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Estimation of Population Size and Dispersal Pattern of Sterile Male Aedes aegypti Using Mark-Release-Recapture (MRR)

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Abstract

Aedes aegypti is currently emerging as a main vector of Dengue, Zika, and Chikungunya transmission. Chemical control was reported to be less effective due to the resistance of this mosquito to some types of insecticides. Therefore, another vector control is needed which is most appropriate to be used, i.e. the sterile insect technique (SIT). Information about optimum range dispersal sterile male Aedes aegypti for optimalization SIT program are needed. This study was designed to determine the dispersal pattern and population estimation of Aedes aegypti sterilized with gamma rays using mark-release-recapture (MRR) method. After the male Aedes aegypti (pupal stage) was irradiated with 70 Gy of gamma rays, the mosquitoes were then marked with Rhodamine-B and released into the study site. MRR experiments were carried out in Batan Indah residential area, and the Aedes aegypti were released in center of the site. Mosquitoes were recaptured at 28 points spread over the Batan Indah Residence for 2, 4, 6, and 8 days after release by using BG-Sentinel Traps. The result showed that the

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Coupled Analysis of Thorium-based Fuels in the High-Performance Light Water Reactor Fuel Assembly

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ABSTRACT

One of the six selected concepts to be part of Generation IV nuclear reactors is the Supercritical Light Water Cooled Reactor. The High-Performance Light Water Reactor (HPLWR) is the European version and it is a very promising design. In recent years, interest in the study of thorium-based fuel cycles has been renewed and its possibilities for current LWRs have been evaluated. The use of thorium-based fuels will be fundamental in the future sustainability of nuclear energy, since in addition to its abundance in nature, thorium has an important group of advantages. In this paper, performance of thorium-based fuels in the typical fuel assembly of the HPLWR reactor is evaluated, using a computational model based on CFD and Monte Carlo codes for the neutronic/thermal-hydraulic coupled analysis. The volumetric power density profiles, coolant temperature profiles, fuel temperature profiles and others are compared with those obtained for standard UO_2 fuel. When the thorium-based fuels are used, the obtained infinite multiplication coefficients are smaller than the value obtained when UO_2 is used, since the ^{232}Th isotope has a lower contribution to the multiplicative properties of the medium than ^{238}U. As a result, a difference of approximately 12 000 pcm was observed. The results verified that the HPLWR is a thermal reactor with a hard spectrum. There are no notable changes in the neutron spectrum if the mass fraction of thorium is slightly varied. With coupled analysis, the potential benefits of the utilization of thorium-based fuels were verified. Moreover, a significant temperature decrease by 136 K on the center line of the fuel elements was observed. When the mass fraction of thorium increases in the oxides mixture, the weighted average temperature on the fuel elements decreases.

INTRODUCTION

Among the concepts selected to be part of Generation IV nuclear reactors is the Supercritical Light Water Cooled Reactor (SCWR). This reactor type has technological, economic and sustainability characteristics that make it truly attractive. The High-Performance Light Water Reactor (HPLWR) is the European version of the SCWR [1].

The HPLWR is cooled by light water that reaches temperature and pressure values higher than those corresponding to its critical thermodynamic state (374 °C, 22.1 MPa). The coolant enters the reactor core with pressure of 25 MPa and temperature of 280 °C, reaching an average temperature of up to 510 °C at its outlet.

SCWRs have electricity production as their main objective, with a thermal cycle efficiency of around 44 %, which is one of the main advantages compared to current light water-cooled reactors (LWR). The LWRs have efficiency values in the range 32-36 %. Reduced construction costs due to the elimination of various components used in LWRs constitute another design advantage. The proposed original fuel for the SCWR concept is standard UO_2, and both a fast and thermal neutron spectrum designs are possible.

A main characteristic of SCWRs is the large variation in the water thermophysical properties

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Impact of Tube Voltage on Radiation Dose (CTDI) and Image Quality at Chest CT Examination

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ABSTRACT

During Computed Tomography (CT) scan examinations, it is important to ensure a good diagnosis by providing the maximum information to detect pathologies and this can be done with a reduced dose. In this respect, several methods of dose reduction have been studied and evaluated. This work investigates the effect of tube voltage while varying the tube current on image quality and radiation dose at Chest CT examination. This study was conducted on HITACHI CT 16 slice Scanner using two phantoms for evaluating the dose and image quality; a PMMA phantom and a CATPHAN 500. Two tube voltages of 120 KVp and 100 KVp have been used for some variation of the tube currents (mAs) and recording the values of the measured quantities (CTDIv, spatial resolution, contrast to noise ratio CNR and noise). The scanning with 100 KVp at Chest CT examination led to a reduction in CTDIv until 45 %, an increase of noise from 17 % to 45 %, and the Spatial Resolution fell slightly (6 and 7 pl/cm) compared to the 120 KVp. The CNR shows a slight regression from 11 to 22 % for the 120 KVp and 100 KVp. This study has shown that despite the increase in the image noise at low tube voltage 100 KVp, it is possible to reduce the radiation dose by up to 45 % without degradation of image quality at Chest CT examination. Further works will evaluate the effect of acquisition parameters in other CT examinations.

INTRODUCTION

Computed tomography (CT) scanning is a diagnostic imaging procedure that uses x-rays to build cross-sectional images of the body. Several studies have been carried out on increasing of the CT scans undergoing on adult patients [1,2]. Nowadays, Morocco has recorded a significant technological evolution in the number of multi-slice CT scanners with more than 360 scanners and several radiology departments [3]. On one hand, these CT scanners have a high diagnostic capacity by reducing unidentified lesions. On the other hand, they provide high doses compared to other conventional radiology devices [4-6]. A single CT scan generates about 100 times or more radiation than a conventional x-ray, or about one year of radiation exposure from natural and artificial sources in the environment [7].

These exposures can lead to the development of radiation-induced cancers over time [8]. According to the ALARA principle, dose optimization is necessary to ensure optimal examination quality with a low dose [9-12]. Although the decrease in tube current (mAs) can reduce the dose, it can also confuse the diagnosis [13]. In this regard, several studies have been conducted to justify that it is possible to decrease mAs while reducing the dose without affecting image quality [14,15].

It is important to ensure high-quality examinations with the lowest possible dose. These conditions depend on the choice of acquisition parameters. A reliable CT diagnosis requires high-quality images with an optimal patient dose [15-18]. Despite the fact that Morocco has a very significant number of CT scanners, the quality assurance system following the recommendations of the IAEA

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Comparisons of Water-Equivalent Diameter Measured on Images of Abdominal Routine Computed Tomography with and without A Contrast Agent

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ABSTRACT

The size-specific dose estimate (SSDE) is a metric for an estimation of patient dose in computed tomography (CT). The SSDE strongly depends on the water-equivalent diameter (D_W). In abdominal CT examinations, a contrast agent is sometimes used to more clearly visualize tissue lesions. The Hounsfield unit (HU) of CT images with and without the use of a contrast agent at specific areas is slightly different and it may affect the D_W value. This study aimed to compare the D_W values calculated from axial CT images in patients who had undergone routine abdominal scans both with and without the use of a contrast agent. Axial images of 144 patients with a weight range of 3.5 kg to 90 kg who had undergone routine abdominal scans both with and without the use of a contrast agent using a Siemens Sensation 64 CT scanner were retrospectively collected. The D_W values were automatically calculated using the Matlab-based IndoseCT (version 15a) software. The results show the percentage difference between $D_{W,contrast}$ and $D_{W,non\text{-}contrast}$ is below 2 %. As a result, the mean $SSDE_{contrast}$ is 1.5 % smaller than $SSDE_{non\text{-}contrast}$. Due to the effect of a contrast agent on the D_W and SSDE values is below 2 %, the axial images of CT abdomen without the use of a contrast agent can be used as the accurate estimation of D_W and SSDE for images with the use of a contrast agent.

INTRODUCTION

Computed tomography (CT) was introduced in the 1970s and has had a crucial role in the diagnostic field due to its excellent image quality [1,2]. Image acquisition in diagnostic CT is very fast due to the advances in acquisition techniques such as helical and multi-slice CT (MSCT). These advantages lead to the growing use of CT in numerous applications. However, its disadvantage is that it contributes to the highest radiation exposure in the medical field [3-5]. Hence, its implementation must be carefully and prudently optimized so that its advantages outweigh its disadvantages.

Estimating accurate patient dose is important. Accurate estimation of patient dose relies on the metric known as the size-specific dose estimate (SSDE) [4-6]. Since SSDE was announced, several softwares have been developed to measure the effective dose and organ dosage based on SSDE [9,10]. Several studies reported that SSDE was used to represent dose optimization values such as diagnostic reference level (DRL) and acceptable quality dose (AQD) [11-14]. SSDE is estimated from the output dose or the volume CT dose index ($CTDI_{vol}$) and patient characteristics. In this case, the patient characteristics include X-ray attenuation and patient size. The X-ray attenuation is based on many factors, such as type of material and its density and energy of X-ray beam. The X-ray attenuation is a fundamental parameter effecting X-ray absorption and the dose absorbed by patient. The patient characteristics are generally represented by the water-equivalent diameter (D_W) [15,16] of the patient. Its value can be determined from patient images [7,17,18].

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