Study on Comprehensive Chemical Risk Assessment and Management System as Disaster and Emergency Response

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[Abstract]

Key Words: Accident and emergency, Chemical risk, Non-steady state chemical risk assessment, Web-information system, anomaly detection, integrated platform, comprehensive analysis, portable analyzers, Chemical substance abundance, Environmental restoration technology

Chemical risk assessment and management system were studied as the disaster and emergency response. The study was conducted by four themes, namely, study on comprehensive chemical risk assessment and management system, theme 2,3,4. The study worked to establish comprehensive methodologies, technologies and data that could be integrated into systematic scientific methodologies for the assessment and management of chemicals in the disaster and emergency situations.

Theme 1 worked on four sub-themes, namely the development of comprehensive information system, study on countermeasure options in risk management, health risk study of selected chemicals in non-steady state exposure scheme, and establishment of methodology to capture exposure directly through passive sampling. We showed the tiered risk management scheme consisting of variety of countermeasure options though several case studies. An example of characteristic outcomes in animal study under non-steady state exposure compared to steady exposure scheme. We established the database of sampling rate of volatiles/semi-volatiles in passive sampling methodologies of chemicals. Web-information system “D.Chem-Core” was developed aiming at to provide all information most effective in disaster and emergency situations. All outputs in theme and also from themes 2 to 4 were compiled with other data sources in the system.

In Theme 2, facilities upstream of the water supply system were identified, and the actual match between the reported discharge destination and the actual situation were analyzed to develop a method for detecting abnormalities. A response flow to accidents will be proposed with reference to examples of chemical substance releases, etc. 1) Investigate methods for detecting abnormalities in continuous monitoring of pollution. We developed a flowchart to respond water quality accidents and have studied substance identification methods using accurate mass spectrometry, 2) rapid analysis methods for actual samples, 3) rapid impact prediction methods for air and water pollution, and 4) development of a platform that can be integrated with surrounding information to perform uncertainty analysis.

In Theme 3, We developed a rapid, accurate and comprehensive method to detect a wide range of volatile substances typically released during industrial accidents or disasters. This method uses portable analyzers to quickly measure a wide range of volatile organic compounds in combination with laboratory analyzers capable of performing exhaustive analysis.

The portable analyzer can simultaneously measure a wide range of substances with sufficient

sensitivity and comprehensiveness, mainly for volatile organic compounds. For the measurement of semi-volatile organic compounds in the event of chemical spills or leaks due to accidents or disasters, we have developed a simultaneous analysis method and created a support tool. In addition, accurate mass and collision cross-section information was registered in the database built into the liquid chromatograph quadrupole time-of-flight mass spectrometer (LC-QTOFMS), focusing on organic compounds with low volatility.

Theme 4 established a method for estimating the abundance of chemical substances based on published data such as PRTR data, which are foundational for disasters and accident response. We built an information infrastructure database for the location and properties of chemical substances. We developed sampling and survey methods that enabled efficient, comprehensive, and low-cost implementation of the medium- to long-term monitoring of residual substances and identification of the scope of post-disaster countermeasures. In addition, we comprehensively investigated the countermeasure technologies for removing existing chemical substances (purification and restoration technologies). The information on residual substances was systematically organized based on various factors, such as applicable substances, contaminated environments, scale, cost, energy consumption, and environmental impact. Consequently, a database of potentially applicable technologies was established.

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