

**A STUDY ON ENERGY (THERMAL) EFFICIENT
AQUACULTURE BUILDINGS FOR RECIRCULATING TANK
SYSTEM**



**RESEARCH MANAGEMENT INSTITUTE (RMI)
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR
MALAYSIA**

**BY:
SABARINAH SH AHMAD
MOHD SALLEH KAMARUDDIN
ELIAS SALLEH**

JULY 2011

Contents

1. Letter of Report Submission	iii
2. Letter of Offer (Research Grant).....	iv
3. Acknowledgements	v
4. Enhanced Research Title and Objectives.....	vi
5. Report	1
5.1 Proposed Executive Summary	1
5.2 Enhanced Executive Summary	2
5.3 Introduction	3
5.4 Brief Literature Review	4
5.5 Methodology	6
5.6 Results and Discussion	8
5.7 Conclusion and Recommendation.....	10
5.8 References/Bibliography	11
6. Research Outcomes	13
7. Appendix	14

2. Letter of Offer (Research Grant)



UNIVERSITI TEKNOLOGI MARA

Institut Penyelidikan, Pembangunan dan Pengkomersilan (IRDC)
Institute of Research, Development and Commercialisation (IRDC)

(Berikan no. bilik sebagai No. Pengalihan dan Perundingan)
 40450 Shah Alam, Malaysia
 Website : <http://www.uitm.edu.my/irc>

Surat Kami : 100 IRDC/E-Science 16
 Tarikh : 20 November 2006

Dr. Sabarinah Sheikh Ahmad
 Pensyarah
 Fakulti Senibina, Perancangan dan Ukur
 Universiti Teknologi MARA
 SHAH ALAM

Puan,

KELULUSAN PERUNTUKAN BAGI MEMBIAYAI PROJEK-PROJEK SCIENCEFUND DI BAWAH RMKe-9 CYCLE 1/2006

Dengan hormatnya perkara di atas adalah dirujuk.

Dimaklumkan Jawatankuasa Kelulusan MOSTI telah mempertimbangkan permohonan puan untuk membiayai projek penyelidikan di bawah dana ScienceFund Cycle 1/2006 pada 20 Oktober 2006.

Sukacita dimaklumkan bahawa projek penyelidikan puan telah pun diluluskan oleh Jawatankuasa tersebut. Walaubagaimanapun puan diminta untuk mengambil perhatian atas ulasan yang diberikan oleh Jawatankuasa dalam bahagian Catatan.

Puan juga dikehendaki untuk mengemukakan *Research Agreement (RA)* atau *Memorandum of Understanding (MoU)*, yang mana berkenaan, yang telah ditandatangani kepada IRDC dalam tempoh 3 hari dari tarikh terima surat ini. Dokumen RA / MoU boleh dimuat turun dari laman web eScienceFund

Pembiayaan keseluruhan yang diluluskan adalah seperti berikut:

Kod Projek	Tajuk	Ketua Projek	Tempoh Projek (Bulan)	Peruntukan Keseluruhan (RM)	Catatan
03-01-01-SF0037	A Study On Energy (thermal) Efficient Aquaculturebuildings For Recirculating Tank System	Sabarinah Sh. Ahmad	24	108,396	In view of the researcher having 2 projects approved under the ScienceFund, he must ensure that he has the capacity to carry through both projects according to plan.

Sehubungan dengan itu juga kami mengucapkan tahniah kepada puan kerana berjaya mendapatkan peruntukan E-Science ini dan semoga berjaya menyiapkan projek penyelidikan ini dengan cemerlang.

PENYELIDIKAN, PEMBANGUNAN DAN PENGKOMERSILAN LANDASAN KEWIBAWAAN DAN KECEMERLANGAN

No. Telefon

Penyelidikan, Penyelidikan dan Penyelidikan
 Ketua Penyelidikan, Pusat Penyelidikan dan Penyelidikan
 Ketua Penyelidikan, Pusat Penyelidikan dan Penyelidikan
 KEMPA INTELIGENSI
 Ketua Penyelidikan (Kewibawaan)

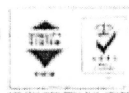
03-55442343
 03-55442347
 03-55442341
 03-55442340
 03-55442390

Ketua Penyelidikan
 Ketua Penyelidikan
 Ketua Ketua Penyelidikan
 Penyelidikan Penyelidikan
 Penyelidikan Penyelidikan

03-55442349
 03-55442350
 03-55442353
 03-55442362
 03-55442399

Pegawai Penyelidikan
 Penyelidikan
 Penyelidikan
 Penyelidikan Penyelidikan
 Penyelidikan Penyelidikan

03-55442357
 03-55442355 (210)
 03-55442398
 03-55442440
 03-55442399



5. Report

5.1 Proposed Executive Summary

(Original proposal – 300 words) – 1 page only

Malaysia plans to increase in its annual aquaculture production to 662,000 tons by year 2015 from the current 200,000 tons. Almost all of these culture systems release untreated effluents and wastes directly into the natural bodies especially coastal waters. This practice has resulted in many environmental problems. It has also affected the quality of culture water especially among the shrimp and marine fish (cage) farmers as the aquaculture effluents accumulated over the years deteriorate the quality of the surrounding waters which is the source of water input. An FAO study shows that upto 79% dietary N and 85% dietary P inputs in a fish cage culture system are lost into the surrounding waters. To sustain a healthy and environmental friendly aquaculture development in Malaysia, intensive recirculating tank systems have to be used. These systems are expected to become increasingly important especially in freshwater aquaculture where the industry has to compete for limited water resource with other agricultural activities, industrial and domestic users. The Ministry of Agriculture and Agro-based Industries (MoA) have started pilot projects in Kedah, Sarawak and Selangor. At present, all recirculating tank systems have to be housed in enclosed buildings. These buildings are designed for temperate and cold climates with its main concern to ward off cold temperature from entering the building while maintaining the inside warm temperature. Buildings designed for temperate and cold climates are not suitable for tropical environments and are thermally uncomfortable (and may become too hot if kept enclosed) for Malaysians. The proposed study is undertaken: a. to measure the environmental conditions of selected buildings that house recirculating tank Systems b. to develop suitable designs for aquaculture buildings for tropical environments. No such study has been done for the hot humid tropical climate and very few studies have been conducted on the designs of the aquaculture buildings for the temperate and cold conditions.

5.2 Enhanced Executive Summary

In view of biosecurity issues and fry quality - new trend amongst Malaysian hatchery and recirculating aquaculture system owners opt to run their operation in enclosed buildings. The suitability of these enclosed buildings for the Malaysian tropical conditions has not been studied. Myth among hatchery operators: the hotter day indoor temperature, the better the night water temperature for larviculture. The aim of the project was to determine the energy and thermal efficiency of aquaculture buildings for recirculating tank system. There were five specific objectives as follows: 1. to determine the thermal condition of existing aquaculture building with recirculating tank system and its correlation with the water temperature for fish rearing inside the building; 2. to determine the energy usage pattern for controlling the inside environment of such aquaculture building under tropical climatic conditions; 3. to understand the indoor requirement of aquaculture building both for human occupancy comfort and fish optimal growth; 4. To simulate better indoor conditions for aquaculture building through alternative designs and materials using validated simulation tool; and 5. To propose design recommendations for energy and thermal efficient aquaculture building based on the simulated findings of the aquaculture building performances.

Objective 2 was not met due to the difficulties of getting complete yearly electricity bills from the companies. The companies were reluctant to give these information and considered this as confidential. The methods undertaken were: 1) Background study and literature review; 2) Design for measurements (Data measurements will be outdoor & indoor temperature, water temperature and RH. Data collection and analyze the data gathered; 3) Simulation and analyse result; and 4) Report write up and propose recommendations for energy efficient aquaculture buildings. The findings were that a) the working conditions were too hot almost all the working hours, b) larval condition: exceed lethal temperature in some days and c) Building design (AnNur) failure. Recommendations are for better roof design, roof insulation and materials, window opening and others (envelope, orientation etc).