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IOP Conference Series: Materials Science and Engineering

International Nuclear Science, Technology and Engineering Conference 2018 (iNuSTEC2018)

"Sustainable Nuclear Economy For The Nation Progress"

Universiti Teknologi Malaysia
Skudai, Johor, Malaysia
23-25 November 2018

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PREFACE

All praises to God the Al-Mighty for giving us the strengths and the His blessing in making Nuclear Science, Technology and Engineering Conference 2018 (iNuSTEC2018) a success.

The history in organizing Nuclear Science, Technology and Engineering Conference started back in 2010. During that year Then, it was called NuSTEC2010 and was organized only at national and regional levels. From that year onwards, we succeeded in organizing our second (iNuSTEC2011), third (iNuSTEC2012), fourth (international iNUSTEC2013), fifth (NuSTEC2014), sixth (international iNuSTEC2015), seventh (international iNuSTEC2016) and eighth (international iNuSTEC2017) conferences. Based on these achievements, we have decided to reconvene the conference sustainability by organizing regional/international iNuSTEC on annual basis.

The iNuSTEC2018 was held from 23- 25 November 2018 at Universiti Teknologi Malaysia (UTM) in Skudai, Johor, Malaysia. The conference continued the tradition of continuous effort by Malaysian Nuclear society to bring together the nuclear communities in an annual event to discuss and to discourse on progress in nuclear researches and related fields. The conference particularly encouraged the interaction of research students, research institutions and academics with the more established community. iNuSTEC2018 also played an essential role in introducing and fostering new research talents and in advancing the future profile of nuclear science, technology and engineering regionally and globally.

iNuSTEC2018 comprised of the conference parallel sessions and Nuclear Youth competition UTM had also organized a post-conference workshop on Introduction to MNCP on the 26 to 27th of November 2018. At the national forefront of science and energy development, we were honoured to be able to highlight the usage of science and engineering in the nuclear fields and to promote the use of nuclear science and technology for peaceful use through these conference, workshop and side-meetings.

We would like to acknowledge the Ministry of Energy, Science, Technology, Environment and Climate Change Malaysia (MESTECC), Ministry of Education Malaysia (MOE), Malaysian Nuclear Agency (Nuklear Malaysia), International Atomic Energy Agency (IAEA), Hitachi-GE Nuclear Energy Ltd., Japan Atomic Energy Agency (JAEA), Japan Atomic Energy Society (JAES), Tokyo Institute Technology, China National Nuclear Corporation (CNNC), Nusantara Technologies Sdn Bhd, Asia-Oceania Neutron Scattering Association (AONSA), ASME Section Malaysia, Malaysian Welding and Joining society, Institute of Nuclear Engineers (INE MNS), Nuclear Engineering Student Society (NESS), NGOs, universities and companies for their moral and financial support. Special thanks to iNuSTEC2018 organizing committees for their effort and commitment during this conference. We look forward to meeting all of you in 2019 – iNuSTEC2019 @ UKM.

Assoc Prof Dr Khaidzir Hamzah (UTM)
Dr Faridah Mohamad Idris (MNS)
Chairs of iNuSTEC2018
Skudai, Johor
Malaysia

MESSAGE FROM:
PRESIDENT, MALAYSIAN NUCLEAR SOCIETY (MNS)

On behalf of the Malaysian Nuclear Society (MNS), I would like to express our thanks to all participants of the International Nuclear Science, Technology and Engineering Conference 2018 (iNuSTEC2018). MNS is honoured to receive supports from distinguished international and national experts in the field of nuclear (neutron) science and engineering as International Advisory and National Advisory Panels for iNuSTEC2018. We are indeed pleased to have Organizing Committees of iNuSTEC2018 and the Secretariats working with along to ensure the success of iNuSTEC2018. At the forefront of nuclear science and engineering MNS collaborates with universities and related NGOs to bring the success of iNuSTEC2018. MNS members shall strive to make it better and stronger in future.

In conjunction with this conference, MNS is also honoured to organise 3rd Nuclear Youth Competition 2018 (NYC2018) to help bring the young nuclear generation into the main stream of nuclear development and issues. A post conference workshop on introduction to MCNP simulation had been organised to give essential knowledge for Malaysian nuclear researchers in using computers as a tool of a simulation method.

This conference brings together experienced and young researchers to discuss and debate latest development in all areas of nuclear science, engineering and technology applications for friendly purposes at international level. This would spur and catalyse further research and development leading to the sustainable and improvement of the quality of life without compromising the quality of the environment in Malaysia and in the world.

We would like to express our gratitude to UTM for hosting iNuSTEC2018, NYC2018 and the post conference workshop and, to all the personnel involved for their unwavering efforts to make this event a reality. I wish to also record my appreciations and thanks to all sponsors for their generous support. May all these efforts bring benefits to all of us and I congratulate everyone involved in making this conference successful event.

"Sustainable Nuclear Science and Technology for Well-Being of Mankind"

Thank you.

Assoc Prof Dr Abdul Aziz Mohamed
President, MNS

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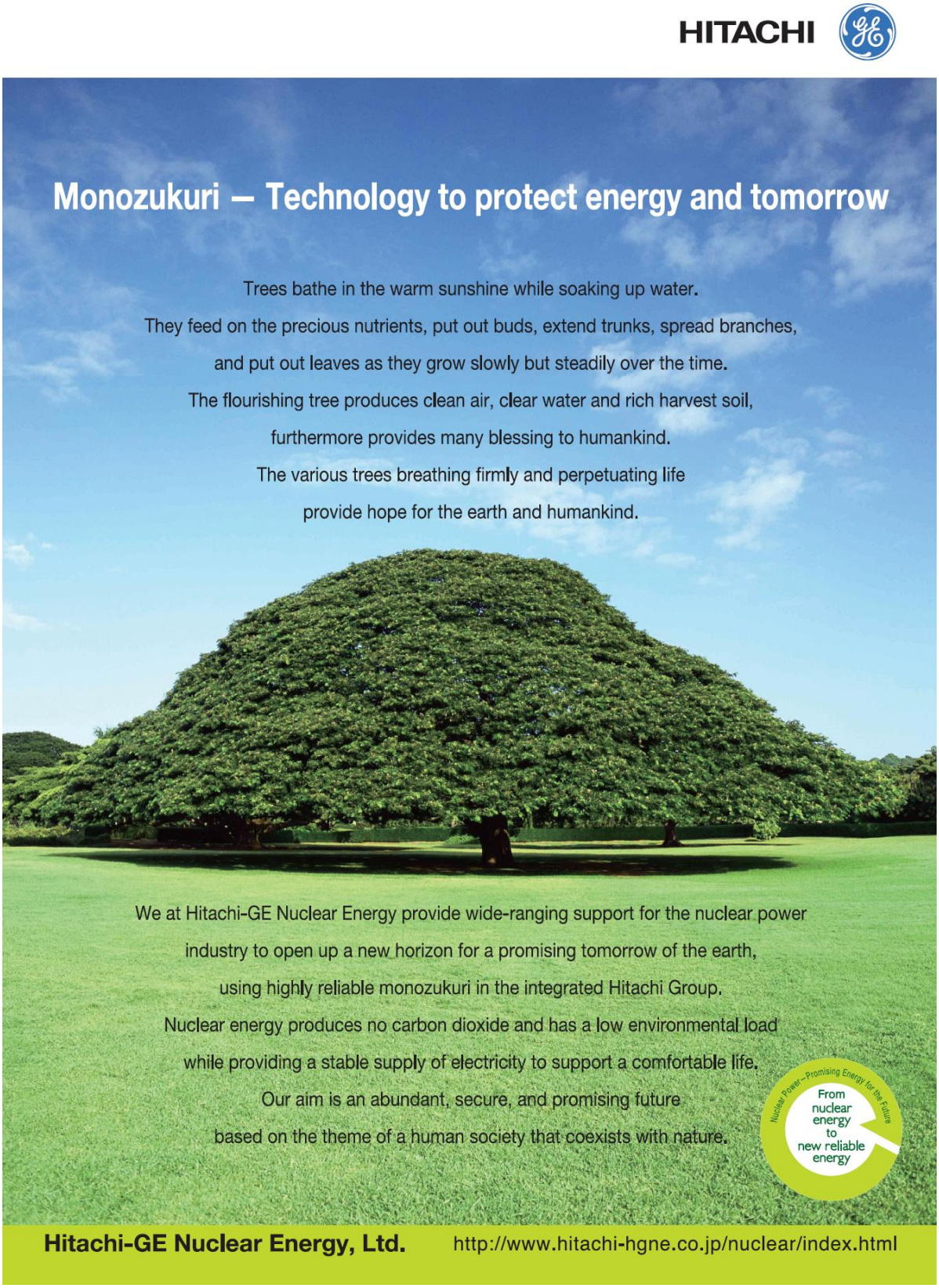
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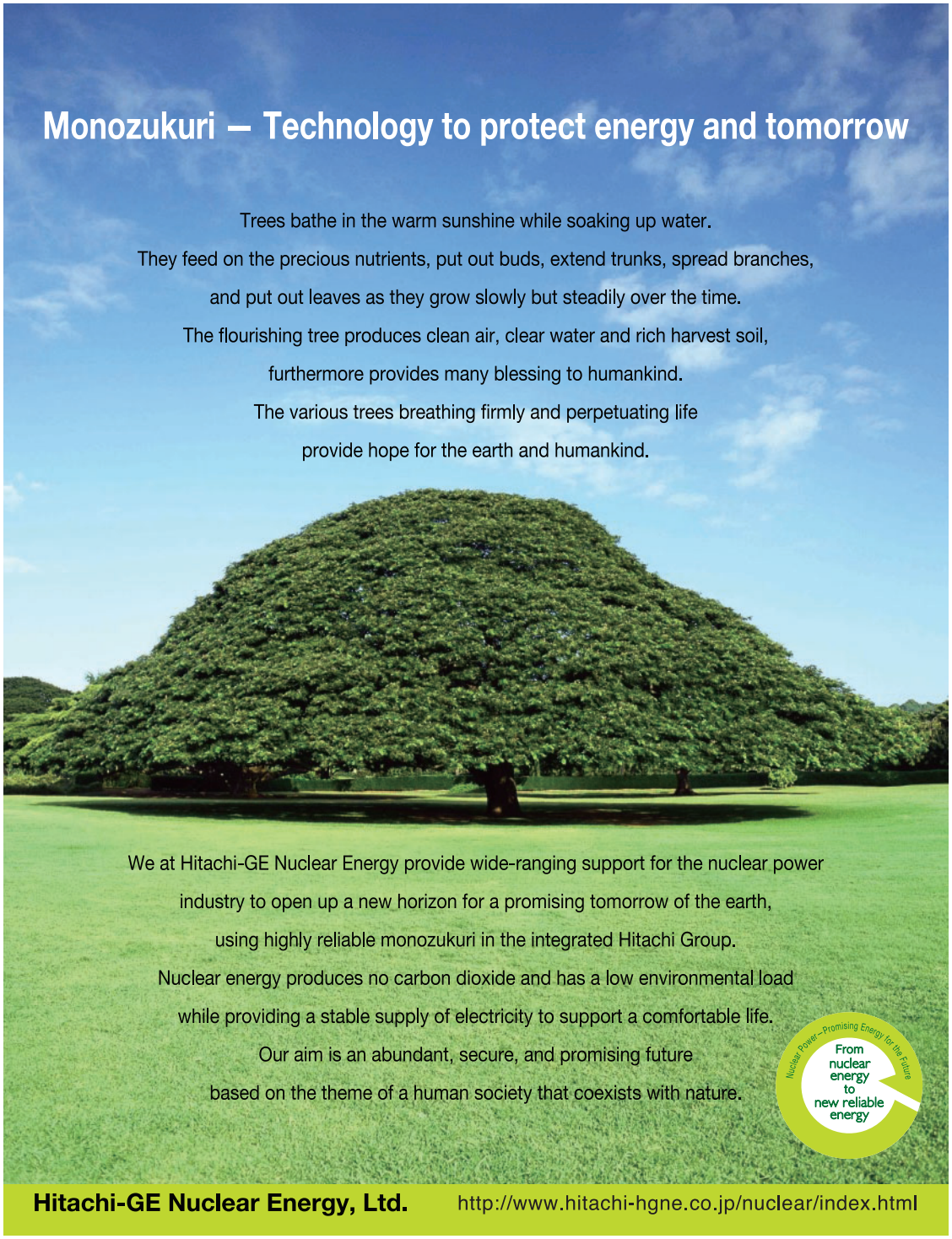

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Abstract. To enhance the crosslinking of prevulcanized natural rubber latex, combination of Irradiation and peroxide vulcanizations were used. Through this method, hexanediol diacrylate (HDDA) from irradiation vulcanization acted as the main sensitizer, while cumene hydroperoxide (CHPO) from peroxide vulcanization would act as the co-sensitizer. The effects of irradiation doses on the mechanical properties of latex film were investigated. 16 kGy irradiation dose, 2.5 parts perhundred rubber (pphr) of HDDA, 0.1 pphr of CHPO and 2.5 phr of Aquanox LP antioxidant were found to be the optimum conditions for compounding formulation. The rubber film obtained had tensile strength, modulus at 500% and modulus at 700% of 27.7, 3.5 and 12.4 MPa respectively, which is more than 21% increment compared to control film. Besides, the crosslink percentage of the rubber film showed 7 % increment from 90.7% to 97.7%.

1. Introduction

Radiation vulcanization of natural rubber latex (RVNRL) and peroxides vulcanization of natural rubber latex (PVNRL) have several advantages over the conventional vulcanization with sulphur such as less or absence of toxicity, free from nitrosamines and accelerator induced allergies, low in cytotoxicity and cleaner process [1-3]. These properties are important for many products, particularly catheters, surgical gloves and other medical and hospital supplies. For such uses, it is important that the products are free of contaminants, toxic and carcinogenic components to avoid harmful effects in human beings. However, the tensile strength of end products from both processes still failed to achieve a minimum of 24 Mega Pascal (MPa) as required by ASTM D3577-01a; which is the Standard Specification for Rubber Surgical Gloves [4].

Based on our previous studies, hybrid vulcanization method which consisted of radiation and peroxide vulcanizations could help to improve the mechanical properties of the vulcanized natural rubber latex films [5][6]. In this paper, the required radiation doses for vulcanization of natural rubber latex via hybrid irradiation and peroxide vulcanizations systems are determined. The other factor such

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as effect of molecular structure of peroxide on the mechanical properties of irradiated latex film is also investigated.

2. Materials and Methods

2.1. Materials

The latex utilized in this work was a high ammonia type of latex (HA latex) supplied by Revertex (M) Pt. Ltd., Malaysia. The sensitizer and co-sensitizer used were hexanediol diacrylate (HDDA) supplied by Allnex, China and cumene hydroperoxide (CHPO) supplied by Merck, Germany respectively. The stabilizer used was potassium laurate supplied by Tiarco Chemical (M) Pt. Ltd., Malaysia and the antioxidant used was Aquanox Lp supplied by Aquaspersion (M) Pt. Ltd., Malaysia. These materials were used as received.

2.2. Preparation of RVNRL compounding formulations

A typical latex compounding formulation for RVNRL (control) preparation is given in Table 1. The sensitizer, stabilizer, antioxidant and water were homogenized into an emulsion prior to addition into the latex with gentle stirring [5][6]. Once the addition of the emulsified materials was completed, the latex mixture was left stirred for three hours. It was then transferred into a one litre screw capped plastic container and irradiated with gamma rays from a Cobalt-60 source at a dose of 12 kGy [6][7]. After almost 6 hours of irradiation, the RVNRL was formed into film by coagulant dipping method.

Table 1. Compounding formulation of standard RVNRL (control).

Materials	Part perhundred (phr)
NR Latex (62% Total Solid Content)	100
Stabilizer	0.06
HDDA	2.50
Antioxidant	2.50
Water	Add to 52% Total Solid Content

The experiment was repeated by adding 0.1 phr of CHPO as the co-sensitizer into 9 kg of latex as formulated in Table 2 [6]. It was then transferred into 9 seperated one litre screw capped plastic container and irradiated with gamma rays from a cobalt-60 source at varying doses of 2, 4, 6, 8, 10, 12, 14, 16 and 18 kGy respectively.

Table 2. Compounding formulation of RVNRL with co-sensitizer.

Materials	Part perhundred (phr)
NR Latex (62% Total Solid Content)	100
Stabilizer	0.06
HDDA	2.50
CHPO	0.10
Antioxidant	2.50
Water	Add to 52% Total Solid Content