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JUDUL : DEVELOPMENT OF A DECISION SUPPORT SYSTEM FOR
NUTRIENT REMOVAL USING ACTIVATED SLUDGE SYSTEM (DSS –
NURAS)

SESI PENGAJIAN: 2005/2006

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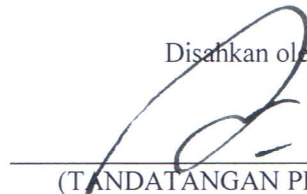
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DEVELOPMENT OF A DECISION SUPPORT SYSTEM FOR NUTRIENT
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(DSS – NURAS)

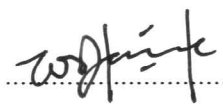
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A report submitted in partial fulfilment of
the requirements for the award of the degree of
Bachelor of Engineering (Civil – Environmental)

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APRIL 2006

I declare that this thesis entitled "*Development of a decision support system for nutrient removal using activated sludge system (DSS – NURAS)*" is the result of my own research except as cited in reference. The thesis has not been submitted for any degree and is not concurrently submitted in candidature of any other degree.

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Date : 24 APRIL 2006

To my beloved Mama, Baba and Ein

Thanks for having faith in me...

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ABSTRACT

Nitrogen (N) and Phosphorus (P) are nutrients commonly available in wastewater management, which are getting more attention due to its contribution to eutrophication. A decision support system (DSS) called DSS-NURAS that stands for **DSS for Nutrient Removal Activated Sludge system** has been developed to design activated sludge system for the removal of N and P. Preanoxic process for N removal and A2O process for P removal were chosen for the development of the system. DSS-NURAS was developed using Microsoft Visual Basic 6.0 with user-friendly interfacing facilities. In addition, to assist calculation tasks, DSS-NURAS also provides users with relevant information and calculation considerations that will minimize the calculation time. Validation of the system was carried out by comparing the calculation output generated by DSS-NURAS and manual spreadsheet calculation using Microsoft Excel.

ABSTRAK

Nitrogen (N) dan Fosforus (P) adalah dua jenis nutrien utama yang diberi penekanan dalam pengurusan air sisa. Kedua-dua unsur ini dikaji kerana kehadirannya menyebabkan proses eutrofikasi. Satu sistem DSS yang dikenali sebagai DSS-NURAS, singkatan untuk *DSS for **N**Utrient **R**emoval **A**ctivated **S**ludge System* telah dibangunkan untuk membantu dalam merekabentuk sistem *activated sludge* bagi penyingkiran N dan P dari airsisa. Dua (2) proses konfigurasi yang diberi penumpuan bagi pembangunan sistem ini adalah proses *preanoxic* untuk penyingkiran N dan A2O untuk penyingkiran P. DSS-NURAS direkabentuk menggunakan perisian Microsoft Visual Basic 6.0 dengan paparan yang mesra pengguna. Selain daripada bantuan pengiraan, sistem ini turut menyediakan maklumat yang relevan kepada pengguna yang dapat menjimatkan masa pengiraan. Pengesahan sistem ini dijalankan dengan membuat perbandingan antara keputusan pengiraan yang dihasilkan oleh DSS-NURAS dengan keputusan yang dihasilkan oleh pengiraan manual menggunakan Microsoft Excel.

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LIST OF SYMBOLS

bCOD	-	biodegradable COD
BOD	-	biochemical oxygen demand
COD	-	chemical oxygen demand
DO	-	dissolved oxygen
F/M _b	-	food to biomass ratio
f _d	-	fraction of biomass remains as cell debris
K	-	maximum specific substrate utilization rate
K _d	-	decay coefficient
K _{dn}	-	decay coefficient for nitrifying organisms
K _s	-	half velocity constant
MLSS	-	mixed liquor suspended solids
MLVSS	-	mixed liquor volatile suspended solids
nbVSS	-	non-biodegradable volatile suspended solid
NO _x	-	nitrate
RAS	-	return activated sludge
rbCOD	-	readily biodegradable COD
SDNR	-	specific denitrification rate
SRT	-	solids retention time
SVI	-	sludge volume index
TKN	-	total Kjeldahl nitrogen
TN	-	total nitrogen
TP	-	total phosphorus
TSS	-	total suspended solids
Y	-	bacteria synthesis yield
Y _n	-	synthesis yield for nitrifying organisms

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Wastewater treatment is necessary to remove physical, chemical and biological impurities. The main constituents of concern in wastewater treatments are suspended solids, pathogen, biodegradable organics, nutrients, priority pollutants, refractory organics, dissolved inorganic and heavy metals (Metcalf and Eddy, 2003). Before releasing the treated wastewater into water bodies, these constituents need to be reduced to a required level.

Nutrients are elements that are essential to the growth of microorganisms, plants and animals. Nitrogen and phosphorus are the common nutrients that exist in domestic wastewater and are gaining concern in wastewater treatment (Peavy et. al, 1985). The presence of these elements in the discharged water creates eutrophication particularly in lakes and slow moving streams.

Development of a decision support system (DSS) for nutrient removal using activated sludge system is important to assist design engineers in making faster and more accurate decisions on design specifications or treatment feasibility studies. The

DSS is interactive-based applications that analyze data and provide problem solving more easily and accurately.

1.2 Problem Statement

Biological phosphorus and nitrogen removal processes involve various design parameters and calculation tasks. A set of important information of nutrient removal is needed by engineers in the preliminary process. Thus, the design procedures will consume a lengthy time if each task is to be conducted manually, and it is common that the relevant information about the process is insufficient prior to design stage.

The development of a DSS for nutrient removal using activated sludge for wastewater treatment will be a useful tool for designing the system. Therefore, this study will be carried out to develop a DSS to replace the existing manual or spreadsheet calculations. The DSS will provide users the information and calculation considerations that will minimize the cost and the calculation time.

1.3 Objectives of the Study

- a) To develop a DSS for nutrient removal activated sludge systems i.e. preanoxic and A2O plants for wastewater treatment using Microsoft Visual Basic 6.0.
- b) To validate the accuracy of calculations and information generated from the proposed DSS against conventional spreadsheet methods.

1.4 Significance of the Study

The development of DSS-Nutrient Removal contributes to the enhancement of design practice and optimizes resources, especially those specializing in the wastewater sector.

The system will be developed in such a way that inputs and outputs of the calculations may be displayed in a single interface. The approach is to simplify the understanding of the problem and provide sufficient information for users.

1.5 Scope of the Study

In this study, DSS for nitrogen (N) and phosphorus (P) removal will be developed. However, only one configuration of each N and P removal was chosen, i.e.:

- (a) Nitrogen removal – Modified Ludzack-Ettinger (MLE) Preanoxic Process
- (b) Phosphorus removal – A²O Process.

The design procedures used are based on design example from Metcalf and Eddy (2003).