Oral Session - WO

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WO-01

재난원인과학조사를 위한 측정 · 분석장비 활용

Disaster Scientific Investigation using Advanced Scientific Devices

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요 약 문

사회가 복잡해지고 개발되면서 대규모 재난이 발생하기 쉬운 환경으로 변화하고 있으며 재난 및 사고의 유형은 점점 복잡화·대형화·다양화 되고 있다. 특히, 최근 구미 불산누출사고 이후, 한화케미칼 집수조 폭발사고와 구미공장 폭발사고 등 반복되는 화학사고로 인해 국민적 우려와 관심이 높아지고 있다. 재난 및 사고는 불확실성과 특수성으로 인해 정확한 사전 예측은 불가능하지만 재난발생 전 위험요인 사전파악을 통해 선제적인 대응체계를 마련할 수 있다. 다양화 되는 재난 및 안전사고 피해영향을 최소화하고 유사재난의 재발방지를 위해서는 과학적인 재난원인조사 기반의 근원적 원인규명이 매우 중요하다. 본 연구에서는 사고 이후 신속하고 객관적인 원인규명을 위한 과학적 방법으로서 Forensic science (포렌식 기술) 개념에 대해 소개하고자 하며, 포렌식 기술 중 측정·분석장비를 활용한 사고원인분석에 대해 논의하고자 한다. 재난의 유형 중 화학사고 및 붕괴 등 사회재난 유형을 대상으로 측정·분석장비의 운용 및 활용에 대한 연구결과를 논의하고자 한다. 측정·분석 장비의 적절한 운용 및 활용은 화학재난현장 등에서는 물적 증거를 채증을 가능하게하며, 조사된 결과는 시뮬레이션 분석 등에 활용되어 객관성이 확보된 피해확산원인 도출 및 개선사항 제안으로 이어진다. 본 연구진은 이러한 연구를 통해 국민안전처 국립재난안전연구원에서 수행중인 재난 및 안전사고의 원인규명을 위한 과학적 기법 및 측정·분석 장비의 활용체계를 수립하고자 한다.

WO-02

서울시 휘발성유기화합물의 공간분포와 오염원 추정
(Spatial Distribution and Source Identification of Volatile Organic Compounds in Seoul)

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요 약 문

대표적인 유해대기오염물질(Hazardous air pollutants: HAPs)인 휘발성유기화합물(Volatile organic compounds: VOCs)은 산업 활동뿐만 아니라, 자동차, 주유소, 페인트 등에서도 다량으로 배출된다. 특히, 서울과 같은 인구밀집 지역은 주거활동과 도로오염원으로부터 다량의 VOCs가 배출되고, 인체 노출이 비교적 많을 것으로 예상된다. 국내 선행연구에서는 대부분 능동대기채취기를 이용하여, 제한된 공간규모의 모니터링을 수행하였다. 본 연구에서는 서울시 36개 지점(도시대기측정망: 25개소(구별), 유해대기측정망: 3개소 포함, 배경 및 고공측정망: 5개소 포함)에 수동대기채취기를 설치하였다. 겨울(2016년 8월 9일~9월 6일)과 여름(2017년 1월 5일~2월 7일)에 각각 모니터링을 진행하여 68종 VOCs에 대한 계절별/지점별 농도 수준을 파악하였으며, 지리정보시스템(Geographic information system: GIS)을 이용한 지리적 분포특성을 확인하였다. 벤젠, 톨루엔, 에틸벤젠, 자일렌은 전체 VOC 농도의 34~79%를 차지하였으며, 그중 톨루엔 농도가 가장 높게 나타났다(2.1~41.2 μg/m^3). 고농도 지점을 제외하면 도로변, 배경, 도심지역별로 실질적인 농도차이는 없었다($p > 0.05$). 또한, 진단비와 주성분분석을 이용한 오염원 추정결과, 전반적으로 서울시는 유기용매(페인트 작업, 인쇄소 등)의 영향을 크게 받았으나, 지점별 특정 VOCs에 대한 영향은 없었다. 추후 대기확산 모델 또는 수용모델을 이용한 오염원 추정이 요구되며, 해당 연구결과는 서울시 유해대기측정망 계획수립, 추가 및 보정, 개선 등을 위한 기초자료로 활용될 수 있다.

WO-03

Dietary Exposure of PCBs in Seafood via Diverse Cooking Recipe in Korean Market Basket

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Abstract

Polychlorinated biphenyls (PCBs), one of the old persistent organic pollutants, are still considered as a global concern due to their ubiquitous detection and adverse effects such as endocrine disruption and carcinogen although their banning since 1979. Among the various exposure pathway to human, dietary intake is known as the major route of PCBs human exposure and especially, consumption of seafoods is regarded as the main contributor to the total dietary intake of PCBs. Besides, the cooking processes might also affect the human exposure to PCBs because of changing PCBs concentration in food by the loss of moisture and fat contents in cooking process. However, most of previous researches were assessed the dietary intake of PCBs using raw food and limited studies were available to investigate the effect of cooking process on PCBs human exposure by seafood consumption. In addition,, their results were inconsistent and the explanation of the cooking effect of PCBs intake was deficient. Therefore, in this study, we estimated the total daily intake of PCBs from seafood consumption by analyzing 82 congeners of PCBs in 237 seafood samples (50 species of fishes and fishery products) including cooked samples using different cooking methods. The samples were extracted with ultra-sonication and analyzed with HRGC/HRMS after multi-layer column clean up. The total PCBs concentration ranged from 0.02 to 20.6 ng/g ww in seafood and the highest total PCBs level was observed in blue crap and salmon, while abalone was the lowest. The estimated dietary exposure (EDI) with cooked seafood was 9.87 ng/kg b.w/day which was 49% of tolerable daily intake (TDI) by WHO in 2003.

WO-04

한강 담수 내 마그네슘 동위원소 분별작용 특징 연구
(Magnesium Isotope Geochemistry in the Han River)

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요약문

마그네슘 동위원소는 강물의 기원을 직접적으로 알아내기 좋은 원소이지만 강물의 마그네슘 동위원소를 결정하는 주요 통제 요소들은 여전히 불분명하다. 이번 연구에서는 한강의 강물과 암석 그리고 비료의 마그네슘 동위원소를 분석하고 보고하였다. 한강은 규산염암을 흐르는 북한강과 규산염암과 탄산염암을 흐르는 남한강으로 구성되어 있다. 두 지류에서 보이는 기반암의 차이는 주 원소, $^{87}Sr/^{86}Sr$, 그리고 마그네슘 동위원소 값에 영향을 미치며 특히 북한강에서는 남한강에 비해 주 원소의 농도가 낮았지만 상대적으로 높은 $^{87}Sr/^{86}Sr$과$\delta^{26}Mg$값을 보였다. 단순 물질 균형식(mass balance)과 혼합 방정식에 의하여 한강의 $\delta^{26}Mg$값이 규산염과 탄산염의 풍화작용에 의해서 영향을 미칠 수 있다고 가정했을 때, 평균 탄산염암의$\delta^{26}Mg$값은 이번 연구에서 측정된 탄산염암의 마그네슘 동위원소의 값보다 낮을 것이라고 생각된다. 한강 수계에서 다양한 과정의 마그네슘 동위원소 분별작용이 영향을 끼칠 수 있지만, 규산염암을 흐르는 강물에서의 ^{24}Mg의 증가는 규산염암으로 구성된 기반암이 용해되면서 발생하는 동위원소 분별작용에 의해 결정된다는 것을 알 수 있었다. 반면 분석된 탄산염암의 마그네슘 동위원소 값과 비교했을 때, 탄산염암을 흐르는 남한강 지역에서 보이는 작은 동위원소 분별작용 현상은 작은 $\delta^{26}Mg$값으로 구성된 지하수의 유입 때문으로 생각된다. 비료의 마그네슘 동위원소 결과는 인간 활동의 의한 영향을 어렵지만 강물에 매우 적게 영향을 미치는 것으로 해석된다. 이번 연구결과는 강물에서 일어나는 마그네슘 동위원소 분별작용의 요소를 더 자세히 제시하였으며 암석학적으로 다른 강에서 마그네슘 동위원소가 강물의 마그네슘 근원지를 알기 위해 활용될 수 있다는 것을 지시한다.

WO-05

탄소섬유를 이용한 수처리 기술개발에 관한 연구
(Development of Water Treatment Technology using Carbon Fiber)

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Abstract

Carbon fiber having a negative charge in the ultra-trace level has the significant bio-affinity due to its low electric resistance. It has been interested in the technology of biological water treatment based on carbon fiber, since the carbon fiber has more minimum environmental load compared to other chemical materials.

This study based on conductance and ilumination of carbon fiber and iron has been carried out in order to confirm the removal effect of phosphorous which is a main cause for eutrophication. Phosphorous has been removed by the sedimentation of phosphate and iron ion which is produced by the iluminatation of iron. It was confirmed that aeration and ilumination could be a key factor for the removal rate of phosphorous. This study was conducted to confirm the feasibility of carbon fiber on the elimination of phosphorous in the water environment, as a basic research.

Key words: Carbon fiber, Electro-chemical corrosion,

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WO-06

국내 지하수 내 신종유해물질 분석
(Analysis of Emerging Contaminants in Groundwater in Korea)

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Abstract

These days, emerging contaminants in groundwater, including artificial sweeteners, and pharmaceuticals and personal care products (PPCPs), have increasingly attracted public attention. Groundwater could be contaminated by wastewater through septic systems, leaking sewers, and land application of human and animal waste to farmland. Accordingly, in order to trace the contamination source of emerging contaminants, there were many attempts to find out indicator compounds in groundwater.

Therefore, in this study, we analyzed six pesticides, five artificial sweeteners and thirty-three PPCPs, including antibiotics, anthelmintics, and etc., in groundwater near feedstock farmhouse and reference sites where there are no activity of stockbreeding to assess the contamination status and potential indicator compounds for groundwater contamination. In reference sites, only four compounds such as caffeine (1.84-5.74 ng/L), crotamiton (0.0854-1.47 ng/L), acesulfame (90.1-1335 ng/L), and saccharin (5.64-25.0 ng/L) were detected. However, in feed stock area, a total of 30 target compounds were detected including four compounds which were detected in the reference site. Among them, sulfamethoxazole (ND-4.23 ng/L) as antibiotic, oxfendazole (0.418-22.8 ng/L) as anthelmintic, and carbofuran (ND-116 ng/L) as pesticide showed relatively higher concentration than other compounds. These results indicate that the activity of agriculture and stockbreeding could influence the groundwater quality and these chemicals can be used as indicator to assess the source effect on groundwater. The further detailed results will be presented in the conference.

WO-07

Quantitative Analysis of 9 *N*-nitrosamines in Atmospheric Particulate Matter using GC-MS/MS

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Abstract

Nine *N*-nitrosamines in atmospheric $PM_{2.5}$ collected in the fall season from an roadside site and a residential in Seoul, Korea have been analyzed using a newly developed method consisting of simple direct liquid extraction assisted by ultrasonication and subsequent quantification using a gas chromatography-triple quadrupole mass spectrometry (GC-TQMS). Excellent recovery values (92-100%) and method detection limits for the target compounds atmospheric PM samples could be achieved even without an evaporation step for sample concentration. The concentration of total *N*-nitrosamines in $PM_{2.5}$ was ranged from 0.3 to 9.4 ng m^{-3} in this study; NDMA, NDEA, NDBA, NPyr, and NMor in $PM_{2.5}$ were found to be the most frequently encountered compounds at the sampling sites. Since no industrial plant is located in Seoul, vehicle exhausts were considered major cause of the formation of nitrosamines in this study. The mechanisms how these compounds are formed and detected in the atmosphere are explained from the viewpoint of secondary organic aerosol. Considering the concentrations of *N*-nitrosamines and their associated potential health risks, a systematic monitoring of nitrosamines present in both ambient air and $PM_{2.5}$ including seasonal and diurnal variations of selected sites (including potential precursor sources) should be carried out in the future. The proposed sample pretreatment method along with the analytical method will definitely help us perform the monitoring study.

Key words: Particulate matter, Secondary organic aerosols, Direct liquid extraction, GC-TQMS

WO-08

Diurnal Variations of 18-PAHs in Atmospheric $PM_{2.5}$ and $PM_{0.1}$ at Roadside Environment

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Abstract

The combustion of gasoline and diesel fuel in motor vehicle engines are the main source of polycyclic aromatic hydrocarbons (PAHs) in urban area. Several PAHs and some of their degradation products such as oxygenated and nitrated PAHs, have been known to have high carcinogetic and mutagenic potential. PAHs with two or three aromatic rings are mostly detected in the gas phase while those larger than four fused rings are generally associated with particulate matters (PMs). A number of studies revealed diurnal variation and the behavior of PAHs in $PM_{2.5}$ due to their adverse health effect. However, only a few studies have been carried out their diurnal variations and composition of PAHs depending on the number of rings, especially in $PM_{0.1}$. In the present study, $PM_{0.1}$ and $PM_{2.5}$ were simultaneously collected for 11 h (daytime and nighttime) at two sites using nanosampler and cyclone $PM_{2.5}$, respectively. 12-day consecutive sampling was carried out to find the influence of motor vehicles on the temporal variations of PAHs in $PM_{0.1}$ and $PM_{2.5}$. 18-PAHs were targeted for the analysis of PAHs in PMs using a gas chromatography-triple quadrupole mass spectrometry (TQMS). The results indicated that 18-PAHs in $PM_{2.5}$ were about 2-3 folds higher at roadside than those found at the site where 100 m away from the roadside whereas 18-PAHs in $PM_{0.1}$ showed insignificant concentration changes for the two sites.

Key words: 18-PAHs, Particulate matter, $PM_{2.5}$, $PM_{0.1}$, Roadside environment

WO-09

Survey of Trace Compounds in Drinking Water

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Abstract

In Korea, the project of monitoring unregulated trace compounds in drinking water is started in 1992. In the project, toxic and potentially dectectable contaminants were selected and surveyed at major water treatment plants in the country, and a total of 418 items were surveyed by 2016. Through the project, 27 items of water quality monitoring items and 30 items of water quality standard were newly established. The project had been successively progressed phase 1 for 12 years (1992 to 2003), phase 2 (2004 to 2006), phase 3 (2007 to 2011) and phase 4 (2012 to 2016). This study was carried out in the final year of the phase 4 project, and the main content of project is to assess the results of the past four years and to prepare a Phase 5 project plan. We estimated 95th percentile human carrcinogenicity and non-carcinogenic risk for 63 items investigated during 2012 to 2016. The risk of carcinogenesis of NDMA and NDEA was more than one carcinogencity per million people, which is the guideline classified as water quality monitoring item. The toxicity risk index of 46 non-carcinogens except chlorate was below 0.1, so no new monitoring items were set. We set the health advisory level by referring to domestic and foreign toxicity values for items investigated in the 4th phase project. It may be useful to determine to administer the substance after investigating trace harmful substances. In addition, we established analysis method for the items surveyed in the 5th phase project and conducted preliminary monitoring.

Finally, We propose two water quality monitoring items and 11 management candidate substances through the 4th phase research project.