

**DEVELOPMENT OF AN ANALYTICAL SYSTEM COMBINING
FIELD-FLOW FRACTIONATION AND
FLOW INJECTION ANALYSIS**

RATTIKAN CHANTIWAS

**A THESIS SUBMITTED TO THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN CHEMISTRY**

**GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
DECEMBER 2002**

**DEVELOPMENT OF AN ANALYTICAL SYSTEM COMBINING
FIELD-FLOW FRACTIONATION AND
FLOW INJECTION ANALYSIS**

RATTIKAN CHANTIWAS

THIS THESIS HAS BEEN APPROVED
TO BE A PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
IN CHEMISTRY

EXAMINING COMMITTEE

Kate Grudpan.....CHAIRMAN

Associate Professor Dr. Kate Grudpan

Ronald Beckett.....MEMBER

Dr. Ronald Beckett

Jaroon Jakmunee.....MEMBER

Dr. Jaroon Jakmunee

M. Rayanakorn.....MEMBER

Assistant Professor Dr. Mongkon Rayanakorn

.....MEMBER

Associate Professor Dr. Ian D. McKelvie

Udom Sriyotha.....MEMBER

Associate Professor Dr. Udom Sriyotha

Y. Vaneesorn.....MEMBER

Assistant Professor Dr. Yuthsak Vaneesorn

2 December 2002

© Copyright by the Graduate School, Chiang Mai University

ACKNOWLEDGEMENTS

I would like to express my gratitude to my supervisor, Associate Professor Dr. Kate Grudpan for his valuable guidance, kind suggestions and encouragement throughout this work. I am grateful to Dr. Ronald Beckett from the Water Studies Centre (WSC), Monash University, Australia, for his discussion, valuable suggestions. Dr. Jaroon Jakmune, Assistant Professor Dr. Mongkon Rayanakorn and Associate Professor Dr. Ian D. McKelvie (WSC), my co-supervisors, and Associate Professor Dr. Udom Sriyotha, Assistant Professor Dr. Yuthsak Vaneesorn are acknowledged for their comments and criticism.

I would gratefully acknowledge the Royal Golden Jubilee (RGJ) PhD Program, the Thailand Research Fund (TRF) for granting the scholarship throughout the study, and the Post graduate Education and Research Program in Chemistry (PERCH) for the supports. I am grateful to the Faculty of Science and the Graduate School, Chiang Mai University for the supports for attending the international conferences.

My thanks are extended to the Department of Chemistry, Faculty of Science, Chiang Mai University; the Water Studies Centre and Department of Chemistry, Monash University for laboratory facilities provided; the Alexander von Humboldt Foundation for donation of the Packard Radiometric Flo-one[®] Detector utilized in this research. I would like to thank Dr. Ponlayuth Sooksamiti from the Office of the Mineral Resources (Region III), Chiang Mai for kindly supplied clay samples. I am also grateful to Dr. Horst Geckeis, Forschungszentrum Karlsruhe (INE), Karlsruhe, Germany for giving a chance on a short visit and his valuable discussion. Sincere thanks are extended to my research group including past and present students and all of my friends for their supports.

Finally, I would like to express my greatest attitude to my family, my past father, my mother, my brothers and my sisters for their love, encouragement and understanding.

Rattikan Chantiwas