

Impacts of the risk of chemical release from unregistered plant triggered by a future local earthquake in Osaka

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In recent years, especially in Europe, a concern arises regarding damage from industrial accidents caused by natural disasters, called Natech (Natural hazard triggering technological disasters). Natech is also a concern in Japan, and in the case of the Great East Japan Earthquake, harmful chemicals have released and caused health damage to numerous people. Chemical release caused by natural disasters have environmental effects on the air, water, and soil. In case of chemical release to the atmosphere, inhalation exposure becomes a central concern. In the area of chemical management, Pollutant Release and Transfer Register (PRTR) has been introduced 20 years ago and notified industrial plants have been required to report their annual release and transfer amount of chemicals. However, unregistered plants are under no such obligation. Therefore, the amount of chemicals handled and management conditions in unregistered plants under PRTR system are unknown. In this study, the impacts of the risk of chemical release from an unregistered plant triggered by the local earthquake originating from the Uemachi fault were examined.

Osaka City, the center of Osaka Prefecture, was selected as the research area. Osaka City has an office density of 22.3 cases / km² and a population of approximately 2.7 million, and can be considered an area with a large release volume of chemicals and exposed population in the event of an accident. As for chemical screening procedure, one of the PRTR chemicals, toluene was selected, which also fulfills Volatile Fire Service Class 4. Given the lack of data on the storage volume of unregistered plants under PRTR for predicting outflow at the time of the accident, the storage volume was estimated using the index of employee number of each geographical mesh (1 km × 1 km). The emission factor (emissions / handling volume) and storage conversion factor (storage volume is equivalent to two weeks of annual handling volume) were used to estimate the amount of storage. In the disaster simulation, a chemical substance was assumed to release from one unregistered plant in the event of the earthquake. Atmospheric chemical concentration was calculated using Atmospheric system exposure analysis software (CAMEO / ALOHA version.5.4.7) (USEPA). Subsequently, the calculated atmospheric concentration was compared to Acute Exposure Guideline Level (AEGL) (NAC/AEGL Committee). AEGL differs for each threshold level, with AEGL-3 set to cause fatal health damage, AEGL-2 to severe health damage, and AEGL-1 to discomfort.

As a result, we found that the area with a large amount of chemical storage, of which the population is also concentrated in the daytime had high risks of health damage in case of the accident. The cumulative exposure amounts of volatilized toluene at 5 m and 10 m from the accident site were 98,007 ppm · min and 25,159 ppm · min, which would cause serious health symptoms, since these values were 7 times and 1.8 times that of AEGL-2, respectively. At 30 m and 50 m points from the site, the values were 1,296 ppm · min and 750 ppm · min, which was 1.9 times and 1.2 times higher than AEGL-1, respectively. Therefore, it is important to stay away from the accident site immediately at least for 5 minutes for minimizing the health damage. This study revealed the risks from a small and unregistered plant and specified the extent of inhalation exposure of chemicals, which would lead the proper evacuation recommendations and alerts under Natech events.

Keywords: Natech(Natural hazard triggering technological disasters), Chemical substance management, Atmospheric dispersion, Earthquake, unregistered plants under PRTR system