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DEVELOPMENT OF A PREDICTIVE ENVIRONMENTAL MODEL FOR WASTEWATER FROM INDUSTRIAL PAPER PRODUCTION USING MULTIVARIATE ANALYSIS TECHNIQUE

Miss Klinpratoom Panyaping

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น้ำเสียจากการผลิตกระดาษ นับเป็นสิ่งท้าทายที่สำคัญอย่างหนึ่งด้านสิ่งแวดล้อม ความเข้าใจที่ดีเกี่ยวกับการผลิตกระดาษอุตสาหกรรมจากชุดข้อมูลปัจจัยการผลิต และความสัมพันธ์ของข้อมูลปัจจัยการผลิตดังกล่าวกับกระบวนการผลิต นำไปสู่ความสามารถในการทำนายภาระน้ำเสีย และสาเหตุรากฐาน ของการเกิดภาระน้ำเสียที่จำเป็นต้องจัดการ เพื่อป้องกันไม่ให้ระบบบำบัดน้ำเสียเกิดภาวะล้มเหลวในการบำบัด การจำแนกและหาความสัมพันธ์ของชุดข้อมูลวัตถุดิบที่ใช้ในการผลิตและภาระน้ำเสียที่เกิดขึ้น เป็นจุดที่สนใจของงานวิจัยนี้

เทคนิคทางคณิตศาสตร์ด้านการวิเคราะห์หลายตัวแปร ประกอบด้วยการวิเคราะห์ตัวประกอบร่วม และการวิเคราะห์ถดถอยพหุคูณ ถูกนำมาใช้พัฒนาแบบจำลองที่ไม่เพียงบอกลักษณะความสัมพันธ์ภายในกลุ่มของตัวแปรที่เป็นปัจจัยการผลิต เช่น เยื่อ สารเคมี น้ำ และไฟฟ้า ยังทำนายความสัมพันธ์ระหว่างภาระน้ำเสียกับภาวะของปัจจัยการผลิตที่ใช้ แบบจำลองข้างต้นถูกพัฒนาขึ้น จากข้อมูลที่สามารถวัดได้จากกระบวนการผลิตกระดาษอุตสาหกรรม ระหว่างเดือนมกราคม 2544 - กันยายน 2545 สำหรับผลิตภัณฑ์กระดาษอุตสาหกรรม 3 ชนิดจากโรงงานที่ศึกษาได้แก่ กระดาษยิปซั่มด้านหน้า กระดาษยิปซั่มด้านหลัง และกระดาษกล่องขาวเคลือบที่มีขนาดน้ำหนักต่างกัน

ผลการศึกษาพบว่า สิ่งปนเปื้อนจากน้ำเยื่อที่ป้อน การควบคุมการเติมสารเคมีและการตกค้างของเส้นใยละเอียดและสารแต่งเติมที่ไม่ดี และการเปลี่ยนเกรดกระดาษที่บ่อยมากเกินไป รวมทั้งการกำหนดเวลาเดินเครื่องจักรระหว่างโรงงานเศษกระดาษและเครื่องจักรทำกระดาษ ทำให้เกิดภาระน้ำเสียที่สูงมาก ได้แก่ ภาระสารแขวนลอยในน้ำ ภาระสารละลายในน้ำทั้งหมด ภาระความต้องการออกซิเจนทางชีวภาพ และภาระความต้องการออกซิเจนทางเคมี การจัดการแบบต่างๆที่ตอบสนองการควบคุมน้ำเสีย ได้ถูกเสนอแนะจากสิ่งที่ได้จากแบบจำลองที่พัฒนาขึ้น

สาขาวิชา การจัดการสิ่งแวดล้อม ลายมือชื่อนิสิต.....

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KLINPRATOOM PANYAPING : DEVELOPMENT OF A PREDICTIVE ENVIRONMENTAL MODEL FOR WASTEWATER FROM INDUSTRIAL PAPER PRODUCTION, THESIS ADVISOR : WIT SOONTARANUN, Ph.D., THESIS COADVISORS: DANIEL J. WATTS, Ph.D., and PETER B. LEDERMAN, Ph.D., 310 pp. ISBN 974-17-4958-9.

Wastewater from papermaking provides an important environmental challenge. Improved understanding of industrial paper production through the set of material inputs used and their interactions with the process itself may lead to the ability to predict the change in wastewater loadings. It should lead as well to the root causes of wastewater load generation that should be managed in order to prevent upsetting of the wastewater treatment system. The identification and derivation of these relationships between material supplied and wastewater load is the focus of this work.

The mathematical multivariate technique consisting of factor analysis (FA) and multiple regression analysis (MRA) was used to develop a model that not only characterizes the interrelationships among the material input variables (pulps, chemicals, water, and electric power) but also leads to the prediction of the relationships between wastewater generation and production conditions. The models were developed based on measurable data obtained from a papermaking facility during January, 2001 to September, 2002 for the three major classes of paper products from the study site (Gypsum face liner board, GF; Gypsum back liner board, GB; and Duplex coated board, DP).

It was found that the contaminants from the feed stock, poor control of addition of chemicals and poor retention of fines and filler, and too frequent change over of paper grade including scheduling of machine operations between paper machine and wastepaper plant contribute greatly to high wastewater loads, namely suspended solids, total dissolved solids, biological oxygen demand, and chemical oxygen demand. Various management responses for wastewater control were suggested based on the findings from this model development.

Field of Study Environmental Management Student's Signature P. Klinpratoom
Academic year 2003 Advisor's Signature W.T. Soontaranun

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GLOSSARY

Main Abbreviations and Terms

A_1 - A_5, and A_9	Various Types of Wastepaper
A_6 - A_8	Types of Virgin Pulp
GP	Gypsum liner board production
GF	Gypsum face liner board
GB	Gypsum back liner board
DP	Duplex coated board production
SS	Suspended Solids
TDS	Total Dissolved Solids
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
FA	Factor Analysis
MRA	Multiple Regression Analysis
kWhr/adt	Unit of energy consumption of paper in terms of air dry metric ton
Wet end operations	The first part of paper machine is the operation in the wet state where paper is formed.
Stock	The mixture of pulp slurry consists of pulp fillers, various papermaking materials, and water.
Furnish	The combination of all of the material used to make paper is in the wet end operations.
Broke	The out-of-specification of paper, sheet or web breaks, and paper trimmings are often reused in the paper mill.
White water	The water contains fines, fiber, chemicals, and water that is used in papermaking through the re-circulated white water system.
WWTP	Wastewater Treatment Plant
WW	Wastewater
FL	Fiber loss