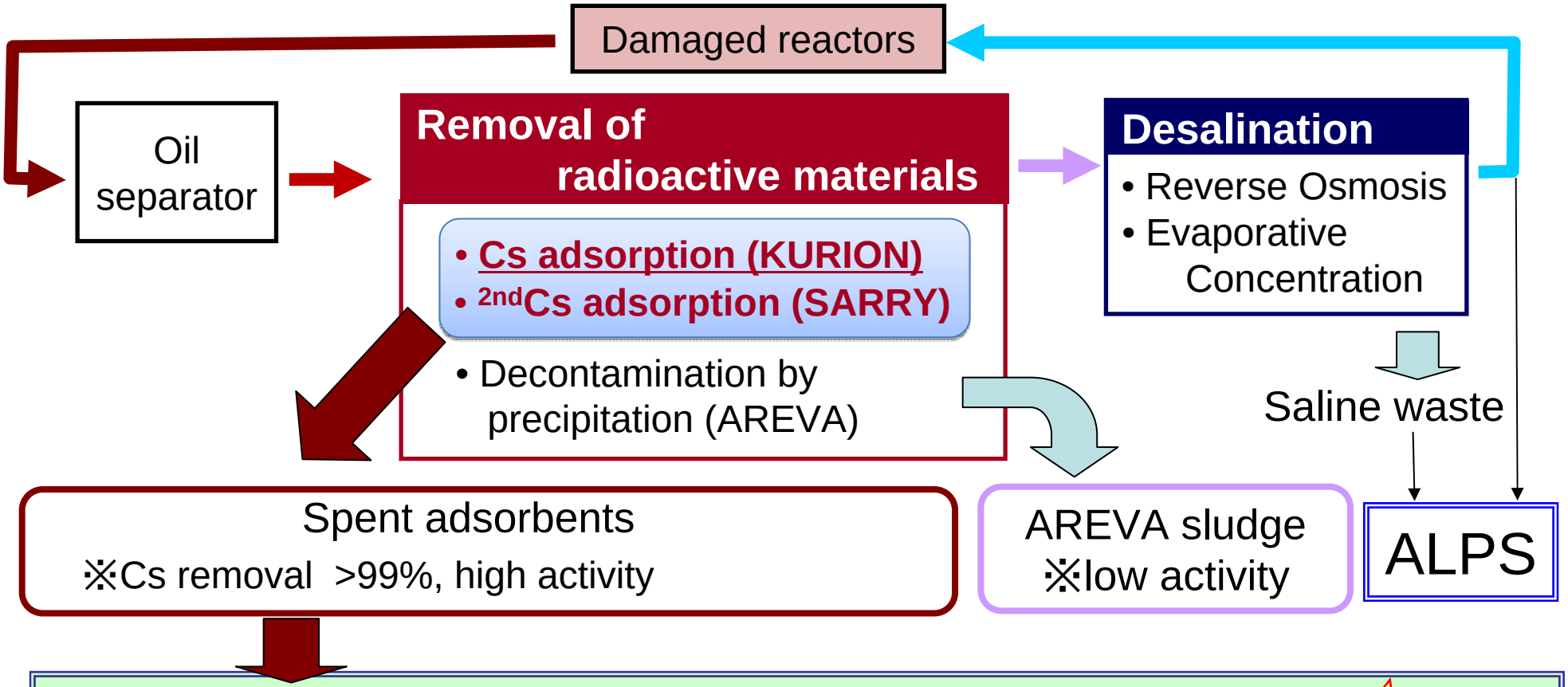
Safe storage of radioactive zeolites

Circulating Water Cooling at Fukushima-1 NPS



- Characterization of spent KURION media
  - ➢ *Radioactivity, thermal conductivity, etc.*
- Verification of its safe storage
  - ➢ *Hydrogen by water radiolysis, corrosion, etc.*

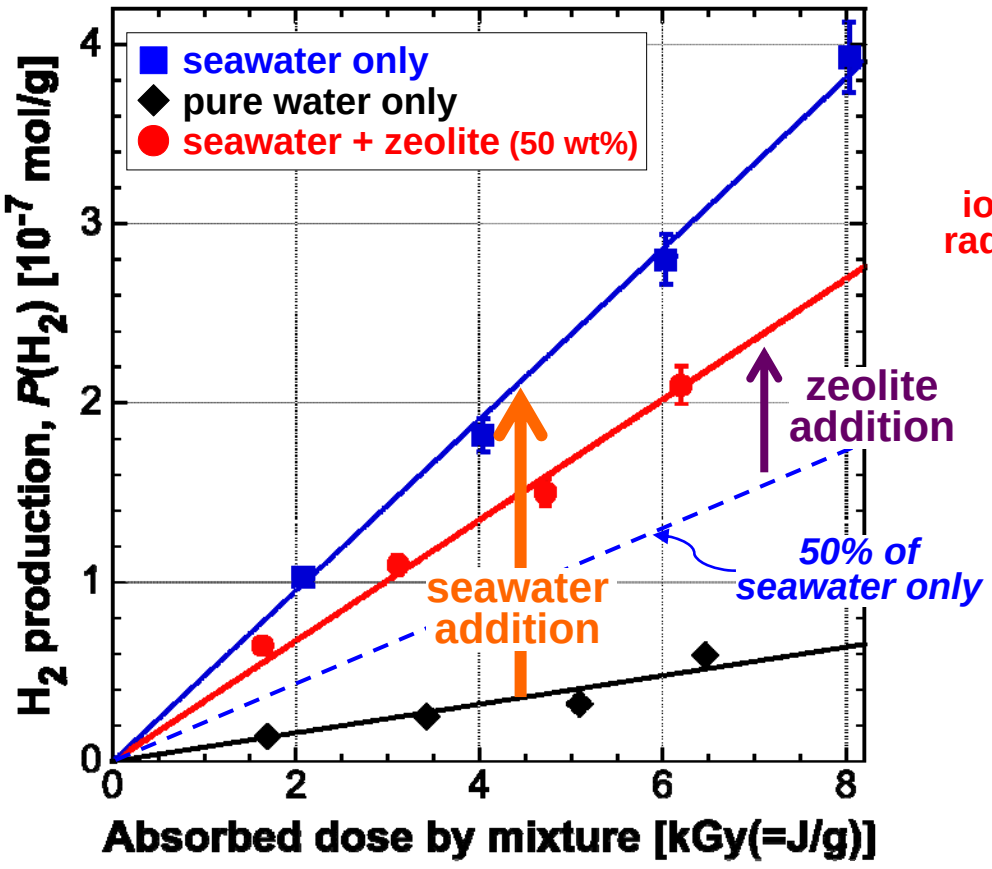
Seawater

Hydrogen production from zeolite mixtures

Dose dependence of H_2 production[*1]

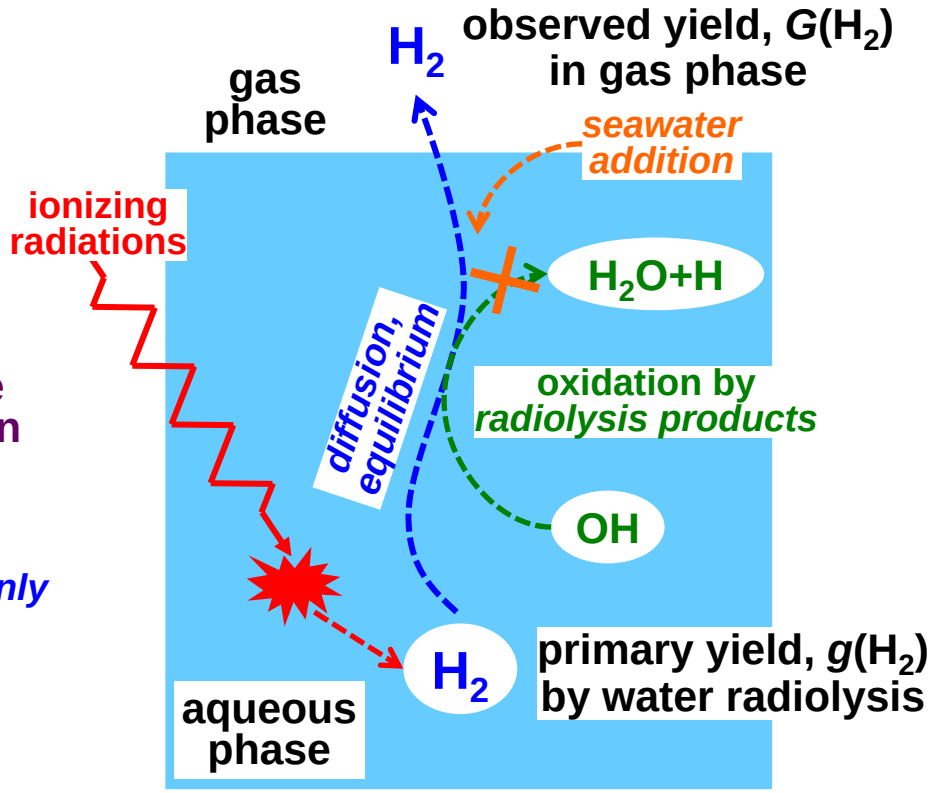
*1 Kumagai *et al.*, *Transactions of the AESJ*, 10(4), 235 (2011).

Air-sat., R.T., dose rate1-4 kGy/h



P [mol/g] = G [mol/J] × D [J/g]

Formation of H_2 in aqueous phase and emission up to gas phase



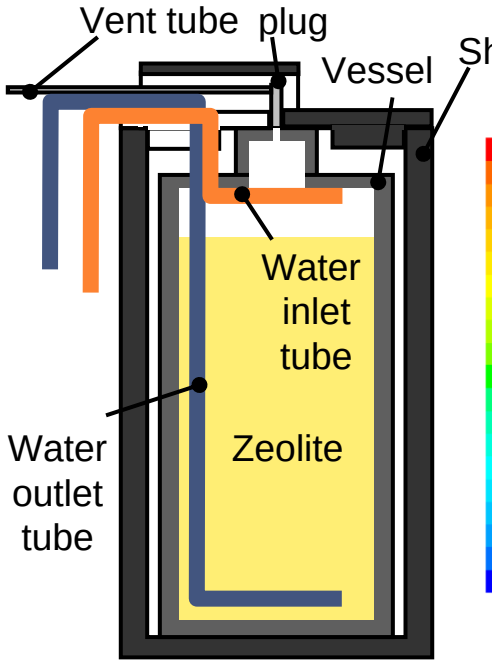
$G(H_2) \leqq g(H_2)$

- H_2 production: seawater(100 wt%) > seawater(50) + zeolite(50) > pure water(100).
  Because H_2 is oxidized to H_2O in pure water but not in seawater.
- Desalination & Dehydration are important for safe storage.

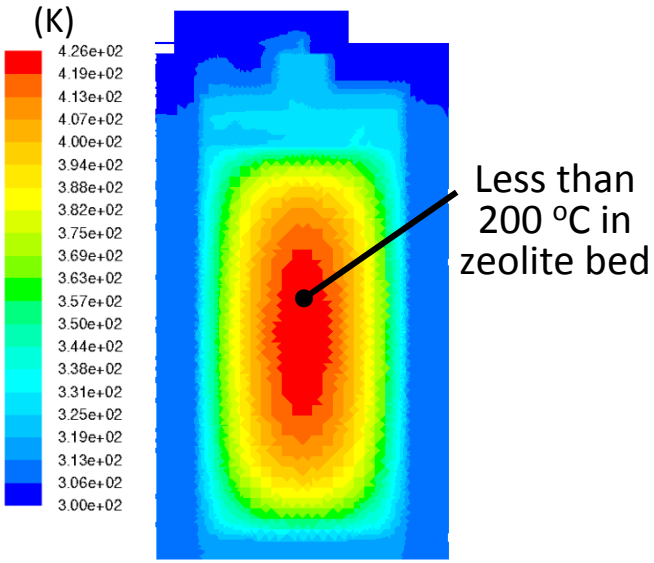
Estimation of temperature and hydrogen in vessel

Thermal-hydraulic analysis

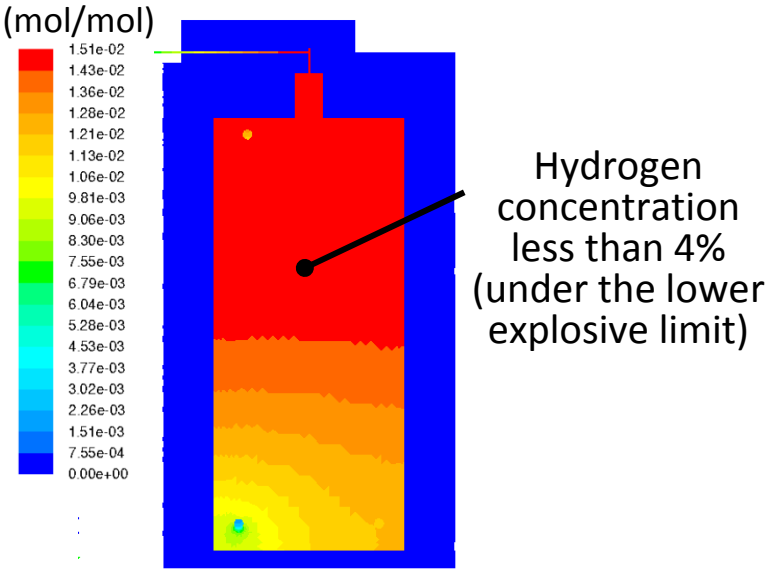
- Model, code: 3D full structure, FLUENT
- Zeolite: dried Herschelite loading Cs 0.07wt%



Schematic of KURION adsorption vessel & shield



Temperature

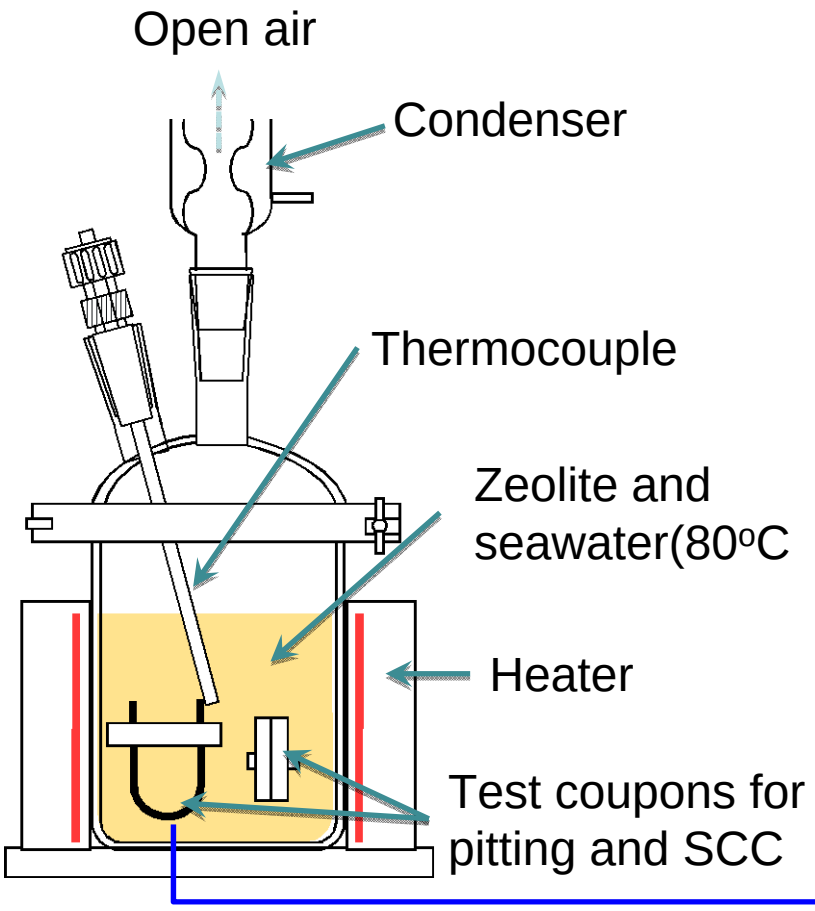


Hydrogen molar fraction

- The maximum temperature of zeolite bed (153°C) became **lower than the self-ignition temperature of hydrogen** (about 560°C).
- Opening end lines of water inlet/outlet and vent tubes, a kind of siphon effect occurred by buoyancy and difference of mixed gas density. **H_2 concentration in a vessel is kept lower than 4%**(the under explosive limit) .

⇒ Opening of the tubes is effective for decreasing of H_2 concentration

Corrosion of adsorption vessel with seawater



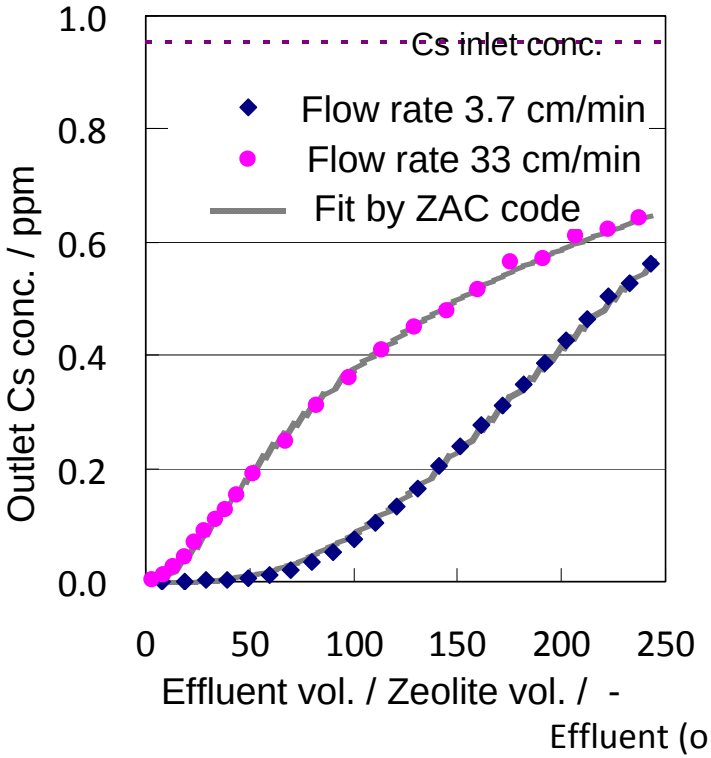
Penetrant testing (dye check) of U-bend coupons after 2000h-test in artificial seawater with zeolite (Mordenite)

Cl : 2000ppm	Cl : 6000ppm
	

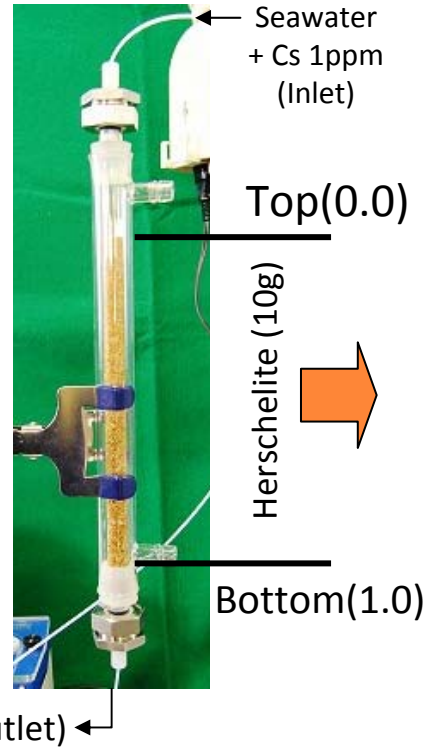
- Stress Corrosion Cracking (SCC) was not observed on the surface of U-bend coupons after the 1000-hour test (Cl^- 20,000 ppm) and 2000-hour tests (Cl^- 2,000 and 6,000 ppm) at 80 °C.

Estimation of Cs in zeolite by ZAC code

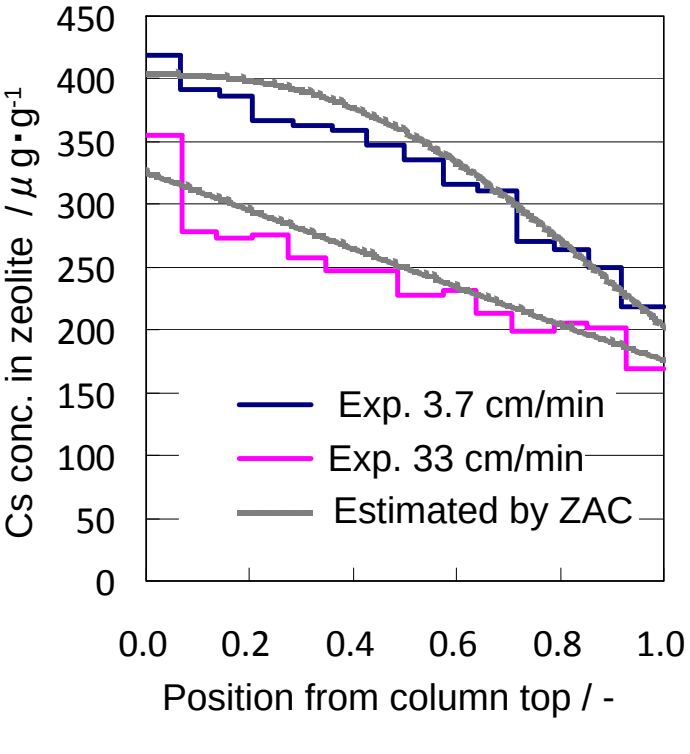
ZAC (Zeolite-Adsorption Column) code



Analysis of Cs in effluent



Column experiment



Estimation of Cs in zeolite

- Distribution of Cs in a vessel is a primary input for more precise evaluation.
- Improved code will be applied to the analysis of an actual vessel.

The results essential to the safe storage will be summarized by the end of FY 2013.