

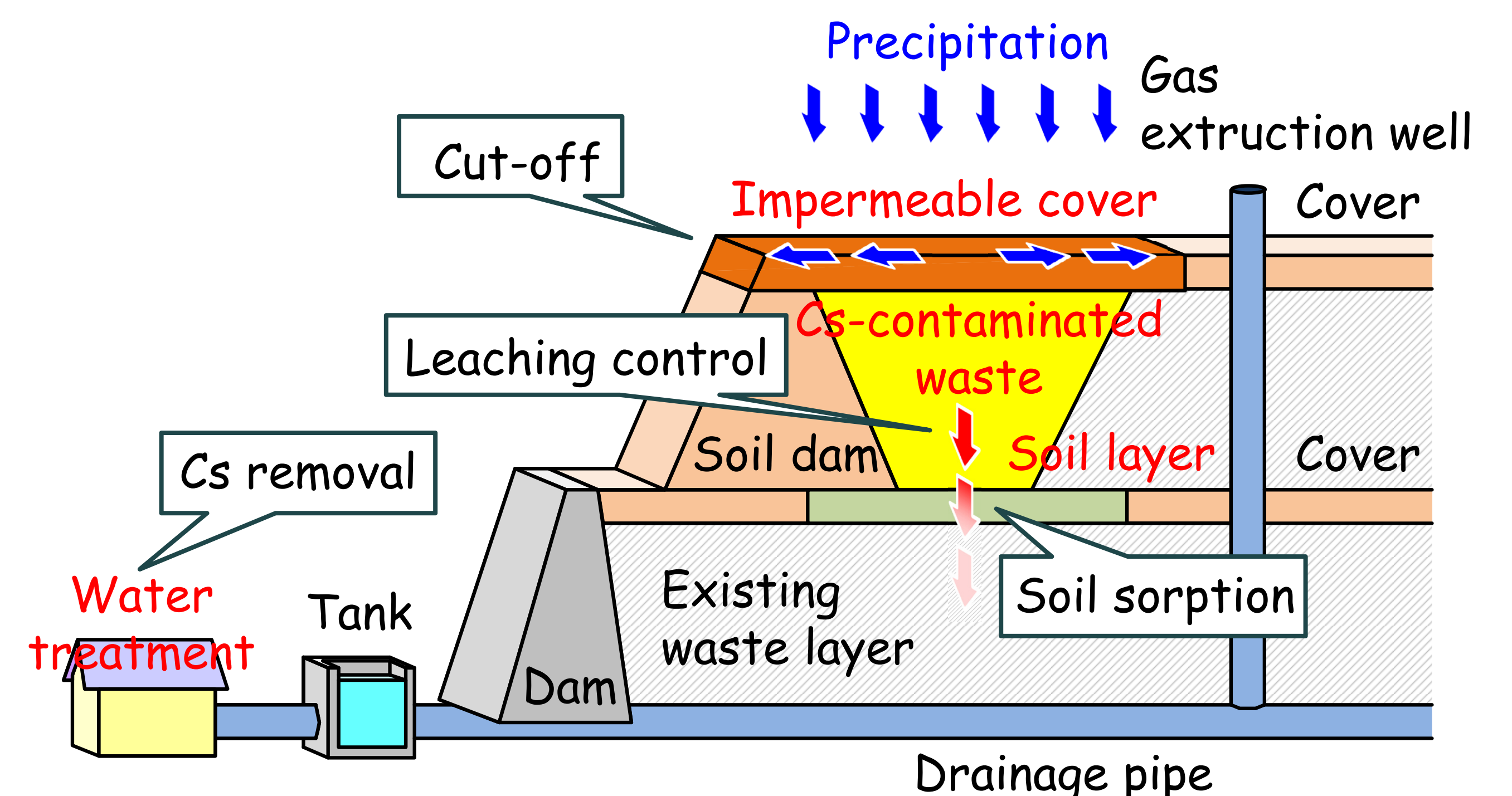
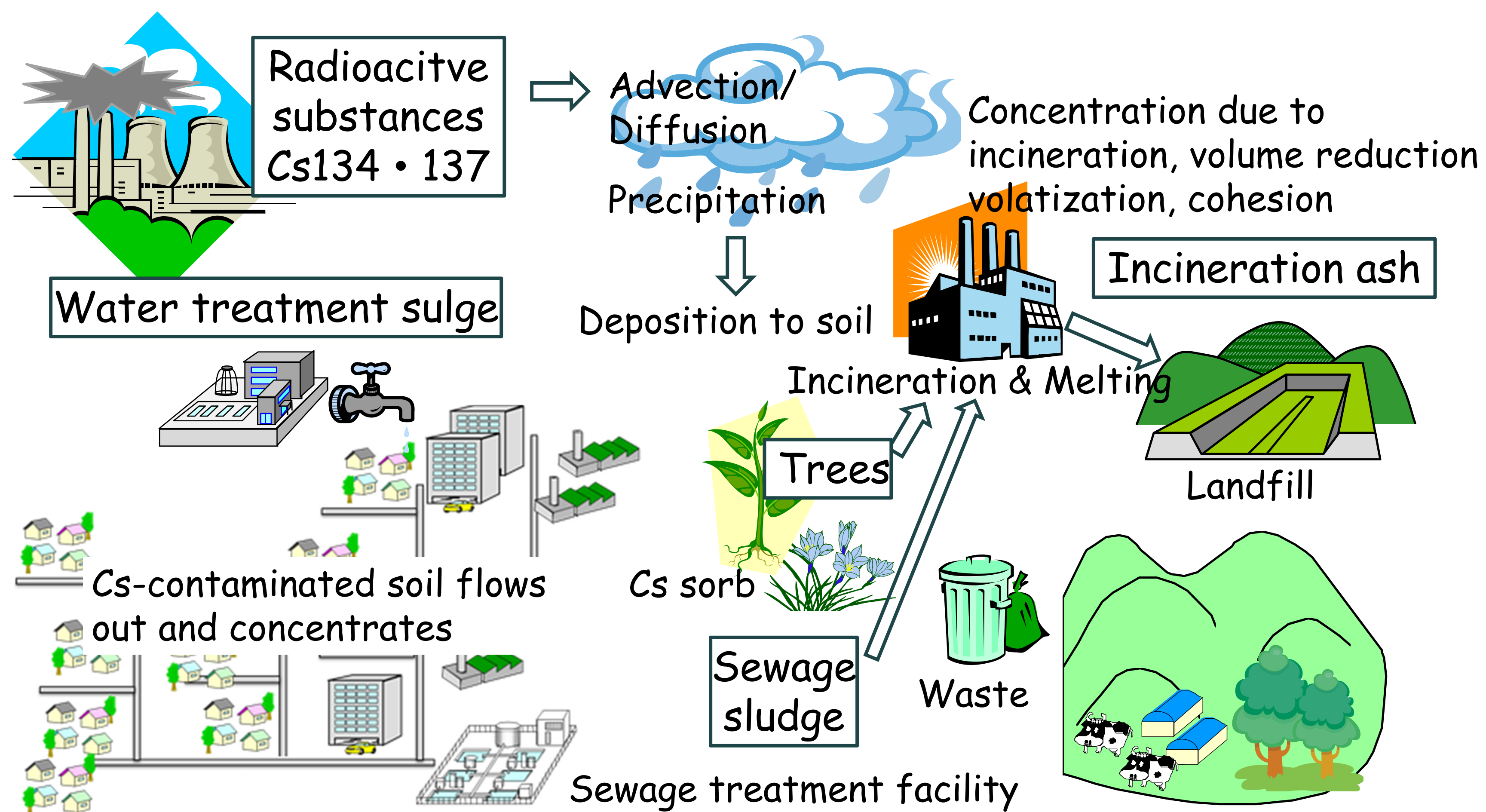
Numerical Model for Leaching & Transporting Behavior of Radiocesium in MSW Landfill

Hiroyuki Ishimori¹, Hirofumi Sakanakura², Kazuto Endo², Masato Yamada², Masahiro Osako²

¹ Ritsumeikan University, 1-1-1 Noji-Higashi, Kusatsu, Shiga, Japan, 525-8577

² National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki, Japan, 305-0053

Radiocesium-Contaminated Wastes and Final Disposal ~Fukushima Daiichi nuclear disaster~



Design concept ~Multibarrier system~

Radiocesium naturally attenuates with time. Many defense technologies are combined in multiples, and the radiocesium can be maintained in landfill. Therefore, it can be decreased to a harmless concentration level.

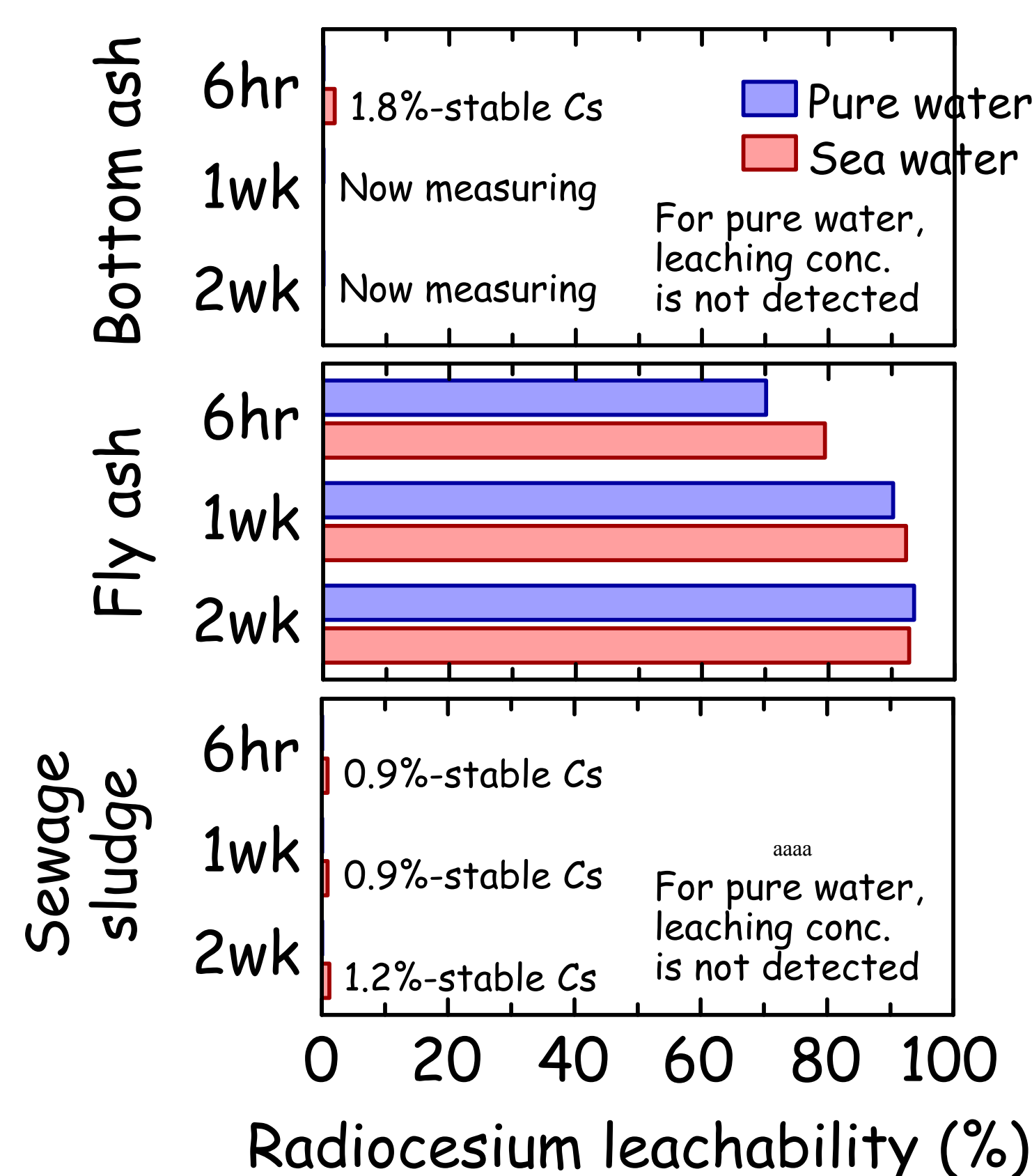
Radiocesium Leaching and Transporting Model

Leaching tests

~Radiocesium leachability to water~



Evaluate the leaching rate of radiocesium in incineration ashes



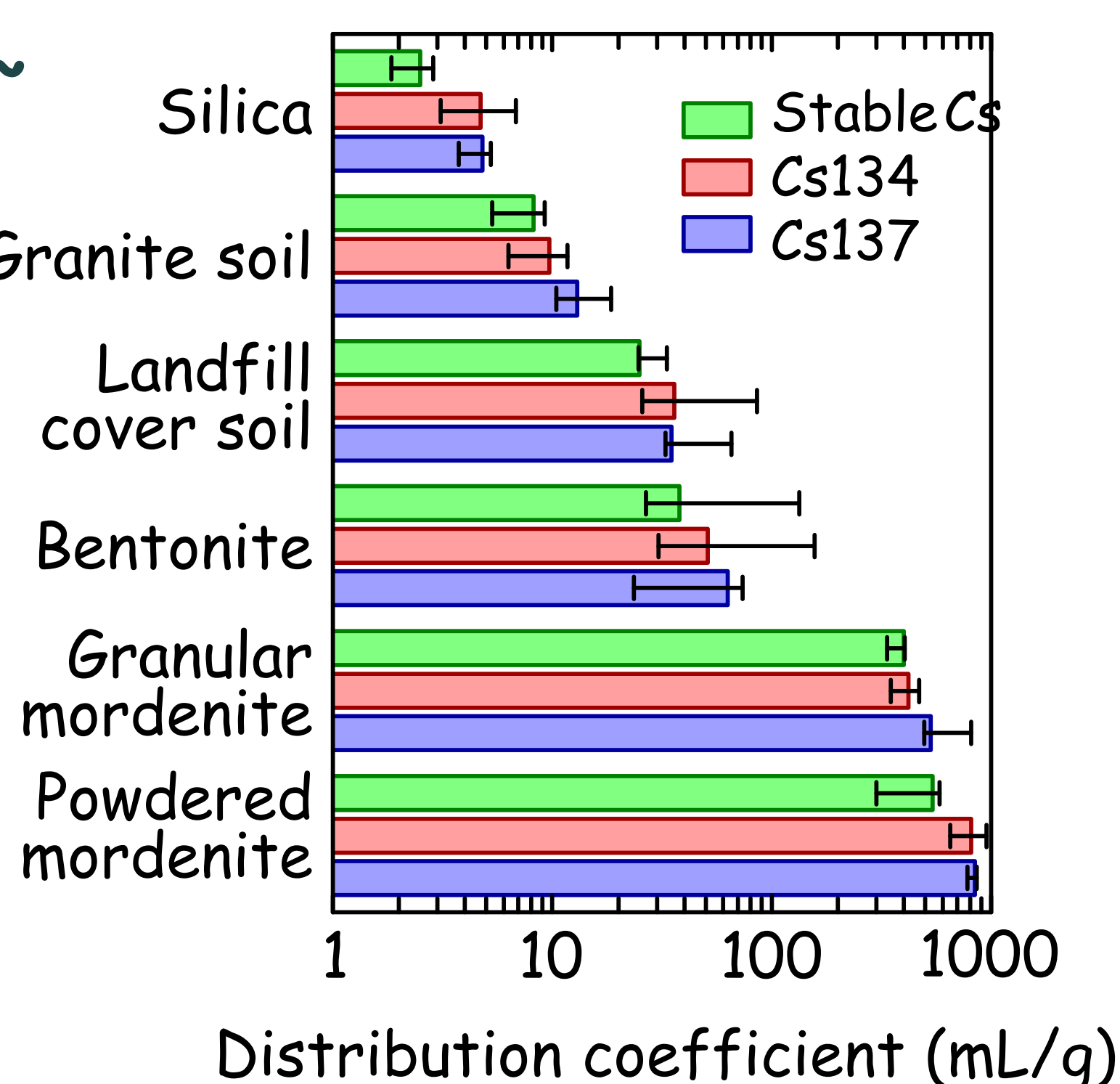
Take care about the landfill of fly ash because of the large leachability

Soil sorption tests

~Distribution coefficient in leachate~



Measure the concentration in the solid phase using waste leachate



Note the handling of these values, because the distribution coefficients are significantly dependent on the chemical compositions of leachate

Numerical simulation model

~Radiocesium leaching and transporting behavior~

Flow Equation
(Richard's model)

$$\frac{\partial(\rho_w \theta_w)}{\partial t} = \nabla \cdot \left[-\rho_w \frac{k_{rw} K}{n_w} (\nabla p_w + \rho_w g \nabla z) \right]$$

Transport Equation
(Advection-dispersion model)

$$\frac{\partial(c_w \theta_w)}{\partial t} + \nabla \cdot (-\theta_w D \nabla c_w + u_w c_w) = -\theta_w \lambda c_w + R$$

Cs Leaching & Soil Sorption
(Based on experimental results)

$$R = \rho_d K t^a - \rho_d \frac{\partial S}{\partial t}$$

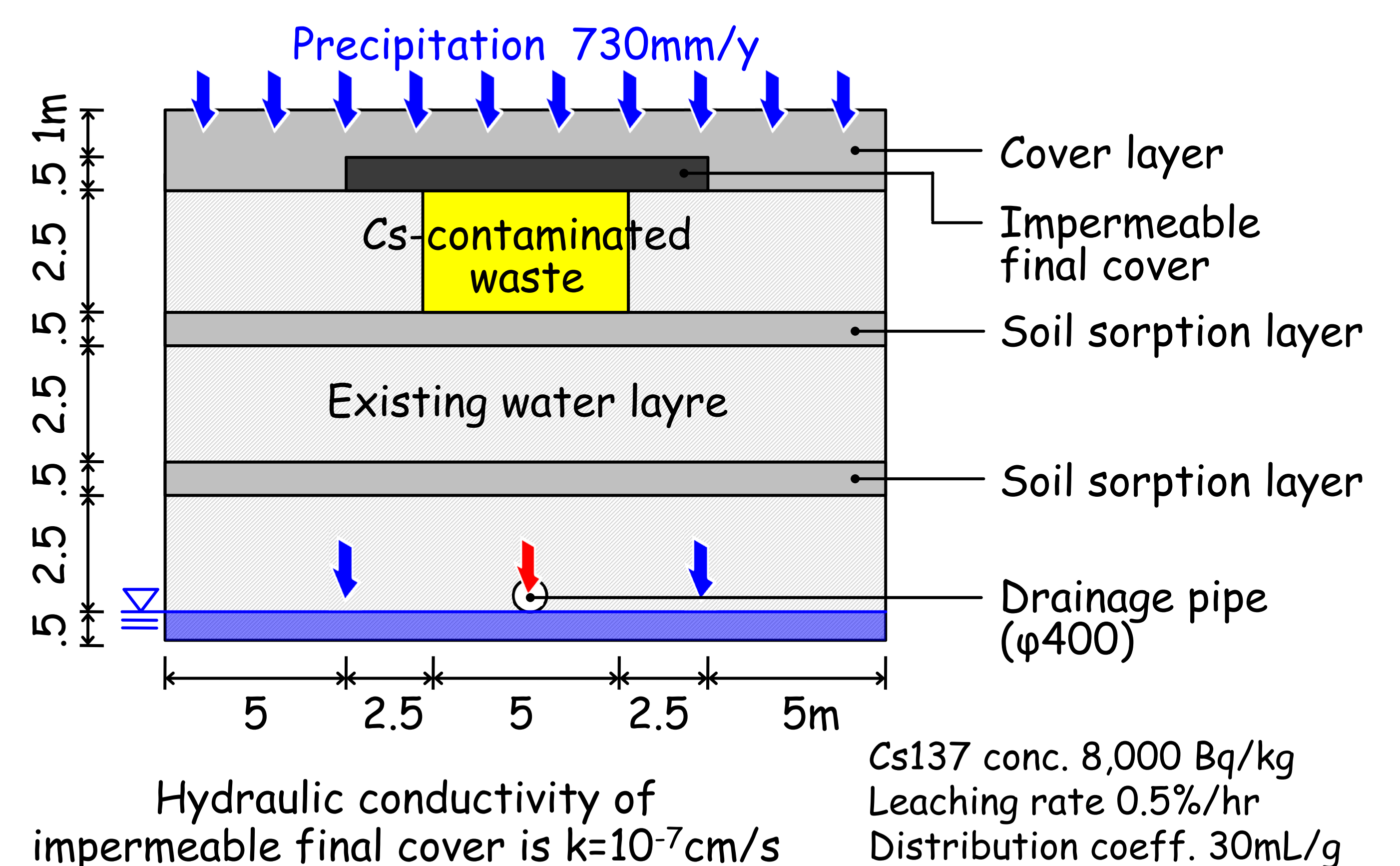
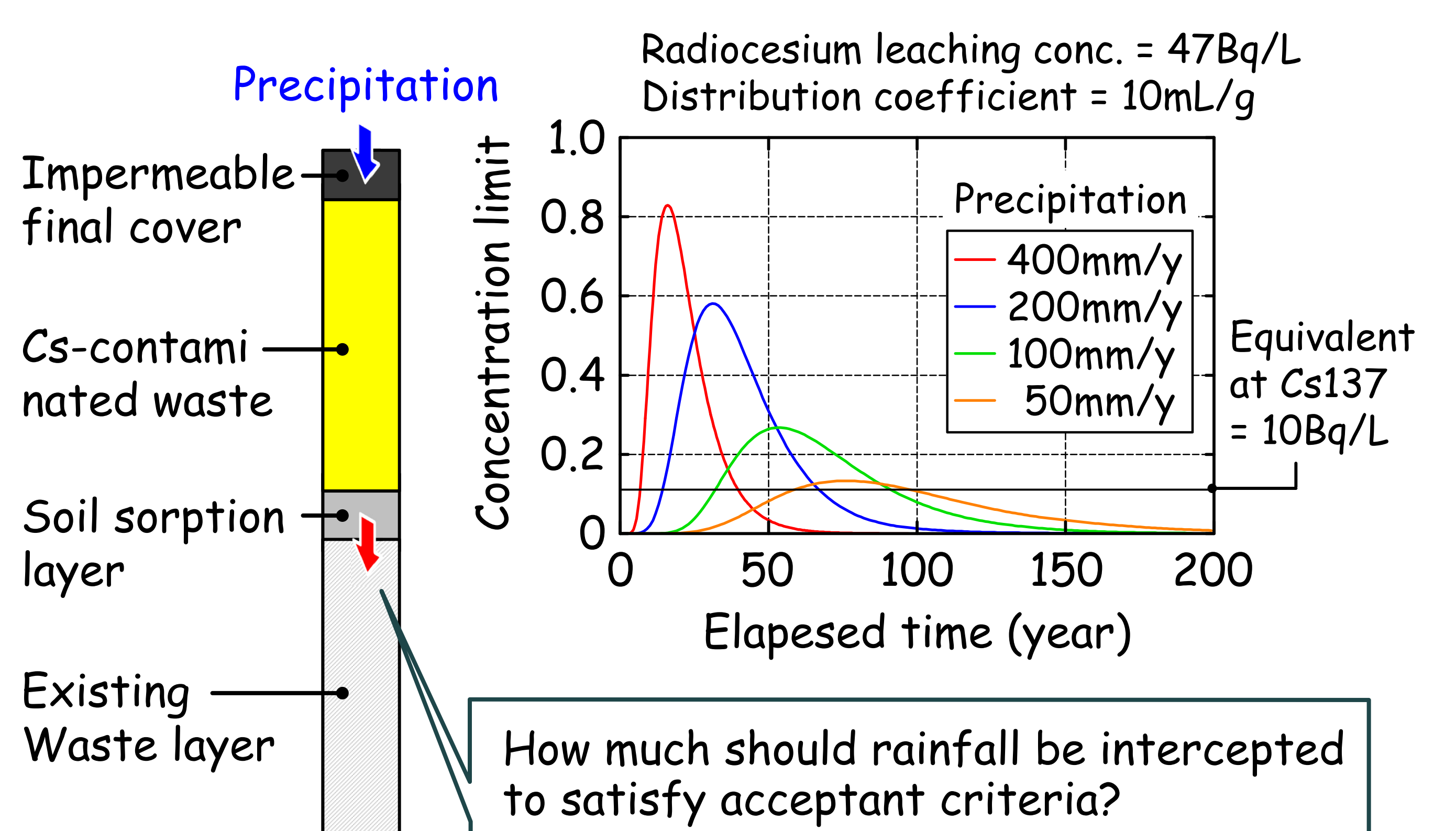
COMSOL can easily solve these equation systems.

Mass balance in solid phase
(Including sorption and decay)

$$\frac{\partial S}{\partial t} = \beta (K_d c - S) - \lambda S$$

Case studies

~Predict radiocesium behavior & design landfill~



Hydraulic conductivity of impermeable final cover is $k=10^{-7}$ cm/s

Cs137 conc. 8,000 Bq/kg
Leaching rate 0.5%/hr
Distribution coeff. 30mL/g

