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Investigation on the Contaminative Influence of Animal Products
Due to the Inhalation of Air and the Ingestion of Soil of Cattle in
Accidental Consequence Analysis

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Abstract

In an accidental release of radioactive materials to the environment, the contaminative influence of animal products due to the inhalation of air and the ingestion of soil of livestock, both of which are dealt with as minor contaminative pathways in most radioecological models but may not be neglected, was investigated with the improvement of the Korean dynamic food chain model DYNACON.

Although mathematical models for both contaminative pathways have been established for considering all animal products and incorporated into the model, investigation was limited to milk. As a result, it was found that both pathways are influential in the contamination of milk in the case of an accidental release during the non-grazing period of dairy cows, *i.e.*, the non-growing season of pasture. In the case of an accidental release during the non-grazing period, the inhalation of air was more influential than the ingestion of soil in the early days following an accidental release. While, it was the opposite with the lapse of time. If precipitation is encountered during an accidental release, contaminative influence due to the ingestion of soil was greater compared with the cases of no precipitation, in general, because of a greater deposition of radionuclides onto the ground. In the case of an accidental release during the grazing period of dairy cows, *i.e.*, the growing season of pasture, radioactive contamination due to the ingestion of pasture was dominant irrespective of the existence of precipitation during an accidental release, consequently the contaminative influence due to the inhalation of air and the ingestion of soil was negligible.

1.

[1].

(dynamic food chain model ;) ,

(FADAS : Following Accident Dose Assessment System [2])

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DYNACON [3]

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[4].

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2.

(interception)

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(absorption)

(desorption)

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(resuspension)

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(compartmental approach method)

[5].

(compartments)

(transfer rate constants)

[3].

$$\frac{dX_i}{dt} = \sum_{\substack{j=1 \\ j \neq i}}^n \lambda_{ji} X_j - X_i \sum_{j=1}^n \lambda_{ij} \quad (1)$$

X_i : i (Bq kg⁻¹ Bq m⁻²)
 λ_{ij} : i j (d⁻¹)
 n : i

(1)

DYNACON

[3] [4]

3.

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$$C(t) = C(t-\Delta t) e^{-(\lambda_d + \lambda_b)\Delta t} + TF \left[(X_A(t) + X_B(t)) F_v + X_C(t) \frac{F_s}{\rho_s L_s} \right] + BR TF [A(t=0) + X_C(t) RF] \quad (2)$$

,

- $C(t)$: t (Bq dry-kg⁻¹ Bq L⁻¹)
- Δt : (=1)
- λ_b : (d⁻¹)
- λ_d : (d⁻¹)
- TF : (d kg⁻¹)
- $A(t=0)$: (Bq m⁻³)
- $X_A(t)$: (Bq dry-kg⁻¹)
- $X_B(t)$: (Bq dry-kg⁻¹)
- $X_C(t)$: (Bq m⁻²)
- RF : (m⁻¹)
- BR : 가 (m³ d⁻¹)
- F_v : 가 (dry-kg d⁻¹)
- F_s : 가 (dry-kg d⁻¹)
- ρ_s : (dry-kg m⁻³)
- L_s : (m)

(2) t , , , t , , t ,

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가 . 가 가 [3,6] , 가 [3]
 . DYNACON

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$$X_A, \quad X_B, \quad X_C \quad (1)$$

4.

DYNACON
 가
 가 , ,
 ,
 (5 1 10 31) 8 15 (227) 3
 15 (74)
 ,
 가 , 1 Bq m⁻³ 가
 0.1 mm hr⁻¹
 가
 1 , 가
 4가
 Case 1 : ()
 Case 2 : 가
 Case 3 : 가
 Case 4 : 가
¹³⁷Cs (30) ⁹⁰Sr (29)
¹³⁷Cs ⁹⁰Sr
¹³⁷Cs ⁹⁰Sr
 ,
 d/L[3]) ¹³⁷Cs (¹³⁷Cs : 3.0 x 10⁻³ d/L, ⁹⁰Sr : 2.0 x 10⁻³
 (¹³⁷Cs : 2 d, ⁹⁰Sr : 3.5 d[3])
 가
 , 가 ⁹⁰Sr
 가

^{90}Sr ^{137}Cs 10 [3].

^{131}I (^{137}Cs ^{90}Sr)
 ^{131}I

가
(elemental iodine) 가 ^{137}Cs ^{90}Sr
10 [4], 0.7 [3]
2 가
1 4가
가 1 ^{137}Cs ^{90}Sr

^{137}Cs ^{90}Sr 가 ^{137}Cs ^{90}Sr
가 가
가 가
가 ^{137}Cs ^{90}Sr
가 ^{137}Cs ^{90}Sr
가 ^{131}I ^{131}I
가 ^{137}Cs ^{90}Sr 0.1 mm hr⁻¹
 ^{137}Cs ^{90}Sr 20 ^{131}I
[4]. ^{131}I

3 [4] 가
2가

Case 1 : ()
Case 2 : 가

Case 1 Case 2

가

6.

[1] H. Muller and G. Prohl, "The Role of Seasonal, Climatic and Meteorological Conditions in Modifying Nuclear Consequences", in : Proceedings of an NEA Workshop on The Influence of Seasonal Conditions on the Radiological Consequences of a Nuclear Accident, pp 139-147, 21-23 September, 1988, Paris (1998).

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[3] W. T. Hwang, G. S. Cho and M. H. Han, "Development of a Dynamic Food Chain Model DYNACON and Its Application to Korean Agricultural Conditions", Journal of Nuclear Science and Technology, 35(6), 454-461 (1998).

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[5] R. E. Faw and J. K. Shultis, "Radiological Assessment : Source and Exposures", pp 523-571, PTR Prentice-Hall, Englewood Cliffs, New Jersey (1993).

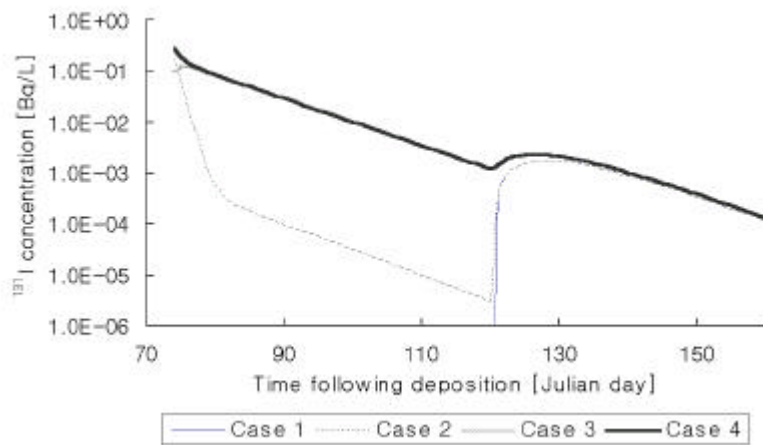
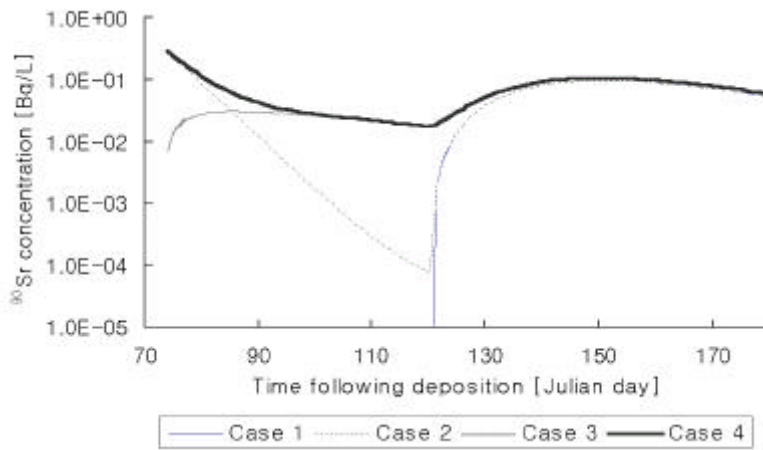
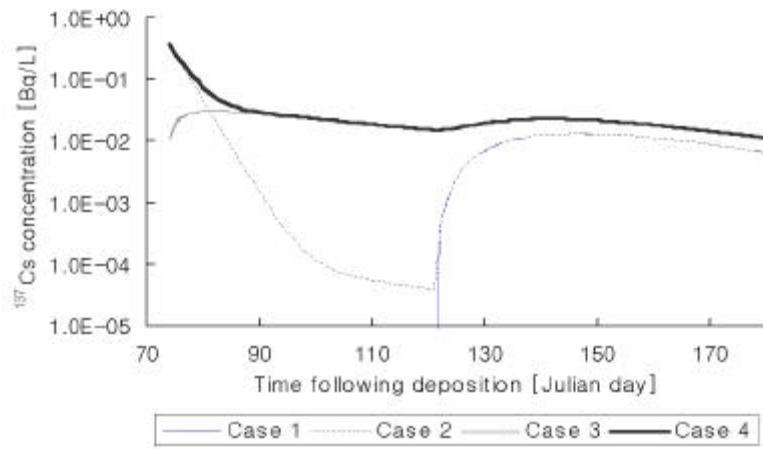
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1. 가

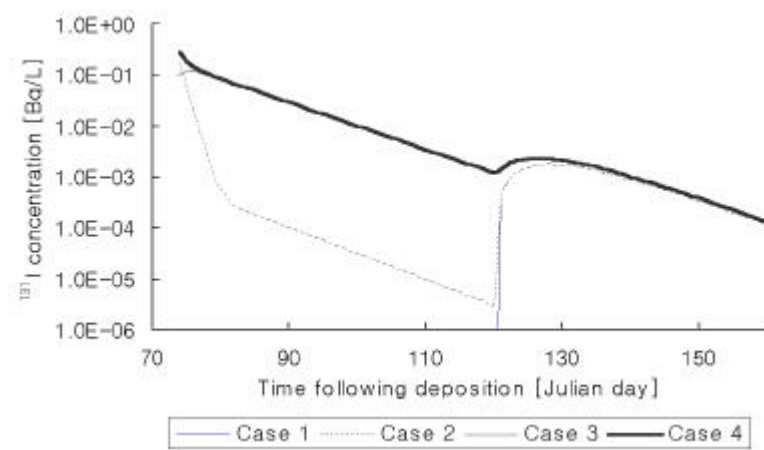
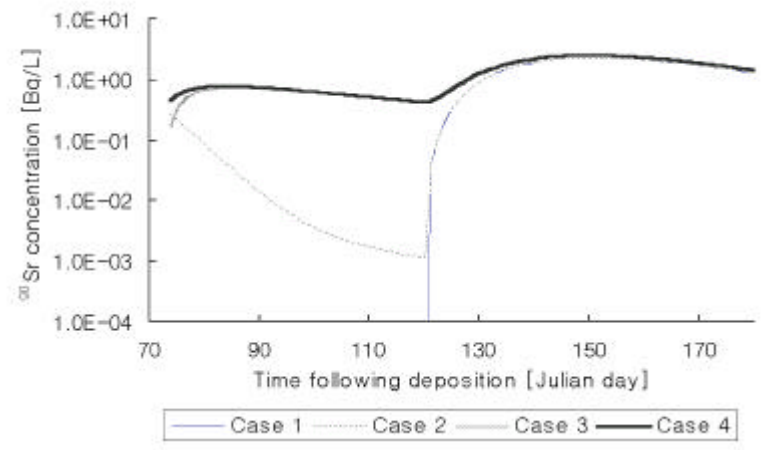
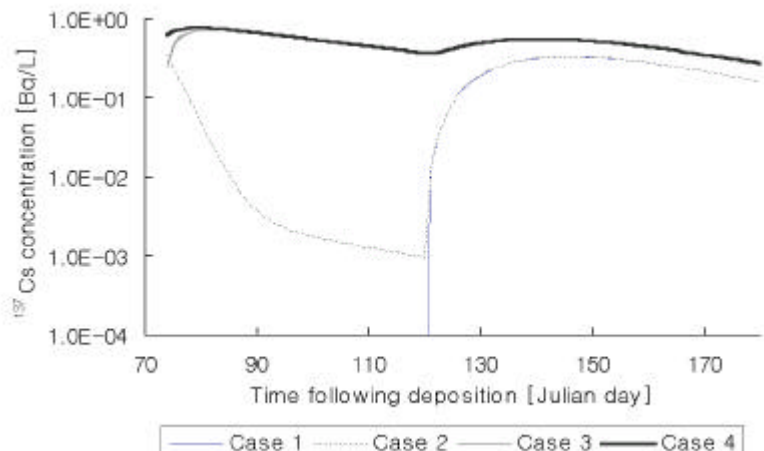
[3,6]

가	(m ³ d ⁻¹)	(kg d ⁻¹)
()	170	0.5
	130	0.5
	30	NG*
	NG*	0.01

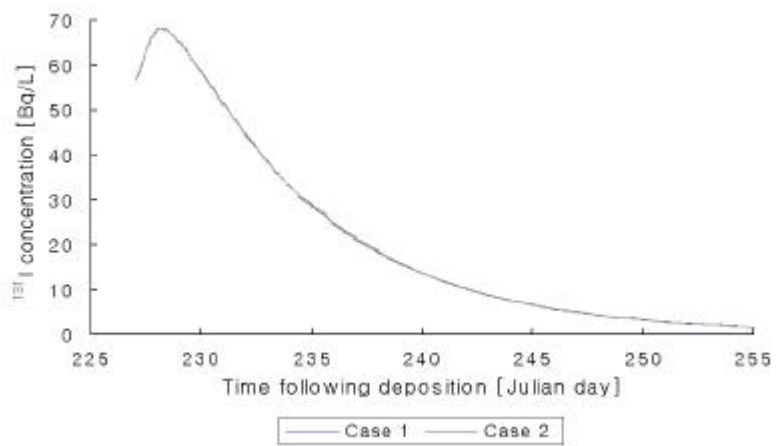
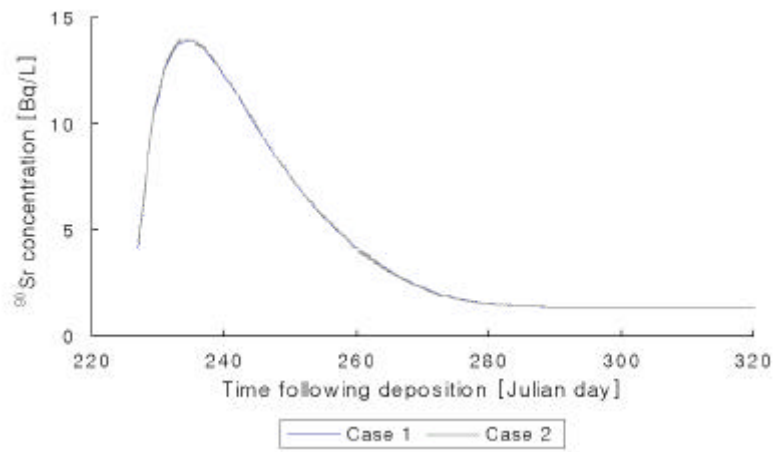
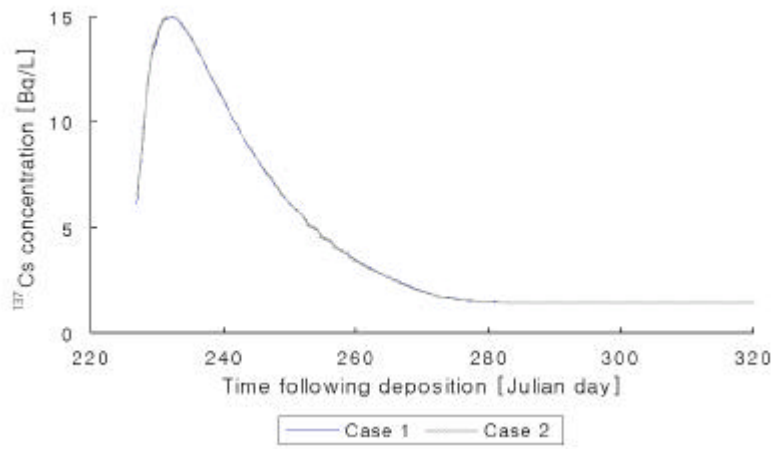
* 가



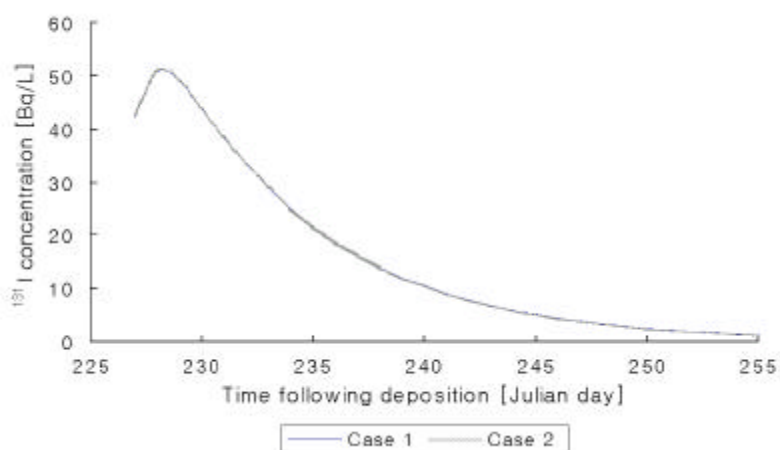
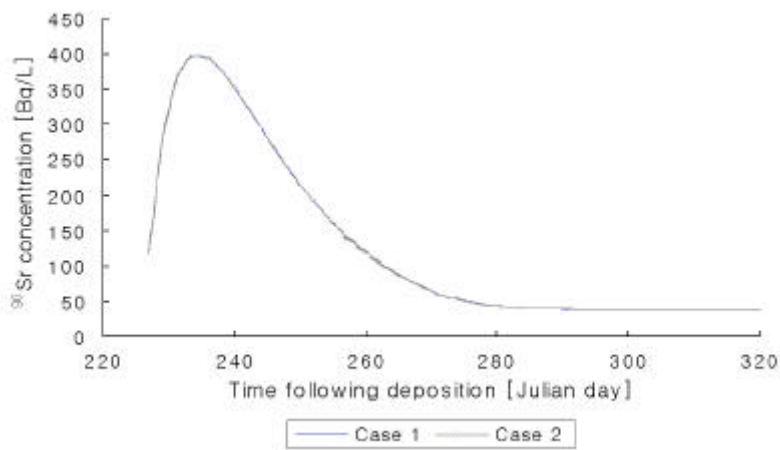
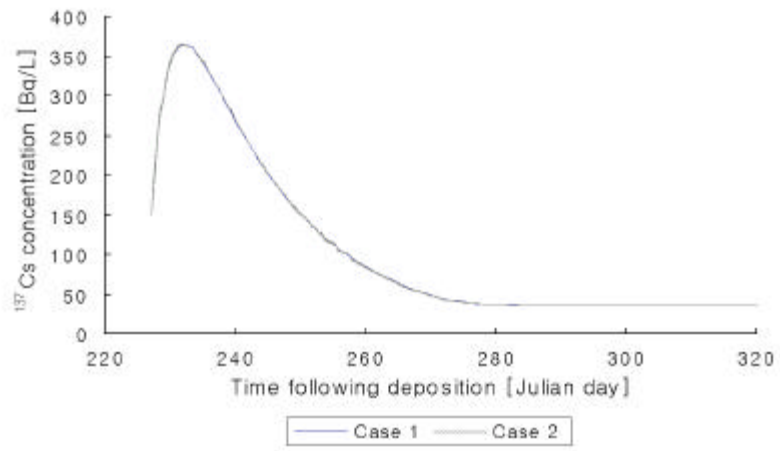
1. (3 15) (; Case 1 : , Case 2 : , Case 3 : , Case 4 :)



2. (3 15) ()
 0.1 mm hr⁻¹; Case 1 : , Case 2 :
 , Case 3 :
 , Case 4 :)



3. (8 15) (; Case 1 : , Case 2 :)



4. (8 15) ()
 0.1 mm hr⁻¹ ; Case 1 : () , Case 2 : ()