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นายสีพร งามสมบูรณ์

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THERMAL DISCHARGE FROM THE LARGE POWER STATION INTO THE SEA

A CASE STUDY OF VERTICAL DISCHARGE

Mr. Siporn Kamolyabutra

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วิจิตร กระจ่าง

(ศาสตราจารย์ ดร. วิจิตร กระจ่าง)

คณบดี

คณะกรรมการตรวจวิทยานิพนธ์

ดร. กุศล วัฒนกุล ประธานกรรมการ
(ผู้ช่วยศาสตราจารย์ ดร. กุศล วัฒนกุล)

ดร. อธิวัฒน์ ปานงาม กรรมการ
(ผู้ช่วยศาสตราจารย์ ดร. อธิวัฒน์ ปานงาม)

ดร. อรุณ งาม กรรมการ
(ผู้ช่วยศาสตราจารย์ อรุณ งาม)

ดร. ปรีดา วิบูลย์สวัสดิ์ กรรมการ
(ดร. ปรีดา วิบูลย์สวัสดิ์)

ดร. ชวชัย เสงี่ยม กรรมการ
(ดร. ชวชัย เสงี่ยม)

อาจารย์ที่ปรึกษาวิทยานิพนธ์

ดร. ชวชัย เสงี่ยม

คณบดีบัณฑิตวิทยาลัย

จุฬาลงกรณ์มหาวิทยาลัย

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แผนกวิชา วิศวกรรมเครื่องกล

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Name Mr. Siporn Kamolyabuttra
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ABSTRACT

The objective of this investigation is to study the temperature distribution at the water-air interphase when hot water is discharged from the condenser of a Power Plant. In this study, the hot water is discharged vertically from the round-shaped outlet lying under the water surface upwards into the flowing ambient water. The two parameters, namely, the size of the nozzle and the ocean current, were used in this experiment to find their effect on the temperature distribution. The experimental results show that, at a certain current speed, increasing the size of nozzle generally reduces the area of the mixing zone. The temperature distribution also depends on the ocean current, that is, the higher the current speed is, the smaller the area of the mixing zone.

Hopefully this investigation would be beneficial for the design of cooling water system of a Power Plant.

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NOMENCLATURE



<u>Symbol</u>	<u>Meaning</u>	<u>Unit</u>
A	Cross-sectional area of the entrained ambient water	m ²
C _p	Specific heat	kw-sec/Kg-°C
D	Depth of Sea	m
d	Pipe diameter	m
E	Heat dispersion rate	
F	Densimetric Froude Number	
g	Acceleration of gravity	m/sec ²
k	$\lambda/\rho C_p D$	
L _r	Ratio of model length to prototype length	
m'	Mass flow rate of hot water in pipe	Kg/sec
Q	Volume flow rate	m ³ /sec
q _i	Rate of heat input to power plant	MW
q _o	Rate of heat being dissipated to the sea	MW
R	Hydraulic radius	m
Re	Reynolds Number	
S	Slope of the bottom of the sea	
S _c	Source or sink within the hot plume	
S _o	The dilution ratio (the ratio between the density difference at any point and density difference at nozzle outlet)	
S' _o	The total dilution	
T	Temperature	°C
ΔT	Temperature rise above ambient temperature (T-T _a)	°C

<u>Symbol</u>	<u>Meaning</u>	<u>Unit</u>
t	time	sec
U	jet velocity	m/sec
V	Tide velocity	m/sec
x	coordinates measured in the direction of the current	m
Y_0	Depth of ambient flow over nozzle	m
α	Concentration of water quality characteristics	
λ	Heat dissipation rate	cal/cm ² -hr·°C
μ	Dynamic viscosity	Kg/m-sec
ρ	Mass density	Kg/m ³
ν	Kinematic viscosity	m ² /sec

Subscripts

a	ambient
m	model
p	prototype