

EVALUATION OF ALGAL GROWTH LIMITING
NUTRIENTS IN AGRO - INDUSTRY EFFLUENTS AND
DOMESTIC EFFLUENT

CHAN SEONG YONG

FACULTY OF FISHERIES AND MARINE SCIENCE
UNIVERSITI PERTANIAN MALAYSIA
SERDANG, SELANGOR
1989/90

TERENGGANU

EVALUATION OF ALGAL GROWTH LIMITING
NUTRIENTS IN AGRO-INDUSTRY EFFLUENTS AND
DOMESTIC EFFLUENT

My sincere thanks to my project supervisor, Dr. Fatimah Md. Sofi, for her guidance and advice during this study.

I would like to thank my lecturer, Dr. Law Ah Theng for allowing me use of his analytical reduction columns.

I am very grateful to Mr. Pecuni Kurnan for rendering his assistance in identifying the algae specimen, and Juan Baharia for help in water analyses.

by

CHAN SEONG YONG

Special thanks to colleagues, Elton and Krishnan for their help during this study.

A project report submitted in partial fulfilment of the requirement for the degree of Bachelor of Science (Fisheries)

FACULTY OF FISHERIES AND MARINE SCIENCE
UNIVERSITY PERTANIAN MALAYSIA
SERDANG, SELANGOR

1989/1990

1100023663

ACKNOWLEDGEMENTS

TERENGGANU

ABSTRACT

My sincere thanks to my project supervisor, Dr. Fatimah Md. Sofi, for her guidance and advice during this study.

I would like to thank my lecturer, Dr. Law Ah Theem for lending me one of his cadmium reduction columns.

I owe my gratitude to Mr. Perumal Kuppan for rendering his help in identifying the algae specimen, and Puan Naharia for helping in water analyses.

Special thanks to coursemates, Zaiton and Krishnan for their help during this study.

ABSTRACT

A study was undertaken to determine the nutrient availability of the palm oil mill effluent, rubber processing factory effluent and domestic effluent. Effluents samples were analyzed for $\text{PO}_4\text{-P}$, $\text{NH}_3\text{-N}$, $\text{NO}_3\text{-NO}_2\text{-N}$ and total alkalinity. Temperature, conductivity, dissolved oxygen and pH were also measured at the sampling sites. Waste waters samples were also collected to determine the type of phytoplankton found in the effluents. Algal bioassays were performed on these effluent by using Selenastrum capricornutum as test algae to determine algae growth limiting nutrient(s) in these effluents.

Mean nutrient contents of palm oil mill effluent were; 5.27 mg/l of $\text{PO}_4\text{-P}$, 6.50 mg/l of $\text{NH}_3\text{-N}$, 0.042 mg/l of $\text{NO}_3\text{-NO}_2\text{-N}$ and 203.81 mg $\text{CaCO}_3\text{/l}$ of total Alkalinity. Mean nutrients content of domestic effluent were; 0.39 mg/l of $\text{PO}_4\text{-P}$, 9.93 mg/l of $\text{NH}_3\text{-N}$, 0.043 mg/l of $\text{NO}_2\text{-NO}_3\text{-N}$ and 118.22 mg $\text{CaCO}_3\text{/l}$ of total alkalinity. Mean nutrients content of rubber processing factory effluent were; 29.20 mg/l of $\text{PO}_4\text{-P}$, 144.07 mg/l of $\text{NH}_3\text{-N}$; 0.06 mg/l of $\text{NO}_2\text{-NO}_3\text{-N}$ and 514 mg $\text{CaCO}_3\text{/l}$ of total alkalinity.

Palm oil mill effluent has a mean dissolved oxygen content of 15.70 mg/l, pH 8.69, conductivity 276.6 uohms and temperature 33.3°C. Domestic effluent has a mean dissolved oxygen content 10.82 mg/l, pH 6.91, conductivity 325 uohms and temperature 29.2°C. Rubber processing factory effluent has a mean dissolved oxygen content 1.83 mg/l, pH 7.65, conductivity 1183.0 uohms and temperature 35.0°C.

Five genera of phytoplankton with an unidentified euglenaceae were found in palm oil mill effluent; Pandorina, Schroederia, Ankistrodesmus, Diatoms and Euglena. Eight genera of phytoplankton and an unidentified chlorophyta were found in domestic effluent; Euglena, Trachelomonas, Scenedesmus, Ankistrodesmus, Botryococcus, Actinastrum and Merisomopedia. Five genera of phytoplankton were found in rubber processing factory effluent; Euglena, Scenedesmus, Closterium, Botryococcus and Oscillatoria.

Algal bioassays showed that palm oil mill effluent enabled the highest maximum specific growth rate and supported the highest growth of Selenastrum capricornutum, followed by domestic effluent, while there was no growth observed in rubber processing effluent. Algal bioassay showed that nitrogen was the

limiting nutrient in palm oil mill effluent which has a 1.24:1 N:P ratio. Phosphorus was found to be the limiting nutrient in domestic effluent sampled on 4th January, 1990, while domestic effluent collected on 16th February, 1990 was not limited by either nitrogen nor phosphorus. The N:P ratios of domestic effluent during both occasion were. 46.91:1 and 20.29: 1 respectively.

ABSTRAK

Satu kajian telah dijalankan untuk menentukan kewujudan nutrien dalam air buangan kilang kelapa sawit, air buangan kilang pemproses getah dan air buangan domestik. Analisis kimia telah dijalankan untuk menentukan kepekatan $\text{PO}_4\text{-P}$, $\text{NH}_3\text{-N}$, $\text{NO}_3\text{-NO}_2\text{-N}$ dan jumlah kealkalian dalam ketiga-tiga jenis air buangan. Nilai suhu, konduktiviti, kepekatan oksigen terlarut dan pH juga telah diukur semasa mengambil sampel air buangan. Sampel ketiga-tiga jenis air buangan telah dikumpul untuk menentukan jenis fitoplankton yang terdapat di dalam air buangan ini dan juga untuk menjalankan "algal bioassay". Analisis kimia menunjukkan purata kandungan nutrient dalam air buangan kilang kelapa sawit ialah 5.27 mg/l $\text{PO}_4\text{-P}$, 6.50 mg/l $\text{NH}_3\text{-N}$, 0.042 mg/l $\text{NO}_3\text{-NO}_2\text{-N}$ dan 203.81 mg/l jumlah kealkalian. Purata kandungan nutrient dalam air buangan perumahan ialah 0.39 mg/l $\text{PO}_4\text{-P}$, 9.93 mg/l $\text{NH}_3\text{-N}$, 0.043 mg/l $\text{NO}_3\text{-NO}_2\text{-N}$ dan 118.22 mg/l jumlah kealkalian. Purata kandungan nutrient dalam air buangan kilang pemprosesan getah ialah 29.20 mg/l $\text{PO}_4\text{-P}$, 144.07 mg/l $\text{NH}_3\text{-N}$, 0.060 mg/l $\text{NO}_3\text{-NO}_2\text{-N}$ dan 514 mg/l jumlah kealkalian.

Air buangan kilang kelapa sawit mengandungi kepekatan oksigen terlarut 15.70 mg/l, pH 8.69, konduktiviti 276.6 ohms dan suhu air 33.3°C. Air

buangan perumahan mengandung kepekatan oksigen terlarut 10.82 mg/l, pH 6.91, konduktiviti 325 ohms dan suhu air 29.2°C. Air buangan kilang pemprosesan getah mengandung kepekatan oksigen terlarut 1.83 mg/l, pH 7.65, konduktiviti 1183.0 ohms dan suhu air 35°C.

Sebanyak 5 genus fitoplankton dan sejenis euglenacea yang tidak dapat dikenalpasti telah dijumpai dalam air buangan kilang kelapa sawit; Pandorina, Schroederia, Ankistrodesmus dan Euglena. Sebanyak 8 genus fitoplankton dan 1 jenis klorofita yang tidak dapat dikenalpasti telah dijumpai dalam air buangan domestik, Euglena, Trachelomonas, Scenedesmus, Ankistrodesmus, Botryococcus, Actinastrum, Closterium dan Merisomopedia. Sebanyak 5 genus fitoplankton telah dijumpai dalam air buangan kilang pemproses getah; Euglena, Scenedesmus, Closterium, Botryococcus dan Oscillatoria.

"Algal bioassays" telah menunjukkan air buangan kilang kelapa sawit boleh menyokong pertumbuhan Selenastrum capricornutum yang paling tinggi dan menunjukkan kadar pertumbuhan maksimum spesifik yang paling tinggi diikuti dengan air buangan perumahan, manakala tiada sebarang pertumbuhan di perhatikan dalam air buangan kilang pemproses getah. "Algal bioassays"

juga menunjukkan bahawa nitrogen merupakan nutrient penghad dalam air buangan kilang kelapa sawit yang mempunyai nisbah N:P 1.24:1. Didapati fosforus merupakan nutrient penghad dalam air buangan perumahan yang dikutip pada 4hb Januari, 1990 manakala tiada nutrient penghad dalam air buangan yang dikutip pada 16hb, Febuari 1990. Nilai nisbah N:P untuk air buangan pada kedua-dua hari tersebut ialah 46.91:1 dan 20.29:1 masing-masing.

APPENDICES	xi
INTRODUCTION AND LITERATURE REVIEW	1
MATERIAL AND METHODS	11
Characteristics of study sites	13
Tanjung Luan, Petaling Jaya	13
Kuala Lumpur processing factory, Ulu Langat	14
Kuala Lumpur Langkat Oil Mill, Dengkil	14
Sample analysis	15
Algal bioassays experiment	18
RESULTS	21
Chemical analyses	23
Phytoplankton	26
Algal assays	30
DISCUSSION	38
SUMMARY AND CONCLUSIONS	47
REFERENCES	49
APPENDICES	55