

2

NEUTRON MEASUREMENT

By

Mr. Yuth Akkaramus

B.Sc.(Hons.), Chulalongkorn University, 1964



007054

Thesis

Submitted in partial fulfillment of the
requirements for the Degree of Master of Science

in

The Chulalongkorn University Graduate School

Department of Physics

April, 1968

(B.E. 2511)

Accepted by the Graduate School, Chulalongkorn
University in partial fulfillment of the requirements
for the Degree of Master of Science.

T. Nilanidhi

.....
Dean of the Graduate School



Thesis Committee Chason Dhamaphajie Chairman

..... Vichai Hayodh

..... Payom Tumsoi

Thesis Supervisor Vichai Hayodh

Date 7th April 1968

Abstract

An Americium-Beryllium was used as neutron source in a water tank and the neutron distribution in the tank was investigated. At 2.5 centimeters from the source centre, the epithermal index was found to be $0.0299 \pm .000354$. The thermal flux at the same position was estimated to be 6.2×10^3 n./cm².sec.

บทคัดย่อ

ศึกษาการแจกจ่ายนิวตรอนในถังน้ำซึ่งได้จากตัวกำเนิดนิวตรอนอะเบอโรเวียม-เบอโรเวียมในถังน้ำและที่ทำแห้ง ๔๖.๔ เซนติเมตรจากศูนย์กลางของตัวกำเนิดนิวตรอน ได้ค่าอัพเทอมอสอินเดกซ์ 0.00000 ± 0.00005 และเทอร์มออลลักษณะที่ทำแห้ง เดียว กันน้ำได้ค่าประมาณ 2.0×10^{-3} นิวตรอน/ชม-วินาที.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation to Mr. Vichai Hayedon, Chief of Health Physics Division, Office of the Atomic Energy for Peace for his advice and guidance given throughout the course of experiment. He also wishes to thank Asst. Prof. Swang Bhodigen for his permission to use the neutron source and standard sources, to Mr. Somchai Thayarnyong for his assistance during experiments, and to Miss V. Sawangpun for typing this report.

TABLE OF CONTENTS

| | Page. |
|---|-----------|
| ABSTRACT | iii |
| ACKNOWLEDGEMENTS | iv |
| LIST OF TABLES..... | vi |
| LIST OF ILLUSTRATIONS | vii |
| Chapter | |
| I INTRODUCTION | 1 |
| II THEORY | 2 |
| 2.1 Neutron Sources | 2 |
| 2.2 Specifications of Neutrons | 4 |
| 2.3 Westcott's Formalism | 12 |
| 2.4 Perturbations. | 17 |
| III DESCRIPTION OF EXPERIMENT | |
| 3.1 Irradiation. | 21 |
| 3.2 Foils. | 21 |
| 3.3 Counting Procedure. | 23 |
| IV EXPERIMENTAL RESULT AND DISCUSSION..... | 24 |
| 4.1 Determination of Epithermal Index $\nu(T/T_0)^{\frac{1}{2}}$ and β at The Position of 3.5 cm. and 2.5 cm. from a Neutron Source in Water. | 24 |
| 4.2 Epithermal Indices at Various Positions in a Water Tank. | 32 |
| 4.3 The Conventional Thermal Neutron Flux in a Water Tank. | 35 |

| | |
|---|----|
| 4.4 Neutron Radial Distribution | 38 |
| 4.5 Efficiency of The Detecting Foil | 41 |
| ANNEX I G_p and G_{th} of Indium - 115 | 44 |
| ANNEX II G_p and G_{th} of Gold - 197 | 46 |
| ANNEX III Determination of CdR_0 by indium foil | 48 |
| ANNEX IV Error Calculation. | 51 |
| BIBLIOGRAPHY. | 52 |

LIST OF TABLES



vi

| TABLE | | Page |
|-------|---|------|
| 4.1.1 | Cadmium ratio at the position of 3.5 cm. (indium)foil's area = $1 \times 1 \text{ cm}^2$) | 24 |
| 4.1.2 | Cadmium ratio at the position of 3.5 cm. (indium foil's area = 7.069 cm^2) | 25 |
| 4.1.3 | Epithermal index at the position of 3.5 cm. from source with various analysis..... | 25 |
| 4.1.4 | Epithermal index at the position of 2.5 cm. from source | 27 |
| 4.1.5 | Summarizes the result of $r(T/T_0)^{\frac{1}{2}}$ and β at the position of 2.5 cm. and 3.5 cm..... | 29 |
| 4.2.1 | Epithermal indices at various positions in a water tank. | 31 |
| 4.3.1 | Conventional thermal neutron flux (Φ_{th}) of gold (Au ¹⁹⁷) at the distance of 2.5 cm. from source..... | 32 |
| 4.3.2 | Φ_{th} of indium (In ¹¹⁵) at various distance from source..... | 36 |
| 4.4.1 | Radial distribution of thermal neutron flux as from source..... | 40 |
| 4.5.1 | Efficiency of the detecting foil (In ¹¹⁵).... | 41 |

LIST OF ILLUSTRATIONS

Figure

| | |
|--|----|
| 4.2.1 Cadmium ratio of a pair of indium foil at various distance from source..... | 33 |
| 4.2.2 Epithermal index calculated from CdR ₀ of annex III as a function of distance from source. | 34 |
| 4.3.1 Conventional thermal neutron flux at various distances from source in a tank filled with water. | 37 |
| 4.4.1 Radial distribution of neutron fluxes as a function of distance from source. ... | 39 |
| 4.5.1 Efficiency of the detecting foil as a function of indium foil thickness (foil area = 1 x 1 cm ²) | 43 |