Accreditation No.: 204/E/KPT/2022

atom indonesia

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Publisher	: Directorate of Repository, Multimedia and Scientific Publishing
Mailing Address	: National Research and Innovation Agency Kawasan Sains dan Teknologi - BRIN, KST B.J. Habibie, Gedung 120 TMC, Jl. Raya Puspiptek Serpong, Tangerang Selatan 15314, Indonesia Phone (+62 21) 7560009, 7560562 ext. 4082 Web: http://aij.batan.go.id, E-mail: atomindonesia@brin.go.id
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atom indonesia
vol. 49 no. 2
August 2023

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EDITORIAL

Dear readers,

It is a great pleasure to provide you with the second issue of Atom Indonesia in 2023, namely Vol. 49 No. 2 (2023). The Atom Indonesia Vol. 49 No. 2 (2023) contains ten articles discussing various aspects and applications of nuclear science and technology. The contributors of those articles are not only from various national institutions and universities but also from international institutions.

"Synthesis of Polyvinyl Alcohol (PVA)-Gelatin Hydrogel from White Snapper (Lates Calcarifer, Bloch) with Gamma Irradiation and its Characterizations" was explored by H. Hariyanti, R. Z. Apriyani, and H. Rahmi from Faculty of Pharmacy and Science, Muhammadiyah University of Prof. Dr. Hamka (UHAMKA), Jakarta, Indonesia, under collaboration with E**.** Erizal and D. P. Perkasa from Centre for Applications of Isotopes and Radiation, National Nuclear Energy Agency (BATAN), Jakarta, Indonesia and I. Lestari from Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Depok, Indonesia. The application of nuclear technology in the health sector is increasing. One example is the use of irradiation in production of wound dressings. Research activities have been conducted to study whether polyvinyl alcohol (PVA)-gelatin-based hydrogel from white snapper scales can be processed using gamma irradiation into wound dressings. A series of PVA (10 %) solutions containing gelatin in various concentrations (0-4 %) were treated with three freeze-thaw cycles and then irradiated at doses of 10 and 20 kGy. They were subsequently characterized using Fourier transform infrared (FTIR) spectroscopy and scanning electron microscope (SEM). Gel fraction, water absorption, and percentage of hydrogel water evaporation rate were tested gravimetrically, while the elongation at break and the tensile strength of the hydrogels were tested with a universal testing meter. The evaluation showed that the hydrogel gel fraction decreased with increasing gelatin concentration from 0 % to 4 % for both irradiation doses (10 and 20 kGy). The rising gelatin concentration demonstrated that increasing gamma radiation dose improved the hydrogel's water absorption, evaporation rate, tensile strength, and elongation at break. PVA-gelatin hydrogel with irregular pore structure was observed from SEM test results. The FTIR measurement results confirmed the formation of crosslinks in the hydrogel matrix. The PVA-gelatin hydrogel produced through gamma irradiation could be used for wound dressings.

"Neutronic Parameter Analysis of Plate-Type Fueled TRIGA 2000 Reactor by MCNPX" was written by A. Nuryana from Gadjah Mada University, Department of Physics, Magister Program, Yogyakarta, Indonesia under collaboration with R. S. N. Mahmudah from Yogyakarta State University, Department of Physics Education, Yogyakarta, Indonesia and A. Khakim from Nuclear Energy Regulatory Agency of Indonesia, Jakarta, Indonesia. A novel simulation to calculate the neutronic parameters of the TRIGA 2000 reactor using plate-type fuel has been performed. The plate fuel used was produced by the Indonesian Nuclear Industry (PT INUKI) with U_3Si_2-Al material. Neutronic parameters based on INUKI's plate-type fuel dimension and the current TRIGA's configuration were simulated using MCNPX. The simulation was performed by modeling the complete reactor's configuration on a fresh fuel core state. We obtained the kinetic parameter values from the simulation, i.e., delayed neutron fraction of 8.11×10^{-3}, a prompt neutron lifetime of 2.0551×10^{-4} s, and an average neutron generation time of 1.87×10^{-4} s. The excess reactivity of the reactor was 9.02 %Δk/k, while reactivity in the one-stuck-rod state was below -0.5 $ with an average value of -3.40 %Δk/k (-4.19 $). The average thermal neutron flux peak occurred at the central irradiation position with the value of 3.0×10^{13} to 3.1×10^{13} n/(cm^2 s). The reactor has a power peaking factor of 1.379 in the control rod position of 0 % on D3 fuel. The reactor had a negative feedback reactivity coefficient, except for the moderator coefficient. These results suggest that the current configuration of plate-type fuel met the nuclear reactor neutronic safety standards.

"Optimizing Neutronic and Photonic Performance in Irradiation Systems of Symmetric TRIGA Cores" was written by S. M. Shauddin from Institute of Nuclear Science and Technology, Atomic Energy Research Establishment, Ganakbari, Savar, Dhaka, Bangladesh. The BAEC TRIGA MARK-II Research

Reactor (BTRR) in Bangladesh has been used for a wide range of purposes, including basic and applied nuclear research and human resource development. Therefore, its core management should be flexible to meet various objectives with different priorities and to deliver the best possible outcome. In this study, neutron and gamma photon flux variation was studied at different radial and axial irradiation systems of the current core (C-0) as well as six symmetric reconfigurations (C-1, C-2, C-3, C-4, C-5, and C-6) of the existing BTRR using the universal MCNP code. While keeping the exact core component and material density, the symmetric reconfigured cores were modeled based on core criticality calculation and excess reactivity in the critical state. Finally, it was observed that the reconfigured core C-1 has the best neutronic and photonic performance at the irradiation systems compared to other reconfigured cores, against the reference core C-0.

"Homogeneity Test on Collimators for Boron-Neutron Capture Therapy based on SNI 8506:2018" was explored by S. Santosa from Research Center for Radiation Detection and Nuclear Analysis Technology, National Research and Innovation Agency, KST BJ Habibie, Tangerang Selatan, Indonesia under collaboration with K. Khotimah from Research Center for Safety, Metrology, and Nuclear Quality Technology, National Research and Innovation Agency, KST BJ Habibie, Tangerang Selatan, Indonesia and H. Yasmine from Bureau for Organization and Human Resources, National Research and Innovation Agency, KST BJ Habibie, Tangerang Selatan, Indonesia. A serial homogeneity test based on Indonesian Standard SNI 8506:2018 were undertaken to investigate 12 manufactured collimators by using double wall single image radiography (DWSI) technique with an x-ray machine ranging from 120 to 150 kV. The standard stated that the film density should be measured on seven different points, and the result obtained must not exceed ± 0.05 from the average density. This paper outlines a testing work for the collimators, calculating the density on six different points in the film. Six different points were selected due to technical constrains of the collimator manufacturing and radiography capabilities of the selected laboratory. The results of film the density for the 12 collimators are: (1) 2.59; (2) 2.57; (3) 2.14; (4) 1.88; (5) 2.10; (6) 1.96; (7) 2.33; (8) 2.28; (9) 2.06; (10) 2.18; (11) 2.24; and (12) 2.33. The result shows that collimator-2 has the most homogenous density. This study concludes that established parameters and process are needed to manufacture the collimator for BNCT in achieving proper performance testing based on the standard.

"Λ-Hypernuclear States as Dihadronic Molecules" was written by A. Jahanshir from Department of Physics and Engineering Sciences, Buein Zahra Technical University, Imam Khomeini Avenue, Buein Zahra, Iran. The study of exotic hypernuclei attracts a great deal of interest in nuclear physics. The reality of heavy hyperon hypernuclei is the subject of intense concern among theoreticians and experimenters in recent years. The core-hyperon model uses to explain abnormal nuclei spectra, recent observations of new exotic heavy hyperon hypernuclei cannot be explained or predicted by ordinary heavy core nuclei. These exotic hypernuclei states are a two-cluster bound states. We calculate the mass spectrum and constituent mass of particles in hypernuclei using the relativistic Schrödinger equation with molecular pseudoharmonic-type potential between particles inside the core and hyperon. Such calculations represent the interaction between the hyperon and the nuclei core. I review recent theoretical studies on the ground states and the excited states of hypernuclei bound states. Finally, we present explicit predictions of the exotic bound states based on the interactions obtained from quantum field theory and the projective unitary representation model. Studies have shown that by increasing the mass number of hyperon-core states, the value of the constituent mass and energy eigenvalue of Λ-hypernucleus increases. Also, by growing and increasing the proton number in the (Λ-N) states the value of the constituent mass of Λ-hyperon increases.

"Assessment of ^{137}Cs in the Environment of Hetauda City, Nepal by In-Situ Gamma Ray Spectrometry" was explored by A. Mishra and R. Khanal from Central Department of Physics, Tribhuvan University, Kirtipur, Kathmandu, Nepal. A significant amount of ^{137}Cs radioactive fallout have been spread in the atmosphere due to nuclear weapon testing and nuclear reactor disasters. This fallout eventually settles on the Earth's surface, and because ^{137}Cs has a long half-life, it remains in the environment for an extended period. Mapping the distribution of ^{137}Cs is crucial, and this study aims to assess the radioactive deposition of ^{137}Cs in the ground to establish baseline data for its distribution in the environment of Hetauda City, Nepal. Recently, Hetauda City has been designated as the capital city of the

Bagmati province. To measure ^{137}Cs deposition, portable (backpack) gamma ray spectrometer was used with a 0.347-liter NaI(Tl) detector. Rapid measurement was carried out while walking at a pace of less than 2 km/h, and the distance between the detector and the ground was maintained at less than 1 m with the detector pointing downward. The surface activity of ^{137}Cs was measured in the range of 0.003 to 2.382 kBq/m2, with an average value of 0.581 ± 0.343 kBq/m2. The spatial variability of ^{137}Cs was found to be smooth in the area, and the mean annual effective dose calculated was 0.379 ± 0.224 μSv. The low dose rates and smooth spatial distribution of ^{137}Cs in the environment indicate no contamination, and the trace amount present could be due to global fallout from weapons testing and nuclear accidents. The results were compared with previously reported values worldwide.

"Elemental Mapping and Quantities in Different Soybean Seed Colors Using Micro X-Ray Fluorescence and Their Correlations with Germination" was written by K. Wibisono from Research Center for Food Crops, Research Organization for Agriculture and Food, National Research and Innovation Agency (NRIA), Bogor, Indonesia and Graduate School of Bogor Agricultural University (IPB University), Bogor, Indonesia under collaboration with W. Nurcholis from Department of Biochemistry, Faculty of Mathematics and Natural Science, Bogor Agricultural University (IPB University), Bogor, Indonesia. Tropical Biopharmaca Research Center, Bogor Agricultural University (IPB University), Bogor, Indonesia. Micro X-ray fluorescence (μ-XRF) possesses a powerful analytical technique able to detect macro- and micro-elements. Each plant variety has a unique elemental composition and important role in the germination process. The aims of this study were to (1) map the elements and quantities in the soybean seed coat and endosperm, (2) investigate how the various elements might mediate the inter-relationship or correlation between elements within soybean seed genotypes with different seed coat colors, and (3) investigate that the targeted morphological characteristics especially in germination would be affected by seed elements. A μ-XRF technique was used for the elemental analysis and quantification. Three genotypes of Indonesian soybean were used in this study: greenish, black, and yellowish. In this study, we found that the silicon (Si) and magnesium (Mg) elements have a significant correlation. The high quantity of Si element in the embryo axis has a positive correlation with root length. The high quantity of Mg element which is evenly distributed on the endosperm has a positive correlation with normal germination. Si and Mg elements in the seeds have a negative correlation with imbibition water absorption. Based on the comparison between the three genotypes, the black genotype was superior in terms of germination and higher Si and Mg elements. Thus, the Si and Mg elements can be used as a reference in determining superiority of genotypes at the germination stage.

"Geologic Influence on Radon Concentrations Levels in Cave: A Case Study of Mimpi Cave in the Maros Karst of South Sulawesi, Indonesia" was explored by Syarbaini and D. Iskandar from Research Center for Nuclear Fuel and Radioactive Waste Recycling Technology, Nuclear Energy Research Organization, National Research and Innovation Agency, B. J. Habibie Science and Technology Area, Tangerang Selatan, Indonesia under collaboration with Kusdiana, Wahyudi and S. Widodo from Research Center for Nuclear Safety, Metrology and Quality Technology, Nuclear Energy Research Organization, National Research and Innovation Agency, Lebak Bulus Raya, Jakarta, Indonesia and S. Dewang from Physics Department, Faculty of Mathematics and Natural Sciences, Hasanuddin University, Indonesia Makassar, Indonesia. Radon gas in the natural environment mainly comes from the release of local bedrock geology and easily accumulate in closed spaces such as basements and caves. This study was performed to investigate the radon concentrations in Mimpi Cave, Bantimurung-Bulusaraung National Park, in the Maros karst area, South Sulawesi, and discussed a possible relationship between the radon concentrations and the local geology. Measurements were carried out using a passive detection technique with CR-39 nuclear tracks detectors by exposing it for a period of three months. The ^{222}Rn levels measured inside the cave ranges from 64.03 Bq m^{-3} to 3396.02 Bq m^{-3}, with an average value of 1075.05 Bq m^{-3}. The results are comparable with radon concentration in different caves environments reported from other surveys in several countries. Geological background of the Maros Karst areas could sustain the measured radon values, due to the presence of limestone rock with a mineral composition, which can lead to higher radon concentrations in Mimpi Cave.

"Radon Concentration in Urban Areas in the North and West of Morocco" was written by A. Tayebi from Laboratory of Materials Physics and Subatomics, Faculty of Sciences, Ibn Tofail, Morocco

and Superior School of Technology, Ibn Tofail, Morocco under collaboration with M. El-Maghraoui and C. El-Mahjoub from Laboratory of Materials Physics and Subatomics, Faculty of Sciences, Ibn Tofail, Morocco and M. Tayebi from Laboratory of Geosciences, Faculty of Sciences, Ibn Tofail, Morocco. Radon is a colorless, odorless radioactive gas produced by the decay of uranium and radium. It is the second cause of cancer of the lungs after smoking. It has been present in Earth's crust since the creation of Earth. Uranium-rich rocks in the deep crust are the main source of radon. Its emanation from the ground surface varies from one point to another depending on the physical characteristics of the terrain crossed as observed in this study between North and West Morocco. A dosimetric study of those emanations was performed by using the LR-115 solid-state nuclear track detector (SSNTD), which was subsequently processed by techniques developed and calibrated in the laboratory. The study revealed high concentrations of this gas in confined spaces at ground level and, in particular, in basements and less-ventilated ground floor rooms. In order to reduce these concentrations of radon and the probability of carcinogenic attacks by these accumulations of this gas, it is recommended to ventilate these premises well. Good air circulation allows the removal of this harmful gas.

"External Bremsstrahlung Studies on Films of Lead Monoxide Filled Polycarbonate Composite" was explored by V. A. Kandagal and B. Lobo from Department of Physics, Karnatak University's Karnatak Science College, Dharwad-580001, Karnataka, India. The development of high-Z (high atomic number) radiation shielding materials is vital in order to protect personnel who work with harmful gamma radiation sources. At the same time, the emission of external bremsstrahlung (EB) radiation in those shielding materials when the radiation source emits beta particles as well as gamma radiation is also of prime concern. The production of EB in films of lead monoxide (PbO) loaded polycarbonate (PC) composite at eleven different filler levels (FLs) varying, in terms of weight fraction, from 0.0 % up to 10.0 % were investigated experimentally by using beta particles from strontium-90/yttrium-90 (^{90}Sr/^{90}Y) radioactive source. A nonlinear relation is observed between EB intensity and target thickness. The effective atomic numbers of the prepared PbO-filled PC composite films (at different FLs) were determined via EB measurements, followed by calculations, and the values obtained were compared with the modified atomic numbers which were determined for the same composite films (at different FLs) using the Markowicz and Van Grieken equation, and it was found that they are in good agreement. Finally, the atomic number dependence of EB in these composite films (PbO-filled PC composites) has been studied. It is obtained that the intensity of EB spectra depends on the square of the atomic number of the target material.

On behalf of Atom Indonesia, I would like to thank you all for your contributions and endless support that have allowed Atom Indonesia to reach an outstanding performance over all the years. This outstanding achievement could not have been reached without great efforts and cooperation from the editors, reviewers, management personnel, authors, and readers.

Editor in Chief