

# atom indonesia

Exist for publishing the results of research and development in nuclear science and technology

## EDITOR IN CHIEF

Prof. Dr. rer.nat. Evvy Kartini

## MANAGING EDITOR

Drs. Budi Prasetyo, M.T.

## EDITORS

- Prof. Dr. Zaki Su'ud *Nuclear Physics and Reactor Safety, Bandung Institute of Technology, Indonesia*  
Prof. Dr. Terry Mart *Theoretical Nuclear and Physics, University of Indonesia, Indonesia*  
Prof. Dr. Muhayatun Santoso *Radiochemistry; Nuclear Analytical Techniques, National Nuclear Energy Agency, Indonesia*  
Dr. Hendig Winarno, M.Sc. *Radiation; Pharmaceutical Chemistry, National Nuclear Energy Agency, Indonesia*  
Dr. Abu Khalid Rivai, M.Eng *Materials; Corrosion and Nuclear Reactor Technology, National Nuclear Energy Agency, Indonesia*  
Edy Giri R. Putra, Ph.D. *Neutron Scattering, Soft Condensed Matter, National Nuclear Energy Agency, Indonesia*  
Imam Kambali, M.Phil., Ph.D. *Radiochemistry and Radioisotopes, National Nuclear Energy Agency, Indonesia*  
Dr. Julwan Hendry Purba *Nuclear Reactor Technology and Safety Assessment, Computational, National Nuclear Energy Agency, Indonesia*
- Dr. Darmawan Darwis *Biomaterials, Radiation Processing of Polymers, Radiation Sterilization and Decontamination of Pharmaceuticals and Healthcare, National Nuclear Energy Agency, Indonesia*
- Dr. Mukh. Syaifudin *Biomedicine Division, Center for Technology of Radiation Safety and Metrology, National Nuclear Energy Agency, Indonesia*
- Prof. Dr. Malcolm F. Collins *Neutron Scattering; Magnetism; Glasses, McMaster University, Hamilton, Canada*  
Dr. Shane J. Kennedy *Neutron Scattering; Superconductor; Superionic Materials, Australian Nuclear Science and Technology Organization, Australia*
- Prof. Dr. Philip K. Hopke *Nuclear Analytical Methods (XRF, INAA); Environmental Analysis, Clarkson University, New York, USA*  
Prof. Dr. Takashi Sakuma *Solid State Physics, Ibaraki University, Japan*  
Sugawara Takanori, Ph.D. *Nuclear Reactor Physics, Japan Atomic Energy Agency, Japan*  
Prof. Dr. T. Kamiyama *Neutron Instrumentation and Materials Energy, High Energy Accelerator Research Organization, Japan*  
Prof. Dr. Shahidan Radiman *Nanomaterials and their applications, National University of Malaysia, Malaysia*  
Prof. Dr. Kell Mortensen *Head of X-Ray and Neutron Science, Niels Bohr Institute, University of Copenhagen, Denmark*  
Bowen Li, Ph.D. *Physics and Astronomy, Engineering, Lanzhou University, China*  
Prof. Dr. Gerard O'Sullivan *Quantum Mechanics, Atomic and Molecular Physics, Applied Optics, Lasers and Photonics, Low Temperature Physics: Superconductivity and Quantum Fluids, Base Einstein Condensation in Cold Gases, University College Dublin, Ireland*
- Ass. Prof. Chris Ling *Solid-state Oxide Chemistry, Magnetism, Ionic Conductivity, Neutron Scattering, Phase Transitions, Modulated Structures, University of Sydney, Australia*
- Prof. Dr. Sun Ming Choi, Ph.D. *Neutron and X-ray Scattering Studies of Molecular Self-Assemblies for Nanostructured Functional Materials, Development of Multi-Component Anisotropic Nanoparticle Superlattice and Their Applications, Structure and Dynamics of Biomembranes Interacting with Proteins, Korea Advanced Institute of Science and Technology, Republic of Korea*
- Dr. Max Audeev *Crystal and magnetic structural studies of inorganic materials with neutron and X-ray scattering and atomistic, Australian Nuclear Science and Technology Organization (ANSTO), Australian*
- Prof. Ikuo Kashiwakura, Ph.D. *Hirosaki University Graduate School of Health Sciences, Departement of Radiation Science, Japan*

## PEER REVIEWERS

- Martalena, M.Sc. Ph.D. *Radiopharmacy, National Nuclear Energy Agency, Indonesia*  
Dr. L.T. Handoko, M.Sc. *Physics Theory, Indonesian Institute of Sciences, Indonesia*  
Prof. Sunarno, Ph.D. *Nuclear Radiation; Nuclear Instrumentation, Gajah Mada University, Indonesia*  
Dr. Ferhat Aziz, M.Sc. *Nuclear Engineering, National Nuclear Energy Agency, Indonesia*  
Dr. Ir. Hadi Suwarno, M.Eng. *Nuclear Materials, National Nuclear Energy Agency, Indonesia*  
Prof. Yasushi Arano *Environmental and Bioanalytical Sciences, Chiba University, Japan*  
Prof. Dr. Michio Yamawaki *Nuclear Fuel and Material, Nuclear Fusion Technology, University of Tokyo, Japan*  
Prof. Dr. Kenji Kikuchi *Nuclear Materials, Ibaraki University, Japan*  
Prof. Dr. Fumio Yoshii *Radiation Chemistry; Radiation Polymerization, Japan Atomic Energy Agency, Japan*  
Prof. Dr. Stefan Adams *Materials Modelling, National University of Singapore, Singapore*  
Ass. Prof. Dr. Ho Jin Ryu *Materials Science and Engineering, Korea Advanced Institute of Science and Technology, Republic of Korea*
- Lucille V. Abad, Ph.D. *Philippine Nuclear Research Institute (PNRI)*

## LANGUAGE EDITOR

Jos Budi Sulisty, Ph.D.  
Drs. Supria, M.Sc.

## ADMINISTRATIVE OFFICERS

Iis Sustini, Noer'Aida, R. Suhendani, Moh. Zen, Heru Susanto, Ajie Noorseto, Moh. Widya, Wenseslaus Roland, Anggiana Rohandi Yusuf

---

Publisher : Center for Informatics and Nuclear Strategic Zone Utilization  
Mailing Address : National Nuclear Energy Agency  
Puspiptek Serpong, Tangerang 15314, Indonesia  
Phone (+62 21) 7560575, 7562860 ext. 9017, Fax (021) 7560895  
Web: <http://aij.batan.go.id>, E-mail : [atomindonesia@batan.go.id](mailto:atomindonesia@batan.go.id)

---

Licences : SIT No. 078/Khs/Dit.PP/II. 1a & 75; 24.5.75  
SIC No. B/289-PK/VI/75; 3.6.75

---

# Contents

<b>Editorial</b> .....	i
Atmospheric Dispersion Analysis for Expected Radiation Dose due to Normal Operation of RSG-GAS and RDE Reactors <b>P.M. Udiyani, S. Kuntjoro, G.R. Sunaryo and H. Susiati</b> .....	115
An Experimental Analysis on Nusselt Number of Natural Circulation Flow in Transient Condition Based on the Height Differences between Heater and Cooler <b>M. Juarsa, J.P. Witoko, Giarno, D. Haryanto and J.H. Purba</b> .....	123
Shielding Design for the PGNAE Experimental Facility at Kartini Reactor <b>T. Sutondo and Syarip</b> .....	131
Phosphate Solubilizing Study on the Determination of Inoculant Dose and Composition for Biofossi Fertilizer <b>A. Citraesmini and E.T. Sofyan</b> .....	137
Study of Cellulose-N,N'-Methylenebisacrylamide-Acrylic Acid as Pb <sup>2+</sup> Ion Adsorbent <b>M. Suhartini, J. Ginting, Sudirman, A.D. Putri and Z.R. Mubarak</b> .....	145
Essential Minerals of Rice in West Java Indonesia and its Daily Intake Estimation <b>W.Y.N Syahfitri, E. Damastuti, N. Adventini, D.P.D. Atmodjo, I. Kusmartini, S. Kurniawati, D.D. Lestiani and M. Santoso</b> .....	155
A Novel Technique for Removal of High Density White Spot Noise from Digital Neutron Radiographic Images <b>A. Hindasyah, D. Sudiana and D. Gunawan</b> .....	165
Pharmacokinetics Interaction of Nonsteroidal Anti-Inflammatory Drugs with <sup>99m</sup> Tc-MDP Radiopharmaceuticals for Bone Imaging <b>I. Mahendra, I. Daruwati, I. Halimah and S.R. Pajrin</b> .....	173
Authors Index .....	179
Keywords Index .....	181
Acknowledgment .....	185

Dear reader, with great pleasure we provide you with the third issue of Atom Indonesia in 2018, namely Volume 44, No.3 (2018). In this issue, we proudly announce a piece of very good news that Atom Indonesia has been indexed by Scopus, so it becomes one of the international journals recognized worldwide. Atom Indonesia has also been indexed by Google Scholar, DOAJ, Crossref, ISJD, and IAEA INIS. Atom Indonesia has provided a Digital Object Identifier (DOI) for each article accepted, so that it can be linked to Crossref. By this indexing, it is expected that Atom Indonesia will become better known among the researchers from around the world and easier to access, thus also increase the impact factor of the journal.

Another important news is that Atom Indonesia has been reaccredited with the highest rank (A) category by the Ministry of Research, Technology and Higher Education (RISTEKDIKTI), and also by the Indonesian Institute of Science (LIPI) with the numbers of 36b/E/KPT/2016 and 767/AU3/P2MI-LIPI/08/2017, respectively. Additionally, the certificate as an international journal was awarded by the Indonesian Institute of Science (LIPI) starting from June 2017 until August 2022. Further information on, and the full articles of, Atom Indonesia Vol.44 No.3 (2018) can be downloaded from <http://aij.batan.go.id>.

We are glad to inform you that, starting this year, the number of articles per issue has been increased from the previous seven to eight. The Atom Indonesia Vol. 44 No.3 (2018) contains eight articles discussing various aspects and applications of nuclear science and technology, ranging from an atmospheric dispersion analysis for expected radiation dose due to normal operation of the RSG-GAS and RDE reactors; an experimental analysis on the Nusselt number of natural circulation flow in transient condition based on the height differences between the heater and the cooler; the shielding design for the PGNAA experimental facility at the Kartini reactor; a phosphate solubilizing study on the determination of inoculant dose and composition for biofossi fertilizer; a study of cellulose-N,N'-methylenebisacrylamide-acrylic acid as  $Pb^{2+}$  ion adsorbent; the essential minerals content of rice in West Java Indonesia and its daily intake estimation; and a novel technique for removal of high density white spot noise from digital neutron radiographic images; to the pharmacokinetics interaction of nonsteroidal anti-inflammatory drugs to  $^{99m}Tc$ -MDP radiopharmaceuticals for bone imaging.

“Atmospheric Dispersion Analysis for Expected Radiation Dose Due to Normal Operation of RSG-GAS and RDE reactors” was written by P.M. Udiyani, S. Kuntjoro, and G.R. Sunaryo from Center for Nuclear Reactor Technology and Safety, National Nuclear Energy Agency, Serpong, Indonesia, under collaboration with H. Susiati from Center for Nuclear Energy System Assessment, National Nuclear Energy Agency, Jakarta, Indonesia. BATAN is planning to build an experimental power reactor, the RDE, to complement the RSG-GAS reactor that is already operating in the Serpong Nuclear Zone (KNS). The experimental power reactor is an HTGR (high-temperature gas-cooled reactor) with a power of 10 MWt, while the RSG-GAS is a pool-type water-cooled reactor with a power of 30 MWt. According to standard regulatory practices, under normal operating conditions of the plant, radiological assessment of atmospheric releases to the environment and assessment of public exposures are considered essential. The purpose of this study is to estimate the dose acceptance in KNS after the RDE operates in KNS-2. To assess the doses, the PC-CREAM 08 computer code was used. It uses a standard Gaussian plume dispersion model and composes a suite of models and data for estimation of the radiological impact assessments of routine and continual discharges from a nuclear reactor.

“An Experimental Analysis on Nusselt Number of Natural Circulation Flow in Transient Condition Based on the Height Differences between Heater and Cooler” was explored by M. Juarsa, J.P. Witoko, Giarno, D. Haryanto, and J.H. Purba from Center for Nuclear Reactor Technology and Safety, National Nuclear Energy Agency, Serpong, Indonesia. A better understanding on the phenomenon of natural

circulation flow for cooling systems is necessary prior to improving the safety of nuclear power plant, not only in normal operation but also in accident conditions. One way to understand this phenomenon is by analyzing the Nusselt number in various geometrical dimensions through experimentation. The purpose of this study is to understand natural circulation phenomenon in transient condition by varying height differences between heater and cooler. To achieve this purpose, an experiment apparatus called NC-Queen was developed and arranged to enable three variations of height differences between heater and cooler, *i.e.*, 1.4 m, 1.0 m, and 0.3 m.

“Shielding Design for the PGNAA Experimental Facility at Kartini Reactor” was explored by T. Sutondo and Syarip from Center for Accelerator Science and Technology, National Nuclear Energy Agency, Yogyakarta, Indonesia. Two steps of preliminary study had been conducted in conjunction with the design of a PGNAA experimental facility at Kartini reactor, *i.e.*, beam characterization of the existing beam ports to select one to be used and the collimator design at the selected beam port. This paper presents the results of the following study concerning the radiation shielding design at the outer area, in front of the beam port exit, where the experiments will be conducted. MCNPX was used for the purpose of simulations, which included the design of neutron beam catcher and the outer shield.

“Phosphate Solubilizing Study on the Determination of Inoculant Dose and Composition for Biofossi Fertilizer” was explored by A. Citraresmini from Center for Isotope and Radiation Technology, National Nuclear Energy Agency, Pasar Jumat, Jakarta, Indonesia, under collaboration with E. Trinurani Sofyan from Faculty of Agriculture, Padjadjaran University, Jatinangor, Sumedang, Indonesia. Phosphorus availability becomes a major problem for the productivity of soil and rice in Indonesia. Utilization of P source which has a slow-release property is one of the solutions to these problems. Biofossi fertilizer is a natural phosphate organic fertilizer which is enriched with phosphate solubilizer bacteria (PSB), to improve the solubility of P and absorption by the plant so that P fertilization becomes more efficient. Experiment conducted on January 2015 at the experimental station of Agriculture Faculty-Padjadjaran University, Bandung, located in Ciparay, West Java. The aim of the experiment was to determine the PSB composition and its inoculation dose toward natural phosphate.

“Study of Cellulose-N,N'-Methylenebisacrylamide-Acrylic Acid as  $Pb^{2+}$  Ion Adsorbent” was explored by M. Suhartini from Center for Isotopes and Radiation Application, National Nuclear Energy Agency, Pasar Jumat, Jakarta, Indonesia, under collaboration with J. Ginting and Sudirman from Center for Science and Technology of Advanced Materials, National Nuclear Energy Agency, Serpong, Indonesia, A.D. Putri from Pancasila University, Depok, Indonesia, and Z.R. Mubarak from Department of Chemistry, Faculty of Mathematics and Natural Sciences, University of Indonesia, Depok, Indonesia. Cellulose can be used as a metal ion adsorbent. However, it is specific to certain metal ions and has some drawbacks. To increase the capture of certain metal ions, cellulose needs to be modified. Cellulose modification was carried out using N, N'-methylenebisacrylamide (MBA) as crosslinking agent and acrylic acid (AA) as grafting agent. Gamma rays from Cobalt-60 was used as the initiator by simultaneous irradiation method. The aim of this study is to improve and observe the capture ability of cellulose as  $Pb^{2+}$  metal ion adsorbent.

“Essential Minerals of Rice in West Java Indonesia and Its Daily Intake Estimation” was written by W.Y.N Syahfitri, E. Damastuti, N. Adventini, D.P.D. Atmodjo, I. Kusmartini, S. Kurniawati, D.D. Lestiani, and M. Santoso from Center for Applied Nuclear Science and Technology, National Nuclear Energy Agency, Bandung, Indonesia. Rice (*Oryza sativa* L.) is the staple food for more than half of the world's population and a major source of essential minerals. Essential minerals such as cobalt (Co), chromium (Cr), iron (Fe), selenium (Se), and zinc (Zn) play an important role in metabolism and physiological function. Information of rice micronutrient and its content quality in Indonesia is limited; however, its availability is important for estimating the daily intake of the nutrients and its contribution to the Recommended Dietary Allowance (RDA). The research aimed to determine the micronutrient content in rice from twelve regions in West Java by means of neutron activation analysis (NAA) and estimate the nutrient intake from rice.

“A Novel Technique for Removal of High Density White Spot Noise from Digital Neutron Radiographic Images” was written by Achmad Hindasyah from National Nuclear Energy Agency, Serpong, Indonesia, under collaboration with Dodi Sudiana and Dadang Gunawan from University of Indonesia, Depok, Indonesia. This paper proposes a novel technique of adaptive switching alternative median (ASAM) filter for high-density white spot noise removal. The ASAM filter is composed of two blocks filtering, namely main and secondary block filtering, respectively. The proposed secondary block filtering is a new technique in high-density impulse noise removal and the main contribution of this research. The ASAM algorithm was tested on the standard 8-bit gray-scale, 512×512 pixel Lena image and a real neutron radiographic image. The results showed significant reduction of white spot noise in both types of images through visual inspection.

“Pharmacokinetics Interaction of Nonsteroidal Anti-Inflammatory Drugs with  $^{99m}\text{Tc}$ -MDP Radiopharmaceuticals for Bone Imaging” was written by I. Mahendra, I. Daruwati, and I. Halimah from Center for Applied Nuclear Science and Technology BATAN, Bandung, Indonesia, under collaboration with S.R. Pajrin from Indonesian College of Pharmacy (STFI), Bandung, Indonesia. Technetium-99m-MDP has been developed as a radiopharmaceutical for bone imaging in nuclear medicine. A drug therapy can alter the pharmacokinetic profiles and biodistribution patterns of radiopharmaceuticals. To achieve an optimum diagnostic outcome, this research focused on pharmacokinetics interaction between two kinds of nonsteroidal anti inflammatory drugs (NSAID) drugs, meloxicam and sodium diclofenac with  $^{99m}\text{Tc}$ -MDP using mice (*Mus musculus*). There were five groups of animal model and each group consists of three mice except for group II and III which consists of six mice.

We continue our tradition of organizing the Atom Indonesia Best Paper Award. This year, it has become the Second International Atom Indonesia Best Paper Award 2018. There were more than 26 articles submitted to this annual event. It is our great pleasure to announce the winners, as follows:

- The First Winner is “Molybdenum-99 ( $^{99}\text{Mo}$ ) Adsorption Profile of Zirconia-Based Materials For  $^{99}\text{Mo}/^{99m}\text{Tc}$  Generator Application”, which was written by: Marlina, E. Lestari, Abidin, Hambali, I., S. Febriana, Kadarisman from Center for Radioisotope and Radiopharmaceutical Technology, BATAN, Indonesia; Saptiama from Faculty of Medicine, University of Tsukuba, Ibaraki, Japan and K. Tsuchiya, K. Nishikata from Oarai Research and Development Center, Japan Atomic Energy Agency, Oarai, Ibaraki, Japan.
- The Second Winner is “Evaluation of Kidney Dose in Neuro Endocrine Tumors patients after Peptide Receptor Radionuclide Therapy using  $^{177}\text{Lu}$ -DOTATATE”, which was written by: NR. Hidayati from Center for Technology of Safety and Radiation Metrology, National Nuclear Energy Agency of Indonesia (BATAN), Indonesia, A. Poon from Department of Nuclear Medicine, Austin Health, Melbourne, Australia, K. Willowson and D.L Bailey from Department of Nuclear Medicine, Royal North Shore Hospital, Australia, E. Eslick and H. Ryu from University of Sydney, Australia.
- The Third Winner is “Assessment of Ionizing Radiation Effect on the Hematological Parameters of Radiation-Exposed Workers” which was written by: H.N.E. Surniyantoro, T. Rahardjo, Y. Lusiyanti, N. Rahajeng from Center for Technology of Safety and Radiation Metrology, National Nuclear Energy Agency of Indonesia (BATAN), Indonesia, A.H. Sadewa and P. Hastuti from Department of Biochemistry, Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta, Indonesia, and H. Date from Faculty of Health Sciences, Hokkaido University, Sapporo, Japan.

On behalf of Atom Indonesia, I would like to thank for all of your contributions and endless support that have allowed Atom Indonesia to reach an outstanding performance for 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