GAMMA-RAY ATTENUATION COEFFICIENTS OF CARBON STEEL PLATES USING IRIDIUM-192

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FACULTY OF SCIENCE
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KUALA LUMPUR

2012
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DISSENTATION SUBMITTED IN FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE

DEPARTMENT OF PHYSICS
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UNIVERSITY OF MALAYA
KUALA LUMPUR

2012
UNIVERSITY OF MALAYA

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Field of Study: Theoretical Physics

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Measurement of gamma radiation attenuation coefficients on carbon steel using gamma radiation beam from Iridium-192 has been made to permit their use for precision measurement, material studies and in various industrial radiographic techniques. The material examined is carbon steel plates with various thicknesses ranging from 2 mm to 13 mm. There are two aspects in this study; determination of the attenuation coefficient using theoretical method, and from experiments. Two types of detectors are used; the film radiography and ion chamber. The gamma ray source is the polychromatic radionuclide Iridium-192. Cross section of the incoherent scattering of every element in the carbon steel material sample has been calculated using the Klein-Nishina formula incorporating the structure function correction. We integrate the Klein-Nishina formula using the Gauss-Legendre quadrature and the cross section agrees very well with the published results. The cross section of the incoherent scattering is used to calculate the theoretical effective linear attenuation coefficient and is found to be 0.231 cm$^{-1}$. The effective linear attenuation coefficient value from the two experiments has the value of 0.340 mm$^{-1}$ as determined from the transmission curves which is consistent with the theoretical value.
ABSTRAK

Pengukuran pekali pengecilan bagi sinaran gama untuk keluli karbon telah dilakukan menggunakan alur sinaran gama daripada Iridium-192 bagi penggunaan untuk pengukuran ketepatan, kajian bahan dan dalam pelbagai teknik radiografi industri. Bahan yang dikaji ialah kepingan keluli karbon dengan pelbagai ketebalan bermula dari 2 mm hingga 13 mm. Terdapat dua aspek dalam kajian ini; penentuan pekali pengecilan menggunakan kaedah teori dan eksperimen. Dua jenis pengesan yang digunakan; radiografi filem dan kebuk ion. Sumber sinaran gama ialah radionuklid Iridium-192 polikromatik. Keratan rentas bagi serakan tak koheren bagi setiap elemen sampel bahan keluli karbon dihitung menggunakan formula Klein-Nishina dengan menggabungkan pembetulan fungsi struktur. Kamiran formula Klein-Nishina dilakukan menggunakan kuadratur Gauss-Legendre dan keratan rentas adalah bersetuju dengan keputusan yang diterbitkan. Keratan rentas serakan tak koheren digunakan untuk menghitung secara teori pekali pengecilan linear di mana nilainya adalah 0.231 cm⁻¹. Nilai pekali pengecilan berkesan diperolehi daripada kedua-dua eksperimen adalah 0.340 cm⁻¹ seperti yang ditentukan dalam lengkungan graf penghantaran dimana nilai ini konsisten dengan nilai teori.
ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor Associate Professor Dr. Hasan Abu Kassim who gave me the opportunity to complete the thesis. I am deeply indebted to him for his supervision, guidance and useful suggestions throughout this research work. His continuous guidance enable me to complete my work successfully.

I also would like to give my special thanks to Ms. Norhasliza Yusof who has been abundantly helpful and assisted me in numerous ways. My warm thanks go to Ms. Nor Sofiah Ahmad and Ms. Azni Abdul Aziz for their valuable help.

Special thanks also go to my Dr. Ab. Razak Hamzah, Dr. Abd. Nassir Ibrahim, Mr. Ilham Mukriz Zainal Abidin and Ms. Sapizah Rahim who have given the continuous and highly strong moral support in completing the thesis.

I cannot end without thanking my family especially my husband, my son, my sister and of course my parents who have been supporting from the beginning of my work till the end. Thank you for all your love, prayers, encouragement, understanding and strong motivation. Not forgetting, my late grandmother whom I believe will definitely give a strong support in whatever I do. To them I dedicate this thesis.

I also would like to acknowledge my organization, Malaysian Nuclear Agency for scholarship on the my MSc.

Last but not least, to the Almighty in whom I place my trust through good and bad times.
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