บันทึกข้อความ

ส่วนราชการ ภาควิชาวิศวกรรมเคมี คณะวิศวกรรมศาสตร์ มหาวิทยาลัยอุบลราชธานี โทร.3343

ที่ ศธ 0529.8.3/ พิเศษ **วันที่** 1 สิงหาคม พ.ศ. 2554

เรื่อง ขออนุมัติเงินสนับสนุนเพื่อนำเสนอบทความทางวิชาการในระดับนานาชาติ

เรียน รองคณบดีฝ่ายวิจัยและบริการ ผ่านหัวหน้าภาควิชาวิศวกรรมเคมี

ด้วยดิฉัน ดร.สุมนา สิริพัฒนากุล อาจารย์ประจำภาควิชาวิศวกรรมเคมี ได้ส่งผลงานวิจัยและได้รับการตอบรับให้นำเสนอบทความ “Optimum Alginate Cell Entrapment for Treating Hospital Wastewater in the Presence of Povidone Iodine Disinfectant” ด้วยวาจา (Oral Presentation) ในการประชุมทางวิชาการ The 4th IWA_ASPIRE Conference & Exhibition ในระหว่างวันที่ 2 ถึง 6 ตุลาคม 2554 ณ Tokyo International Forum เมืองโตเกียว ประเทศญี่ปุ่น

ดิฉันมีความประสงค์ขออนุมัติเงินสนับสนุน เพื่อนำเสนอบทความทางวิชาการดังกล่าวเป็นจำนวนเงินตามที่จ่ายจริงแต่ไม่เกิน 40,000 บาท (สี่หมื่นบาทถ้วน) ซึ่งดิฉันได้แนบเอกสารประกอบการพิจารณาโดย ได้แก่ 1) โครงการประชุมวิชาการระดับนานาชาติเพื่อเสนอผลงานวิจัย 2) จดหมายตอบรับร่วมประชุม The 4th IWA_ASPIRE Conference & Exhibition 3) รายละเอียดของการประชุม และ 4) บทความฉบับสมบูรณ์ มาพร้อมกันนี้

จึงเรียนมาเพื่อโปรดพิจารณา

(ดร.สุมนา สิริพัฒนากุล)
อาจารย์ประจำภาควิชาวิศวกรรมเคมี

เรียน รองคณบดีฝ่ายวิจัยและบริการ
เพื่อโปรดพิจารณาอนุมัติ
สมภพ สรวงวาร

เรียน ERI เพื่อพิจารณา
3/8/54

เรียน รองคณบดีฝ่ายวิจัยและบริการวิชาการ
ตามที่ ดร.สุมนา สิริพัฒนากุล ได้ขออนุมัติเงินสนับสนุนการนำเสนอผลงานวิชาการระดับนานาชาติที่ต่างประเทศ ได้ตรวจสอบแล้ว [illegible]
จึงเรียนมาเพื่อโปรดพิจารณา
3/8/54

โครงการประชุมวิชาการระดับนานาชาติเพื่อเสนอผลงานวิจัย

1. ชื่องานประชุม The 4th IWA_ASPIRE Conference & Exhibition (2 ถึง 6 ตุลาคม 2554)

2. สถานที่ Tokyo International Forum เมืองโตเกียว ประเทศญี่ปุ่น

3. ผู้ขอรับทุน ดร.สุมนา สิริพัฒนากุล อาจารย์ประจำภาควิชาวิศวกรรมเคมี คณะวิศวกรรมศาสตร์

4. หลักการและเหตุผล

ตามที่ International Water Association ได้จัดการประชุมทางวิชาการ ได้จัดการประชุมทางวิชาการ The 4th IWA_ASPIRE Conference & Exhibition ในระหว่างวันที่ 2 ถึง 6 ตุลาคม 2554 ณ Tokyo International Forum เมืองโตเกียว ประเทศญี่ปุ่น ดร.สุมนา สิริพัฒนากุล ได้ส่งผลงานวิจัยและได้รับการตอบรับให้นำเสนอบทความ "Optimum Alginate Cell Entrapment for Treating Hospital Wastewater in the Presence of Povidone Iodine Disinfectant" ด้วยวาจา การนำเสนอผลงานดังกล่าวเป็นการเผยแพร่ความรู้ทางด้านการจัดการสิ่งแวดล้อมเมืองในประเทศไทย ซึ่งเป็นปัญหารุนแรงในปัจจุบัน รวมทั้งเป็นการแลกเปลี่ยนความรู้และสร้างเครือข่ายนักวิจัยในระดับนานาชาติ ตลอดจนเป็นการสร้างชื่อเสียงให้กับมหาวิทยาลัยและประเทศไทย

5. วัตถุประสงค์ของโครงการ
   - เพื่อเผยแพร่ผลงานวิจัยเรื่อง Optimum Alginate Cell Entrapment for Treating Hospital Wastewater in the Presence of Povidone Iodine Disinfectant
   - เพื่อเข้าร่วมแลกเปลี่ยนความรู้จากวิทยากรผู้เชี่ยวชาญอื่น เพื่อส่งเสริมพัฒนาผลงานวิจัย
   - เพื่อศึกษาเรียนรู้วิทยาการสมัยใหม่ เพื่อใช้พัฒนาศักยภาพงานวิจัยและงานสอนต่อไป

6. ระยะเวลาดำเนินงาน

   ระยะเวลารวม 11 วัน (รวมวันเดินทางตั้งแต่มหาวิทยาลัยอุบลราชธานี) ระหว่างวันที่ 30 กันยายน 2554 ถึง 10 ตุลาคม 2554

7. ประโยชน์ที่คาดว่าจะได้รับ
   - ได้มีโอกาสเผยแพร่ผลงานวิจัย คณะวิศวกรรมศาสตร์ และมหาวิทยาลัยต่อนักวิชาการจากนานาชาติ
   - ได้มีโอกาสเผยแพร่ผลงานวิจัยและแลกเปลี่ยนองค์ความรู้ระหว่างนักวิจัยจากประเทศต่าง ๆ
   - ได้มีโอกาสเพิ่มพูนความรู้ทางด้านการจัดการสิ่งแวดล้อมจากงานประชุมนี้

8. งบประมาณ

ประมาณการค่าใช้จ่ายการนำเสนอผลงานวิจัย

รายการ	จำนวนเงิน (บาท)
1. ค่าเดินทาง	
1.1 ค่ารถไฟเส้นทางในประเทศ อบ.-กท.-อบ.	1,500
1.2 ค่าเครื่องบินเส้นทางระหว่างประเทศ กท.-โตเกียว-กท.	25,000
1.3 ค่าเดินทางภายในต่างประเทศ (ตามที่จ่ายจริง)	3,000
1.4 ค่าเดินทางระหว่างบ้านพักถึงสนามบินในประเทศ	600
2. ค่าลงทะเบียนประชุม (50,000 เยน)	19,500
3. ค่าที่พักในต่างประเทศ	28,000
4. ค่าเบี้ยเลี้ยง	
4.1 ค่าเบี้ยเลี้ยงในประเทศ (2 วัน)	480
4.2 ค่าเบี้ยเลี้ยงระหว่างวันที่ 1-7 ตุลาคม 2554 (7 วัน)	14,700
5. ค่าธรรมเนียมวีซ่า (จ่ายตามจริง)	2,000
รวม	**94,780**

อัตราแลกเปลี่ยน 100 Yen = 39 บาท ณ 1 สิงหาคม 2554

ทั้งนี้อาจเดินทางด้วยสายการบินอื่นหากมีราคาต่ำกว่าการบินไทยมากกว่าร้อยละ 30

(ดร.สุมนา สิริพัฒนากุล)
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(IWA-ASPIRE) Information for Your Presentation (00395)

FROM: The 4th IWA-ASPIRE Call for Papers Desk Mond

TO: jeans_sumana@yahoo.com

Dear Dr. Sumana Siripattanakul,

Thank you very much for your great contribution to the upcoming 4th IWA-ASPI
pleasure to inform you of your presentation schedule as follows.

Presentation style: Oral presentation
Abstract Receipt No.: 00395
Abstract Title: Optimum Alginate Cell Entrapment for Treating Hospital Wastew
Presence of Povidone Iodine Disinfectant

<Your presentation schedule>
Session Name: 14-7: Wastewater Treatment
Session Date: 4 Oct. 2011
Session Time: AM
Allotted time for your presentation: 15 minutes (Including questions and answer

*Your presentation schedule may change due to adjustments of the program. If
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Prior registration and payment is REQUIRED for the presenter. Please complet
by **JULY 31, 2011** (Deadline of earlybird registration).
There is a possibility that your presentations will be canceled if the presenter of
to complete pre-registration by July 31, 2011.
For the details, visit the "Registration" page.
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**If you are the first author, please login with ID and Password you entered for t
submission to the online registration system.

Those who had already registered for the conference, thank you for your advan

Should you have any questions, please feel free to contact the following Desks.

Yours sincerely,

The 4th IWA-ASPIRE Program Committee

Inquiries:
The 4th IWA-ASPIRE Call for Papers Desk

Key Dates

Abstract Submission Open
Early October, 2010

Abstract Submission Deadline
January 31, 2011

March 31, 2011 Authors notified of acceptance
June 15, 2011 Full paper submission deadline
June 30, 2011 Early bird registration deadline

Abstract Submission Information

① Language
English

② Maximum Number of Words
500 words or less

③ Points to Note in Preparing Abstract
Abstracts are to be text only – no tables, diagrams, photographs, etc.

④ Conference Topics
Please select the field from below, and submit the abstract according to the chosen field.

(1) New Vision, Governance and Regulation
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(3) Environmental Sanitation and Health Related Issues
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(8) Improvement of Revenue Water Ratio
(Non Revenue Water Reduction, Leakage Prevention)
(9) Maintenance and Renewal of Facilities
(10) Instrumentation and Operation
(11) Water Quality Management
(12) Drinking Water Treatment
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(14) Wastewater Treatment
(15) Sewage and Industrial Wastewater Collection, Treatment and Management
(16) Small Scale Treatment Systems
(17) Water Reuse, Rainwater Harvesting
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⑤ Abstract Submission Deadline
January 31, 2011

⑥ Abstract Submission Guidelines
- Abstracts are to be submitted online. Please follow the submission guidelines on the website- http://www.aspire2011.org/abst.html
- Abstracts can be submitted as "oral" or "poster". Please note abstracts submitted as "oral" may get accepted as poster after peer review;Oral and poster presentations will be regarded equal status.

⑦ Others
- Non-members of IWA may be welcomed to submit abstracts.
- You may submit more than one abstract.
- You may amend or withdraw abstracts online until the submission deadline.
- Obtain consent from co-authors prior to submission.
- The official language of the conference is English. No simultaneous interpretation service will be available.

Presentation Selection
- Abstracts will be selected based on logicality, originality, novelty and benefit, etc.
- Papers for the purpose of advertising products will not be accepted.
- The decision on acceptance or non-acceptance will be made by the 4th IWA-ASPIRE Program Committee.

Events Following Abstract Submission
- When contributors are notified of their tentative selection into the program, they will be notified of the type of presentation they will be invited to give (i.e."oral" or "poster").
- For an oral presentation, please submit a full paper (eight A4 pages or shorter including all references, tables and figures) on or before the deadline (June 15, 2011).
- For a poster presentation, submission of a full paper is optional. Please submit a full paper, however, if the presenter wishes to publish the paper in IWA journals, etc.
- All the full papers accepted will be published on proceedings to all delegates who attend the conference other than the collection of abstracts.

Outstanding Papers

① Publication in Journals, etc.
Selected oral and poster papers, will be published in the following media after peer review:
- IWA journals
  - Water Science and Technology
  - Water Science and Technology : Water Supply
  - Water Practice and Technology, etc.
- "Journal of Water and Environment Technology," electronic journal in English of the Japan Society on Water Environment

② Awards
- A student competition will be organized for the Best Student Awards.
- A poster competition will be organized for the Best Poster Awards.

For Call for Papers Information

The 4th IWA-ASPIRE Call for Papers Desk
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Optimum Alginate Cell Entrapment for Treating Hospital Wastewater in the Presence of Povidone Iodine Disinfectant

S. Siripattanakul*

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Abstract
This study aims to investigate hospital wastewater treatment in presence of povidone iodine disinfectant using cell entrapment technique. Synthetic wastewater with initial chemical oxygen demand (COD) of approximately 370 mg/L with povidone iodine of 0.1% and acclimated activated sludge were used. Calcium alginate cell entrapment was selected for the study. To determine the optimum cell entrapment condition, the activated sludge was entrapped with different cell-to-matrix ratios of 1:5, 1:10, and 1:20 (volume:volume). The analogous tests with the free cells were performed for comparative purpose. The result indicated that the entrapped cells obviously performed better than the free cells. The cell-to-matrix ratio of 1:20 gave the highest treatment efficiency of 86%. The entrapped cell system at the optimum entrapment condition could reduce the effect of disinfectant (inhibition of 9%) while the free cell system acquired the inhibition of 47%. The result also showed the system at the entrapped cell loading of 2,000 mg/L performed the highest COD removal of 62%. In addition, the result indicated that the entrapped cell system had higher treatment performance than the free cell system.

Keywords
Calcium alginate; cell entrapment; disinfectant; inhibition; hospital wastewater treatment

INTRODUCTION

Hospital is one of service facilities having its own wastewater treatment system which generally is activated sludge system. It is commonly found that the treated effluent from the systems do not meet hospital wastewater standard for organic (Biochemical Oxygen Demand or Chemical Oxygen Demand (COD)) removal. One of potential major sources could be biocides including antibiotics and disinfectants contaminating in the wastewater (Chitnisa et al., 2004; Rezaee et al., 2005). It is known that a large amount and various types of disinfectants are used in hospital, such as halogenated, aldehyde, and phenolic compounds. Povidone iodine (PI) is one of common used disinfectants for wound treatment. The disinfectant did not only kill germ for medical purpose but also can cause failure in wastewater treatment system. However, to the best of our knowledge, there is no study on improvement technology to solve the problem.

Entrapped cell system is a potential alternative for answering this problematic issue. The microorganism entrapped in porous polymeric material is known as one of effective techniques for environmental applications (Hill and Khan, 2008; Siripattanakul et al., 2008; Siripattanakul and Khan, 2010). The technique was proved that it can be applied to alleviate the limitation associated with the traditional (free) cell wastewater treatment. The system provides high cell loading and toxic protection which result in better wastewater treatment efficiency. Numerous successful previous applications for wastewater treatment included carbon and nitrogen treatments as well as toxic substance treatments, such as toxic dyes and pesticides (Hill and Khan, 2008; Pramanik and Khan, 2008; Siripattanakul et al., 2008; Siripattanakul and Khan, 2010). In this context, the technique sounds applicable to the problem. Moreover, the system does not require the sedimentation process attributing to easy and flexible for operation. In this case, the entrapped cells can be used in the existing facility for practical.

Based on above information, the aim of this study is to examine performance of povidone iodine-contaminated wastewater treatment using cell entrapment technique. Optimum entrapped cell preparation and entrapped cell loading for hospital wastewater treatment were determined. Calcium alginate (CA), a widely used cell entrapment matrix, was selected for this study.

METHODS

Synthetic hospital wastewater

Synthetic hospital wastewater was prepared followed wastewater characteristics from a model district hospital in Warinchamrap, Ubonratchathani, Thailand. The wastewater synthesized from $C_{12}H_{22}O_{11}$, $CO(NH_2)_2$, and $Ca(H_2PO_4).H_2O$ at COD:N:P of 100:5:1. The COD and pH values were approximately 370 mg/L and 6.5 to 7.0, respectively. Commercial PI of 0.1% was added in the synthetic wastewater.

Activated sludge cultivation and acclimatization

Municipal activated sludge was used in this study to avoid residue of disinfectant in hospital activated sludge. The activated sludge was cultivated and acclimated in a 30-L reactor for 2 months before application. The reactor was operated in sequencing batch reactor (SBR) mode with hydraulic and solid retention times of 1 and 30 days, respectively. Dissolved oxygen concentration (DO) of higher than 1 mg/L was continuously supplied.

Free and entrapped activated sludge preparation

The activated sludge from the 30-L reactor of 1,000 mL was centrifuged at 7,000 rpm for 10 min to obtain concentrated cells. The concentrated cells were vigorously resuspended in sterile de-ionized water (DI) of 10 mL. The resuspended cells were used as the free activated sludge (details described in the next section) and for entrapped cell preparation.

The activated sludge was entrapped in CA according to a technique adapted from Smidsrod and Skjak-Braek (1990). The technique was chosen because of several successful prior applications (Gentry et al., 2004; Hill and Khan, 2008; Siripattanakul and Khan, 2010). Sodium alginate (Fluka, Singapore) was dissolved into sterile DI at 2% (w/v). The resuspended activated sludge from earlier section was uniformly mixed with a sodium alginate solution. The mixture contents were described in the next section. The mixture was manually dropped into a calcium chloride solution of 3.5% (w/v) using a sterile syringe (bead size of 3-5 mm). The droplets remained in the solution for 2 hr to form and harden spherical beads.

Optimization of cell entrapment preparation

For typical entrapped cells, the effect of the cell-to-matrix (CA) ratios on substrate diffusivity and contaminant removal ability was one of major concerns previously reported in several studies (Kim et al., 2001; Siripattanakul et al., 2008). The aim of this part was to investigate the optimum cell-to-matrix ratio for treating wastewater contaminated with disinfectant. In the present experiment, 8 reactors containing different content of the cells and the matrix were prepared to test the effect of cell-to-matrix ratio (Table 1).

Duplicate 8-hr batch experiment was performed. The synthetic wastewater of 250 mL with the selected disinfectant (PI) at the selected concentration (0.1%) was filled in a reactor inoculated with the content shown in Table 1. All reactors were shaken at 150 rpm and 30°C. Dissolved oxygen concentration of higher than 1 mg/L was continuously supplied. During the 8-hr experiment, wastewater samples of 10 mL were taken every hour for measuring soluble COD. Wastewater treatment reaction kinetics and wastewater treatment efficiency were determined. Inhibition of wastewater treatment was then calculated as shown in equation 1 followed Ochoa-Herrera et al. (2009). The CA matrices were taken for observing microstructure using scanning electron microscopic (SEM) technique for insight information.

$$Inhibition\ (\%) = \frac{Average\ treatment\ activity\ of\ the\ reactor}{Average\ treatment\ activity\ of\ the\ control} \times 100 \qquad equation\ 1$$

Table 1. Descriptions of components in the optimum cell-to-matrix ratio investigation

Reactor	Cell type	Cell-to-matrix ratio (mL of cells: mL of calcium alginate)		
		Volume of cells (or DI) (mL)	Volume of CA (mL)	Total inoculated volume (mL)
CM-1:05	Entrapped cells	10 [(1)]	50	60
CM-1:10		10 [(1)]	100	110
CM-1:20		10 [(1)]	200	210
FC-1:00	Free cells	10 [(1)]	0	10
CA-0:05	Only CA matrices	10 [(2)]	50	60
CA-0:10		10 [(2)]	100	110
CA-0:20		10 [(2)]	200	210
NC-0:00	Control	10 [(2)]	0	10

[(1)] Concentrated activated sludge at the final concentration in reactor of 1,000 mg SS/L
[(2)] Sterile DI

Optimization of cell loadings

It is known that microbial cell loading is one of the most important factors for contaminant removal by either free or entrapped cells (Siripattanakul et al., 2009). This part intended to find the optimum entrapped cell loading compared to that by the free cells. Also, the long-term performance of the system was investigated.

Duplicate experiment was conducted in SBR mode. Six reactors of 150 mL including the entrapped cell reactors (EC-1,000, EC-2,000, and EC-3,000) and the free cell reactors (FC-1,000, FC-2,000, and FC-3,000) were tested for the cell loadings of 1,000, 2,000, and 3,000 mg SS/L. Note that optimum cell preparation (cell-to-matrix ratio) investigated in earlier section was applied. The reactors were consecutively run for 10 cycles. Each cycle included five periods followed traditional SBR cycle: 1) fill of 0.25 hr, 2) react of 6 hr, 3) settle of 2 hr, 4) draw of 0.25 hr, and 5) idle of 0.50 hr followed time period in the model hospital wastewater treatment system. Influent and effluent from each cycle were taken for COD measurement. Wastewater treatment performance was determined.

Analytical procedures

COD, SS, and pH were measured according to standard methods (APHA et al, 1998). After filtering water sample using GF/C filter glass paper, soluble COD was measured by potassium dichromate digestion method. The filtrate was used for measuring SS whereas pH was measured by using a pH meter (inoLab pH level 1, WTW GmBH, Weilheim, Germany).

For SEM observation, the method described earlier (Siripattanakul et al, 2010) was applied. The entrapped cell beads were rinsed in 0.1 M $CaCl_2$ for 15 min twice and fixed in a solution containing 2.5% glutaraldehyde and 0.1 M $CaCl_2$ for 1 hr. The samples were rinsed in 0.1 M $CaCl_2$ for 15 min twice. The beads were then dehydrated in solutions (30 min each) containing 30% ethanol and 0.07

M $CaCl_2$, 50% ethanol and 0.05 M $CaCl_2$, 70% ethanol and 0.03 M $CaCl_2$, 90% ethanol and water, and 100% ethanol, respectively. The dehydrated beads were critical point dried using an autosamdri-810 drier with liquid carbon dioxide as a transitional fluid. After that, the beads were cut, attached to aluminum mounts by silver paint, coated with gold using a Balzers SCD 030 sputter coater, and examined using a JEOL JSM-6300 scanning electron microscope.

RESULTS AND DISCUSSION

Optimization of cell entrapment preparation

Figure 1 presents normalized COD remaining in the synthetic wastewater during the test for 8 hr. In Figure 1a, the results from the control test (NC-0:00) and the tests with only CA at different entrapment preparation conditions (designated CA-0:05, CA-0:10, and CA-0:20) are shown. These reactors were performed to determine effect of matrix adsorption. The COD remaining in the control test was quite stable for entire of the experiment while the results from the CA-0:05, CA-0:10, and CA-0:20 reactors were similar. The COD value rapidly decreased within the first hour for 11 to 25% and remained stable thereafter. At the end of the experiment (8 hr), COD remaining of 95, 79, 75, and 73% from the NC-0:00, CA-0:05, CA-0:10, and CA-0:20 reactors, respectively were observed. This clearly indicated that COD was just slightly adsorbed by CA entrapment matrices for all entrapment conditions. This was similar to a previous study which reported insignificant adsorption of atrazine pesticide by entrapment matrices (Siripattanakul et al., 2008).

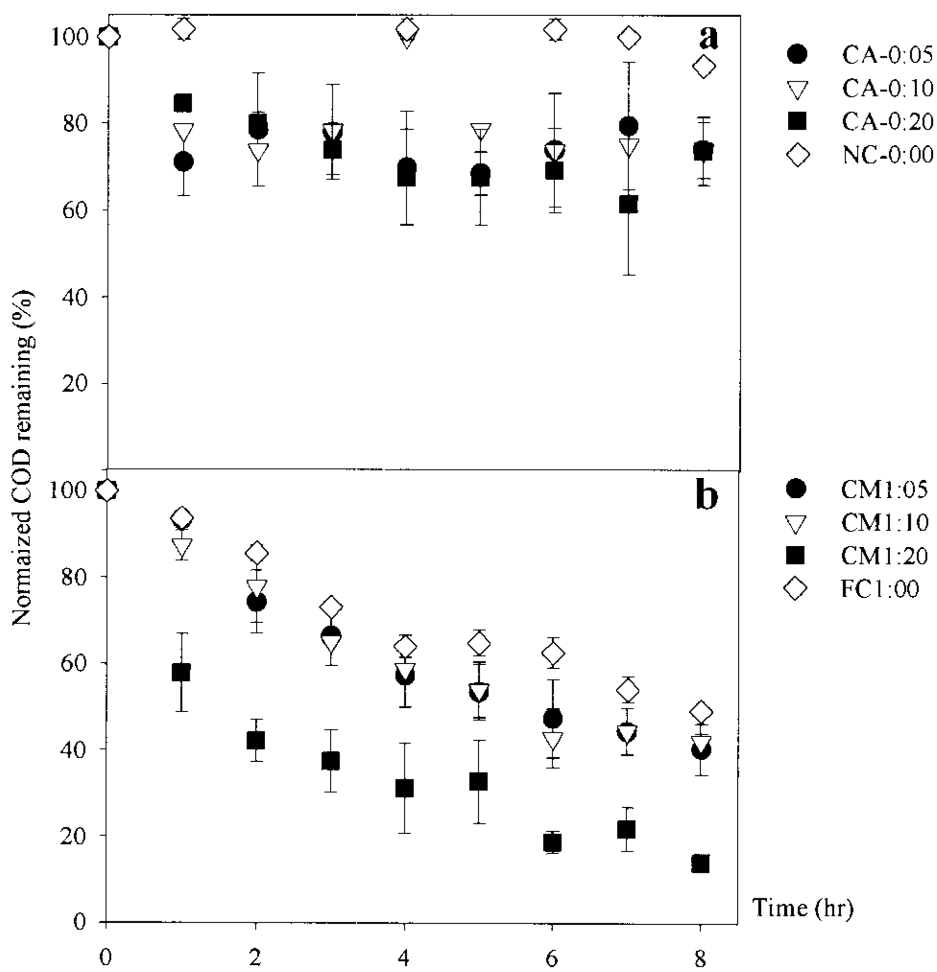

Figure 1. Normalized COD remaining in the optimization of cell entrapment preparation test

In Figure 1b, the results from the free cell test (FC-1:00) and the entrapped cell tests at different entrapment preparation conditions (designated CM-1:05, CM-1:10, and CM-1:20) are shown. The results from all reactors were similar. The COD value quickly decreased within the first 6 hr and gradually reduced thereafter. At the end of the experiment (8 hr), COD remaining of 50, 43, 42, and 14% from the FC-1:00, CM-1:05, CM-1:10, and CM-1:20 reactors, respectively were observed. This noticeably proved that entrapped cells performed better than the free cells. As expected, the cell entrapment condition played a role in enhancement of disinfectant-contaminated wastewater treatment performance. This was similar to prior studies (Kim et al., 2001; Siripattanakul et al., 2008). The studies reported that different cell-to-matrix ratios resulted in different cell densities inside the matrices. At the same cell mass (1,000 mg/L), the matrices in the CM-1:05 reactor were lower than those in the CM-1:10 reactor resulting in higher cell density in the CM-1:05 reactor.

Based on the result shown in Figure 1b, in this study, it is obvious that the lowest cell density (CM-1:20) provided in the best wastewater treatment efficiency. This could be because the entrapped cells at the low cell have enough space to grow and low substrate diffusion limitation. Figure 2 presents a cross-sectional image of the entrapped cells in micro-structural level. The CA entrapment is a cross-linking reaction between entrapment material (sodium alginate) and salt (calcium chloride). It was found that the cross-linking network was really dense resulted in the calcium alginate sheets with a number of cells fixed inside the beads (Figure 2). The sheets were combined and caused numerous of voids attributing to high substrate and oxygen diffusion.

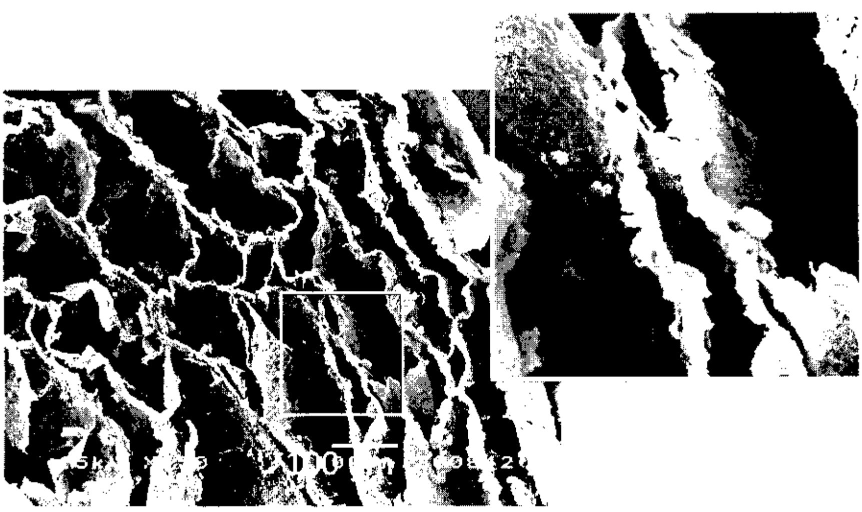

Figure 2. Cross-sectional image of the CA entrapped cells

Moreover, as expected, the entrapment matrices were able to protect the cells from toxic substance (Gentry et al., 2004; Siripattanakul et al., 2008; Siripattanakul and Khan, 2010). Generally, the cell damage mechanism by PI was that the cells after contacting to PI were inactivation (Durani and Leaper, 2008). In PI, polyvinylpyrolidone was a source of free iodine. The free iodine was continuously released from the source and contacted to the bacterial cells. Then, the free iodine diffused though cell membrane and destroyed protein, fatty acid, and nucleotide inside the cells. Based on the result that the entrapped cells worked better than the free cells; this could be because the entrapment matrices can lessen the cell-PI contact resulting in lower cell inactivation.

The wastewater treatment inhibition and kinetics were shown in Table 2. The inhibition by the disinfectants was between 9 and 47% of the control (no disinfectant). The removal of COD by the reactors with disinfectants followed the first order kinetic reaction at the rate constants of 0.09 to

0.24 hr^{-1}. This remarkably signified that the entrapped cells at the optimum entrapment condition performed much better than the free cell. The treatment rate by the entrapped cells at the optimum condition was about the rate by the traditional wastewater treatment without the disinfectant. The treatment trend was similar to the control as shown in Figure 3. This obviously proved that the CA entrapped cells were really potential for treating hospital wastewater. The entrapped cells performed well and sounded applicable for the typical on-site hospital wastewater treatment system.

Table 2. Treatment kinetics and inhibition

Reactor name	COD removal (%)	Inhibition (% of control)	Wastewater treatment kinetics: Equation [(1)]	R^2	Rate constant (hr^{-1})
CM-1:05	57	39.36	Y = -0.11X+4.56	0.96	0.11
CM-1:10	58	38.30	Y = -0.21X+4.35	0.92	0.21
CM-1:20	86	8.51	Y = -0.24X+4.41	0.83	0.24
FC-1:00	50	46.81	Y = -0.09X+4.60	0.97	0.09
Control[(2)]	94	Control	Y = -0.25X+4.64	0.98	0.25

[(1)] Y = ln COD and X = time

[(2)] Control is the traditional (free cell) wastewater treatment system without the disinfectant.

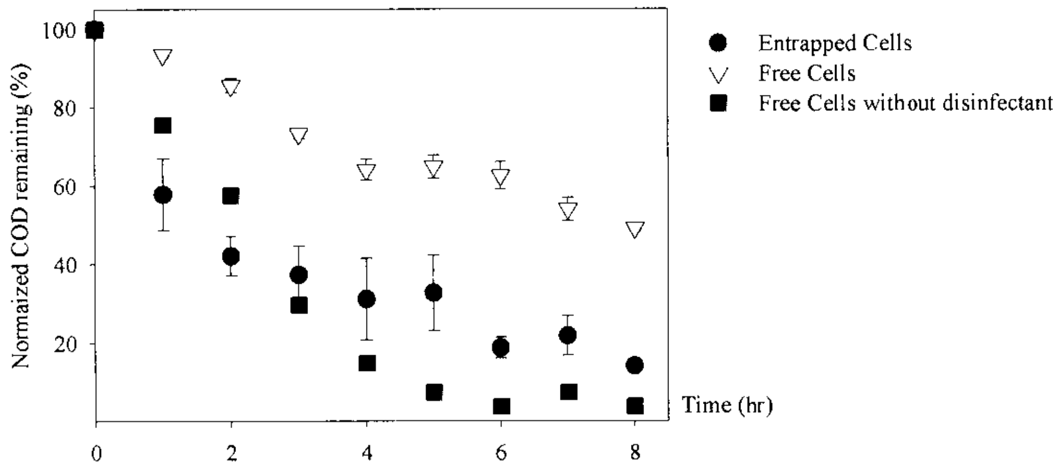

Figure 3. Comparison of the wastewater treatment by the entrapped and free cells

Optimization of cell loadings

The results were shown in Figure 4. For the entrapped cell reactors, trend of normalized COD removal was quite stable (Figure 4a). The EC-1,000, EC-2,000, and EC-3,000 reactors removed COD of 44, 62, and 47%, respectively. For the free cell reactors, trend of normalized COD removal concurrently decreased (Figure 4b). The FC-1,000, FC-2,000, and FC-3,000 reactors removed COD of 31, 38, and 44%, respectively.

Based on the trends, the entrapped cells performed more stable compared to the free cells. This should be because the entrapment matrices provided better environment for the cells (Siripattanakul et al., 2008). Besides protecting the cells for the toxic substance, the entrapped cell system had better cell separation in the settling period. This is apparent; the entrapped cells were much heavier than the free cells and were settled more than the free cells. Therefore, the entrapped cell system had less cell loss resulting in better performance.

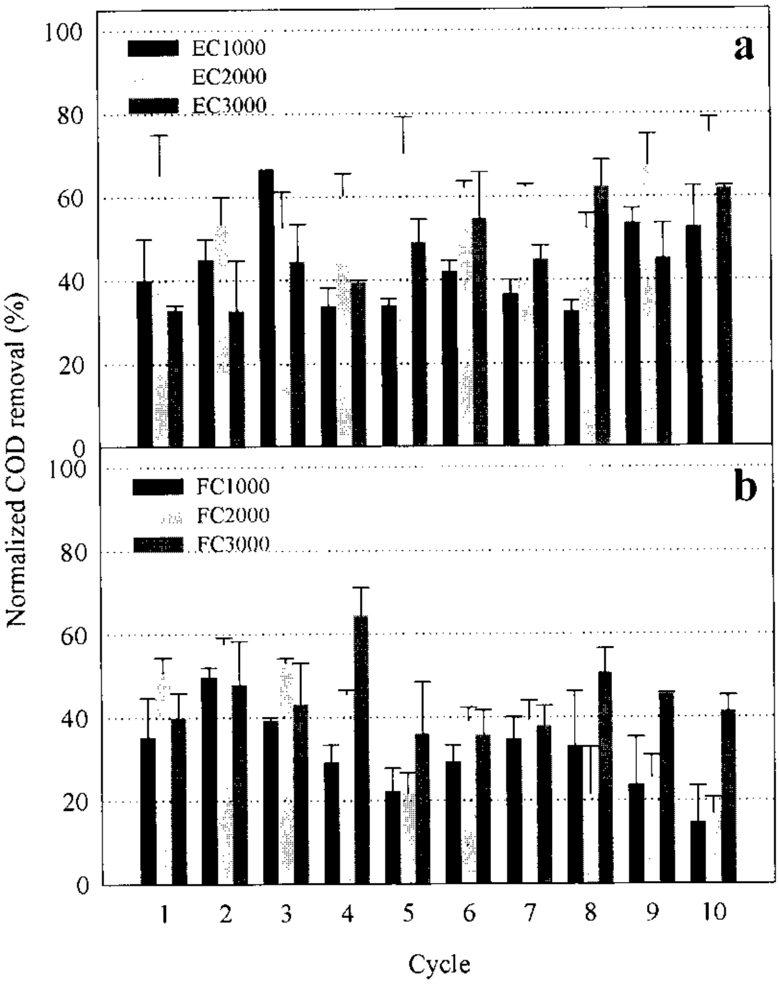

Figure 4. Normalized COD removal by the entrapped and free cells in SBR mode

CONCLUSIONS

It has been known that hospital wastewater treatment systems are not successfully operated. This could be from numerous chemicals used in hospitals including drugs, disinfectants, and laboratory chemicals. Povidone-iodine substantially inhibited the wastewater treatment efficiency. The entrapped cell system can apparently alleviate the problem. At the optimum cell entrapment condition (1:20), the entrapped cell system gave the treatment efficiency of 86% (only inhibition of 9%). In this case, the entrapped cells had much superior wastewater treatment. The continued work on disinfectant-tolerated microbial community was recommended for insight information.

ACKNOWLEDGMENTS

This material is based upon work supported by Office of the National Research Council of Thailand. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of Office of the National Research Council of Thailand. The author thanks Warinchamrap Hospital, Ubonratchathani, Thailand for providing the wastewater samples and disinfectant utilization information. The author also thanks my students including Napajaree Sangsing, Pongsatorn Taweetanawanit, Warayut Patichot, Supot

Punbut, and Suwirat Lakhornphon for their assistance.

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The 4th IWA-ASPIRE Conference & Exhibition

Toward Sustainable Water Supply and Recycling Systems

2nd Announcement
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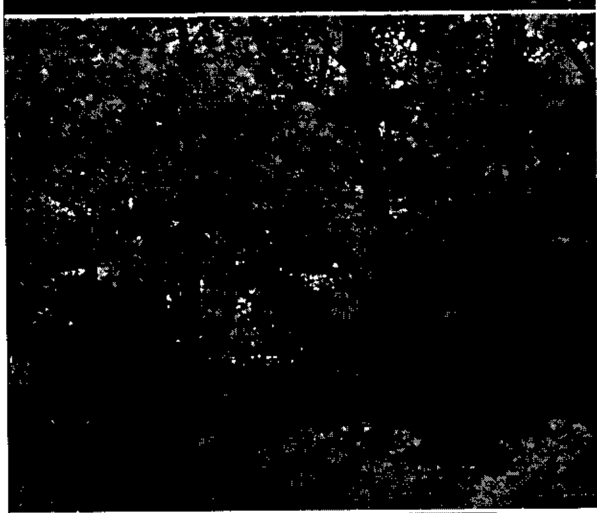
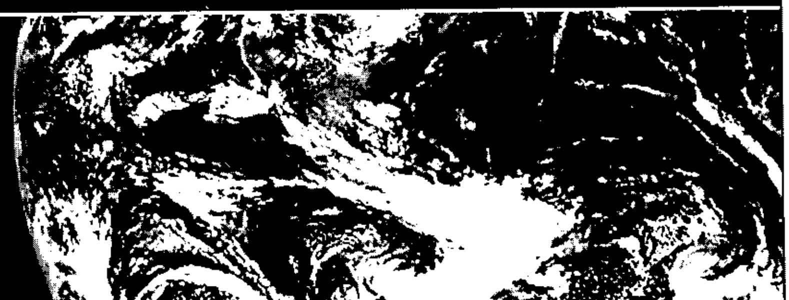
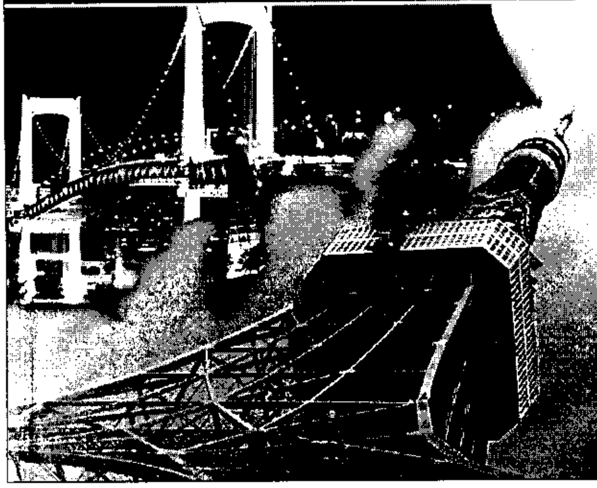




2-6 October 2011
Tokyo International Forum, Tokyo, Japan



Organizer **The 4th IWA-ASPIRE Organizing Committee**

Co-Organizers Bureau of Waterworks, Tokyo Metropolitan Government
Bureau of Sewerage, Tokyo Metropolitan Government
Japan Society on Water Environment
Japan Water Works Association
Japan Sewage Works Association

Welcome Message

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[Co-chairs of the Organizing Committee]

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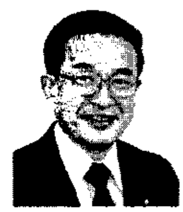
Dr. Masaru Ozaki



Mr. Yoshihiko Misono

Program Outline

2011	Morning	Afternoon	Evening
2 October (Sun)	Workshop [Young Water Professionals Program]	Workshop [Young Water Professionals Program]	Welcome Reception
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The 4th IWA-ASPIRE Conference & Exhibition

- Toward Sustainable Water Supply and Recycling Systems -

2-6 October 2011 Tokyo International Forum, Tokyo, Japan

Registration

1. REGISTRATION FEES

Category	Earlybird* Until ~~30 June~~ 31 July 2011	Standard* Until 15 Sep 2011	On-site* From 16 Sep 2011
IWA member *1	78,000 JPY	89,000 JPY	101,000 JPY
IWA non-member	101,000 JPY	112,000 JPY	122,000 JPY
IWA member (LIC *2)	50,000 JPY	62,000 JPY	73,000 JPY
IWA non-member (LIC *2)	67,000 JPY	78,000 JPY	89,000 JPY
Student *3	45,000 JPY	50,000 JPY	55,000 JPY
1-Day *4	23,000 JPY	28,000 JPY	34,000 JPY
Accompanying person *5	20,000 JPY	20,000 JPY	20,000 JPY

*1 **Including members of JSWE(Japan Society on Water Environment), JWWA(Japan Water Works Association) and JSWA(Japan Sewage Works Association).**

*2 LIC means low income country. Click here for more information.

*3 Student participants are required to send a copy of their student ID card to the Registration Desk by fax, e-mail or post.

*4 1-Day registration's fee covers daily Session meetings, Poster sessions, Workshops and Exhibition, including Opening Ceremony and Closing Ceremony. For Welcome Reception and Conference Dinner, another registration is required.

*5 Accompanying persons' fee covers Welcome Reception, Conference Dinner, Opening Ceremony, Closing Ceremony and Exhibition. For technical sessions, another registration is required.

* Deadline of Early bird registration is ~~30 June~~ 31 July 2011. Your payment in full must be received no later than ~~30 June~~ 31 July 2011 after online registration or sending the registration form by fax or post. On and after ~~1 July~~ 1 August 2011, Standard registration fee is applied automatically and deadline of Pre-registration is 15 September 2011. From 16 September 2011, we will accept new registration at the on-site Registration Desk. For details, please ask for The 4th IWA-ASPIRE Registration Desk.Please note that only registration by credit card is acceptable after 1 September 2011.
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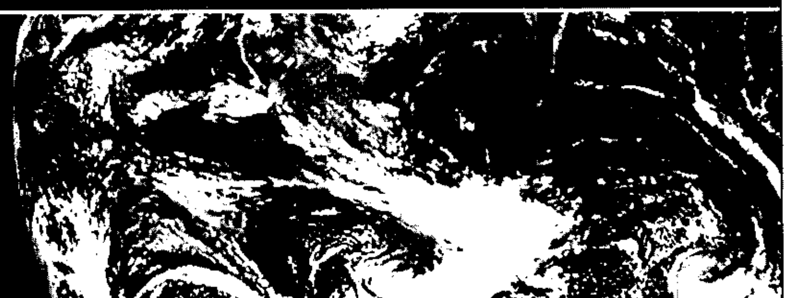

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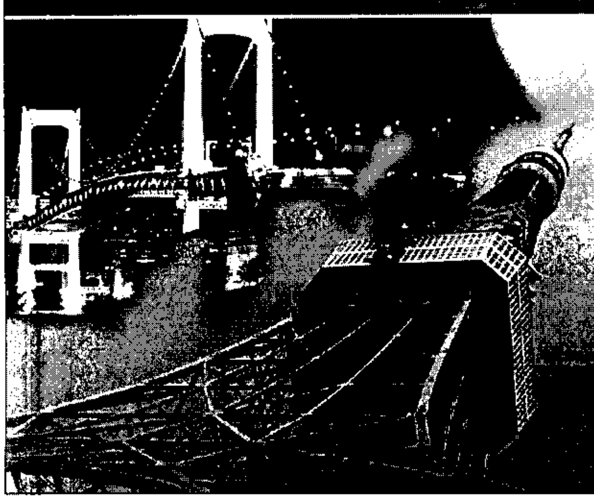

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as of June 30, 2011

Program at a Glance (tentative)

Date	Room / Time	HallB5-1	HIIB5-2	HallD5	G402	G407	G408	G409	G410	G502	G503	G504	G505	G507	G508	G509	G510	G701	Exhibition Hall
2 October Sun	09:00-17:00	IWA Utility Leaders Forum at HallD7																	-
	09:00-16:00	IWA Young Water Professional Program at G701																	
	12:30-14:30	IWA 2012 Project Innovation Awards Promotional Luncheon at Hall B5																	
	18:00-20:00	Welcome Reception at Hall B5																	
3 October Mon	09:00-11:45	Opening Ceremony & Keynote Speech at Hall C																	-
	12:10-12:30	Opening for Exhibition at Exhibition Hall																	Opening for Exhibition
	12:30-13:30	Lunch																	Exhibition Industy Forum
	13:30-15:00	Session	Session	Workshop1	Session	Session	Session	Workshop2	Session	Session	JWWA Seminar	Session	Session	Session	Session	JST Exhibition	Session	Workshop3	Exhibition Industy Forum Poster Session1
	15:00-15:30	Coffee Break																	
	15:30-17:30	Session	Session	Workshop1	Session	Session	Session	Workshop2	Session	Session	JWWA Seminar	Session	Session	Session	Session	JST Exhibition	Session	Workshop3	
4 October Tue	09:00-10:30	Workshop4		Workshop5	Session	Session	Session	Session	Session	Session	JWWA Seminar	Session	Session	Session	Session	JST Exhibition	Session	Workshop6	Exhibition Industy Forum Poster Session1
	10:30-11:00	Coffee Break																	
	11:00-12:30	Workshop4		Workshop5	Session	Session	Session	Session	Session	Session	JWWA Seminar	Session	Session	Session	Session	JST Exhibition	Session	Workshop6	
	12:30-14:30	Lunch & **Poster Session 1 at Exhibition Hall & IWA-ASPIRE Council Meeting and Luncheon at TOH-TEN-KOH, 7F**																	
	1430-16:00	Workshop4		Workshop5	Session	Session	Session	Session	Session	Session	JWWA Seminar	Session	Session	Session	Session	JST Exhibition	Session	Workshop6	Exhibition Industy Forum
	16:00-16:30	Coffee Break																	
	16:30-17:30	Workshop4		Workshop5	Session	Session	Session	-	Session	Session	JWWA Seminar	Session	Session	Session	Session	JST Exhibition	Session	Workshop6	
	18:00-	Conference Dinner at Tokyo Kaikan																	-
5 October Wed	09:00-10:30	Session	Session	-	Session	Session	Session	Workshop7	Session	Session	JWWA Seminar	Session	Session	Session	Session	JST Exhibition	Session	Workshop8	Exhibition Industy Forum Poster Session2
	10:30-11:00	Coffee Break																	
	11:00-12:30	Session	Session	-	Session	Session	Session	Workshop7	Session	Session	JWWA Seminar	Session	Session	Session	Session	JST Exhibition	Session	Workshop8	
	12:30-14:30	Lunch & **Poster Session2 at Exhibition Hall**																	
	1430-16:30	Session	Session	-	Session	Session	Session	Workshop9	Session	Session	JWWA Seminar	Session	Session	Session	Session	JST Exhibition	Session	Workshop8	
	16:30-	Closing Ceremony (Hall B5)																	-
6 October Thu	Full day	**Technical Tours** (Meeting point: Tokyo International Forum Lobby)																	-

FOOTNOTE:
This program current as of June 30, 2011. For the latest information, please check the 4th IWA-ASPIRE website.
Main Venus: Tokyo International Forum
JWWA:Japan Water Works Association
JST:Japan Science and Technology Agency

Workshop1	Countermeasures for the huge earthquake	**Workshop6**	JSC-ADBI-JSWA Regional Workshop
Workshop2	Water Environment Partnership in Asia	**Workshop7**	Environmental leadership education
Workshop3	Leaders Summit	**Workshop8**	Asian Waterworks Utilities Network
Workshop4	International Cooperation Forum	**Workshop9**	Sound and sustainable water cycle
Workshop5	Smart Water Portfolio		