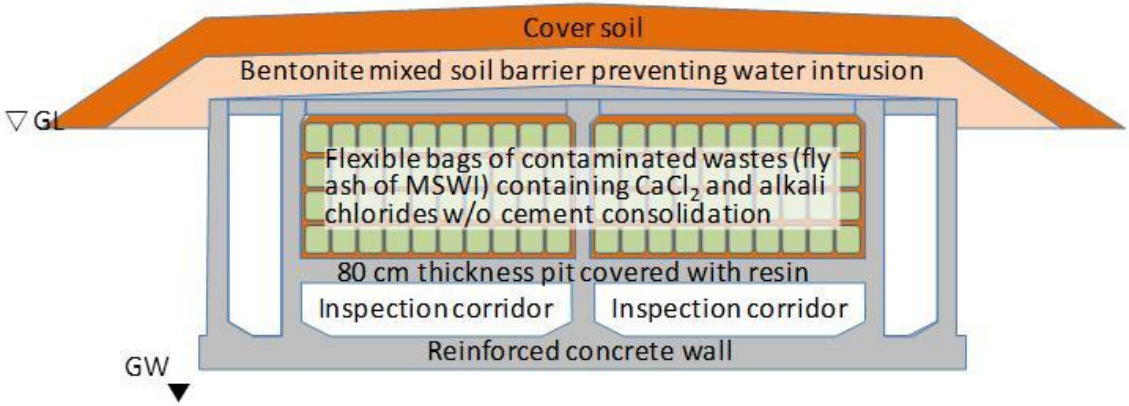
Toward safe disposal of radioactively contaminated municipal solid waste incinerator fly ash -Moisture absorption and Cs immobilization-



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Problems of radionuclide contaminated wastes in artificial extensive recovering system

Release
(^{134}Cs・^{137}Cs)

Moving, Spread

Rainfall

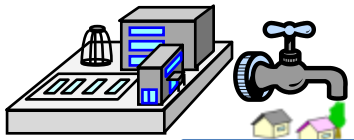
Deposit to land

Concentration
Volume reduction
(bottom ash, insoluble)
Evaporation-deposition
(fly ash, water soluble)

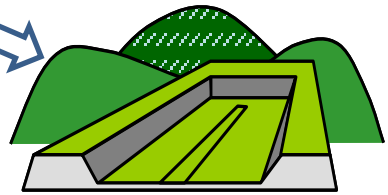
Water sludge

Soil

Incineration



Decontamination



Final disposal site

General wastes
Municipal solid waste

Vegetation

Cs absorption

Cs contaminated soil wash out

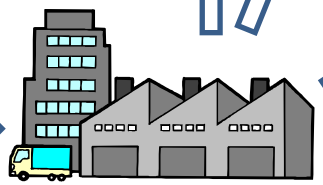
下水管

Swage sludge

Osako（2011）

Disaster waste

Construction waste



Crashing selection

Recycle

Examples of major elements in fly ash of MSWI

	Moving gates		Fluidizing bed	
	mass%	(soluble)	mass%	(soluble)
Ca	23.3	(8.5 %, 23.6 % as $CaCl_2$)	21.3	(1.8 %, 5.0 % as $CaCl_2$)
K	4.0	(3.6 %, 6.8 % as KCl)	3.1	(1.8 %, 3.4% as KCl)
Na	3.2	(2.3 %, 5.8 % as NaCl)	4.1	(1.9%, 4.8 % as NaCl)
Cl	25.2	(19.5 %)	10.7	(7 %)
Al	2.3		5.5	
Si	7.7		9.2	
Cs	2.7 ppm	(1.7 ppm)		

Fly ash of MSWI = Powder including

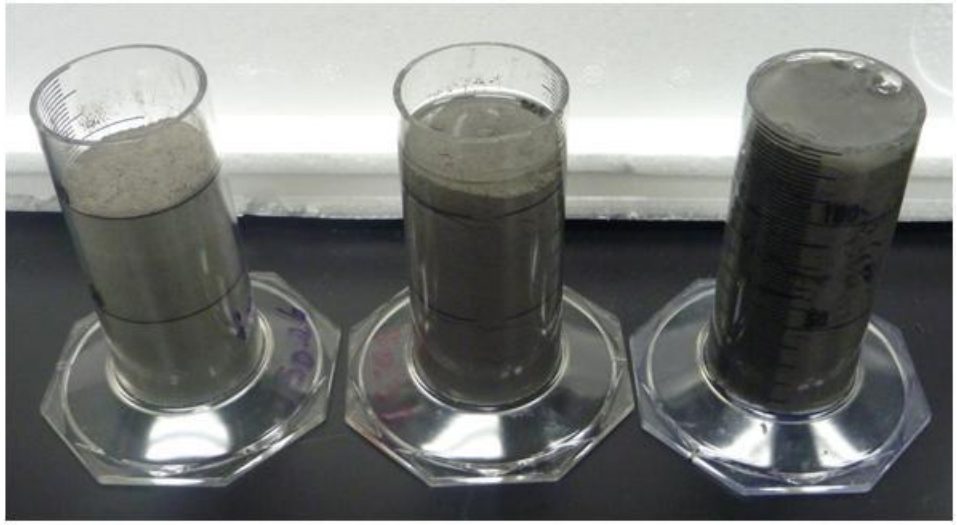
Large quantity of $Ca(OH)_2$ and $CaCl_2$ = 2 mol/kg,

NaCl = 1 mol/kg, KCl = 1 mol/kg

Majority of stable and radioactive Cs is water soluble.

Final disposal of deliquescent salt powder is a challenging subject.

Self generation of concentrated chloride solution



$CaCl_2$ = 10 wt%　　20 wt%　　30 wt%
Moisture absorption of MSWI-FA
1000 hrs at 30 ºC and 90 %RH.

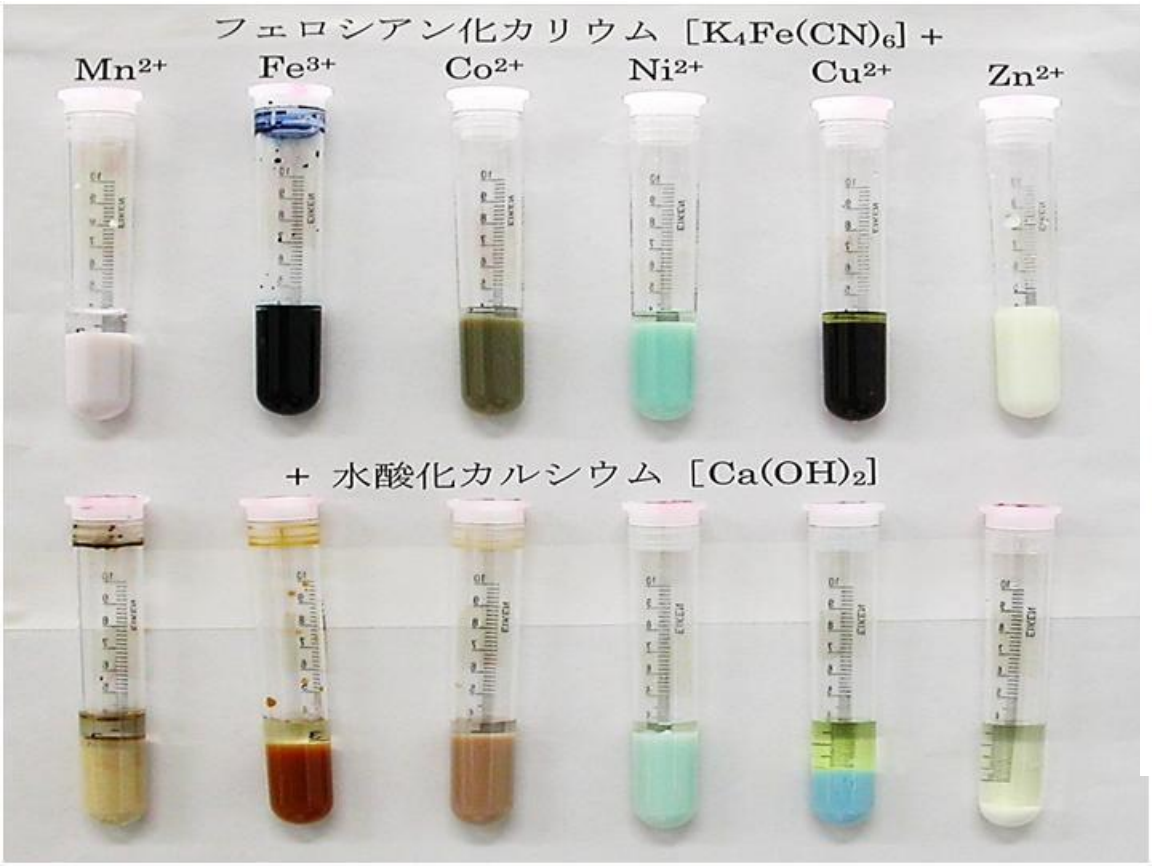
Modeling of moisture absorption

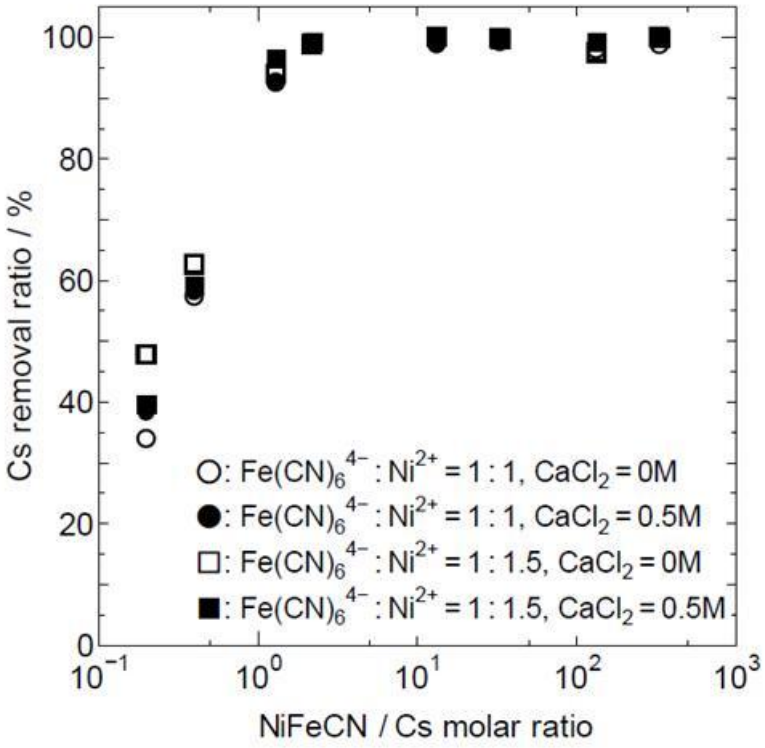
$T = (L\phi/100)^{1/2}/k$
L: height of MSWI-FA,
ϕ: porosity of MSWI-FA in %,
k: rate of moisture absorption

$k = CH^{3.2}\exp(-4790/K)$
K: absolute temperature,
H: relative humidity

The leaching time of MSWI-FA containing 30 wt% of $CaCl_2$ is estimated as 6000 days.
Assuming the moisture absorption for two months/year at 30 ºC and 90 %RH,
The leaching time is 100 years, long enough for decreasing the radioactivity of Cs-137.
However, if the height of MSWI-FA is reduced to 1/10, the leaching time is shortened to 60 days.
Therefore, insolubilization is required.

Stability of ferrocyanides in alkaline solution & adsorption of Cs





- Only NiFeCN is stable in alkaline solution.
- 2 mole of NiFeCN is enough to remove 1 mole of Cs from alkaline solution, so that the required amount of NiFeCN is less than 100g per one ton of MSWI-FA.