A Methodology for Assessment of Averaged Deposition Velocity According to Urban Residential Area Types

Joeun Lee [a*], Wontae Hwang, Moonhee Han, Eunhan Kim
[a]*Korea tomic Energy Research Institute, Daedeok-daero 989 beon-gil, Yuseong-gu, Deajeon, Korea, 34057*
[*]*Corresponding author: leejoeun@kaeri.re.kr*

1. Introduction

According to the Ministry of Land, Infrastructure and Transport announcement in 2016, 91.82% of 51.7 million people in Korea live in urban areas [1]. When nuclear accidents occur, radioactive materials can spread to large urban areas and affect many people since nuclear plants in Korea have large cities around them. Therefore, it is very important to evaluate the deposition of radioactive materials in urban areas and their effects.

Deposition in an urban environment might be considered as an overall effect or as deposition to individual surface types [2]. However, due to the various types of surface and structures of the urban environment, it is difficult to apply the generalized urban deposition velocity. Therefore, Underwood proposed that an estimate of an integrated deposition velocity for an urban area might be obtained by summing the surface types for a given type of location. [2].

The purpose of this study is to estimate the generalized urban deposition velocity which can be applied to a wide area reflecting various types of urban residential area.

For this purpose, 3-D modeling was performed for each type of urban residential area, and the average deposition velocity was obtained by summing each surface.

2. Methods and Results

2.1 Types of Residential Area

The residence type of Korea can be divided into a single house, a multi-family house, and an apartment. Figure 1 shows the change of housing type in Korea [3].

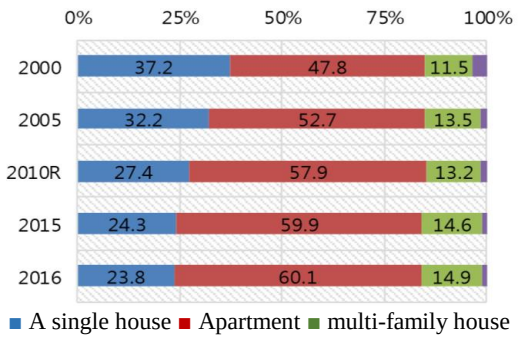

Figure 1. The change of housing type in Korea

2.2 3D Modeling of Residential Area

To add each surface, the surface area of all the surfaces of each residence type was obtained by 3D modeling.

In the case of a single house, the coverage ratio is 50 % according to the Daejeon City Ordinance [4]. The building is one story, with grass and trees in the yard.

Figure 2. 3D model of a single house

For a multi-family house, according to the Daejeon City Ordinance, the coverage ratio is 60 % and the floor space ratio is 200 % [4].

Because the floor space ratio is limited to 200 %, the building consists of three floors. There is no green space, and there is a parking lot in the yard of the building.

Figure 3. 3D model of a multi-family house

In the case of an apartment, the distance between the buildings should be at least 50 % of the height of the building because of its high height. The building consists of eighteen floors. The coverage rate is 20 % and the green land rate in the complex is 30 %.

Figure 4. 3D model of apartment

2.3 Deposition Velocities for Residential Area Types

To estimate the averaged deposition velocity for each type of residential area, the deposition velocity for roof, paved road, wall, soil and tree was applied. These deposition velocity values are from a model for estimates the transient behavior of radioactive materials in the Korean urban environment (METRO-K) and are shown in table I [5].

Table I: Deposition Velocity of the Surface of Residential Area

	Cs	Ru	I (Particulate)
Roof	4.32E-04	2.68E-04	1.07E-03
Paved Road	8.14E-05	2.82E-04	2.45E-04
Wall	1.80E-05	4.93E-05	1.28E-04
Lawn/soil	6.12E-04	1.27E-03	1.62E-03
Tree	1.21E-03	3.27E-03	1.99E-03

The surface area of each residence area obtained by 3d modeling was multiplied by the surface deposition velocity of each surface. The averaged deposition velocity was obtained and the results are shown in the table II.

Table II: Deposition Velocity for Residential Area Types

	Cs	Ru	I (Particulate)
A Single House	5.38E-04	8.08E-04	1.43E-03
A Multi-family House	3.57E-04	3.99E-04	1.01E-03
Apartment	3.31E-04	6.54E-04	1.06E-03

3. Conclusions

To estimate the generalized urban deposition velocity, 3-D modeling was performed for each type of urban residential area, and the average deposition velocity was obtained by summing each surface.

This study is a preliminary step in the development of decision-making systems for responding to radioactive contamination in urban areas. By applying this method to the system, it can contribute to the dose assessment of a wide range of radioactive contamination in urban areas.

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