INSINUME 2019
8th International Symposium on IN SItu NUclear MEtrology
as a tool for radioecology

23-26 April 2019
Richmond Ephesus Resort, KUSADASI-TURKEY

BOOK OF ABSTRACTS

- Regulatory framework concerning the release of radionuclides and the monitoring of radioactivity in the environment
- New technologies and methodologies in radioactivity metrology
- Quality Assurance
- Radioactivity levels in environment and transfer of radionuclides
- Impact of radioactivity on environment, population and biota
- Nuclear metrology in incidental/accidental conditions
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23-26 April 2019
Richmond Ephesus Resort,
KUSADASI-TURKEY

PROGRAMME

Scientific Secretariat
e-mail:insinume2019@gmail.com

Organization Secretariat
+90 232 446 06 10
info@motto.tc
International Organizing Committee:
Chairman: Grégory DELECAUT, IRE ELIT, Fleurus - Belgium

Local Organizing Committee
Chairman: Assoc. Prof. Sabriye YUŞAN, Ege University, Institute of Nuclear Sciences, İzmir-Turkey

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Günsel YAPRAK Ege University Institute of Nuclear Sciences, Turkey

Symposium Venue:
Richmond Ephesus Resort Hotel
Kuşadası, TURKEY
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<td>Biomonitroging of radioactive contamination of the VенисеI river Alexander Bobovskovskiy, Dmitry Dementiev, Elena Trofimova, Ekaterina Inokstina</td>
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<td>Plutonium and Americium in the deep black sea bottom sediments Vladislav Yu. Prokaznin, Nataliya N. Tereshchenko, Artem A. Paraskiv, Oleg D. Chukhovskoe-Prokaznin</td>
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<td>Influence of contaminated sediments in shchekino reservoir on 137Cs concentration in fish Natalia Kuzmnenko, Mukhamet Iusuf, Toshurin WADA, Kenji NABABA, Ludmila Efimova, Atyam UOSHO, Natachta NAODA, Lygeny KONSTANTINOV, Alexander ROZHKOV, Volodym GOLGOV</td>
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<td>FEEDBACK ON THE BELGIAN IMPLEMENTATION OF THE 2015/85 EURATOM DRINKING WATER DIRECTIVE - THE TECHNICAL CHALLENGES FOR AN ENVIRONMENTAL LABORATORY ANDREAS STRAUB/INVITED SPEAKER (CHAIRMAN: DR. Michel BRUGGERMAN)</td>
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25 APRIL 2019, THURSDAY

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09.00-09.30 CALIBRATION OF IN-SITU GAMMA SPECTROMETRY SYSTEMS
Nasik Damme INVITED SPEAKER

09.30-10.00 ACCELERATOR MASS SPECTROMETRY APPLICATIONS IN NUCLEAR SCIENCE
Dr. Turgut Dogan INVITED SPEAKER CHAIRMAN: Dr. Damran Bürger

10.00-10.30 COFFEE BREAK

10.30-12.00 ORAL PRESENTATIONS - HALL A
CHAIRMAN: Prof. Dr. Helmut A. A. Auern, Amad Prof. Dr. Sathia YSVU

10.30-11.45 ADSORPTION OF URANIUM-238 WITH DASIT STONE IN COLUMN SYSTEM
Ertan Dahi, Ozlem Selcuk Zorer, Erdinç Aladag, Dilara Ozturk

11.45-12.00 BIOSORPTION STUDIES OF SAMARBIUM ON CROSSLINKED ALGINATE, DIATOMITE, MAGNETITE COMPOSITES
Olcay ERDEN, Yusuf OZCAN, Duygu TAKANOGLU BULUT, Cem Gök

11.00-11.15 NEW EFFICIENT MODIFIED CALIX[4]PYRROLES ON THE DECONTAMINATION OF AQUEOUS MEDIA FROM RADIUM
Ahmad Hafid, Nancy Al-Haydari, Pierre Eduard Danjou, Francisca Cazier, Rosa Borgdor, Bilal Neuoi, Cem El Sarooghi

11.15-11.30 ADSORPTION STUDIES OF Ce(III) onto the MULTI-WALLED CARBON NANOTUBES BY USING RESPONSE SURFACE METHODOLOGY
Canan EMİS YİLMAZ, Ayhan ORAL, Metin A. A. A. ALAM, Murat ŞENOĞLU, Gurer KOTAHYALI ASLAN

11.30-11.45 AIR EXCHANGE RATE ESTIMATION IN DWELLINGS WITH ELEVATED BADION CONCENTRATION USING VOC TRACER - SORPTION TUBE SYSTEM
Michel Faghi, Koral Jilek, Jan Lenk, Šárka Mětková, Aleš Froňka, Ivan Hupka

11.45-12.00 EXAMINATION OF REMOVAL OF 238U WITH DIATOMITE IN CONTINUOUS FLOW SYSTEM
Erkan Dahi, Dwina Ozgun, Ozlem Selcuk Zorer, Erdinç Aladag

12.00-13.30 LUNCH

13.30 SOCIAL TRIP (EPHEMUS - VIRGIN MARY)

26 APRIL 2019, FRIDAY

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09.00-09.15 RADIATION SHIELDING PROPERTIES OF ALKALI ACTIVATED CEMENT MORTARS FOR NUCLEAR APPLICATIONS
Bülent Çavuş, Oktay, Cevdet Çaglayan, Bülent Çavuş, Erdinç Aladag

09.15-09.30 THE ADAPTATION OF COMPUTER TOMOGRAPHY OF SAMPLE PARTS ACCORDING TO THEIR MANUFACTURING METHOD AND THEIR GEOMETRY
Cem Yardı, Muhammet Dursunbasa

09.30-09.45 EVALUATION OF THE MEDIUM TERM SEDIMENT DEPOSITION ON THE PEIRCE RIVER FLOODPLAINS BY MEANS OF "C" GASLAND YAMAN, River ISP'T, Sule ZYTAS, Dogan YASAR, Osman GÖRAN, Sahin YUSUF, Halil S. SADAK, Cem KINÇAL, Gencalp DÜRSUN, Tunc COLAKOGLU

09.45-10.00 DOSE AND RISK ESTIMATION OF Cs-137 AND I-131 RELEASED FROM AN HYPOTHETICAL ACCIDENT IN AKKUYU NUCLEAR POWER PLANT
Efe Bülge, Osman Gündüz

10.00-10.15 ASSESSMENT OF THE RADIOLOGICAL IMPACT OF COAL-FIRED POWER PLANTS TO TERRESTRIAL BIOTA USING ERICA TOOL
Ayse Nur Eren, Serhat Hacıyakupoglu, Seçma Akaylı Ercan

10.15-10.30 COFFEE BREAK
DISTRIBUTION OF RADIONUCLIDE CONTAMINATION IN WATER BODIES OF ANTHROPOGENIC ORIGIN AT SEMIPALATINSK TEST SITE

DETERMINATION OF DODS IN MILK BY CHEMICAL RADIATION AFTER MICROWAVE DIGESTION: PREPARATION OF SAMPLES

DEVELOPMENT OF STATION FOR ARTIFICIAL GAMMA-RADIOACTIVITY MEASUREMENT IN SURFACE WATER BODIES

SELECTING OPTIMAL METHOD FOR SAMPLE PREPARATION OF AIRBORNE AEROSOL PARTICLES (PM10) FOR ELEMENTAL ANALYSIS BY INDUSTRICALLY COUPLED PLASMA MASS SPECTROSCOPY

STUDY ON OCCURRENCE OF CHEMICAL ELEMENTS IN BOTTOM SEDIMENTS OF THE UZUNBULAK CREEK AT THE SEMIPALATINSK TEST SITE

FEATURES OF THE PLUTONIUM RADIOACTIVITY DISTRIBUTION IN THE SALT LAKES OF THE CRIMEAN PENINSULA

PASSIVE BOREHOLE LOGGING FOR RADIOLOGICAL SITE CHARACTERISATION

THE "SOIL-BIOTIC-PLANT" SYSTEM IN THE YERKES RIVER FLOODPLAIN

COMPLETE RESEARCH PROPERTY OF A RADIONUCLIDE MONITORING STATION IN KAZAKHSTAN

ON DEVELOPMENT OF RADIOCHEMICAL METHOD OF DETECTING AMERICIUM-241 IN THE ENVIRONMENT

NATURE OF RADIOACTIVE CONTAMINATION IN SOILS OF THE PINE FOREST IN THE TERRITORY ADJACENT TO SEMIPALATINSK TEST SITE

DETERMINATION OF THE NATURAL BACKGROUND GAMMA RADIATION DOSE RATE IN URAIL: COMPARISON BETWEEN INDIRECT AND EXPERIMENTAL MEASUREMENT METHODS

EVALUATION OF ENVIRONMENTAL RADIATION AROUND A TYPICAL TITANIUM MINE

ENHANCING THE ANALYTICAL RESULTS IN NAA METHOD: GOLD DECONVOLUTED APPROACH

"SR IN WATER AND BOTTOM SEDIMENTS OF LAKES ADZHIGOL AND KUCHUK-ADZHIGOL AND THE ADJACENT AREA OF THE BLACK SEA

STUDY OF NATURAL RADIOACTIVITY AND ITS ASSOCIATED RADIOLOGICAL HAZARDS IN CIRCULAR VESSEL BUILT IN ALBANIA

CALCULATION OF THE RADIATION DOSE FOR SOME HYDROBIOTA OF THE BALTIC SEA DURING THE OPERATION OF THE NUCLEAR POWER PLANT

RADIATION MONITORING AT BEO MOURSALA HIGH-ALTITUDE STATION

MODERN SPECTROSCOPIC METHODS FOR Sr-90 DETERMINING

COSMIC RAYS' RADIATION IMPACT ON THE EARTH

LANTHANUM ADSORPTION BY ALGINATE CAPSULES CONTAINING AN EXTRACTANT (TOA) AND DIAMMONIUM TUNGSTATE

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INFLUENCE OF THE NATURAL AND ANTHROPOGENIC RADIOACTIVITY ON PLANT AND ANIMAL ORGANISMS IN MOUNTAIN ECO SYSTEMS

NEW TRENDS FOR MODERN RADIOWISDOM: RADIATION WEATHER, RADIATION MAPPING/ENVIRONMENTAL IDENTIFICATION

SYNTHESES OF SILAS (TURKISH) VERMICULITE FUNCTIONALIZED WITH PREUSIAN BLUE NANO PARTICLES

POLONIUM-210 IN THE MARINE ECOSYSTEMS OF THE CRIMEAN COAST OF THE BLACK SEA

THE CONTENT OF TRITIUM (H3O AND H3) IN THE AIR ENVIRONMENT OF RADIATION-HAZARDOUS SITES OF SEMIPALATINSK TEST SITE

A NOVEL CLAY COMPOSITE FUNCTIONALIZED BY GELATINE FOR ADSORPTION OF NEODIUM

ENVIRONMENTAL ASSESSMENT OF BEACH SANDS BY DETERMINATION OF RADIONUCLIDES

CLOSED REMARKS
HISTORICAL PLACES TO VISIT AT KUSADASI

Kusadasi is a beach resort town on Turkey's western Aegean coast. A jumping-off point for visiting the classical ruins at nearby Ephesus or Efes, it's also a major cruise ship destination. Its seaport promenade, and harbor are lined with hotels and restaurants. Just offshore is the island of Foca, a walled Byzantine castle that once guarded the town, connected to the mainland via causeway.

EPHESEUS ANCIENT CITY

Ephesus was the ancient Greek city on the coast of Ionia, three kilometers southwest of present-day Selcuk in Izmir Province, Turkey. It was built in the 6th century BC on the site of the former Arzawan capital by Attic and Ionian Greek colonists. Ephesus was an ancient port city whose well-preserved ruins are a modern-day Turkey. The city was once considered the most important Greek city and the most important trading center in the Mediterranean region. Throughout history, Ephesus survived multiple attacks and changed hands many times between conquerors. It was also a hotbed of early Christian evangelism and remains an important archaeological site and Christian pilgrimage destination.

EPHESEUS MUSEUM

In Ephesus, the archeological artifacts that were dug up between 1867-1905 were transported to the British Museum; and findings from 1905-1925 were taken to Vienna. With the founding of the New Turkish Republic, the government forbade taking antiquities out of the country and required the artifacts that were taken outside the country back to Turkey. In 1964, the Ephesus Museum was founded and the findings from the excavations at Ephesus archaeological site and around were put to this museum. At this charming and well-organised museum, there are not only findings from the ongoing excavations at Ephesus archaeological site, but also the artifacts from the Cukurcilar Mausoleum, and the Basilica of St John, and the Temple of Artemis. At one of the sections, one can see a wide collection of coins dating back to when money was first used in history.

The museum of Ephesus, unlike most of other museums, is not designed according to the chronological order but the galleries are filled with artifacts according to a theme.

HOUSE OF VIRGIN MARY

House of Virgin Mary is located on the top of the "Babali" mountain 9 km ahead of Ephesus, the shrine of Virgin Mary enjoys a marvelous atmosphere hidden in the green. It is the place where Mary may have spent her last days. Indeed, she may have come in the area together with Saint John, who spent several years in the area to spread Christianity. Mary preferred this remote place rather than living in crowded place. The house of Virgin Mary is a typical Roman architectural example, entirely made of stones. In the 4th century AD, a church, combining her house and grave, has been built. The original two-storied house, which consist of an anteroom (where today candles are proposed), bedroom and praying room (Christian church area) and a room with fireplace (chapel for Haslam). A front kitchen fell into ruins and has been restored in 1940’s. Today, only the central part and a room on the right of the altar are open to visitors.
ŞIRİNCE VILLAGE
This pretty old Orthodox village, 12 km away from Ephesus and 50 km from Kusadasi, was once Cirkince (“ugly”). Indeed its inhabitants gave this name on purpose as they did not want to be bothered by foreigners nor to share the beauty of their village. Still after years, visitors understood that the village was not ugly at all and called it Şirince (“pretty”). As the village is located on the top of a mountain, anyone will enjoy the impressive vineyards’ and peach trees’ views on his way. Today the village is a perfect synthesis of Turk-Greek culture as of the 1920’s: after the Independence War, people exchange between Greeks and Turks has occurred and all those typical Greek houses, though they kept their original outside characteristics, have received the local layout inside. The most beautiful specimens are open to visitors. And even in the courtyard of one of them, one will discover a nicely restored Orthodox church.

GÜVERCİNADA
PIGEON ISLAND
Güvercinada Fortress, located in the Hacıfeyzullah District of Kusadasi City, was built on the mouth of the harbour to protect it. There is an inner fortress (built by Barbaros Hayrettin Pasha) and fortress walls (built by Iyas Aga) on the island. These walls were built to protect against the expected attacks from the Greek islanders and from the sea during the Mora Revolt period. Walls were built approximately 3 m-high and surrounded the island completely. The stones used in construction of the fortress were transported from Yıläncı Cape. To three south of the walls, there is gate protected by two towers with arches which can be climbed by means of stairs facing toward the south. While the north tower is in a pentagon shape, the southern tower is structured in a cylindrical form.

ÜKÖZ MEHMET PASA KERVANSARAY
This caravanserai was built by the Grand Vizier Ükoz Mehmed Pasha at the same time as the Kasımpaşa Camii in Kusadasi to support maritime trade in the region. It is a brick construction, consisting of a two-storied portico around a courtyard approximately 18.5 meters (60 foot) long and 21.6 meters (71 foot) wide, where there was once a fountain. The main entrance is through a 2.96 m wide marble gate in the north. A second gate on the east side opens onto the market. Stairs are located in the northwest and southeast corners. The caravanserai was restored in 1965-1966 and converted to a hotel.

DİLEK PENINSULA NATIONAL PARK
Dilek Peninsula National Park in Kusadasi (Dilek Peninsulası – Great Menderes Delta National Park) is among the most important natural heritages of Turkey, with an area of 27,598 hectares. Dilek Peninsula, declared in 1966 as a national park, covers 10,985 hectares. Great Menderes Delta, declared in 1994 as national park, covers 16,613 hectares. The national park can be reached via the Kusadasi (Kuşadası) - Soke (Soke) highway, and lies roughly in the middle of the two towns. It is possible to stay in the national park in tents or caravans, and there is food available. Dilek Peninsula National Park in Kusadasi has extraordinary beauty of Mediterranean flora with blue and emerald colored clear beaches.
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Acknowledgements

The Organizing Committee of INSINUME 2019 Symposium would like to thank the International Atomic Energy Agency (IAEA) and all the Sponsors for their valuable financial support.

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The Organizing Committee expresses special appreciation to Dr. Grégory Delécaut, Chairman of the International Organizing Committee, for his cooperation in organizing INSINUME 2019.

The Organizing Committee acknowledges the organizations that supported INSINUME 2019:
- Institute for Radioelements –IRE and its subsidiary IRE ELIT
- International Atomic Energy Agency (IAEA)
- Ege University
- Ege University Institute of Nuclear Sciences
Preface

The 8th International Symposium on “IN SItu NUclear MEtrology as a tool for radioecology – INSINUME 2019 is organized by Ege University Institute of Nuclear Sciences and the Institute for Radioelements –IRE and subsidiary IRE ELIT, in cooperation with the International Atomic Energy Agency-IAEA between 23-26 April 2019 in Kuşadası-TURKEY

The previous INSINUME Symposia were organized in Ohrid (Macedonia 2017), Brussels (Belgium, 2012), Dubna (Russia, 2010), Rabat (Morocco, 2008), Kuşadası (Turkey, 2006), Albena (Bulgaria, 2004) and Fleurus (Belgium, 2002). The scope of the Symposium covers the following sessions:

- New technologies and methodologies in radioactivity metrology
- Nuclear metrology in incidental/accidental conditions
- Radioactivity levels in environment and transfer of radionuclides
- Impact of radioactivity on environment and population

The aim of the Symposium is to gather scientists, students, regulatory authorities, international organizations as well as industrial sector to exchange information and experience in the radiological monitoring of the environment and new technologies in nuclear metrology.

On behalf of Organizing Committee, we would like to thank the International Atomic Energy Agency-IAEA and other sponsors for providing financial support. We would like to express our appreciation to International Scientific Committee, Invited Speakers and participants who involved in INSINUME 2019 with their valuable contributions and efforts.

The selected papers will be published in a special Issue of The Journal of Environmental Radioactivity (Elsevier).

Yours Sincerely,

Sabriye YUŞAN
Ege University Institute of Nuclear Sciences
Izmir-TURKEY

Grégory DELECAUT
Institute of Radioelements
Fleurus-BELGIUM
Committees

International Organizing Committee

Chairman: Grégory DELECAUT, IRE ELiT, Fleurus - Belgium

Local Organizing Committee

Chairman: Assoc. Prof. Sabriye YUŞAN, Ege University, Institute of Nuclear Sciences, İzmir-Turkey

Members:

Ceren KÜTAHYALI ASLANİ, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
Mahmut A.A. ASLANİ, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
Şule AYTAŞ, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
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Elçin EKDAL KARALI, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
Turgay KARALI, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
Fatma YURT ONARAN, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
Banu ÖZDEN, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
Şenol SERT, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
Caner TAŞKÖPRÜ, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
Doğukan Alkim TÜRKÖZÜ, Yüzüncü Yıl University, Faculty of Engineering and Architecture, Department of Environmental Eng., Van-Turkey

Scientific Secretary

Sabriye YUŞAN, Ege University, Institute of Nuclear Sciences, İzmir-Turkey
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François BRECHIGNAC, International Union of Radioecology, IRSN, France
Fernando CARVALHO, Technical University of Lisbon, Portugal
Sema ERENTURK Istanbul Technical University, Turkey
Sergey FESENKO, Department of Nuclear Safety and Security, IAEA, Austria
Cem GÖK, Pamukkale University, Turkey
Sergey GULIN, Institute of Marine Biological Research of Russian Academy of Sciences, Sevastopol, Russia
Aleksey KONOPLEV, Fukushima University, Japan
Sheldon LANDSBERGER, Nuclear Engineering Teaching Lab., University of Texas, USA
Galina LUJANIENE Center of Physical Sciences and Technology, Lithuania
Nina NIKOLAVA Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, Bulgaria
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Iolanda OSVATH, Division of the Environment Laboratories, IAEA, Monaco
Pavel POVINEC Comenius University, Slovakia
Erdal Recepoglu, Turkish Atomic Energy Authority
Kovacs TIBOR, Institute of Radiochemistry and Radioecology, Veszprem, Hungary
Trifce SANDEV, Radiation Safety Directorate, Skopje, Macedonia
Günseli YAPRAK Ege University Institute of Nuclear Sciences, Turkey
Topics

Main conference themes

- New technologies and methodologies in radioactivity metrology
- Nuclear metrology in incidental/accidental conditions
- Radioactivity levels in environment and transfer of radionuclides
- Impact of radioactivity on environment and biota
KEYNOTE LECTURES
FEEDBACK ON THE BELGIAN IMPLEMENTATION OF THE 2013/51/EURATOM DRINKING WATER DIRECTIVE - THE TECHNICAL CHALLENGES FOR AN ENVIRONMENTAL LABORATORY

D. Braekers, S. Di Pasquale, C. Doumont, G. Delécaut
IRE ELiT, Fleurus, Belgium
E-mail of corresponding author, damien.braekers@ire-elit.eu

Abstract:

Since 2016, the EU directive 2013/51/Euratom laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption was transposed into a Royal Decree in Belgium. In this framework, the Federal Agency for Nuclear Control (FANC) is responsible of the water’s monitoring on the Belgium territory. The Laboratory of Radioactivity Measurements (LMR) of IRE ELiT participates in this monitoring by analyzing water samples coming from all over the country. The ISO 17025 standard accreditation of all analysis methods used is a mandatory requirement for participating laboratories.

The presentation gives an overview of the technical challenges faced by an environmental laboratory performing radioactivity analyses in this context. Firstly, the decisional tree of the Belgian approach, based on screening technics (e.g. tritium, gross alpha-beta, radon…) coupled with nuclides specific measurements, is detailed. Secondly, the analytical methods used by the laboratory to meet the requirements set out in the Royal Decree of 31 May 2016 are presented and discussed in terms of performance, convenience and limits. The data collected by the LMR laboratory during the last two years are presented and the main conclusions of all these measurements are drawn. The difficulties encountered by the laboratory as well as the anomalies observed during the analyzes of certain samples are developed in order to help all laboratories involved in this type of control to better face the many technical challenges. Ultimately it will improve the determination of the indicative dose (ID). This study also aims to improve the understanding of the behavior of natural radioelements in water intended for human consumption for a better interpretation of the provided results by the stakeholders.

Keywords: Directive 2013/51/Euratom, drinking water, indicative dose, ISO 17025
CALIBRATION OF IN-SITU GAMMA SPECTROMETRY SYSTEMS

Hasan DİKMEN

Turkish Atomic Energy Authority, Department of Radiation and Accelerator Technologies
Saray Mh. Atom Cd. No. 27 Kahramankazan, Ankara, Turkey
E-mail of corresponding author, hasan.dikmen@taek.gov.tr

Abstract:

In situ gamma spectrometry is a quick, easy and accurate technique to estimate the activity concentration of gamma emitting radionuclides in soil or on the soil surface if suitable calibration methodologies are applied. Calibration of an in-situ gamma ray spectrometer can be performed by theoretical, experimental and quasi-experimental methods.

In the early years, use of spiked concrete calibration pads (as a set of at least four large and well separated pads of blank, potassium, uranium and thorium) to calculate the efficiency was the method of choice. This method has been extensively used for the calibration of large scintillator detectors in particular. The calibration pads can also be used for the calibration of airborne systems and HPGe detectors.

Another experimental method is "Cross Calibration Between In-situ & core sampling". This method is based on in situ sampling and laboratory analysis. The sampling strategy can be selected according to the properties of the calibration area. The sampling strategy may be a) aligned homogeneous grid, b) unaligned homogeneous grid, c) random sampling and d) hexagonal sampling. Core sampling is required to calculate the vertical distribution of the radionuclide.

The most widely used semi-theoretical calibration method is the three factor method proposed by Beck in 1972. It is based on the empirical determination of detector response as a function of angle of incidence and energy of the incoming radiation, and a mathematical calculation of the photon fluence incident on the detector. In this method there is a need for realistic knowledge about the radionuclide distribution in soil during geometrical factor calculation. The activity depth profile can also be determined using the in-situ spectrometric methods namely, “Multiple photopeak method”, “Peak-to-valley ratio method” and “Collimation or lead-plate method”.

In theoretical methods, the detector response is calculated analytically and used in Monte Carlo radiation transport simulations to verify the results. Accurate parameters such as soil characteristics and composition, soil depth profile, detector characteristics (dead layer, dimensions, materials, etc.), detector vertical and horizontal responses are needed. The model should be validated for a variety of geometries and sources. For any method used, attention should be paid to the calculation of the calibration factor uncertainties.

Keywords: Calibration, in situ, gamma spectrometry
ENHANCEMENT OF ENVIRONMENTAL RADIOACTIVITY AND OTHER IMPACTS OF PAST URANIUM MINING

Fernando P. CARVALHO

Laboratório de Protecção e Segurança Radiológica (LPSR)
Instituto Superior Técnico (IST)/ Universidade de Lisboa
Estrada Nacional 10, km 139, 2695-066 Bobadela LRS, Portugal
E-mail: carvalho@itn.pt

Abstract:

Uranium mining in Portugal and Europe spanned the entire 20 century but ceased nearly in all countries by the turn of millennium. A vast legacy of uranium mining and milling waste was accumulated at sites that generally were not properly decommissioned mainly due to lack of adequate environmental and radiation protection regulations at the time. Radiological impacts were assessed and results generally conduced to the implementation of mine site remediation programs aiming to prevent further waste dispersal and enhancement of radiation exposure of the population. Environmental radioactivity studies were carried out in the mine areas focusing on radionuclides from uranium family and their transfer in food chain, radiation dose assessment to the public, and toxicity of radionuclides on non-human biota. Social impacts and stakeholder issues related to uranium legacy and environmental remediation are described. Results are reviewed and summarized herein.
TRUE ECOLOGICAL RISK ASSESSMENT OF RADIATION REQUIRES AN ECOSYSTEM APPROACH

François BRECHIGNAC

1Institut de Radioprotection et de Sureté Nucléaire (IRSN) & International Union of Radioecology (IUR), Centre de Cadarache, BP 3, 13115 St Paul-lez-Durance cedex, France
francois.brechignac@irsn.fr

Abstract: There is still no consensus within the scientific community as to whether or not radioactive environmental contamination, such as resulting from the Chernobyl or Fukushima disasters, is promoting a deleterious ecological impact. This situation is critical as it is prone to favor unjustified distrust from society with respect to the ability of authorities to take adequate measures for mastering nuclear risk and protecting the environment. It is argued that one key challenge for radiation research when facing this general context is to widen traditional radiation biology, focused on DNA and cells of individual organisms, towards radiation ecology featuring an ecosystem-centered conceptualization. If life is driven by processes that act at subsystem level, i.e. the molecular engineering that founds the organisms’ physiology, it depends as well on processes that act at system level, i.e. emergent properties of the ecosystem dimension such as life support, since both types of processes have jointly emerged through evolution. Organisms and populations of species only exist as embedded within an ecosystem featuring multispecies interactions. Due to this basic consideration, environment protection measures that are developed exclusively from subsystem understanding (dose-response curves established for individual organisms) for practical reasons, as in current radioprotection guidance, may actually miss their protection objective and explain some recently reported discrepancies in assessing ecological impact. A few examples will be discussed to illustrate that ecological impact of radiation (as well as of any stressor) cannot easily be understood if not addressing the issue also from an ecocentric perspective.

Keywords: Radiation, ecological risk assessment, environment protection, ecosystem
PROTECTION STRATEGY, ENVIRONMENTAL RADIOLOGICAL MONITORING AND USE OF OPERATIONAL INTERVENTION LEVELS DURING EMERGENCIES IN NUCLEAR POWER PLANTS

Sertan YEŞİL

Turkish Atomic Energy Authority, Department of Nuclear Safety
Mustafa Kemal Mh. Dumlupınar Bulv. No: 192 Çankaya/Ankara, Turkey
E-mail of corresponding author, sertan.yesil@taek.gov.tr

Abstract:

Radioactive materials released to the atmosphere from the nuclear power plant to the environment during emergency situations can cause biological effects on people living in the region of 3-5 km radius within a few hours from the release, if necessary protective actions are not conducted properly. The most effective way to prevent high radiation doses during an emergency situation is to initiate protective actions as soon as possible according to the protection strategy which is a brief description of the response expected to be implemented during an emergency. At this stage, the implementation of radiological monitoring studies should not delay the implementation of urgent protective actions. The results of radiological monitoring studies should be used in later phases of emergency situations during taking decisions regarding the implementation of protective actions.

An international generic criterion has been set for the protective actions such as evacuation, sheltering, relocation and food restrictions. However, the generic criteria cannot be used operationally because they are not directly measurable quantities off-site during the emergency situations. Operational criteria (Operational Intervention Levels) that are based on the generic criteria should be developed for the use of the results of the radiological monitoring studies carried out during the emergency. Operational Intervention Levels should be used in order to make decisions on the implementation of response actions and other response activities for the protection of the public, the employees and the environment.

Personal radiological monitoring via γ and β dose rate measurements, γ dose rate measurements to be performed in the emergency planning zones and activity concentration measurements of the marker radionuclides in the food, milk and drinking water samples are the main radiological measurements to be performed during an emergency in a nuclear power plant. However, results of the radiological monitoring activities to be obtained during the early phases of the emergency situation will be confusing and probably inconsistent. As a result these reasons, the decision takers should be very careful and should take the characteristics of the measurements, the natural and social environment of the area and the representativeness of the measurements into account.
PLUTONIUM ISOTopes IN THE ENVIRONMENT: SOURCES AND DETECTION TECHNIQUES

Galina LUJANIENĖ

SRI Center for Physical Sciences and Technology, Savanoriu av. 231, LT-02300 Vilnius, Lithuania

E-mail of corresponding author, galina.lujaniene@ftmc.lt

Abstract: Plutonium is one of the most toxic elements and it causes serious concern when released into the environment. Recent developments in analytical techniques, accelerator mass spectrometry (AMS) and inductively coupled plasma mass spectrometry (ICPMS), have enabled researchers to detect long-lived radionuclides at ultra-low levels to investigate their environmental behavior and bioavailability as well as to apply radioactive isotopes introduced into the environment after nuclear weapon tests or released during accidents in tracer environmental studies. Specifically, Pu isotopes have been representing a new tool for investigation of atmospheric processes, to better understand past events in the environment as well as to predict future environmental changes. Plutonium isotopes have mainly been introduced into the environment during the atmospheric nuclear weapon tests and the burn-up of the SNAP-9A satellite, while other accidents (e.g., the Chernobyl disaster, Fukushima accident etc.) contributed to a lower extent or were more or less of local origin. Plutonium isotopes injected into the atmosphere after the nuclear weapon tests had a high potential to spread in the environment with a mean residence time varied for tropospheric and stratospheric plutonium-bearing aerosols from several months to about one and half year (Lujaniene et al., 2009; 2012). The global fallout has been found to be the main source of Pu in the environment (Lujaniene et al, 2014; 2017). Increased Pu activity concentrations recently detected in aerosol samples are due to secondary sources, which are mainly caused by the transfer of resuspended dust particles. Characteristic plutonium isotopes ($^{238}$Pu/$^{239,240}$Pu, $^{240}$Pu/$^{239}$Pu, $^{241}$Pu/$^{239,240}$Pu) can be employed to identify sources of the high Pu activity in environmental samples to better understand their fate and transport, which is important for predicting and evaluating the long-term radiological impact.

Keywords: Pu isotopes, sources, atmospheric transport, distribution in environment
Accelerator Mass Spectrometry (AMS) Applications in Nuclear Science

TURHAN DOĞAN¹, ERHAN İLKME¹

¹TÜBİTAK MAM YDBE GEBZE KOCAELİ TURKEY,

Accelerator mass spectrometry (AMS) is now widely accepted as the main measurement technique for ultra-sensitive analysis of long-lived radioisotopes with very small isotopic ratios (10⁻¹⁰ to 10⁻¹⁵). Extremely low backgrounds are achieved by making use negative ions that reach sufficiently high energies and counting of individual atoms using gas ionization or solid-state detectors. The Accelerator Mass Spectrometry (AMS) program at TÜBİTAK MRC EMSI was established in 2016 with a major focus on research for the radiocarbon measurements and applications in nuclear sciences. In this work, developments in AMS instrumentation and areas of applications will be reviewed and National 1 MV AMS Laboratory at TUBITAK will be presented.

KEYWORDS: Accelerator Mass Spectrometry, AMS, radioisotopes, radiocarbon, iodine isotopes,
ORAL PRESENTATIONS
O-01 THE ADAPTATION TO COMPUTER TOMOGRAPHY OF SAMPLE PARTS ACCORDING TO THEIR MANUFACTURING METHOD AND THEIR GEOMETRY

Cem YURÇI1, Numan M. DURAKBASA2

1Redlab Engineering Ltd. Company, Barbaros Mahallesi, Halk Caddesi, No:47/2, Ataşehir/Istanbul, Turkey
2TU Wien, Department of Interchangeable Manufacturing and Industrial Metrology, Institute for Production Engineering and Laser Technology, Getreidemarkt 9/BA09, 1060 Wien, Austria

yurci_cem@yahoo.com

Abstract: Today quality control is very important in manufacturing. In recent years, computer tomography has began to play an important role in quality control. This system is one of coordinate measuring machines including a method functioning with X-Ray. By this system the part rotates about an axis. This system identifies voids (especially in injection molding and casting) and internal stress fractures in metallic and non-metallic samples, solid and fibrous materials with smooth and irregularly surfaces. Like in scanning systems, with this system a 3D CAD comparison can be made. Its main advantage is non-destructive inspection without any contact. Cutting the workpiece into small pieces is not needed. For this application, some parts will be achieved from the automotive part sector. These parts will be pressure die cast, forged and plastic materials. Their adaptation to computer tomography and the efficiency by this application will be tested. The production and material defects such as voids and stress fractures will be inspected. The pressure cast parts are motor and armrest parts. They will have EN AC-Al Si9Cu3(Fe) and EN AC-Al Si17Cu4Mg materials. The second one is a new material for the part manufacturer. Also, these materials’ die cast properties will have been investigated, too. The plastic material will be injection molded material. The forged part will be steel material whose compatibility to computer tomography will be tested. An overview of porosity properties of these parts and the adaptation to the computer tomography according to the manufacturing method and to the geometry will be achieved.

Keywords: Computer Tomography, Pressure Die Casting, Production Defects, Geometrical Product Specifications and Verification (GPS)
O-02 BIOMONITORING OF RADIOACTIVE CONTAMINATION OF THE YENISEI RIVER

Oral Presentation /

Alexander Bolsunovsky¹, Dmitry Dementyev¹, Elena Trofimova¹, Ekaterina Iniatkina ¹,

¹Institute of Biophysics SB RAS, Krasnoyarsk 660036, Russia,

The Yenisei River, one of the world’s largest rivers, is contaminated by artificial radionuclides released by one of the Russian facilities producing weapons-grade plutonium (the Mining-and-Chemical Combine, MCC), which has been in operation for 60 years. Artificial radionuclides (Cs and Eu isotopes, 60Co, 90Sr, and transuranium elements) were detected in river bottom sediment within 2000 km downstream of the plutonium complex. Radioactive particles of reactor origin were found in the River floodplain affected by the radioactive discharge of the MCC. The most active fuel particles, which contain up to 30 MBq of 137Cs per particle, are a possible source of increased γ-radiation for living organisms and people. Aquatic plants are an important component of water ecosystems, which can accumulate high levels of radionuclides and, thus, can be used in biomonitoring and bioassays. This study presents the results of using plant bioassays (aquatic plants and Allium-test) to assess toxicity of γ-radiation from radioactive sediments and particles. Results of biomonitoring involving the use of aquatic plants suggest that at the MCC discharge site and downstream, the occurrence of chromosomal aberrations in anaphase cells of the plants was considerably higher (up to 30%) than in the control areas (6%). The laboratory experiments with the aquatic plant Elodea canadensis exposed to radiation from the radioactive particle showed adverse effects of the low doses of γ-radiation on root growth and the incidence of chromosome aberrations. Experiments with onion seedlings (Allium-test) exposed to γ-radiation also demonstrated an increase in the frequency of chromosome aberrations in cells and micronuclei. Thus, the existing levels of radioactive contamination of the Yenisei River floodplain affected by the radioactive discharge of the MCC may have negative effects on living organisms.

KEYWORDS: Artificial radionuclides, bottom sediment and fuel particles, low doses of γ-radiation, bioassay, aquatic plants and Allium-test
O-03 MCNP Modeling of Real-Time Airborne Alpha Beta Detection System

Oral Presentation /

Si Hyeong Sung¹, Hee Reyoung Kim¹,

¹Nuclear Engineering, Ulsan National Institute Of Science And Technology, Ulsan, Republic F Korea,

An airborne alpha beta detection system using passivated implanted planar silicon (PIPS) detector was proposed. In the proposed system, a radionuclide aerosol sample is collected from an air filter, which is then subject to nuclide analysis and dose measurement using a PIPS detector. Detection efficiency and resolution of the modeled detection system were analyzed by MCNP simulation, where the structure of the detection system and geometry of the commercial PIPS detector were constructed based on it. The type of aerosol filter was constructed with cellulose-asbestos paper, and the radioactive material was randomly placed inside the filter. Using the generated simulation code, the alpha beta spectrum of the detection system was derived. Simulation for resolution analysis of detection system using Gaussian energy broadening (GEB) function was performed. The full width at half maximum (FWHM) of 35.214 keV for alpha particles was ranged from 34 to 38 KeV, which is the FWHM range of the actual detector, and the FWHM of 16.569 keV for beta particles was constructed with a similar model to 17 keV, which is the FWHM range of an actual detector. In addition, the detection efficiency and the resolution were simulated according to the distance between the detector and the air filter. When the distance was decreased to 2 cm from 8 cm, the efficiencies of the alpha and beta particles detection were improved from 4.3% to 18.2% and from 1.8% to 14.3%, respectively, and the FWHM of the alpha and beta particles were enhanced from 58.214 KeV to 35.214 keV and 72.325 keV to 16.569 keV, respectively. Based on the simulation results, the performance of the proposed detection system was confirmed. By using this detection system, it is expected to monitor radioactive contamination around the nuclear power plant actually and the exposure of the nuclear dismantling worker by real-time measuring of alpha beta contamination in the air.

KEYWORDS: PIPS Detector, MCNP6, Semiconductor Detector, Modeling, Resolution, FWHM
O-04 RADIOLOGICAL SURVEY THE SURROUNDING OF A CLOSED ORE MINE IN HUNGARY

Oral Presentation /

Edit Tóth-Bodrogi¹, Erika Kocsis¹, Anita Peka¹, Anita Csordás¹, Tibor Kovács¹,

¹Institute Of Radiochemistry And Radioecology, University Of Pannonia,

The remediation work of the closed ore mine in Gyöngyösosorosi (Hungary) has been started in 2005. The main aim of the remediation work to inhibit the acid producing oxidation – caused by interaction of oxygen, water and pyrite – of huge amount of remaining pyrite content can be found in lode-system of Mátraszentimre. During this study the activity concentration of the radon in the mine has been investigated using CR-39 detectors, furthermore the activity concentration of U-238, U-234, Th-232 and Po-210 isotope of the mines spill water, deposited sludge with high Fe(OH)₃ content, and treated technological spill waters were determined simultaneously with alpha spectrometry. In the case of polonium isotopes spontaneous deposition, and for uranium and thorium isotopes electrodeposition source preparation method were applied. Based on our results it can be stated that the radon concentration is between 104-924 Bq/m³, which is higher than the Eu-BSS reference level (300 Bq/m³) in some cases. The uranium isotopes activity concentration of water samples varied between 6.7±0.73 and 18.42 ± 1.71 in case of U-238 and between 7.64 ± 0.76 and 20.60 ± 1.82 mBq/l in case of U-234 isotope and there is not equilibrium between the two isotopes. the Po-210 activity concentration in water samples varied between 5.76± 1.82 and 260.76± 50.62 and varied between 6.11±0.69 and 61.4±3.38 in sludge samples. The thorium isotopes were low or under detection limit in the investigated water and sludge samples as it were expected. On the basis of the obtained results it can be safely stated that the investigated radionuclides were found in normal or below activity concentration compared with environmental level in the case of examined technology.

KEYWORDS: ore mine, polonoium, uranium, radon
O-05 THE CORRELATION OF THE SEISMIC ACTIVITIES AND RADON CONCENTRATION IN GROUNDWATER

Oral Presentation /

MEHMET SEZER², FERİDE KULALI¹

²Department of Systems Engineering Turkish Naval Research Center Command, Istanbul, Turkey,
¹Uskudar University, Vocational School of Health Services, Nuclear Technology and Radiation Safety

Radon is a gas form element of the Uranium decay chain, which diffuse through all kinds of materials. Its relatively long half-life allows it to travel along fractures and faults and to accumulate in caves or groundwater. Due to its inert gas structure it does not react chemically, radon concentration in groundwater is not affected by the general hydrological characteristics. Therefore, it is stated that the fluctuations of radon concentration in groundwater occur largely depending on tectonic movements. In this study, the radon concentration in groundwater samples, which collected from Karahayit geothermal area and Pamukkale geothermal source, were measured continuously for six months. The earthquake data of the region has been recorded simultaneously and used for calculation of its effect on radon emanation. The obtained value compared with radon concentrations for investigation of the correlation between earthquakes and radon anomalies.

KEYWORDS: Radon, Radon Anomalies, Groundwater, Earthquake Prediction
AIR EXCHANGE RATE ESTIMATION IN DWELLINGS WITH ELEVATED RADON CONCENTRATION USING VOC TRACER – SORPTION TUBE SYSTEM

Oral Presentation / 

Michal Fejgl¹, Karel Jílek¹, Jan Lenk¹, Šárka Maříková¹, Aleš Froňka¹, Ivan Hupka¹

¹National Radiation Protection Institute, Prague, Czech Republic,

The background level of radon concentration in the Czech Republic is one of the highest in the world. Hence, the Czech legislation recommends utilizing the air exchange rate measurements as a diagnostic tool facilitating the assessment of radon exposure and, therefore, enabling the initiation of remedial measures implementation or further intervention to reduce the exposure. The fundamental objective of this project is to develop a detection method of air exchange rate in several types of dwellings (e.g. residential buildings, schools, workplaces) using different volatile organic compounds (VOC) as tracers and sorption tubes (ST) as passive integral detectors. For this purpose, a glass tracer gas source (GTS) – ST and thermal desorption – gas chromatography (TD-GC) systems enable the determination of integral amount of tracers adsorbed on tubes throughout the exposure time. In present experiments, three different types of sorbents were used to fill the tubes. To simulate the deployment of GTS – ST system in dwelling conditions several measurements were performed and are still in progress using a 48 m³ sealed room with controlled air flow, temperature and humidity, simultaneously applying multiple GTS with known compound flow. The campaign duration is from one to five weeks. The range of evaporation speed for utilized sources is 5-30 mg/day depending on a tracer and temperature. As the calculated amount of tracer in ST depends on the exposure time, its calculated range is 1-1000 ng/tube. The detection limit of this method is ~ 0,1 ng/tube. The main outcome of the research is to allow public to have a possibility of air exchange rate testing through parcel delivery (GTS – ST system) with subsequent evaluation at NRPI. After the validation and verification parts are complete, this method will be prepared for the accreditation process.

KEYWORDS: Radon, VOC, ventilation
O-07 Radioactive contamination of water bodies and fish health within the Chernobyl Exclusion Zone

Oral Presentation /

Dmitri Gudkov¹, Alexander Kaglyan¹, Sergey Kireev², Natalia Pomortceva¹, Alexander Nazarov², Khristina Ganzha¹, Vladislav Pavlovsky³,

¹Department of Aquatic Radioecology, Institute of Hydrobiology, Kiev, Ukraine, ²State Specialized Enterprise "Ecocentre", Chernobyl, Ukraine, ³Department Of Ecology And Zoology, Educational And Scientific Center "Institute Of Biology And Medicine" Of The Taras Shevchenko National University Of Kiev, Ukraine,

During 1998-2018 we studied dynamics and bioavailability of the main dose-forming radionuclides in components of aquatic ecosystems as well as effects of long-term radiation exposure on fish within the Chernobyl Exclusion Zone (CEZ). The main dose-forming radionuclides for fish in water bodies within the CEZ are Sr-90 and Cs-137. The highest values of the specific activity of radionuclides were found in fish lakes located at the left-bank flood lands of the Pripyat River with highest density of radioactive contamination of soils - up to 30100 Bq kg⁻¹ (wet weight) for 90Sr and up to 31900 Bq/kg for Cs-137. The mean value of the absorbed dose rate for fish of the CEZ during the research period was in range 6.5-110.8 μGy/h. For fish of reference reservoirs, the absorbed dose rate did not exceed 0.07 μGy/h. Despite the absence of significant changes in the population structure, as well as a small number of external morphological disorders and malignant neoplasms in fish, we determined an increase in abnormalities of the axial skeleton, histopathology of liver, gills and gonads, as well as significant changes in the peripheral blood of fish. Drawing attention the high rate of red cells aberrations and abnormalities in blood of fish from lakes, where the dose rate on three orders higher in comparison with reference lakes. It can testify to certain mutagenous of environment and possible display of radiation-induced genetic instability of fishes in the conditions of chronic radiation impact. The increased levels of erythrocyte damages for pray fish in 4-12 times and for predatory fish in 7-15 times were higher in comparison with fish from the reference lakes. Hereby the long-term radiation exposure of fish in lakes within the CEZ causes reactions, showing the damage of important biological systems. The special significance may acquire cytogenetic and genetic effects resulting from disorders of the genome stability with high probability of appearance in the form of increased mutation rates, decreased fertility and loss of the most sensitive species. Cumulative radiobiological processes can last for many generations allowing currently assume the possibility of incomplete realization of the long-term effects

**KEYWORDS:** Aquatic ecosystems, Chernobyl Exclusion Zone, fish, radioactive contamination, radiation-induced effects
O-08 VERIFICATION OF GAMMA SPECTROMETRY ANALYTICAL RESULTS USING SIMULATED AND EXPERIMENTALLY DERIVED EFFICIENCY CURVES

Oral Presentation /

Anfal Ismaeel1.

1Kuwait Institute For Scientific Research,

A correct efficiency curve is a crucial element to determine the activity contents correctly in different environmental matrices in gamma spectrometry techniques. Different critical parameters (such as sample's geometry, type of radionuclide, density, and chemical composition of the samples) affect the accuracy of such an efficiency curve. The most recommended method to calculate such a curve is the experimental method using certified reference materials. The experimental approach is usually expensive and time-consuming, primarily when a wide range of samples with different matrices and radionuclides are analyzed. An alternative method is to generate the efficiency using either the semi-empirical or a numerical calculation, which is based on photon interaction with the materials and the detector-sample geometries. This work presents an approach to experimentally verify the efficiency curves generated by LabSOCS (Laboratory Sourceless Object Calibration Software) to analyze various environmental samples. Different IAEA PT samples were analyzed using the efficiency curves generated by the two methods. The analytical results were compared, and the necessary correction factors for cascade summing were applied. A comparison between the efficiency curves generated experimentally and by LabSOCS has been carried out. The results showed that the efficiency curve generated by LabSOCS could be used to determine the concentration of different radionuclides with less than 10% bias from the target values for water samples and less than 20% for soil samples. It was found that the elemental composition of the sample and the parameters of the counting geometry should be accurately and precisely defined in the software to obtain accurate and precise results, in particular when analyzing low energy gamma emitters (241Am, 234Th, and 210Pb). The advantages of using the LabSOCS were to apply the cascade summing corrections, in addition, to accurately determine the activity of low energy gamma emitters in different matrices.

KEYWORDS: Simulation efficiency, radioactivity measurement, cascade summing correction
O-09 DYNAMICS OF DOSE EQUIVALENT RATE ABOVE THE SOIL SURFACE AS INDICATOR OF NATURAL ATTENUATION PROCESSES

Oral Presentation /

Alexei Konoplev¹, Toshihiro Yoshihara², Yoshifumi Wakiyama³,

¹Institute of Environmental Radioactivity, Fukushima University, Fukushima, Japan, ²Central Research Institute Of Electric Power Industry, Chiba, Japan, ³Institute of Environmental Radioactivity, Fukushima University, Fukushima, Japan

Eight sites in Fukushima contaminated area were surveyed in situ for long-term changes in dose equivalent rates above the soil surface using D-shuttle dosimeters with a collimated lead shield. D-shuttle readings in most cases decreased faster than if due to radioactive decay only. The faster reduction is explained by natural attenuation processes such as erosion of the topsoil layer, vertical migration of radionuclides in soil and deposition of cleaner sediments transported by surface runoff. From the time dependencies in D-shuttle dose rate readings, an estimated integral rate constant of natural attenuation were obtained using an exponential trend-line. The estimated rate constant of natural attenuation ranged from 7.3×10⁻³ year⁻¹ on the catchment of the pond in Okuma town to 0.48 year⁻¹ on Takase river catchment and corresponding periods of dose rate half-reduction were in the range 1.4-95 years. Data for the sites on Takase river catchment are indicative of an essential reduction in dose rate during flooding periods in November 2015 and from the end of May-June 2016, as well as during snowmelt and resulting surface runoff. The only site on Niida river floodplain demonstrated an increase in D-shuttle dose rate readings due to an accumulation of contaminated sediments from upstream during the flood in raining season of 2016. Therefore, D-shuttle monitoring is able to differentiate two distinct trends in the ambient dose equivalent rate depending on the specific geological traits of monitoring spots; sedimentation and erosion of cleaner/contaminated soils. This research was supported in part by a Grant-in-aid for Scientific Research from the Japan Society for the Promotion of Science (JSPS Projects 15H04621 and 18H03389).

KEYWORDS: Fukushima, D-shuttle dosimeter, natural attenuation
O-10 NEW EFFICIENT MODIFIED CALIX[4]PYRROLES ON THE 
DECONTAMINATION OF AQUEOUS MEDIA FROM RADIIUM

Oral Presentation /

Ahmad RIFAI¹, Nancy AL-HADDAD², Pierre Edouard DANJOU², Francine CAZIER², 
Rana BAYDOUN¹, Bilal NSOULI¹, Omar EL SAMAD¹,

¹Lebanese Atomic Energy Commission - National Council For Scientific Research , ²UCEIV- 
Université Littoral Cote D’Opale - Dunkerque ,

Radium-226 is a naturally occurring radionuclide that is derived from U-238 series, and it is 
present at low concentrations in rocks, soil and groundwater. It decays to various progeny 
radioactive isotopes and terminates by the stable isotope Pb-206. However, human activities 
such as mining, fertilizers industries and oil and gas industry could increase its concentration 
in the environment. Many efforts have been exerted for decontamination from Radium in 
different media. In this work new modified macromolecules phenoxy calix[4]pyrroles with 
ether and ketone functional groups, which have great affinity for alkali metals, were synthesized 
and are intended for the decontamination of Radium. The synthesized product was first tested 
on Barium, the stable element having similar chemical behaviour as Radium. The effect of 
complexation of this compound with Ra-226 was studied in an acidic solution with known 
activity concentration. After complexation, gamma spectrometer with High Purity Germanium 
detector of relative efficiency 50 % was used to determine the activity concentration of Ra-226 
remaining in the solution and that taken by the modified calix[4]pyrroles compound. Results 
showed that the compound has extracted 18% of the present Ra-226. This lead to carry out 
further studies in order to enhance this extraction, through the determination of optimum 
conditions of complexation.

KEYWORDS: Ra-226, modified phenoxy calix[4]pyrroles, complexation, Gamma 
spectrometer
O-11 DISTURBANCE OF HYDROLOGICAL REGIME AS A FACTOR OF PARTICULATE Cs-137 MIGRATION IN THE UPA RIVER

Oral Presentation /

Maksim Ivanov\textsuperscript{1}, Valentin Golosov\textsuperscript{2}, Nadezhda Ivanovs\textsuperscript{1}, Alexei Konoplev\textsuperscript{3}, Yoshifumi Wakiyama\textsuperscript{3},

\textsuperscript{1}Faculty Of Geography, Lomonosow Moscow State University, Moscow, \textsuperscript{2}Faculty Of Geography, Lomonosow Moscow State University, Moscow; \textsuperscript{3}RAN Institute Of Geograpaphy, Moscow, \textsuperscript{3}Institute Of Environmental Radioactivity, Fukushima University, Kanayagawa, 1, Fukushima, Japan,

Lateral migration of Cs-137 via temporary and constant watercourses is the main mechanism for spatial transformation of initially deposited contaminants on Chernobyl affected territories. In Central Russia, highly contaminated areas occur on densely populated territories where watercourses are exposed to major human impacts. As far as the highest concentration of Cs-137 in soils and deposits can be attributed to the Chernobyl fallout, the floodplain strata turn out to be a very important of landscape record. Depth increment study of floodplain deposits provides information about Cs-137 concentration in suspended sediments during flood events in the post-Chernobyl period. The analysis of floodplain morphology and topography can reveal modern trends of river valley development. This information can be used for interpretation of obtained radiocesium data. Moreover, accumulation of sediments on the floodplains in contaminated areas illustrates the process of natural attenuation, which should be considered in remediation strategy development. Studies conducted in 2009-2018 in the Upa River basin (right-hand tributary of the Oka River) have made it possible to identify trends in particulate Cs-137 lateral migration in different reaches of the river. The most part of sediment-associated Cs-137 delivered from the cultivated slopes of the Upa River upper reaches have been trapped in Schekinskoe reservoir. As the result, incision is observed downstream and accumulation of sediment-associated Cs-137 on the floodplains is decreasing dramatically. In the middle reaches, the sedimentation rates on floodplain returned to normal. The low reach of the Upa River is characterized by significant incision caused by intensive excavation of sands from the channel of the Oka River since the last decades of 20th century. However, high sedimentation rates on the Upa floodplain is observed due to different hydrological regime of the Oka and the Upa Rivers. The results for Upa River basin are compared with data for Niida River and Abukuma River in the contaminated areas as a result of the accident on Fukushima Dai-ichi NPP. The research is funded under RFBR-JSPS Project “Assessment and prediction of sediment and radionuclide fluxes in river basin affected by severe nuclear accident”.

KEYWORDS: Cs-137, Chernobyl contamination, floodplains, sediments, lateral migration
O-12 RADIONUCLIDIC IMPURITY DETERMINATION OF 99mTc AND EVALUATION OF UNCERTAINTY BUDGET

Oral Presentation /

NAZİFE ASLAN¹, GÜLTEN ÖZÇAYAN²,

¹ANKARA HACI BAYRAM VELİ ÜNİVERSİTESİ, POLATLI FEN EDEBİYAT FAKÜLTESİ KİMYA BÖLÜMÜ, ²TÜRKİYE ATOM ENERJİSİ KURUMU RADYASYON VE HIZLANDIRICI TEKNOLOJİLERİ DAİRESİ BAŞKANLIĞI,

Abstract: Radionuclides are essential for nuclear medicine, especially for imaging. Since the radionuclidic impurities contribute significant effects on the patient’s overall radiation dose, it is important to have a product with acceptable quality control (QC) parameters. Quality control (QC) parameters include tests for radiochemical, radionuclidic, and chemical purity for pharmaceutical concerns. The definition of radionuclidic purity is the ratio of the indicated radionuclide activity to the total radioactivity. In this study, the determination of radionuclidic impurities were done by sequentially separation of target radionuclides (89Sr, 90Sr and total alpha/beta emitters) followed by sensitive measurement using Liquid Scintillation Counting (LSC) system in 99mTc eluate from 99Mo/99mTc generator. This sequential separation method was validated with standard solutions of the radionuclides used and the measurement uncertainty of the method were evaluated in detail. The uncertainty associated with the activity concentration has been calculated according to the appropriate rules of uncertainty propagation to give a combined standard uncertainty. The parameters contributing to the uncertainty budget include the uncertainties in the counting statistics, detector efficiency, quench parameter [SQP(E)], misclassification, mass of sample and activities of the standard radionuclide solutions. The major contributions come from the counting statistics as expected.

KEYWORDS: Radionuclidic impurity, Uncertainty, 99mTc, Liquid Scintillation Spectrometry
O-13 INFLUENCE OF CONTAMINATED SEDIMENTS IN SHCHEKINO RESERVOIR ON 137Cs CONCENTRATION IN FISH

Oral Presentation /

Natalia Kuzmenkova¹, Maksim Ivanov², Toshihiro WADA³, Kenji NANBA⁴, Ludmila EFIMOVA², Artyom GURINOV², Nadezhda IVANOVA⁵, Evgeny KONSTANTINOV⁶, Alexandra ROZHKOVA¹, Valentín GOLOSOV²

¹Lomonosov Moscow State University, Faculty Of Chemistry, ²Lomonosov Moscow State University, Faculty Of Geography, ³Institute Of Environmental Radioactivity, Fukushima University, Kanayagawa, 1, Fukushima, Japan, ⁴Institute Of Environmental Radioactivity, Fukushima University, ⁵Lomonosov Moscow State University, Faculty Of Geography, ⁶RAS Institute Of Geography,

The Shchekino reservoir is located in Tula region within the “Plavskiy radioactive spot” impact zone, which is characterized by the highest initial contamination level on the high distance from Chernobyl NPP. The level of contamination of soil exceed 185 kBq/m² after initial fallout in 1986 in the reservoir catchment. Maximum specific activity of Cs-137 in bottom sediments was about 4500 Bq/kg in 1986. The goal of our study is to evaluate the 137Cs transfer from catchment area for the 32 years after accident and to determine the influence of 137Cs sedimentation in reservoir of fish. Field investigations were undertaken in low water periods (January and July 2018). In February 2018 four bottom sediment cores were taken in the typical locations of the upper half of reservoir, which were selected using results of georadar survey of reservoir bottom along the few cross section profiles. 17 samples of fish were collected (1 carp (Hypophthalmichthys), 12 crucian carp (Carassius), 4 roach (Rutilus rutilus) from reservoir in July 2018. 137Cs activity in samples of sediment and fish was measured using a semiconductor gamma spectrometer with a HPGe detector. Water samples for geochemical analysis were taken also in January and July. The reservoir water is characterized by the moderate mineralization belong to the hydrocarbonate class, the group of calcium and magnesium and it is slightly alkaline (pH - 7.6 - 8.5). Based on the interpretation of 137Cs vertical distribution in the bottom sediments, the 137Cs concentration dynamics changes in sediment yield of the Upa River over 1986-2018 were restored. During the post-Chernobyl period, radionuclides concentration in sediments reduced considerably. Therefore intensive siltation resulted into burial of sediment layers with maximum concentrations of 137Cs. Exploration of fish showed that the level of 137Cs activity in the muscles is much lower than the existing maximum permissible level. The obtained data allow us to conclude that the current state of the Shchekino reservoir fish is satisfactorily assessed. The research is funded under RFBR-JSPS Project “Assessment and prediction of sediment and radionuclide fluxes in river basin affected by severe nuclear accident”.

KEYWORDS: 137Cs, reservoir, Chernobyl pollution, sediments migration, radionuclides in fish.
O-14 AN APPROACH TO ADOPT A PRE-SELECTED SITE FOR RADIOLOGICAL MONITORING IN KUWAIT

Oral Presentation /

Abdulaziz ABA¹, Omar ALBOLOUSHI¹,

¹Kuwait Institute For Scientific Research,

Abstract: It was a challenging task to adopt a location for radiological monitoring by field measurements in the desert environment of Kuwait. The purpose of this work was to seek for an area that most likely fulfills the criteria of the reference site for monitoring the radioactivity levels of 137Cs concentration by high-resolution gamma filed measurements. The approach was based on optimizing the modelling parameters of the ISOCS software (In Situ Counting System, Canberra) employing the laboratory measurements of 137Cs and 40K. The pre-selected site was chosen based on site-documented history that follows the criteria: neither soil loss nor gain is occurring. A systematic grid sampling design with a spacing of 10 m by 10 m for collecting deep soil by coring techniques was developed and implemented. Deep soil samples up to 30 cm were obtained by a corer of 7 cm diameter from each point in the grid. Laboratory measurements of 137Cs and 40K concentrations were used to derive the distribution of the radionuclides in depth. The derived parameters of 137Cs distribution were used as the input modelling parameters of ISOCS. In-situ gamma spectrum was collected using 1-meter height of HPGe detector from the centre of each rectangle (20 m x 20 m) in the grid. The inventory of 137Cs and the concentration of 40K of both in-situ and laboratory measurements were compared and found that the bias was less than 20%. The spatial distribution of 137Cs of the selected site showed that the in-situ measurements were susceptible to the variation of 137Cs inventory. The obtained results of 137Cs inventory by field measurements were compared with the hypothetical deposition model in the northern hemisphere and found in a good agreement (the variations were less than 20%). It was concluded that the pre-selected undisturbed site could be used for radiological monitoring emergencies.

KEYWORDS: 137Cs, In-situ, ISOCS, Spatial distribution, Kuwait
O-15 PLUTONIUM AND AMERICIUM IN THE DEEP BLACK SEA BOTTOM SEDIMENTS

Oral Presentation /

Vladislav Yu. Proskurnin1, Nataliya N. Tereshchenko1, Artem A. Paraskiv 1, Olga D. Chuzhikova-Proskurnina1, 2, 2, 2

1Department Of Radiation And Chemical Biology, The A.O. Kovalevsky Institute Of Marine Biological Research Of RAS, Sevastopol, Russia,

The world’s largest marine anoxic basin of the Black Sea is known to be affected by two major sources of anthropogenic radioactivity quite separated in time: the global radioactive fallout (peaked in early 1960s) and atmospheric fallout caused by Chernobyl NPP accident in April 1986 followed by riverine discharge during early years after the accident. Both mentioned sources contained plutonium isotopes, which can be considered as one of the most informative tracers for the dating of seabed sediments. Plutonium isotopic composition from both sources mentioned besides α-emitters as 238Pu, 239Pu, 240Pu contained low-energy β-emitting 241Pu being the parent radionuclide for 241Am and causing the 241Am increment in the environment. This study aimed at analysis of 239+240Pu, 238Pu, 241Pu and 241Am vertical distribution in sediments from the western Black Sea deep area, dating of the sediments as well as estimation of 241Am enhancement in different sediment layers due to 241Pu decay. 239+240Pu, 238Pu and 241Am concentrations were measured by means of semiconductor alpha-spectrometry; 241Pu was measured by liquid-scintillation alpha-beta-spectrometry. Bottom sediments were dated by geochronological reconstruction of their plutonium contamination. Profiles of all studied isotopes showed two concentration peaks: in 2.75-3.00 and 4.00-4.50 cm sediment layers. The upper peak layer was dated as 1986 (Chernobyl fallout) while the deeper – as 1963 (global fallout) according to 238Pu/239+240Pu activity ratio. 241Pu concentration exceeded the detection limit only in the peak layers. The total inventories of the isotopes on sampling date (2013) for the area studied were estimated as: 239+240Pu – 39.4±2.7, 238Pu – 1.7±0.2, 241Pu – not less than 62.0±1.4, 241Am – 17.2±0.7 Bq•m-2. The 241Am inventory enhancement by 241Pu decay in Chernobyl sediment layer was calculated as 85% of initial deposited value, and so 46% of the actual inventory was likely to be accumulated after the radionuclides deposition from water column. The value of expected 241Am inventory enhancement in global fallout layer was estimated to exceed twice the actual 241Am inventory obtained and further study is needed to make this point clear. The study was supported by the government assignment for the IMBR RAS entitled «Molismological and biogeochemical fundamentals of marine ecosystems homeostasis» №AAAА-A18-118020890090-2.

KEYWORDS: (238, 239+240, 241Pu), 241Am, Black Sea, bottom sediments
As known, in each soil there is a small amount of natural radioactive material, such as uranium, thorium and potassium with a number of their radioisotopes. In some populated areas with relatively high natural radioactive soils and well water, there is a need for performing detailed measurements and investigations to determine the radiation exposure to the public. As people work in agricultural fields and use or drink water from wells and rivers, as well as using the soil to build their houses, they are continuously exposed to relatively high natural radiation. Later, as they live in such houses, they are also exposed to direct radiation from the walls of their houses as well as through inhalation of radon, especially in the basement or underground rooms.

In Turkey, in the areas of old uranium mines the radiation and radioactivity measurements in soil and well waters were performed in the past. But these measurements involved hydrogeological studies, which were not planned to investigate public radiation exposure and their risks in the vicinity. These findings indicate the need for detailed measurements through an investigation program to determine radiation doses to the public and their associated risks.

Beyond measurement of radioactivity concentrations, it would also be necessary to perform time/distance studies to determine doses relative to main radiation areas or hot spots. Additionally, radon concentrations and inhalation times must be measured in rooms that are occupied by individuals. Radioactivity concentrations in soil, vegetation, foodstuffs and water must also be measured as well as the monthly and annual intake by the public. Afterwards, the doses and risks must be evaluated using appropriate health physics methods. The results obtained must finally be compared with the limits of international standards to judge the risks.

This presentation describes the methodology and the details of the investigation project which may not be known by each discipline. The project should be performed by specialists at the universities and TAEK as a research group. It is recommended that possibly a TUBITAK Project might be undertaken with the support of local municipalities.

**KEYWORDS:** Radiation measurement, Exposure of Public, Natural Radioactivity , Radiation dose and Risk
O-17 Interaction of cesium and strontium ions with engineering barrier material and their dose risk assessment

Oral Presentation /
Sevilay Haciyakupoglu, Sema Akyil Erenturk, Ayse Nur Esen, Bahire Filiz Şenkal

1Istanbul Technical University, 2Istanbul Bilgi University,

One of the important energy production sources the nuclear power plants produce high level nuclear waste and they have to being stored. Storage of the waste can be provided by burying them to deep underground repositories in specifically chosen geological formations. The repositories generally rely on a multi-barrier system to isolate the waste from the biosphere. This multi-barrier system comprises natural geological barriers provided by the repository host rock and its surroundings and engineered barrier systems. In this way long half-life radionuclides in waste can be stopped even before they reach the earth. The existence of long-lived and high fission yield radionuclides such as cesium-137 ($t_{1/2} = 30.1$ years) and strontium-90 ($t_{1/2} = 28.5$ years) is the main source of radiotoxicity in high-level waste. Many researchers worked on removal of these radionuclides from various media. In this study, amino pyridine sulfone amid resin as a barrier material was synthesized and utilized as a potential adsorbent for the removal of cesium (Cs+) and strontium (Sr2+) ions from aqueous solution. The effects of adsorbate concentration, pH of the solution, temperature and contact time on the engineering barrier material efficiencies of Cs+ and Sr2+ were investigated and evaluated. Additionally, the suitability of the barrier system was examined radiologically and the radiological dose risk assessments of cesium and strontium that can be diffused into the barrier system were evaluated by using the program Environmental Risk from Ionising Contaminants: Assessment and Management (ERICA) for reference organisms (amphibian, annelid, arthropod, bird, flying insects, lichens & bryophytes, mammal-large, mammal-small, mollusc, reptile, shrub and tree) living around the waste area. This study is part of the project supported by the Istanbul Technical University Scientific Foundation.

KEYWORDS: nuclear waste, barrier material, sorption, interaction, cesium, strontium, biota
O-18 PREPARATION OF CHITOSAN-ALGINATE COMPOSITE HYDROGEL (CACH) FOR STRONTIUM REMOVAL FROM AQUEOUS SOLUTION AND EVALUATION OF ADSORPTION PERFORMANCE

Oral Presentation /

Alparslan Enes ORAL\textsuperscript{1}, Şule AYTAŞ\textsuperscript{1}, Sabriye YUŞAN\textsuperscript{1},

\textsuperscript{1}Ege University Institute Of Nuclear Sciences Bornova Izmir TURKEY,

When radioactive strontium atoms taken inside of living body, radioactive strontium starting to act like a normal calcium atom. Therefore, it is necessary to study the separation of strontium especially from drinking water and other water samples. In this study, in order to eliminate strontium ions from aqueous solution, Chitosan + Alginate Composite Hydrogels (CACH) was synthesized and used for the adsorption of strontium. Hydrogels are considered as a good adsorbent for adsorption process. Because they can be economical produce and stable in water. Therefore, it’s important to know hydrogels properties as an adsorbent. In the study, chitosan alginate hydrogels were synthesized and adsorption properties towards strontium ions have been investigated. Sorption potentials of Sr(II) ions were studied using CACH biopolymer beads in diluted aqueous solutions. The ability of CACH beads to adsorb strontium (II) from aqueous solution has been studied at different optimized conditions of solution pH, Sr (II) concentration, contact time, biopolymer dosage and temperature. In order to determine the adsorption characteristics, Langmuir, Freundlich, and Dubinin-Radushkevich adsorption isotherms were applied to the adsorption data. The thermodynamic parameters such as variations of enthalpy, entropy and variation of Gibbs free energy were calculated. The results suggested that chitosan-alginate composite hydrogels could be suitable as a biopolymer sorbent for adsorption and removal of strontium ions from dilute aqueous solutions.

**KEYWORDS:** Strontium, Removal, Chitosan, Alginate, Composite
A CASE STUDY: IS 222Rn in RAIN WATER A FINGERPRINT for EARTHQUAKE?

Nurdan AKAKÇE1, Aysun UĞUR GÖRGÜN2, M. KIRAMI ÖLGEN3, Ercüment AVŞAR4,

1EGE UNIVERSITY, Institute Of Nuclear Sciences, 2EGE UNIVERSITY, Institute Of Nuclear Science, 3EGE UNIVERSITY, Department Of Geography, Faculty Of Literature, 4Turkish State Meteorological Service

Abstract: Radon is a nature gas with half life of 3.82 days and it is a product of uranium decay series. Uranium and Thorium are exist in almost all rock and soils. A relationship between earthquake producing processes and radon emanation can provide significant information to use as a possible precursor of earthquake. The objectives of this study are to investigate the between earthquake forecast and radon concentrations in rain water considering the meteorological factors such as atmospheric pressure, prevailing wind direction and force, and rain. The rain water samples were collected from 1 March 2017 to 28 February 2018 in İzmir. The 222Rn activity concentrations of the samples were found vary between 0.021 and 0.647 Bq/l, with average value of 0.234 Bq/l, using collector chamber method. In the study, a detailed synoptic analysis of meteorological systems were investigated. In the meteorological analysis of the precipitation, satellite and radar systems were used and the development of the system causing the precipitation was shown. Bornova Meteorological Observation Station (OMGİ) data, satellite images, Radar PPI (Plan Position Indicator), Radar MAX (Maximum Display) images were evaluated and in addition, the results of the synoptic situation, numerical estimation models, and the Skew T Log-P diagram were calculated by calculating some indexes and the results were mapped. Keywords: 222Rn, rain water, earthquake, rainfall frontal

KEYWORDS: Rn-222, rain water, earthquake, rainfall frontal
O-20 ADSORPTION STUDIES of Ce(III) onto THE MULTI-WALLED CARBON NANOTUBES by USING RESPONSE SURFACE METHODOLOGY

Oral Presentation /

Cansu ENDES YILMAZ1, Hakan ÖNAL2, Mahmut A.A. ASLANİ1, Mustafa DEMİRCİOĞLU2, Ceren KÜTAHYALI ASLANİ1,

1Ege University, Institute Of Nuclear Sciences, 2Ege University, Chemical Engineering Department,

The demand for rare earth elements is increasing day by day as it has widespread use in the latest technology areas such as engineering, information storage, communications, automobiles, metallurgy and nuclear energy. This increase in demand causes more release of rare earth elements to the environment. Rare earth elements can lead to significant negative impacts on health, such as genetic poisoning in bone marrow cells and DNA damage. Cerium element is one of the cheapest and abundant rare earth elements which has widespread use in industry in polishing powder and ceramics, catalyst support, pyrophoric alloys and metallurgical fields. When cerium reaches to living organisms, it usually accumulates in the liver, lungs and kidneys of the human body. Therefore, many methods are applied to remove cerium from liquid wastes (ion exchange, solvent extraction, adsorption, chemical precipitation, membrane filtration and electrochemical process). Adsorption is the most widely used and cost-effective process which eliminates the disadvantages such as; secondary waste generation and low selectivity of the other separation methods. Carbon nanotubes are one of the most effective adsorbents which are used in adsorption process. Carbon nanotubes are relatively new materials that were first discovered by lijima in 1991 and have superior properties in graphite structure. Since their discovery, they have attracted great attention with their unique chemical, physical and mechanical properties. They have a large surface area, porous and layered structure. The use of carbon nanotubes as sorbent materials in the environmental area gives promising results in the management and treatment of liquid wastes. The scope of this study is to investigate the adsorption effectiveness of multi-walled carbon nanotubes (MWCNTs) on cerium(III) ions. Three different modifications (with HNO3, H3PO4 and H3PO4 on HNO3) were applied to MWCNTs. Important parameters effecting the adsorption (contact time, pH, initial Ce(III) concentration and temperature) were examined and optimum conditions determined by using Central Composite Design technique.

KEYWORDS: Cerium, Adsorption, Carbon Nanotubes, Response Surface Methodology
O-21 RADIOLOGICAL ANALYSIS MONITORING AND SAMPLING EQUIPMENT SYSTEMS (RAMSES): LATEST TECHNOLOGY FOR RADIOLOGICAL MONITORING

Oral Presentation /

Carlo De Lellis¹, Grégory Delécaut¹,

IRE ELiT, Belgium,

For more than 20 years, the radiological monitoring and early warning systems developed by the National Institute for Radioelements (IRE, Belgium) and its subsidiary IRE ELiT are of particular interest for the control of the environment and nuclear facilities where anthropogenic activities can be of major relevance for the environmental protection and public health. Very recently, IRE ELiT has achieved the development of its 3rd generation of monitoring systems called RAMSES (Radiological Analysis Monitoring and Sampling Equipment Systems). This state-of-the-art system allows the remote configuration and data management of both continuous monitoring and sampling equipment. Although the main application of the system is to detect routine or accidental releases from nuclear facilities into the environment, other industries such as NORM and hospitals are also concerned by the continuous surveillance of the effluents generated by their activities, notably due to the "zero-release" policy currently prevailing in most countries. Among others, RAMSES is suitable for the radiological survey of water resources such as seas, rivers, lakes and underground waters. As water is a vital element for Humans, a potential radioactive contamination would have a strong psychological impact on the population but also on the societal organisation considering the effects on the food chain, agriculture, food industry, and drinking water availability. RAMSES will be installed in the Belgian continuous monitoring network (Telerad) managed by the Federal Agency for Nuclear Control to update the current stations surveying rivers and release channels from Belgian NPPs. RAMSES is also successfully used for the radiological surveillance of gaseous effluents in nuclear installation producing nuclear medicine radionuclides. All the recent developments and applications will be fully detailed through this communication.

KEYWORDS: RAMSES, environmental monitoring, sampling equipment, early warning
O-22 Removal of Radionuclides from Aqueous Solutions by Sorption Techniques

Oral Presentation /

Fotini Noli¹

¹ Aristotle University,

Sorption techniques have been applied to remove radionuclides from aqueous solutions using different sorbents as inorganic compounds and biosorbents. The sorbents were synthesized and characterized before and after sorption by Scanning Electron Microscopy SEM/EDS, IR Spectroscopy (FT-IR), X-Ray diffraction (XRD) and determinations of specific surface areas by the BET method and potential of zero charge (pzc). The sorption experiments were undertaken under batch conditions using aqueous solutions of various radionuclides (U, Th, Cs, Eu) with different initial concentrations. The equilibrium sorption isotherms were analyzed by the linear, Freundlich and Langmuir models and the kinetics using the pseudo-first-order and the pseudo-second-order model. The pH measurements, the effect of counter ions, the thermodynamic data as well as the results from the characterization techniques, provided information about the potential sorption mechanism. Most of the investigated materials exhibited remarkable sorption capacity in comparison with literature data and could be used as an attractive alternative to treat contaminated groundwater or waste water.

KEYWORDS: Radionuclides; sorption; inorganic sorbents; biosorbents;
Assessment of the radiological impact of coal-fired power plants to terrestrial biota using ERICA tool

Oral Presentation /

Ayse Nur Esen¹, Sevilay Haciyakupoglu², Sema Akyil Erenturk²,

¹Istanbul Bilgi University, ²Istanbul Technical University,

This paper presents the radiation risk assessment in the terrestrial ecosystem to evaluate effects of coal-fired power plants (CFPPs) on the environment. The activities of the coal industry can potentially lead to an increase in natural radioactivity in the environment, since coal may contain relatively high levels of naturally occurring radioactive materials from uranium and thorium decay series. Nine provinces, Ankara, Bursa, Çanakkale, Kahramanmaraş, Kütahya, Manisa, Muğla, Sivas and Zonguldak, in which CFPPs located were selected because of the availability of the information on activity concentrations both in soils and coals. 226Ra, 232Th and 40K concentrations in soils and coals, as well as 137Cs concentrations in soils, were compiled from existing literature. When activity concentrations in soils and coals were compared, it was determined that in coals 226Ra concentrations are higher and 40K concentrations are lower than that of soils in all provinces. However, for 232Th concentrations a general tendency has not been observed. The radiological impact on terrestrial ecosystem was estimated by Environmental Risk from Ionising Contaminants: Assessment and Management (ERICA) Tool using 226Ra, 232Th, and 137Cs activity concentrations in soils. ERICA Tool estimates activity concentrations, external dose rate, internal dose rate, total dose rate and total dose rate per organism and risk quotient for reference organisms (amphibian, annelid, arthropod, bird, flying insects, lichens & bryophytes, mammal-large, mammal-small, mollusc, reptile, shrub and tree). The results showed that the expected risk value is less than unity and total dose rate per organism is less than the default screening dose rate value, 10 μGy h⁻¹ for all organisms. Among the organisms, the highest total dose rate and the highest risk quotient is estimated for lichens & bryophytes. According to the results, 226Ra is the main contributor radionuclide to the total dose rate for all organisms, in the range of 82% to 99%.

KEYWORD: radiological impact, dose risk assessment, coal mine, biota
O-24 CURRENT STATE OF THE HUNGARIAN INDOOR RADON MAP

Oral Presentation /

Tibor Kovacs1, Erika Kocsis1, Anita Csordas2, Katalin Zsuzsanna Szabo3, Zsolt Homoki4.

1Institute Of Radiochemistry And Radioecology, University Of Pannonia, Veszprem, HUNGARY, 2Nstitute Of Radiochemistry And Radioecology, University Of Pannonia, Veszprem, HUNGARY, 3Nuclear Security Department, Centre For Energy Research, Hungarian Academy Of Sciences, Budapest, HUNGARY, 4National Public Health Center, Budapest, HUNGARY,

CURRENT STATE OF THE HUNGARIAN INDOOR RADON MAP

Tibor KOVÁCS1, Erika KOCSIS1, Anita CSORDÁS1, Katalin Zsuzsanna SZABÓ2, Zsolt HOMOKI3, 1Institute of Radiochemistry and Radioecology, University of Pannonia, Egyetem str. 10. Veszprém,H-8200, Hungary 2Nuclear Security Department, Centre for Energy Research, Hungarian Academy of Sciences, Konkoly-Thege Miklós út 29-33, Budapest, H-1121, Hungary 3National Public Health Center, Albert Flórián út 2-6., Budapest, H-1097, Hungary E-mail of corresponding author: kt@almos.uni-pannon.hu

Abstract: The most important contributor to the human population radiation dose is the radon and its decay products. In several studies it was confirmed that the high radon concentration increases the lung cancer risk. To reduce this risk the most important task is to identify the radon-prone areas by carrying out indoor and soil gas radon concentration measurements. In 2005 the Joint Research Centre (JRC) realized a huge problem: the indoor radon measurements (protocol, methods, etc.) and the mapping techniques in the European countries were not uniform, so the data were not comparable to each other. In 2006 the JRC started a new project, the goal was to draw the European Indoor Radon Map. The Map represents the arithmetic means (AM) of annual indoor radon activity concentration in ground floor of homes over 10 km x 10 km grid cells. The national competent authorities were asked to share their cell statistics. In case of Hungary, the cell statistics was provided by the National 'FJC' Research Institute for Radiobiology and Radiohygiene; the University of Pannonia; and Rad Lauder Labor. Historically the first radon surveys were carried out in 1980s in Hungary and continued in the last decades. According to the current status, indoor radon concentration measurements were performed in 20 % of the Hungarian cells. In this paper the current state of the Hungarian indoor radon map are presented. Keywords: indoor radon measurements, European Radon map, Hungarian radon surveys

KEYWORDS: indoor radon measurements, European Radon map, Hungarian radon surveys
O-25 IN SITU NORM BIOMONITORING SYSTEMS IN INDUSTRIAL DEPOSITS

Oral Presentation /

Anita Csordas¹, Anita Peka¹, Edit Toth-Bodrogi¹, Tibor Kovacs¹.

¹Institute Of Radiochemistry And Radioecology, University Of Pannonia, Veszprem, HUNGARY.

High concentrations of NORM and heavy metals are characteristic pollutant sources in industrial byproduct deposits. In situ monitoring of leachates and transfer factor estimations are warranted to contain measurements or calculations about possible environmental risks in the vicinity of these deposits such as uranium, manganese, lead, bauxite and coal mines, slag and fly ash dumps of coal-fired power plants and red mud reservoirs. As Po-210 ions are mobile and easily solubilized in weakly acidic aqueous media and their concentrations can be determined with high precision and extreme sensitivity. Previous investigations have shown, Po-210 migration and transfer is a reliable surrogate measurand for such risk estimations. Therefore, in this study we put carried out Po-210 tracing. Our system of in situ biomonitoring around these sites uses indicator organisms to establish both the transfer and the associated risks of environmental pollution involving NORM and heavy metals. In previous work we established a close relationship of soil Po-210 content and it’s tobacco herba concentration. For further biomonitoring applications, field-deployed tobacco plants (n>23 per site) were grown in deposits of uranium, manganese and coal mines for a vegetational cycle in selected representative areas. Local soil and harvested plant (herba and leaf, entire and surface wash) Po-210 and U and Ac-line NORM concentrations were determined using PIPS alpha spectrometry. Absorbed Po-210 leaf and air-borne Rn-222 concentrations were also correlated in sites. For biomonitoring of soil ecosystem water-borne NORM risks we utilized two earthworm species, namely Lumbricus terrestris L. and Eisenia fetida S. Based on earthworm biology we use a correlative approach to determine ICP-based Cd ion concentration and Po-210 concentration in the animals. Hence, we combined the approach of in situ indicator tobacco plant and animal methodology with Po-210 measurements to create a framework for realistic NORM risk estimations in multiple industrial environmental risk areas. Tobacco plant and leaf Po-210 has clearly shown a close relationship with soil Po-210 levels. Our results indicate the application of in situ plant and animal biomonitoring species method to be an informative and sensitive approach for tracing NORM or heavy ion migrations and risks in complex aqueous transfers on-site.

KEYWORDS: Po-210 measurements, Biomonitoring, NORM depositories, Tobacco, Earthworm
O-26 EARTHWORM SPECIES AS IN VIVO SENTINEL ORGANISMS OF NORM TRANSFER IN SOIL ECOSYSTEMS

Oral Presentation /

Domokos Mathe1, Ferenc Budan2, Anita Peka3, Edit Toth-Bodrogí3, Tibor Kovacs3,

1Institute Of Clinical Experimental Research, Semmelweis University, Budapest, HUNGARY, 2Institute Of Environmental Engineering, University Of Pannonia, Veszprem, HUNGARY, 3Institute Of Radiochemistry And Radioecology, University Of Pannonia,Veszprem, HUNGARYR,

Earthworms (Oligochaete and Annelida species) are one of the most important bioindicators of soil services. However, their sensitivity to radiation and heavy metal accumulating capacities can considerably differ by species. This warrants measurements and data collection of at least two species for further transfer factor calculations. Previously, in an in vivo earthworm model utilizing Positron Emission Tomography (PET) with 18F-fluor-deoxy-glucose (FDG) tracer significant correlation was found between Cd exposure and decreasing of FDG uptake in the upper parts (above the clitellum) of earthworms. According to the literature, other toxic heavy metals may increase the deleterious effects of Cd. Our investigations target ex vivo determination of locally collected earthworms (Eisenia fetida S. and Lumbricus terrestris L. species) NORM concentrations to elucidate if Po-210 is correlated to Cu, Cr, Fe, Hg, Ni content of soil samples, or not. We also carried out a further in vivo PET study on earthworms utilizing Cu-64 tracer, both homogenized in the soil and also adding to Ringer solution in a short-term experiment (without soil). Moreover these experiments were supplemented with FDG PET tests as well as Po-210 tracing. The purpose of this study was to map the correlations of environmental heavy metal content and the uptake of the mentioned radiotracers. Imaging based biomarker may provide previously unknown data about the physiological behaviour of NORM and heavy metals.

KEYWORDS: NORM concentration measurements, earthworm, environmental test, biomonitoring
O-27 Examination of Removal of $^{238}$U with Diatomite in Continuous Flow System

Oral Presentation /

D. Alkım Türközü¹, Erkan Dişli¹, Dilara Öztürk¹, Özlem Selçuk Zorer², Erdinç Aladağ¹,

¹Van Yuzuncu Yil University, Faculty Of Engineering, Deparment Of Environmental Engineering, Van, Turkey, ²Van Yuzuncu Yil University, Faculty Of Science, Deparment Of Chemistry, Van, Turkey,

$^{238}$U is the most common isotope of uranium found in nature, with a relative abundance of 99%. Generally, the highest potential radiation-related health risk for uranium mining or processing facility workers is lung cancer associated with inhaling uranium decay products. One of the most suitable methods for the removal of $^{238}$U is adsorption. So it is important in adsorption procedure to use low-cost and highly efficient adsorbents. While in a laboratory-scale study a small amount of adsorbent material is used, on industrial scale it will use tons of adsorbent. For this reason, adsorbent must be abundant in nature and cost efficient. Diatomite is a naturally occurring, soft, siliceous sedimentary rock that is easily crumbled into a fine white to off-white powder. With this research the adsorption of $^{238}$U ions on diatomite collected from the deposits located at the Kahramankazan in Ankara in Turkey was investigated in continuous column system. Column’s height is 40mm and radius is 25 mm. Feeding solution flow rate was selected as 25mL/min. Under optimum operational conditions maximum adsorption yield was observed as % 94. The results suggest that diatomite can be used as efficient and cost effective adsorbent for $^{238}$U removal.

Keywords: Uranium, Diatomite, Removal
O-28 Adsorption of Uranium-238 with Dasit Stone in Column System

Oral Presentation /

D. Alkım Türközü¹, Erkan Dişli¹, Özlem Selçuk Zorer², Erdinç Aladağ¹, Dilara Öztürk¹,

¹Van Yuzuncu Yil University, Faculty Of Engineering, Deparment Of Environmental Engineering, Van, Turkey, ²Van Yuzuncu Yil University, Faculty Of Science, Deparment Of Chemistry, Van, Turkey,

Due to mining activities and increasing energy demand, the amount of uranium released into the nature is rising day by day owing to the increasing number of nuclear power plants. The search for economic and effective removal for the Uranium-238 occupies the agenda of scientists because it negatively affects the health of human and natural habitats and leads to ecotoxicological risks. Adsorption is a eco-friendly process which eliminate the use of chemicals. Adsorbent is a main actor on adsorption process so it should have high adsorption capacity, reusable, economic and abundant in nature. Dasit is a type of volcanic frozen rock that has an aphanitic texture to porphyritic and has an intermediate composition between andesite and rhyolite. In this study aims to investigate the adsorption of Uranium-238 from aqueous solutions with column system. Dasit stone (collected from Meydan Volcaino in Van) which has 250 mesh particle size was filled to column. Prepared uranium-238 solution was feed to column with a peristaltic pump at fixed flow rate (25 mL/min). Under optimum operational conditions maximum removal yield was observed as % 84. In the light of the experimental data obtained, it can be said that dasit has a certain potential in the removal of uranium-238.

Keywords: Uranium, Dasit stone, Removal
O-29 Determination of 90Sr Activity Concentration in Tea Matrix and Uncertainty Evaluation

Oral Presentation /

Gülten Özçayan¹

¹Turkish Atomic Energy Authority, Ankara- Turkey,

Environmental monitoring is very important in nuclear facilities and in regions close to these areas during the construction and operation. It requires many and different radioactivity measurements in order to radiation protection, radioactive waste management and environmental protection. Turkey has currently no nuclear power plant in operation or decommissioned but it has an ongoing nuclear power plant program. Also, the radioactivity measurement capabilities of laboratories in Turkey will be very important in near future. Taking all of these factors into consideration, the measurement capabilities of radiostrontium (Sr-90) in different matrices in national laboratories of Turkey should be enhanced. In this study, the method used for determining activity value of Sr-90 in the tea matrix was investigated. The most important step for the activity concentration determination of the sample material is dissolving by acid leaching procedure. For this purpose, the method based on the digestion of the sample and the separation of Sr-90 by Sr-resin extraction chromatography was determined taken into the consideration of previous studies about determination activity value of 90Sr in various matrices. In addition, the subsequent measurement of the activity using a Wallac 1220 Quantulus ultraslow-level liquid scintillation counter (LSC) was done at the optimum measurement conditions. The accuracy and precision of the method was evaluated by LSC measurements of prepared spike samples at different activity concentrations. After validation, the activity value of Sr-90 in the PT material prepared by TAEK was determined with the mentioned modified method. The minimum detectable activity concentration, counting efficiency and radiochemical recovery for Sr-90 measurement were also determined. Uncertainties arising from counting statistics, weighing, decay correction, radiochemical recovery, efficiency and homogeneity were calculated. This study’s results show that the modified dissolution and radiochemical separation procedures are applicable for the accurate determination of Sr-90 activity concentration in tea matrix. This method can be extended to other different matrices samples such as vegetation and sediment matrices.

KEYWORDS: Strontium-90, activity value, acid leaching, liquid scintillation spectrometry, tea
O-30 PRE-OPERATIONAL RADIOLOGICAL MEASUREMENT PROGRAM AT A NUCLEAR REACTOR SITE

Oral Presentation /

Yüksel Atakan¹

¹Privat Senior Radiation Consultant Office,

PRE-OPERATIONAL RADIOLOGICAL MEASUREMENT PROGRAM AT A NUCLEAR REACTOR SITE: The objectives of this program are to provide information on the pre-operational environmental radiation and radioactivity around a reactor site. Previous work by this author, performed as an IAEA short-term expert (IAEA Report, Pre-Operational Environmental Radiological Monitoring at the reactor site of Akkuyu TUR/9/005/1982), will be outlined with updates under consideration for new regulations and international standards. It should be emphasized that the main nuclides and background radiation to be measured and the measurement program in the environment of nuclear reactors did not change much in the last several decades. It is important to document baseline radiation and radioactivity levels to determine any impact from reactor operation in future. A systematic measurement and evaluation program would provide for regular monitoring of critical nuclides in air, soil, water and vegetation as well as foodstuff surrounding the reactor. Additionally, the background radiation is measured regularly in several locations around the reactor site to compare them with the future levels, if any change occurs. Previous site surveys and updated methods will be discussed to show the aim, essentials and importance of an environmental monitoring program at Akkuyu as an example for future nuclear sites. Three fixed stations were installed around Akkuyu reactor site for continuous sampling of air particulates (aerosols) and iodine as well as measurements of direct radiation. The locations were selected with respect to the following factors: • Population distribution and density • Dominant wind directions • Road access to the reactor site for transportation of equipment and • Availability of electricity for continuous operation of fixed equipment. The Pre-Operational measurement program would usually be performed in 3 Phases with different measurements and evaluations, the details of which are described in some detail in this presentation: • 6 months before the start of construction of the reactor building (RB) • After the start of construction of RB • After the RB is completed. This presentation will show the necessary materials and methods for radiological measurements and evaluations program around Akkuyu site and other proposed reactor sites.

KEYWORDS: Akkuyu Reactor, environmental measurements, Background, pre-operation, radiation
O-31 RADIATION SHIELDING PROPERTIES OF ALKALI ACTIVATED CEMENT MORTARS FOR NUCLEAR APPLICATIONS

Oral Presentation /

Buket Canbaz Ozturk¹, Cavit Cagatay Kızıltepe², Banu Özden³, Erkan Guler⁴, Serdar Aydın⁵,

¹Ege University, Faculty Of Science, Department Of Physics, ²Bursa Technical University, Civil Engineering Department, ³Ege University, Institute Of Nuclear Sciences, ⁴Dokuz Eylül University, Mining Engineering Department, ⁵Dokuz Eylül University, Civil Engineering Department,

Investigation of radiation shielding materials is of significant importance due to the utilization of nuclear technology in different fields such as industry, medicine, agriculture, and scientific research. Among the different types of radiation (X and gamma rays, alpha particles, beta particles, and neutrons), gamma radiation has the most penetration capability. The gamma radiation shielding capability of construction materials needs to be developed in order to influence positively the environment and human health. The focus of this study is therefore on the determination of the gamma linear attenuation coefficients in alkali-activated cement mortar mixtures both experimentally and theoretically. Different precursors such as ground granulated blast furnace slag, fly ash, metakaolin and waste clay material containing boron were studied to evaluate effectiveness as a shielding material. All measurements were performed by NaI(Tl) gamma-ray spectrometry system using standard point sources of 137Cs (662 keV) and 60Co (1173 and 1332 keV). The theoretical gamma linear attenuation coefficients were obtained by calculating the theoretical mass attenuation coefficients using XCOM for the energy range of 10-3000 keV. In addition, neutron attenuation coefficients were theoretically calculated with the NCNR software. The agreements of theoretical and experimental coefficients of the linear gamma attenuation for all mortar mixtures have been found to be quite good. The results showed the gamma attenuation coefficients of the mortar mixtures increased linearly with density. The attenuation coefficient for slow and especially thermal neutrons is significantly higher in mixtures containing WCB than the other mixtures.

KEYWORDS: Gamma linear attenuation, transmission thickness, neutron attenuation, alkali-activated cement mortar
O-32 DOSE AND RISK ESTIMATION OF CS-137 AND I-131 RELEASED FROM AN HYPOTHETICAL ACCIDENT IN AKKUYU NUCLEAR POWER PLANT

Oral Presentation /

Efem Bilgiç¹, Orhan Gunduz²,

¹Dokuz Eylul University, The Graduate School Of Natural And Applied Sciences, Izmir, TURKEY, ²Dokuz Eylul University, Department Of Environmental Engineering, Izmir, TURKEY,

The construction of Akkuyu Nuclear Power Plant (NPP) was launched in 2018 and the plant is expected to be operative by the year 2023. Being situated in the Mediterranean coastline, Akkuyu NPP will be the first nuclear power generation facility in Turkey. The plant will have four Russian VVER-1200 type pressurized water reactors and will have a total installed capacity of 4800 MW. In this study, atmospheric dispersion and ground level deposition of Cs-137 and I-131 released from a possible accident in Akkuyu NPP was estimated using a Lagrangian particle dispersion model, FLEXPART, for different time periods representing relatively extreme meteorological conditions for Mersin. The source term used in simulations was assumed to be the same with that of the Chernobyl NPP accident which occurred in 1986. In addition, cumulative dose and risk values were calculated from FLEXPART output datasets considering potential exposure pathways such as inhalation, ground-shine exposure and cloud-shine exposure. The results were further analyzed with python codes and dose and risk maps were created for local and regional scales. The outputs were finally compared with past nuclear accidents and related risk studies in literature. According to results of the study, it was found that the vicinity of Mersin and Central Anatolia were simulated to be the most significantly affected areas from the accident under both scenario conditions. The northern and western parts and all coastlines of Turkey were simulated to be more contaminated in the simulations conducted under December 2009 conditions, whereas southern and western parts of Turkey and some parts of Middle East countries like Syria, Iraq and Lebanon were simulated to be comparatively contaminated under the runs conducted for August 2010 period. Thus, it can be clearly stated that the meteorological conditions were among the most important parameters for the fate and transport of radioactivity that originated from such a catastrophic event.

keywords: nuclear power plant, dose estimation, risk assessment, atmospheric fate and transport modelling, Lagrangian particle dispersion
O-33 EVALUATION OF THE MEDIUM TERM SEDIMENT DEPOSITION ON THE MERIC RIVER FLOODPLAINS BY MEANS OF 137CS

Oral Presentation /

Günseli YAPRAK¹, Ilker SERT¹, Sule AYTAS¹, Dogan YASAR², Osman CANDAN³, Sabriye YUSAN¹, Hakan S. SAZAK⁴, Cem KINCAL³, Goncagul DURSUN¹, Tunc COLAKOGLU¹

¹Institute Of Nuclear Sciences, Ege University, Izmir, Turkey, ²Institute Of Marine Sciences, Dokuz Eylül University, Izmir, Turkey, ³Engineering Faculty, Department Of Geology, Dokuz Eylül University, Izmir, Turkey, ⁴Faculty Of Sciences, Department Of Statistics, Ege University, Izmir, Turkey,

The most important issues are floods related to the water management in Trans boundary River Meric and Arda, Tunca rivers that Turkey is downstream country. The most important process about grown and increased flood size is sediment accumulation in the river and the surrounding. soil conservation and sediment management is seen as a key component of river basin management. Hence, there is a need for a detailed study about the determination of medium term sediment deposition on the Meriç River Floodplains by means of 137Cs. For this purposes, sediment bulk cores were collected systematically at 50 stations in the Meriç River flood plains during 2018. Furthermore, bottom sediment cores were taken from the flood plains. The core length is varied from 30 to 53 cm. The cores were sliced at 1-cm intervals for further analyses. Sediment subsamples were dried at 40-60 0C to constant weight, and water content was determined. The dried samples were powdered in a ball-mill for geochemical and radionuclide analysis. In this study, the quantitative determination of the 137Cs was carried out by HPGe gamma spectrometry. In current studies, the vertical distributions of 137Cs were completed for three cores. Sediment dating will be realized when the all measurements of the bottom cores will be completed.

KEYWORDS: floodplain, heavy metals, Arda, Meric and Tunca Rivers
O-34 BIOSORPTION STUDIES OF SAMARIUM ON CROSSLINKED ALGINATE, DIATOMITE, MAGNETITE COMPOSITE

Oral Presentation /

Dicle ERDEN¹, Yusuf ÖZCAN¹, Duygu TAKANOĞLU BULUT², Cem GÖK³.

¹Pamukkale University, Faculty Of Technology, Biomedical Engineering, ²Pamukkale University, Advanced Technology Application And Research Center, ³Pamukkale University, Faculty Of Technology, Metallurgical And Materials Engineering,

Samarium, as a rare earth element, with bear unique electronic and optical characteristics arising from their 4f electrons has received a lot of attention in many fields. Alginate, a natural polysaccharide extracted from brown seaweeds, is a very promising biosorbent material due to several advantageous properties. Alginate biopolymers were prepared by a simple process with Na - Alginate salt obtained from brown algae with a natural seaweed. It was mixed with a precipitate composed of fossilized siliceous shells of single-celled microscopic algae called diatom and a composite material was prepared which combined the properties of these materials. Composite material was prepared using alginate, diatomite and magnetite to by the emulsion cross-linking method using calcium chloride as a cross-linker. Magnetic alginate beads have potential biosorbent for sorption of heavy metals and radionuclides from an aqueous medium. Also nano materials can be used for many applications in various areas. In this respect, some physical properties of prepared biocomposite will be determined and characterization studies are carried out by fourier transform infrared spectroscopy, scanning electron microscopy and X-ray diffraction methods. The physicochemical parameters of sorption process are also investigated for optimum conditions by batch technique. Sorption mechanisms were determined using experimental results and calculated parameters from some models as thermodynamic, isothermal and kinetic. Batch experiments were performed to study the equilibrium, kinetics, and thermodynamics of samarium sorption. The effects of physical parameters as initial solution pH, initial samarium concentration, and temperature were investigated. Thermodynamic, kinetic and isotherm experiments were carried out at the optimum conditions. According to obtained results, these hydrogel composite were proven to be potent material for increasing the biosorption of samarium with high efficiency in aqueous solution. In connection with high sorption capacity of the hydrogel, plus its easy preparation process, economic advantage and environmental friendly nature would make these composites a promising removal and recovery agent for lanthanides. These results suggest that crosslinked alginate, diatomite and magnetite composite could be used as an effective promising biosorbent for the removal of samarium ions from aqueous solutions.

KEYWORDS: Biosorption, biocomposite, alginate, diatomite, samarium
O-35 Preliminary study of Compton suppression system for in-situ monitoring nuclear decommissioning sites

Oral Presentation /

Chanki Lee¹, Hee Reyong Kim¹,

¹Department Of Nuclear Engineering, UNIST,

We develop and validate a transportable Compton suppression system that can be used for in-situ monitoring nuclear decommissioning sites. The Compton suppression system uses anti-coincidence between main detector and guard detector. Two 2x4x16-inches-NaI scintillators are in center as a main detector, and three polyvinyltoluene (PVT) scintillators cover main detector as a guard detector. In order to validate the developed system, we use Monte Carlo N-Particles (MCNP) code to computationally simulate the anti-coincidence circuit and compare to the developed system. After simulated gamma spectra are matched with those of actual detection system, considering both system design and energy resolution as well as circuit itself, we analyze the performance of the system depending on different soil types and distances between the system and these soil samples. For example, various depth profiles of Cs-137 in soil are simulated using Gaussian distribution, and relevant detection efficiency data are produced to determine efficient distances for monitoring nuclear decommissioning sites. Based on these data, we correlate the detection efficiency with other considered parameters to suggest a function to compensate detection efficiency statistically.

KEYWORDS: Compton suppression, Monte Carlo simulation, depth profile, Cs-137, correlation.
O-36 ARTIFICIAL AND NATURAL RADIONUCLIDES IN LAKES OF CRIMEA

Oral Presentation /

Natalia Mirzoeva¹, Andrey Korotkov¹,

¹Radiation And Chemical Biology Department, FSIS Institute Of Marine Biological Research, Sevastopol, 299011 ,

ARTIFICIAL AND NATURAL RADIONUCLIDES IN LAKES OF CRIMEA Mirzoyeva N.Yu., Korotkov A.A. Institute of Marine Biological Research, Sevastopol, Crimea, Russia Salt lakes of Crimea represent unique water ecosystems. The high salinity of water in these lakes is maintained mainly due to its intensive evaporation in summer period. This can lead to the concentration of chemical elements, including radioactive ones. The purpose of the study is to identify the biogeochemical patterns of formation of the modern radioecological state of salt lakes of Crimea in regarding to the artificial (90Sr and 137Cs) radionuclides and natural radionuclide 210Po. The concentrations of 90Sr, 137Cs, and 210Po in water, sediments, and hydrobionts were determined by methods generally accepted in international practice. In 2016-2018 yrs. for the first time in the history of the salt lakes of Crimea a radioecological study was conducted on the contamination of the ecosystems of the 10 salt lakes of Crimea. Over the entire study period, the highest average concentrations of 90Sr and 137Cs were observed in the water of Lake Sasyk-Sivash (162.0±12.4 and 106.8±8.9 Bq/m³, respectively) with an average salinity of water is 294‰. The lowest concentrations of these artificial radionuclides were noted in the water of Lake Kyzyl-Yar (7.8±1.0 Bq/m³ for 90Sr and 0.8±0.1 Bq/m³ for 137Cs), with a salinity of 4.3‰. The highest concentration of 210Po is noted in Lake Chokrak (229.0±1.1 mBq/l) at a salinity of 260‰, it is twice as high as the MAC, which is 120 mBq/l (NRS-99). Perhaps this is due to the presence of oil fields on the Kerch Peninsula. The lowest concentration of 210Po was observed in the water of Lake Kyzyl-Yar (0.6±0.01 mBq/l). In the bottom sediments, an inverse distribution for all investigated radionuclides pattern was observed. It was determined that the dependence of the concentration of radionuclides on the salinity of water in lakes has an exponential character. Of all the radionuclides considered, only 210Po is the main dose-forming radionuclide for cysts and adults of Artemia from the salt lakes of Crimea. The work was supported by the Russian Science Foundation – grant № 18-16-00001.

Keywords: Crimea, salt lakes, 90Sr, 137Cs, 210Po.

KEYWORDS: Keywords: Crimea, salt lakes, 90Sr, 137Cs, 210Po.
O-37 DETERMINING THE 90Sr TO 137Cs FISSION PRODUCTS RATIO AT THE «EXPERIMENTAL FIELD» SITE

Oral Presentation /

Yuliya Baklanova¹, Murat Umarov¹,

¹Branch "Institute Of Radiation Safety And Ecology, National Nuclear Center Of The Republic Of Kazakhstan, Kurchatov, Kazakhstan,

The work provides results of researching 90Sr to 137Cs ratio values is soil of epicentral zones, as well as the territories, subjected to radioactive fallouts, within the «Experimental Field», designed for surface and atmospheric nuclear tests of various yields from 1949 till 1962. Radioactive contamination of the site area is characterized by fission products (137Cs, 90Sr), neutron activation products (152Eu, 154Eu, 60Co) and nuclear charge material (241Am, 239+240Pu). To determine 137Cs activity cheap and fast gamma-spectrometric method is used, however classical methods of determining 90Sr activity are labor intensive and expensive. Alternatively, 90Sr activity can be assessed using 137Cs activity. If 90Sr/137Cs ratio value is constant it becomes possible to estimate activity of one radionuclide using known activity of another. According to the literature data, the 90Sr/137Cs ratio value depends on the type of nuclear substance and it remains unchanged for the same test. For a 235U-based nuclear charge the 90Sr to 137Cs ratio equals to 0.88; for a 239Pu-based charge this ratio equals to 0.3. There is no document supported information available on the types of charges used in the nuclear tests at Semipalatinsk Test Site. According to results of researches conducted by the Institute’s employees nuclear tests with mainly plutonium charges or charges of mixed type were used in the nuclear tests. Based on this the initial 90Sr/137Cs ratio is assumed to range from 0.30 to 0.88. The research methodology included sampling the top layer of soil, laboratory analyses, statistical processing and interpretation of measurement results. As the result of research the 90Sr/137Cs ratio at the radioactive fallout plumes and in epicentral zones was found to range from 1.0 to 2.5 and from 0.4 to 4.8 respectively. The majority of experimentally obtained 90Sr/137Cs ratio values are beyond the theoretical assessment interval. By now this issue remains issue. The main result of this work is the conclusion, that each researched object at the «Experimental Field» should be characterized by its own average 90Sr/137Cs ratio, since the ratio values differ between different objects of the researched site depending on origin of radioactive contamination.

KEYWORDS: Semipalatinsk Test Site, "Experimental Field" site, 90Sr/137Cs ratio, soil
POSTER PRESENTATIONS
P-01 Development of station for artificial gamma radioactivity measurement in surface water bodies

Poster Presentation /

Ivan Hupka¹, Michal Fejgl¹, Miroslav Hýža¹,

¹Section Of Monitoring, National Radiation Protection Institute, Prague, Czech Republic,

The construction of the autonomous station for artificial gamma radioactivity measurement in surface water bodies (SAGMA) is a crucial part of the Czech Ministry of the Interior project. General purpose of this project is to develop the detection technique of SAGMA and to establish a monitoring network comprising several SAGMAs around the Czech Republic. Ultimately, it will lead to formation of a system for continuous gamma activity monitoring (SCOMO). Chernobyl and Fukushima accidents revealed that system measuring gamma activity in water environment in real-time conditions would be a favourable instrument under such circumstances. The SCOMO system will enable a prompt and reliable detection of the artificial radioactivity contamination of the surface water bodies, which cover more than 50 % of all drinking water sources in the Czech Republic. At the same time, this system can provide additional information about radioactive air plume behaviour. The principal component of SAGMA is an unshielded scintillation NaI(Tl) probe designed to be fully immersed directly in deep water of the examined river or lake. The station is powered by combined solar and wind source, with added satellite data transfer feature. Development of detection methods proceeded in accordance with activity concentration levels of gamma emitters of the highest interest (e.g. 137Cs and 131I) expected on basis of the aforementioned accidents experiences and with respect to the requirements of the Czech legislation. For spectra analysis, a method of noise adjustment singular value decomposition (NASVD) was employed to reduce the background fluctuation related to various radon progenies present in water due to weather variations. The resulting level of minimal detectable activity concentration (MDAC) was below 1 Bq/L for measurement lasting one hour, which is comparable with more complicated monitoring systems equipped with lead shielding. The MDAC level meets the requirements of the Czech governmental emergency preparedness system. Detection capabilities of SAGMA tool and current stage of the SCOMO construction will be presented in this poster. This contribution is supported by research programme VI20172020083

KEYWORDS: Artificial radioactivity, caesium, water contamination, monitoring
P-02 FEATURES OF THE PLUTONIUM RADIONUCLIDES DISTRIBUTION IN THE SALT LAKES OF THE CRIMEAN PENINSULA

Poster Presentation /

Nataliya N. Tereshchenko¹, Alexandr V. Trapeznikov², Artem A. Paraskiv¹, Vladislav Yu. Proskurnin¹, Anatoliy P. Plataev²,

¹Department Of Radiation And Chemical Biology, Institute Of Marine Biological Research Of RAS, Sevastopol, Russian Federation, ²Department Of Continental Radioecology, Institute Of Plant And Animal Ecology Of RAS, Ekaterinburg, Russian Federation,

Abstract. The study of the alpha-emitting radionuclides 239+240Pu concentration activity in the surface layer (0-5 cm) of bottom sediments in ten Crimean salt lakes from 4 groups of balneary mud resources of the Crimea was carried out for the first time. The highest amounts were observed in bottom sediments from lakes of different groups: the Lake Kyzyl-Yar (419 ± 27), Dzharylgach (443 ± 24) and Tobechik (451 ± 43 mBq/kg 239+240Pu), the lowest amounts – in three investigated lakes of the Perekop group. The vertical distribution profiles of these radionuclides in sediment cores with a depth of 25-30 cm in lakes from all 4 groups were obtained. The highest value was recorded in 10-15 cm sediment layer in the Lake Sasyk-Sivash (2 Bq/kg) from the Evpatoriya group. The level of 239+240Pu in lake surface water varied within 0.84-16.47 mBq/m3. The average value of 239+240Pu in water for all groups of lakes was 6.5 mBq/m3, whereas in surface water of the western part of the Black Sea deep-water basin it was 1.66 and in near shore area – 0.45 mBq/m3. The comparative analysis showed the average 239+240Pu levels in sediments to be 3 times lower than in salt lakes of the Crimean peninsula than in the coastal Black Sea ecosystems. But the average 239+240Pu level in salt lakes’ water was 4-14 times higher than in the Black Sea water. In hydrobionts (multicellular algae and crustaceans) as well as in bottom sediments the 239+240Pu concentration activity was lower than in the Black Sea hydrobionts. Salinity can be considered as the main factor influencing the distribution of plutonium in the components of lake ecosystems and ranged in the lakes within 50-300‰, except the Lake Kyzyl-Yar where salinity was 4-7 ‰. The granulometric composition of sediments also played an important role for the 239+240Pu accumulation in bottom sediments. Investigation was supported by the state assignment of IMBR of RAS "Molecular and Biogeochemical Basis of the Homeostasis of Marine Ecosystems", No.AAAA-A18-118020890090-2 and the Russian Foundation for Basic Research Grant No. 16-05-00134.

KEYWORDS: 239+240Pu distribution, salt lakes of Crimea, Black Sea
An accurate estimate of the three-dimensional distribution of radioactive contamination is important for impact assessment and remediation option evaluation of an affected site. To reduce both the measurement uncertainty and the spatial uncertainty of the estimated activity distribution, methodological developments are needed. The main objective of our research was to design and validate a reliable and sufficiently sensitive measurement technique for in-situ determination of the depth distribution of radionuclide activity in the ground. Two different approaches were considered. In the first one, gamma-ray spectroscopy of contaminated soil layers was carried out by lowering a Lanthanum Bromide (LaBr3:Ce) scintillation detector into a borehole down to a depth of 100 cm in 5 cm steps. The detector also provided a direct dose-rate reading, which was used for comparison with the TLD measurements that formed the basis of the second approach. The TLDs (Thermoluminescence Dosimeters) were attached to a stick and placed into the same borehole at the soil depths corresponding to the LaBr3 measurement to measure the dose accumulated over a period of time. During borehole drilling, soil samples from each 5 cm layer were also collected for low level gamma spectrometry analysis in laboratory conditions using a HPGe detector. Then, Monte Carlo simulations with the PENELOPE package were used to calculate the LaBr3 detector efficiency required to convert the measured peak count rate into the specific activity of a certain soil layer and to disentangle from it the contribution of the adjacent layers. In a similar manner, the TLD method also has the goal of deducting the activity concentration by combining dose rate measurements and results from Monte Carlo simulations assuming that the radionuclides are known. This is in many ways a more practical alternative to spectrometric measurements, which are not possible in all geometries and are quite labour intensive. At a Cs-137 contaminated site, the specific soil activities obtained with both the spectrometric method and the TLD approach are in good agreement with the laboratory results. The suitability of both methods is evaluated.

**KEYWORDS:** Activity depth distribution, In-situ measurement, Gamma-ray spectrometry, TLD, Site characterisation
P-04 The 137Cs isotope removal through “soil – rhizosphere - plant” system in the Yenisei river flood-plain

Poster Presentation /

Marya Kropacheva¹, Aleksei Chuguevsky¹, Mikhail Mel'gunov¹, Irina Makarova¹,

¹Sobolev Institute Of Geology And Mineralogy SB RAS, Novosibirsk, Russian Federation,

Over the years, the Yenisei River flood-plain had been seriously affected by the nuclear fuel cycle plant (Krasnoyarsk MCC). Although the radioecological situation has drastically improved in recent years, significant reserves of long-lived isotopes have accumulated in floodplain deposits. They overlap by clean deposits quite well, and do not present an immediate danger. However, floodplain land plants have access to contaminated soil layers through their root systems. The isotopes entering through the root system are deposited in plant upper parts. Then they can move further along food chain, or flow back into aquatic environment after the plant dies off. Thus, plants are a factor that actively involves a number of isotopes in secondary migration. Our task was to evaluate such isotopes' removal. The Atamanovskaya spit was chosen as a model object. It is located in the MCC near impact zone in close proximity of the plant. The spit has a relatively small size. In the period of high water, the spit is flooded, sometimes completely. The vegetation cover is represented mainly by perennial grasses (reeds, sedges), forming dense sod. The sod does not allow flooding destroy the soil layer completely, and at the same time it is well washed during flood. The 137Cs isotope is present in all components of the “soil – rhizosphere – plants” system. The average 137Cs content in upper layer of the soil is 510 Bq/kg, easy movable fractions account for 0.31% of the total. The isotope removal can reach 6*10⁶ Bq with full flooding spit, and 1-2*10⁶ Bq with partial (only the coastal zone) one. The average 137Cs content in the rhizosphere is 350 Bq/kg, easy movable fractions account for 1.12% of the total. The isotope removal for rhizosphere can reach 7-8*10⁶ and 2*10⁶ Bq accordingly. The average 137Cs content in plants is average 200 Bq/kg of dry weight, easy movable fractions account for 70% of the total with flood duration of more than 2 days. The isotope removal from plants is 3-4*10⁵ Bq, and 0.9-1*10⁵ Bq accordingly. The work is done on state assignment of IGM SB RAS and is partly support by RFBR Grants 18-05-00953

KEYWORDS: 137Cs, removal with flooding
Semipalatinsk test site (STS) was one of the world’s largest test sites to test nuclear weapons. STS tests resulted in contamination not only in the test site territory but also beyond it. Thus, after the first above-ground nuclear test conducted on August 29, 1949 in adverse conditions strong wind caused a radioactive cloud to move rapidly in the eastern direction. This fact resulted in the radioactive plume formed in the ribbon pine forest located in the north-eastern direction from STS. Research into the nature of radioactively contaminated soils in the pine forest included a choice of research sites, assessment of radioactive contamination by field spectrometry, digging out soil profile cuts followed by layerwise soil sampling. Activity concentration of Cs-137 and Am-241 was determined with a Canberra GX-2020 gamma-spectrometer, Sr-90 and Pu-239+240 – using radiochemical isolation followed by measuring with a TRI-CARB 2900 TR beta-spectrometer and Camberra (mod. 7401) alpha-spectrometer, respectively. As a result of research, it is found that percentage of radionuclides such as Am-241 and Cs-137 in a 0-5 cm soil layer is 68 and 81 %, in a 10-20 cm layer, concentration of these radionuclides is significantly reduced. Maximum content of Pu-239+240 (71%) is in the 0-5 cm topsoil. Next, it moves to the depth of 10-15 cm. The content of Sr-90 in the 0-5 cm layer does not exceed 36 %, and next, at a depth of down to 20 cm is uniformly distributed. High mobility of Sr-90 in soil in this case may be caused by its higher migration properties due to good solubility. For comparison also considered data on vertical distribution of radionuclides in soils of conventionally ‘background’ territories STS. It found that the migration nature of radionuclides like Am-241 and Pu-239+240 in soils of the Near-Irtysh ribbon pine forest is similar to that in conventionally ‘background’ STS areas while Sr-90 and Cs-137 mobilities are much different.

**KEYWORDS:** Semipalatinsk Test Site (STS), pine forest, soils
After the Chernobyl accident in May 1986, 0.3 PBq of 90Sr precipitated on the Black Sea area, including Crimea (Polikarpov et al., 2008). Latter the accident before April 2014, the Crimean peninsula, including the lakes, was polluted by secondary chronic radionuclide contamination of 90Sr by mainly the Dnieper waters from the North-Crimean Canal (Mirzoyeva et al., 2008; Gulin et al., 2013; Gulin et al., 2016). In April 2014, the North-Crimean Canal was closed (Gulin et al., 2016; Shadrin et al., 2018). The first determinations of the post-accident 90Sr content in the water of the lakes of Crimea were carried out in 2013 on the hypersaline lakes of the Perekop group, and it was shown that the concentration of 90Sr significantly dropped in 2015, when the North-Crimean Canal did not work, and varied from the lake to the lake (Mirzoyeva et al., 2015, 2016). The work was carried out on the basis of sampling in expeditions of 2018. The objects of the study were the lakes of the Feodosia group: Lake Adzhigol (surface area = 0.528 km², salinity of 150 g/l) and Lake Kuchuk-Adzhigol (surface area = 0.326 km², salinity of 5 g/l). They are located at a distance of no more than 450 m from each other, separated from the Black Sea by a narrow sand spit. In the sea, samples were also collected.

KEYWORDS: 90Sr, activity, salt lakes
P-07 STUDY OF NATURAL RADIOACTIVITY AND ITS ASSOCIATED RADIOLOGICAL HAZARDS IN CERAMIC SAMPLES MANUFACTURED IN ALGERIA

Poster Presentation

Esma SAADI1, Ahmed Azbouche2, Fatima Benrachi1,

1Frères Mentouri Constantine 1 University, Algeria, 2Nuclear Research Center Of Algiers, 02 Bd Frantz Fanon, BP 399, Algiers, Algeria

Ceramics are widely used as finishing materials in Algerian building constructions, they are considered as a source of hazardous contamination because of their naturally occurring radionuclides content, mainly Uranium and Thorium families and the radioactive isotope of Potassium. The presence of such primordial radionuclides in ceramics is due to their natural composition of clay, feldspar, silica, talc kaolin minerals and zirconium silicates (ZrSiO4). In order to estimate the harmful effects of ionizing radiations emitted by this material, broad investigations of natural radioactivity levels must be established. In this study, seven samples collected from ceramic dealers were analyzed using a high-resolution HPGe semiconductor detector with (1.8 keV for 60Co 1332.5 keV line). The spectra were analyzed using the Genie 2000 software dedicated to the processing of gamma spectra. Activity concentrations of 226Ra, 232Th and 40K were found in the ranges (18.94±0.58 – 30.34±0.74), (28.45±1.19 – 40.61±1.35) and (418.86±10.54 – 790.78±13.32) Bq.kg⁻¹, respectively. The results were above the worldwide average ones for 40K. Therefore, they were below the recommended values for 226Ra and 232Th. Distinct variations were observed among the calculated radiological hazards parameters and the related reference values for some samples, where they had values lower than the world average for radium equivalent (Raeq), external and internal hazards indexes (Hex, Hin) and representative level index (Iγ), while they were above the world average regarding to absorbed dose rate (D), annual effective dose equivalent (AEDE) and annual gonadal dose equivalent (AGDE).

KEYWORDS: Ceramics, radionuclides, ionizing radiations, activity concentrations, radiological hazards.
P-08 Radiation monitoring at BEO Moussala high-altitude station

Poster Presentation /

Christo Angelov¹, Nikolay Tyutyundzhiev², Hristo Nichev³, Ilia Penev⁴, Todor Arsov¹, Georgi Georgiev⁵, Ludmil Tsankov⁶,

¹Institute For Nuclear Research And Nuclear Energy, Bulgarian Academy Of Sciences, 1784 Sofia, Bulgaria, ²Institute Of Electronics, Bulgarian Academy Of Sciences, 1784 Sofia, Bulgaria, ³Institute Of Electronics, Bulgarian Academy Of Sciences, 1784 Sofia, Bulgaria, ⁴Institute For Nuclear Research And Nuclear Energy, Bulgarian Academy Of Sciences, 1784 Sofia, Bulgaria, ⁵Faculty Of Physics, University Of Sofia “St. Kliment Ohridski”, Sofia, Bulgaria, ⁶Faculty Of Physics, University Of Sofia “St. Kliment Ohridski”, Sofia, Bulgaria,

The scope of research at the Basic Environmental Observatory (BEO) Moussala (2925 m a.s.l.), Rila Mountain, comprises studies of the aerospace and terrestrial environments. The global climate change, natural hazards and anthropogenic pollutions are natural parts of these investigations. In this respect, the real-time measurement of various types of radiation being conducted at the BEO is an important field of research. Thus, the natural and technogenic radioactivity of air aerosols has been monitored at the BEO since 2006. A detector, part of the SEVAN worldwide network, is in operation at the observatory as well, measuring the intensity of the secondary cosmic rays particles with three counting channels – low-energy (electron-photon component), neutral (mainly neutrons) and high-energy particles (mainly muons). The Muon Telescope at BEO consists of eight water Cherenkov detectors and has been in operation for more than 12 years. In this paper, we discuss the results obtained from these measurements. Another important object of exploration is the UV radiation as related to its damaging impact on biological species. The report presents the recent results of one-minute-resolution UVA, UVB and UVC solar-radiation measurements at the BEO, the highest mountain location in Bulgaria. The equipment employed for the above purposes include a broadband Kipp&Zonen pyranometer for measuring the solar global horizontal irradiation; a Liulin-6MB (developed in Bulgaria) silicon-diode-based radiation dosimeter for radiation monitoring at high-altitude observatories; and two AIRDOS M dosimeter units (developed in the Czech Republic) for measuring low-intensity mixed ionizing radiation fields, which were operating simultaneously at the BEO Moussala from December 2017 to August 2018. We present analyses of the energy spectra thus obtained. Furthermore, a recently-deployed large-volume NaI(Tl) scintillator is being used to monitor the intensity and energy distribution of energetic cosmic particles. The performance and setup of the system are discussed along with preliminary results. To complete the set of studies on the environmental conditions, the ambient equivalent radiation dose is measured by an IGS421B1 gamma probe. As an important example, we show data from gamma-ray background monitoring during the Fukushima accident. The analysis of the results demonstrate that the background radiation is within acceptable limits.

KEYWORDS: Gamma-spectrometer, NaI detector, UV solar radiation, secondary cosmic rays
P-09 COSMIC RAY’S RADIATION IMPACT ON THE EARTH

Poster Presentation /

Nina NIKOLOVA¹, Dimitar TONEV¹, Ivo ANGELOV¹, Todor ARSOV¹, Christo ANGELOV¹,

¹Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, 72, Tsarigradsko shosee Blvd., 1784 Sofia, Bulgaria,

Cosmic rays and energetic particles in the surrounding of Earth play an important role in several atmospheric processes and human health. The relation between secondary cosmic rays (CRs) and recently discovered atmospheric phenomena such as TGF (terrestrial gamma ray flashes) and TGE (thunderstorm ground enhancements) is not yet understood, and progress in the field requires simultaneous measurements of a large variety of observables. The TGEs are often called gamma ray glows or gamma ray emissions and are usually several minutes long. They were observed on high mountains almost at sea level in Japan during winter storms with extremely low thundercloud altitudes and from balloons and aircrafts. Its suppose that the electric field in the thundercloud can accelerate the electrons in the situation when (where) the force from the electric field affecting the electrons overcomes their stopping power in the air. Gamma rays can be produced via the bremsstrahlung in the atmosphere. Space Environmental Viewing and Analysis Network (SEVAN) channel 1 can observe the increase of count rate due to the incidence of gamma rays plus e+, e – component. Basic Environmental Observatory BEO Moussala (42.10 N, 23.35 E) located on the top of the highest mountain at Balkan Peninsula, is a great place for such measurements of cosmic ray and for environmental studies, and observations of the Sun-Earth system. Measurements of cosmic rays on Lomnicky Stit (49.20 N, 20.22 E) in High Tatra Mountains are appropriated as well.

KEYWORDS: BEO Moussala, Lomnicky Stit, radiation, cosmic rays
P-10 LANTHANUM ADSORPTION BY ALGINATE CAPSULES CONTAINING AN EXTRACTANT (TOA) AND DIATOMITE

Poster Presentation /

Tunç ÇOLAKOĞLU, Şule AYTAŞ, Sabriye YUŞAN

1Ege University Institute Of Nuclear Sciences Bornova Izmir TURKEY,

In the past four decades, the applications and the usage of rare earth elements have grown considerably. The application area of rare earth elements is very wide despite the rare sources and lack of rich ores in the earth crust. Lanthanum, one of the rare earths, is now used in many branches of industry. Lanthanum is found in rare minerals such as other cerium group elements such as monazite [(Ce, La, Nd, Th) PO4] and bastnasite [(Ce, La) CO3] F. For this reason, it is necessary to recover lanthanum from the ore and to separate and purify it from some industrial waste. The immobilization of the extractants in a solid polymeric matrix possesses some advantages, for example simplicity of preparation, applicability for a wide range of extractants and lesser loss of harmful chemical compounds to the environment. Alginate is a biopolymer consisting of 1,4 linked β-D-mannuronic (M) and α-L-guluronic acid (G) residues, each containing one carboxylate group per monomeric unit. The carboxylate groups of the polymer give it ability to form gels in the presence of calcium ions. The gel have been used as the matrix for the immobilization some compounds and metal extractants via entrapment. The present study deals with the preparation of Ca-alginate beads enclosing Trioctylamine (TOA) extractant and diatomite, characterization and the uptake properties of lanthanum from aqueous solution. TOA (%1-%10)/Kerosene and diatomite have been entrapped in calcium alginate beads. The effect of various parameters such as solution pH, initial La(III) concentration, adsorbent dosage, contact time, temperature and matrix ion effects have been studied. Langmuir, Freundlich, and Dubinin-Radushkevich adsorption isotherms were applied to the adsorption data. The thermodynamic parameters such as variations of enthalpy, entropy and variation of Gibbs free energy were calculated. The results suggested that TOA (10%) + diatomite in Ca alginate hydrogels could be suitable as a composite adsorbent for the adsorption of lanthanum ions from aqueous solutions. The immobilization of the extractant in a solid polymeric matrix is very useful technique for metal ions extraction.

KEYWORDS: Lanthanum, Alginate, Trioctylamine (TOA), Diatomite, Composite
P-11 COLUMN BEHAVIOR OF PERMEABLE REACTIVE BARRIER MATERIALS FOR CESIUM REMOVAL FROM RADIOACTIVE WASTE SOLUTION

Poster Presentation /

Zeyneb Camtakan¹, Sevilay Hacıyakupoğlu¹, Şule Aytaş²,

¹İstanbul Teknik Üniversitesi, Enerji Enstitüsü, Ayazağa Kampüsü, İstanbul, Türkiye, ²1Ege Üniversitesi Nükleer Bilimler Enstitüsü, İzmir, Türkiye,

The permeable reactive barrier (PRB) technology is being introduced as an alternative method for controlling and treating groundwater contaminated with heavy metals, chlorinated organics, radionuclides, etc. To regulate the PRB technology cost to minimum in line with regulatory decontamination requirements for contaminants, the reactive media should be readily available at a low level of moderate cost. In this work, we propose to investigate an alternative barrier system for controlling and preventing the migration of radiocesium into the groundwater. The proposed media included Zeolite (Clinoptilolite) and Sepiolite both as natural raw materials. Their ability of these materials to remove cesium was tested by using the column technique from radioactive Cs-134 solution and actual waste in the laboratory. The column technique was used to approximate the operating conditions for the information about the transport behavior of the radio cesium in PRB system. In the present study, the parameters of cesium activity concentration in the feeding solution and flow rate were investigated using PVC columns that contain Zeolite and Sepiolite. Obtained results have been evaluated by means of retardation factor, breakthrough capacity and the amount of cesium stored in the column. Validated data from the column experiments and the reactive transport model will be used to predict the sequential placement of the reactive material in the bench scale PRB demonstration.

KEYWORDS: Cesium, permeable reactive barrier, radioactive waste.
P-12 REMOVAL OF RA-226 AND CERIUM CONTAMINANTS FROM THE WATER USING PET (POLY (ETHYLENE TEREPTHALATE)) WASTE AS A SORBENT

Poster Presentation /

Şenol Sert¹, Mutlu İçhedef¹, Banu Özden¹,

¹Ege University Institute of Nuclear Sciences, ²Izmir,

Radium-226 is a naturally occurring radionuclide which is found in the Uranium-238 decay series and is an alpha and gamma radiation-emitting. As a result of increased NORM (naturally occurring radioactive material) and TENORM (technologically enhanced naturally occurring radioactive material) industries, some radionuclides, particularly Ra-226, as well as toxic metals affect the whole ecosystem when they enter the food chain. Continuous and intermittent exposure to these radionuclides and toxic metals long periods of time may cause a health problem. Cerium which is one of the rare earth elements has been widely used in the technology. Additionally, it is a fission-produced lanthanide (Ce-144), can be found in the nuclear waste streams. Therefore, the recovery of Ce from aqueous solution is very important from economical and environmental point of views. The commercial plastic production has increased extremely since introduced to the world market. The estimated production of plastic were 1.7 Mt (million metric tons) in 1950 and ranging between 322 and 380 Mt in 2015. The accumulated plastics in natural environment is estimated approximately 60% of the produced plastics. The polymers containing an ester group in the polymer backbone are called as polyester. Poly(ethylene terephthalate) (PET) is an example of polyesters which has many commercial forms such as textile fibers and drink bottles. Using plastic waste for the treatment of water can be a new way in order to reduce environmental pollution. Also, improving our knowledge of the ability and effectiveness of plastic absorbent used to remove naturally occurring radium-226 and cerium from water treatment is a significant issue to minimize the potential health risk. In this study we examined the adsorption of radium-226 and cerium from aqueous solution using waste plastics (PET bottles) by isotherm modelling and kinetic studies.

KEYWORDS: Ra-226, cerium, adsorption, PET (Poly(ethylene terephthalate), waste material
P-13 INFLUENCE OF THE NATURAL AND ANTHROPOGENIC RADIOACTIVITY ON PLANT AND ANIMAL ORGANISMS IN MOUNTAIN ECOSYSTEMS

Poster Presentation /

Elena GELEVA¹, Nina NIKOLOVA¹, Dimitar TONEV¹, Todor ARSOV¹, Christo ANGELOV¹,

¹Institute For Nuclear Research And Nuclear Energy, Bulgarian Academy Of Sciences, 72, Tsarigradsko Shosee Blvd., 1784 Sofia, Bulgaria,

Studying the ecosystem’s condition within and outside the mountain regions’ boundaries is of particular importance from both regional and global points of view. The state of the ecosystems studies in mountain regions, which are of considerable social and economic significance in Bulgaria, cannot be assessed separately from the overall state of scientific research in the country. Institute for Nuclear Research and Nuclear Energy is directly involved in issues of research by its scientific and experimental base on peak Moussala, but existing complex scientific analyzes are still insufficient. Scientific research on high-mountain regions is among the priorities promoted by the European Commission, e.g., through the UNESCO, GLOCHAMORE - Global Change and Mountain Regions Research Strategy (FP6), 2006. The components of mountain ecosystems are sensitive to the impact of changing climatic factors and the general background radiation in these areas. In establishing correlations and changes in the state of ecosystems and biota will be studied the following key assumptions: The natural background radiation, the intensity of cosmic radiation and ionizing effect are factors that directly affect living organisms. Another major factor is human activity that leads to changes in the environment. Whether the growing influence of people could be found in sensitive ecosystems, such as alpine through indicators reflecting changes in the state of ecosystems and biological response of model groups of organisms?

KEYWORDS: radioactivity, living organisms, ecosystems, BEO Moussala
Radioactive waste is a problem because it remains dangerous for tens of thousands to millions of years. Inorganic absorbents have been used to remove metal ions due to their stable structures. But, for enhance the adsorption capacity and selective of adsorbents can be need to expanding the they’s pore and modifying them with various materials and acids. It is well known that vermiculites have very high cation exchange capacities due to substitutions of Mg²⁺ and Fe²⁺ in place of Al³⁺ in the octahedral positions. In this study, the vermiculite was modified with Prussian blue (PB). PB and its analogues have been widely applied in the selective removal of cesium ions from radioactive waste water. Raw vermiculite was obtained from in Sivas region (TURKIYE). Chemical compound was found as SiO₂ 36.3 %, MgO 14.6 %, Al₂O₃ 14.8 %, K₂O 4.8 %, Fe₂O₃ 12.4 %, TiO₂ 2.7 %, CaO 4.2% and Na₂O 0.3 % using XRF technique. First, PB/Fe₃O₄ powders was synthesized by applying the processes and using different proportions of the iron salts. After, the different amounts of vermiculite were added to this powders to create a PB/Fe₃O₄/VER product. A absorption peak corresponding to the cyanide group (-C=N-) stretching vibration appeared at 2065 cm⁻¹ in FTIR spectra of PB/Fe₃O₄/VER. The batch experiments were performed using glass bottles containing 25 mL Cs solution (100 mg/L) with pH value of 5 and stirring for 6 hours at 25°C. The results indicate that maximal adsorption capacities of PB/Fe₃O₄ containing 2.5 mM PB (minerals have not been added) and 1 mM PB (minerals have not been added) for Cs⁺ are 30.33 and 40.61 mg/g, respectively. When 1 g of vermiculite was added in Fe₃O₄ powder created with 2.5 mM PB, adsorption is 20.31 mg/g. Also, when 2 g of vermiculite was added in same powders, the adsorption is 20.73 mg/g. When the Fe₃O₄/VER modified with PB after the vermiculite react with iron salts (Fe₃O₄/VER), the capacity has been decreased (6.07 mg/g). We concluded that the changes in the synthes study must be made. The study continues.

KEYWORDS: Vermiculite, Prussian blue, adsorbent
P-15 A Novel Clay Composite Functionalized by Gelatine for Adsorption of Neodymium

Poster Presentation /

Funda ÇAKMAK¹, Canan ONAÇ², Cem GÖK³, Yusuf ÖZCAN¹, Ömer BOZKAYA⁴,

¹Pamukkale University, Faculty Of Technology, Biomedical Engineering, ²Pamukkale University, Advanced Technology Application And Research Center, ³Pamukkale University, Faculty Of Technology, Metallurgical And Materials Engineering, ⁴Pamukkale University, Faculty Of Engineering, Geological Engineering,

The ability of gelatine-clay composite to remove neodymium ions from aqueous solutions was investigated in this study. The mixture of these two specific materials as a biosorbent for elimination and recovery of lanthanides is required for a selective and effective separation technique. Gelatine raw material is cheap and plentiful worldwide. Gelatine is produced from chemical denaturation of collagen. It is a complicated polypeptide and is used in different situations that are widely used in the pharmaceutical, photography, cosmetic, medical and food industries. Clay minerals are part of the phyllosilicate class, covering layered structures of shared octahedral aluminium and tetrahedral silicon pieces; water molecules and hydrated cations can move in and out of the interlayer spaces. Clay is also cheap, chemically and thermally stable, and has good mechanical properties. Growths in scientific knowledge and technology on clay minerals have contributed significantly to human civilization through many uses of clay-based products, from traditional ceramics to modern functional nanocomposites. Recently, scientists, the interest of clay, has focused on the properties of clay minerals as natural nano-sized particles used in adsorption, catalysis and biology, in parallel with the rapid growth in nanotechnology research on synthetic materials. Adsorption trials of neodymium were performed by batch process. Effective physiochemical parameters such as pH, initial concentration, contact time and temperature has been investigated. Moreover, adsorption process is analysed according to various isotherm models and thermodynamic parameters. According to results, prepared material can be used as a biosorbent for neodymium form aqueous solution. Furthermore, considering the importance of neodymium in the fields of biomedical, nuclear and electronics, the sorbent material obtained can be applied in many different fields.

KEYWORDS: gelatine, clay and clay minerals, biosorption, biocomposite, neodymium
P-16 Environmental Assessment of Beach Sands by Determination of Natural Radionuclides

Poster Presentation /

Osman Günay¹, Mutlu İcwhel², Caner Taşköprü², Müslim Murat Saç²,

¹Istanbul Okan University, Vocational School of Health Services, ²Institute Of Nuclear Sciences, Ege University,

The earth materials include natural radionuclides and their decay products with varying activity concentrations depending on the geological structure and material properties. Several factors such as the climate, vegetation, erosion and also tidal flows can be also effected the concentration of these radionuclides in this kind of materials. Beach sands are the earth materials which can be used as a tracer for natural radionuclides. In this study, natural radioactivity levels (226Ra, 232Th, 40K) were determined in beach sands collected from Antalya and its distinct. In order to achieve secular equilibrium in the 238U series (between 226Ra and its daughters) and in the 232Th series (between 228Th and its daughters), the samples were sealed hermetically to avoid (222Rn and 220Rn) emanation. The hermetically sealed containers were stored for at least 40 days prior to being measured by gamma-ray spectrometry. The samples were measured with NaI(Tl) scintillation gamma spectroscopy.

KEYWORDS: Beach sand, Natural radioactivity, Gamma spectrometry, Dose assessment
P-17 Fast neutron- and γ-ray coincidence detection for nuclear security, safeguards and environmental applications

Poster Presentation /

Bo Cederwall¹, Débora M. Trombetta¹, Kåre Axell²,

¹Department Of Physics, KTH Royal Institute Of Technology, ²Swedish Radiation Safety Authority,

The use of passive and active interrogation techniques to evaluate materials concerning their content of special nuclear materials (SNM) is fundamental in fields such as nuclear safeguards and security. Detection of fast neutrons and γ rays, which are a characteristic signature of SNM, has several potential advantages compared with the commonly used systems based on thermal and epithermal neutron counters, the most important being the much shorter required coincidence times and the correspondingly reduced rate of background events due to accidental coincidences. Organic scintillators are well suited for this purpose due to their fast timing properties and composition being based on carbon and hydrogen with large elastic scattering cross-sections for fast neutrons. Furthermore, such detector materials have reasonable detection efficiency for γ rays and exhibit pulse shape properties which are favorable for distinguishing between neutrons and γ rays. We present experimental results and Monte Carlo simulations for a neutron-neutron and γ-neutron coincidence detection setup for identification and characterization of SNM based on such detectors. The measurements were carried out on different samples of PuO₂ material with varying content of 240Pu at the Joint Research Center (JRC) of the European Commission, Ispra, Italy. The results demonstrate a higher sensitivity for the novel approach of fast neutron-γ coincidence detection over fast neutron-neutron coincidence counting for certain applications, e.g. for nuclear security systems, even in the presence of moderate amounts of shielding. We also investigate the possibility to use fast neutron-γ coincidence counting as a new method for detecting small amounts of SNM in the environment. Keywords - fast neutron and gamma detection; organic liquid scintillator detector; Monte Carlo simulations; Non-destructive analysis (NDA); nuclear security; nuclear safeguards; environmental radiation protection.

KEYWORDS: fast neutron and gamma detection, organic liquid scintillator detector, Monte Carlo simulations, Non-destructive analysis (NDA), nuclear security, nuclear safeguards, environmental radiation protection
P-18 STUDY OF THE EXTRACTION OF Ce (III) BY LIQUID-LIQUID EXTRACTION TECHNIQUE AND THE EXTRACTION AT CLOUD POINT, USING A DIAMINOPHOSPHONIC ACID AND THE TWEEN-80

Poster Presentation /

OUAZENE Mokhtar¹, KAID M’hamed ²,

¹Faculty Of Technology, University Of Saïda, Algeria, ²Laboratory Of Physico-chemical Studies. Faculty Of Science. University Of Saïda, Algeria,

The industry rejects waste and various molecules in the environment, some of which prove toxic not only for flora and fauna but also for the human species. These wastes are liquid, solid or gaseous. They can change the natural environment with unpredictable consequences. The environmental risks linked to the development of a growing exploitation of rare earths are part of this polluting whole. The isolation of cerium cation from aqueous industrial waste is an operation of great importance both for the valorization of these elements and for the protection of the environment. As a remedy, liquid-liquid extraction has been considered as a preventive method of treating aqueous industrial waste before it is released into the environment. The liquid-liquid extraction process for the protection of the environment is a very efficient way to recover or make industrial waste inert. In addition, the application of new high-performance methods that adhere to the principles of green chemistry and ensure a good economic aspect is preferred. These three criteria characterize the technique of extraction by cloud point (ECP).

The oxygenated organophosphorus acids are compounds whose extractive performance towards metal cations. These acids constitute an important class of biologically active compounds, and their synthesis has attracted considerable attention in organic synthetic chemistry as well as in medicinal chemistry. They are capable of extracting metal ions by both cationic exchange and solvation. The main objective of this work is to study the extraction of cerium cation by the liquid-liquid extraction technique and the cloud point extraction using a diaminophosphonic acid and Tween-80. Extraction yields close to 100% are obtained for the extraction of cerium (III).

KEYWORDS: Cérium(III), liquid-liquid extraction, diaminophosphonic, Cloud point , Tween-80.
P-19 Study of the extraction of nickel and zinc by amino-octyl-phosphonic acid

Poster Presentation /

DERKAOUI KADDA¹, KAID M'HAMED², BENDRAOUA Abdelaziz³,

¹Faculty Of Chemistry, Department Of Industrial Organic Chemistry, USTO, ²Faculty Of Science, University Of SAIDA, ALGERIA, ³Department Of Industrial Organic Chemistry, USTO,

Voluntary or accidental pollution of water and soil, by some industrial wastes (heavy metals, dyes, phenols, ...) or agricultural (pesticides, fertilizers, ...) constitutes a source of environmental degradation and is currently of a particular interest at the international scale. Heavy metals are, in fact, highly toxic species beyond a certain concentration. They possess the ability to concentrate along the food chain and accumulate in certain organs of the human body. It is therefore essential to completely eliminate the ions of heavy metals present in the various industrial wastes or to reduce their quantities below the admissible thresholds defined by the international standards. We’ve studied the liquid-liquid extraction of nickel (nitrate and chloride) and Zinc in the sulphate medium, from solutions prepared in the laboratory followed by the spectro-photometric method UV / Vis in the presence of arsenazo (III) as a dye and by the amino-octyl-phosphonic acid. (A.O.P.A) as extractant, has been synthesized at LCMT ENSI Caen; France, satisfactory results were recorded during laboratory experiments. These amino-alkyl-phosphonic acids have shown good performance with respect to liquid-liquid extraction. An application was made on a sample of an industrial release and gave an encouraging performance despite the discomfort of several ions present in the solution. This method can be generalized for almost the rest of the metals that constitute the waste generated by this plant and contribute to the degradation of our environment. Key-words: phosphonic acid, liquid-liquid extraction, nickel, zinc.

KEYWORDS: phosphonic acid, liquid-liquid extraction, nickel, zinc.
P-20 Natural and anthropogenic radionuclides concentrations in Baccharis articulata from Briozzo Lagoon, Uruguay

Poster Presentation / Ana Noguera1, Cristina Bañobre1, Heinkel Bentos Pereira1, Laura Fornaro1,

1Centro Universitario Regional Del Este, Universidad De La República, Rocha, Uruguay,

The activity concentrations of 238-U, 226-Ra, 210-Pb, 210-Po, 232-Th, 40-K and 137-Cs were evaluated in Baccharis articulata, and the surrounding soil from Briozzo Lagoon ecosystem in order to evaluate the transfer of radionuclides. Samples were measured by gamma-spectrometry with an HPGe detector GMX35P4-76-RB and by alpha spectrometry (ALPHA DUO ORTEC). 210-Po was measured by alpha spectrometry using the 5.308 MeV emission and 209-Po as tracer. Samples were processed by acid Microwave decomposition, the samples were evaporated and residue was dissolved in 2M HCl, Ascorbic acid was added to reduce Fe3+ to Fe2+ to eliminate its interference. Spontaneous deposition of 210-Po was carried out using silver disks. All other radionuclides were measured by gamma-spectrometry. 238-U was studied by the 234-Th photopeak (63.3 keV), 226-Ra by the 214-Bi photopeak (609.3 keV) and 232-Th by the 228-Ac photopeak (911.1 keV). 40-K (1460.0 keV) and 210-Pb (46.5 keV) were evaluated by their own photopeaks, and 137-Cs radionuclide by the 137m-Ba (661.7 keV) photopeak. The activity concentrations for 210-Po, 210-Pb, 40-K and 137-Cs in Baccharis articulata were found to be 13.6 - 50, 17-77, 179-310, <0.015 – 2.9 Bq.kg-1, respectively. 238-U, 226-Ra, and 232-Th were below the MDA (1 Bq.kg-1, 3.2 Bq.kg-1, 4.2 Bq.kg-1 respectively). The activity concentrations for 238-U, 226-Ra, 210-Pb, 210-Po, 232-Th, 40-K and 137-Cs in soil were found to be 14.3 – 19.5, 8.69 – 13.21, 16.60 – 43.1, 21.2 - 51.7, 21.4 - 45.6, 186.6 – 307.6, 0.20 – 1.34 Bq.kg-1 respectively. The mean transfer factors for Baccharis articulata for 210-Po, 210-Pb, 40-K and 137-Cs were, 0.263 + 0.033, 2.33 + 0.47, 1.209 + 0.086 and 1.57 + 0.73 respectively, which implies that 210-Po, 210-Pb, 40-K and 137-Cs transfer from soil to this species, although more determinations must be made in order to know the 210Pb-210Po fallout intake.

KEYWORDS: Natural radionuclides, transfer factor, Baccharis articulata
P-21 Chitosan-graphene oxide composites for pre-concentration of radionuclides from aqueous solutions

Poster Presentation /

Galina Lujaniene¹, Sergej ŠEMČUK¹, Ėva UOGÎNTĖ¹, Diana TRACEVÎČÎENĖ¹, Saulius TUMĖNAS¹,

¹SRI Center For Physical Sciences And Technology, Department Of Environmental Research, Vilnius, Lithuania,

One of the most common natural biopolymers chitosan derives from chitin, which is the main component of crustaceans, such as crabs and shrimps. Chitosan has received tremendous attention as a non-toxic, biodegradable, biocompatible and renewable polymer material due to its high potential for widespread use in industrial and biomedical fields as well as in the environmental protection and detection. Chitosan has a high sorption capacity for heavy metals and organic matter. The aim this study was to synthesize the chitosan-graphene oxide (CS-GO) composites and apply then for pre-concentration of radionuclides from aqueous solutions. The CS-CO composite was characterized using SEM, TEM, XRD, FTIR and Raman spectroscopy. CS-CO composite was used in sorption experiments with Cs, Co, Pu and Am radionuclides. The sorption efficiency has been studied using modelling solutions and natural seawater.134Cs, 60Co, 242Pu and 243Am were used in sorption experiments. The activity of pre-concentrated radionuclides was measured by gamma and alpha spectrometry. The effect of pH on sorption of Am(III) and Pu(IV) isotopes as well as Cs(I) and Co(II) to Cs-GO composites was studied in equilibrium and kinetic experiments. Large variations in the uptake of Co(II) by the CS-GO composite depending on the initial and final pH of solutions were observed. Uptake of Pu(IV) to CS-GO was found to be rather high (>95%) in a wide range of pH values while the maximum of Am uptake was observed in a pH region of 5-6. A fast uptake of all studied elements was found in sorption kinetic experiments. The synthesized CS-CO composites were applied for pre-concentration of radionuclides from seawater samples.

KEYWORDS: Cs, Co, Am, Pu
P-22 CROSSLINKED CHITOSAN-GRAPHENE-MAGNETIT COMPOSITE FOR BIOSORPTION OF LANTHANUM

Poster Presentation /

HANİFE GÖKKAN¹, ŞEVİN AY¹, Cem GÖK², Yusuf ÖZCAN¹,

¹Pamukkale University, Faculty Of Technology, Biomedical Engineering, ²Pamukkale University, Faculty Of Technology, Metallurgical And Materials Engineering,

The ability of chitosan-graphene-magnetite composite to remove and recovery of lanthanum ions from aqueous solutions was investigated in this study. Composite material was prepared using chitosan, magnetite and graphene by the emulsion cross-linking method using glutaraldehyde as a cross-linker. Graphene is a wonder material with many superlatives to its name. One possible route to harnessing these properties for applications would be to incorporate graphene sheets in a composite material. The manufacturing of such composites requires not only that graphene sheets be produced on a sufficient scale but that they also be incorporated, and homogeneously distributed, into various matrices. Chitosan, a hydrophilic biopolymer, is obtained industrially by hydrolysing the aminoacetyl groups of chitin. It is a natural, non-toxic, biodegradable polysaccharide available as solution, flake, fine powder, bead and fibre. The sources, biochemical aspects, structure and chemical modification, physico-chemical and functional properties, and applications of chitosan have been investigated extensively in the literature. Advantages of this polymer include availability, low cost, high biocompatibility, biodegradability and ease of chemical modification. The physicochemical properties of chitosan, as well as its numerous applications, are reviewed with particular emphasis on its use in water treatment, pharmaceutics, agriculture and membrane formation. Characterization studies obtained materials are carried out by Fourier Transform Infrared Spectroscopy, Scanning Electron Microscopy and X-Ray Diffraction Methods etc. Batch experiments were performed to study the equilibrium, kinetics, and thermodynamics of lanthanum sorption. The effects of physical parameters like initial solution pH, initial lanthanum concentration, and temperature were investigated. Thermodynamic, kinetic and isotherm experiments were carried out at the optimum conditions. Prepared composite is showing enhanced performance to extract lanthanum from water. The results of this work are of great significance to in vitro drug releasing and molecular docking, especially for environmental applications with good stability, biosorption capacity, and regeneration ability. These results suggest that crosslinked chitosan-graphene composite could be used as an effective promising biosorbent for the removal of lanthanum ions from aqueous solutions and biomedical applications.

KEYWORDS: Chitosan, graphene, magnetit, biosorption, biocomposite
P-23 137CS IN THE ABIOTIC COMPONENTS OF LAKES OF CRIMEA REGION

Poster Presentation /

Oksana Miroshnichenko1, Natalya MIRZOYEVA1,

1The A.O. Kovalevsky Institute Of Marine Biological Research Of RAS, Russian Federation, Sevastopol,

Lake Sasik-Sivash and Lake Kizil-Yar are the lakes, relating to the Yevpatoriyskaya group of the salt lakes of Crimea. These lakes were chosen as objects of investigation, since they are located in close proximity to each other, but have a different nature of the entry of anthropogenic 137Cs (important factor of water pollution). The aim of these investigations was to identify patterns of redistribution of 137Cs between water and bottom sediments of Lake Sasyk-Sivash and Lake Kyzyl-Yar during 2016-2018. The determination of 137Cs content was carried out by methods generally accepted in international practice (Polikarpov et. al.2008). Three-year dynamic of 137Cs content in water and bottom sediments of the studied lakes was obtained for the first time. The level of 137Cs in the water of Lake Sasyk-Sivash for the period 2016-2018 changed from 83 to 142 Bq/m3, but in the bottom sediments increasing of 137Cs concentration was not found. The opposite trend was observed in lake Kyzyl-Yar. The level of 137Cs in water of this lake changed from 0.75 to 2.90 Bq/m3, and in bottom sediments changed from 15 to 0 Bq/kg. Note that in Lake Sasyk-Sivash the average salinity was 290 ‰, the concentration of 137Cs in the water was maximum. For the study period the salinity of water Lake Kyzyl-Yar increased from 3.5 to 7 ‰, while the content of 137Cs increased almost three times, and in the bottom sediments decreased to zero. From which it follows that the salinity of the lakes affects the distribution of 137Cs between water and bottom sediments of the studied water objects. Thus, in the absence of sources of anthropogenic radionuclides, levels of 137Cs in lakes change, mainly, by redistributing 137Cs between the aquatic environment and bottom sediments depending on the salinity of the water ecosystems. This work was supported by the Russian Science Foundation - grant number 18-16-00001.

KEYWORDS: salt lakes, 137Cs, Crimean Peninsula.
Thorium is a long-lived element found in the Earth's crust about three times more than uranium. Naturally found thorium is found in soil, rocks, plants and waters, and has many usage areas in both industrial and medical fields as well as its use as nuclear fuel. The toxic nature of this radionuclide constitutes a risk of lung, pancreas, bone cancer in humans, and it is therefore important to remove thorium from waste solutions. To this end, a number of techniques have been developed to remove thorium from aqueous solutions, such as chemical precipitation, extraction, electro-flotation, ion exchange and reverse osmosis. However, these methods have many disadvantages, such as high cost, being ineffective in wastes containing very low metal concentrations (<100 mg.L⁻¹) which are harmful for humans and toxic metal production in the case of non-selective precipitation. Compared to these methods, biosorption is an eco-friendly, low-cost and high-efficiency method for removing metals from aqueous solutions. Due to the carboxyl, hydroxyl and phosphate active groups on the surfaces of biological materials, their metal binding capacity is high and therefore their use in radioactive waste removal is promising. Helianthus annuus, is considered as one of the most important oil crops grown for seed and oil in the world and Turkey. The structures contain large amounts of lignin, cellulose and hemicellulose, and therefore are cellulosic materials that contain functional groups such as C = C, C-O, O-H and carboxylic acids, and are capable of adsorbing metal ions effectively. Taguchi is a systematic optimization application that reduces the cost of design, analysis and cost of the experiments. The signal-to-noise (S/N) ratio corresponding to each combination is calculated using a standard orthogonal array containing each experimental variable at different levels and is analyzed to determine the optimal settings as well as the validity of the design based on ANOVA. This study is about the use of Helianthus annuus core shells for the biosorption of thorium ions. The parameters affecting the biosorption (contact time, pH, initial thorium concentration, temperature) were examined and optimized using Taguchi Design to ensure maximum removal of thorium.

**KEYWORDS:** Thorium, Biosorption, Helianthus Annuus, Taguchi Experimental Design
P-25 REFERENCE LEVELS of NATURAL and ARTIFICIAL RADIOACTIVITY in and AROUND the ÇANDARLI GULF of AEGEAN SEA, TURKEY

Poster Presentation /

Senay Sahin1, Gunseli Yaprak1, Ilker Sert1,

1Institute Of Nuclear Sciences, Ege University,

The aim of the study is to determine the naturally occurring radionuclides (226Ra, 232Th and 40K) as well as 137Cs in the beach sands, surface soils and rocks around the Çandarlı Gulf of Aegean Sea. For these purposes, the activity concentrations of the relevant radionuclides in these samples were measured by HPGe gamma spectrometry systems. The activity concentrations of the 226Ra, 232Th, 40K and 137Cs in and around the Çandarlı Gulf were mapped using GIS. Furthermore, based on the activity concentrations of natural radionuclides, radiation hazard parameters were also calculated and compared with the typical range of the worldwide average values noted in the UNSCEAR (2000) report.

KEYWORDS: Çandarlı Gulf, soils, natural radionuclides, 137Cs, radiation hazard parameters
P-26 Determination of 222Rn and 226Ra levels of Tap Water Samples to Evaluate Their Radiological Impacts

Poster Presentation /

Mutlu İçhedef1

1Institute Of Nuclear Sciences, Ege University,

Radon (222Rn) and its parent radionuclide Radium (226Ra) are the largest contributors for the public annual effective dose. These radionuclides are also classified as carcinogen. Human expose to radon in water via inhalation and ingestion, although ingestion is the only way for radium to enter the human body. In this research, tap waters (municipal supply and artesian water) collected from Bornova distinct was studied to determine the concentration of radon (222Rn) and radium (226Ra) for evaluating their radiological impact. The measurements were performed using a collector chamber method. The mean concentrations of 222Rn and 226Ra were determined as 0.85 and 0.76 Bq/L, respectively. It can be stated that the 222Rn and 226Ra concentrations of tap waters here are lower than the international reference levels. Obtained concentration levels were applied to estimate annual effective dose due to the inhalation and ingestion. The dose values are also found to be lower than the recommended maximum values.

KEYWORDS: radon, radium, water, annual effective dose
P-27 TECHNOGENIC RADIONUCLIDES DISTRIBUTION IN GRAIN-SIZE FRACTIONS OF SOIL IN THE AREA OF EXCAVATION NUCLEAR TEST ("ATOMIC LAKE")

Poster Presentation /

Alua Kabdyrakova¹, Ayan Mendubaev¹, Natalya Larionova¹,

¹Institute Of Radiation Safety And Ecology, Kurchatov, Kazakhstan,

The first excavation explosion («Chagan» explosion, 15.01.1965) at Semipalatinsk Test Site was aimed at obtaining information about possibilities of using nuclear explosions for creating water reservoirs in arid areas. Artificial reservoir called «Atomic lake» was created as the result of the explosion. Radioactive contamination of soil here mainly belongs to the area with the radius of 4-5 km, adjacent to soil dump. The methodology of research included a sampling of topsoil layer, grain-size fractionation of samples and determining concentrations of radionuclides in the fractions. The soil in the area of the «Atomic lake» was sampled by longitudinal profile (total length - 2,7 km), along the radioactive fallout plume starting from the dump. The depth of sampling was 5 cm. Grain-size fractionation was carried out by ‘wet’ sieving and sedimentation in aquatic medium techniques. Medium and coarse fractions of aggregates ranging from 1000 to 40 µm were separated by sieving, fractions of fine aggregates in the range from 40 to 1 µm – using sedimentation technique. In general, each sample was divided by 9 particle-size fractions. Resulting fractions were dried, weighed and analyzed for concentration of Cs-137, Am-241, Sr-90, and Pu-239+240. Cs-137 and Am-241 in samples were determined using a γ-spectrometric method, for Sr-90 – direct β-spectrometric method was applied and for Pu-239+240 – α- spectrometric method with preliminary radiochemical treatment was used. According to results, two contradictory tendencies in the distribution of nuclear charge elements (Am-241, Pu-239+240) and fission products (Cs-137, Sr-90) in particle-size fractions of soil were found near the «Atomic lake». Am-241 and Pu-239+240 are getting concentrated in soil fractions sized of 1000-500 µm and 40-8 µm. In its turn, radionuclides Cs-137 and Sr-90 are concentrated in <1 µm fraction. The maximum enrichment of soil fractions by researched radionuclides relatively their average concentrations in bulk soil reaches 5 times. Therefore, the character of radionuclides distribution in grain-size fractions of soil in the «Atomic lake» area to some extent reflects the peculiarities of radionuclides fractionation during excavation nuclear explosion and formation of radioactive contamination in various radioactive fallout zones.

KEYWORDS: technogenic radionuclides, soil, grain-size fractions, nuclear explosion, Semipalatinsk Test Site
P-28 DEVELOPMENT OF ACTIVITY RATIOS RESEARCH METHOD FOR THE 241Pu AND 241Am IN THE SOIL OF THE MAIN STS TEST SITES.

Poster Presentation /

Vladimir Kashirsky¹, Irina Zvereva¹, Anton Shatrov¹,

¹Branch "Institute Of Radiation Safety And Ecology" Of The RSE "National Nuclear Center Of The Republic Of Kazakhstan", Kurchatov, Kazakhstan,

241Am is one of the main dose-forming radionuclides, the increase in activity of which over time will significantly affect the radiological situation of the Semipalatinsk test site (STS). 241Am is a decay product of 241Pu. Thus, it is necessary to know the distribution of 241Pu in the STS at the moment. Determining the amount of 241Pu is quite a challenge. For a detailed study of the distribution of 241Pu in the landfill, taking into account the landfill area, it is necessary to analyze several tens of thousands of samples. The budget option for estimating the concentration of 241Pu is to calculate it by the concentration of 241Am, which is a decay product of 241Pu. However, this is possible if the ratio of concentrations of 241Pu / 241Am is known and is constant at least within the local STS sites. The goal of this work was to develop a method for studying the 241Pu and 241Am activity ratios in STS soil. To achieve the goal, within the framework of this work, two tasks were set: to develop a radiochemical method for the determination of 241Pu and to determine the ratio of 241Pu / 241Am concentrations in the soil of STS. Studies were conducted on the basis of which a radiochemical method was developed for the determination of 241Pu with an instrumental ending on a TRICARB liquid scintillation beta spectrometer. The developed method was tested on various STS test sites. The paper presents the obtained data on activity levels of 241Pu and concentration ratios of 241Pu / 241Am.

KEYWORDS: Semipalatinsk Test Site (STS), plutonium, americium, radiochemical method.