ภาคผนวก

ภาคผนวก ก

ตารางค่าวิกฤตของ t ที่ระดับความเชื่อมั่นต่างๆ

ตาราง ค. 1 ค่าวิกฤตของ t ที่ระดับความเชื่อมั่นต่างๆ (สราวุฒิ สมนาม, 2557)

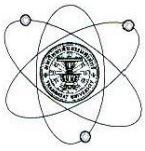
ระดับความเสรี	ระดับความเชื่อมั่น			
	90 %	**95 %**	**98 %**	**99 %**
(n - 1)	**(P = 0.10)**	**(P = 0.05)**	**(P = 0.02)**	**(P = 0.01)**
1	6.31	12.71	31.82	63.66
2	2.92	4.30	6.96	9.92
3	2.35	3.18	4.54	5.84
4	2.13	2.78	3.75	4.60
5	2.02	2.57	3.36	4.03
6	1.94	2.45	3.14	3.71
7	1.89	2.36	3.00	3.50
8	1.86	2.31	2.90	3.36
9	1.83	2.26	2.82	3.25
10	1.81	2.23	2.76	3.17
12	1.78	2.18	2.68	3.05
14	1.76	2.14	2.62	2.98
16	1.75	2.12	2.58	2.92
18	1.73	2.10	2.55	2.88
20	1.72	2.09	2.53	2.85
30	1.70	2.04	2.46	2.75
50	1.68	2.01	2.40	2.68
∞	1.64	1.96	2.33	2.58

ภาคผนวก ข

การนำเสนอผลงานที่ได้จากโครงการวิจัย

1. บทความวิจัยตีพิมพ์ในวารสารทางวิชาการ

ได้รับการตอบรับให้ตีพิมพ์บทความวิจัยในวารสารวิทยาศาสตร์และเทคโนโลยี มหาวิทยาลัยธรรมศาสตร์



วารสารวิทยาศาสตร์ และเทคโนโลยี

ที่ ววท. 2559/ 137

วันที่ 4 กรกฎาคม 2559

เรื่อง แจ้งตอบรับการตีพิมพ์บทความวิจัย

เรียน ผู้ช่วยศาสตราจารย์ ดร. สราวุฒิ สมนาม

กองบรรณาธิการวารสารวิทยาศาสตร์และเทคโนโลยี ขอแจ้งให้ท่านทราบว่าบทความวิจัยของท่านเรื่อง “การหาปริมาณฟอสฟอรัสที่พืชใช้ประโยชน์ได้ในดินโดยใช้ระบบไฮโดรไดนามิกซีเควนเชียลอินเจคชันแบบประหยัด” ได้ผ่านการพิจารณาคุณภาพจากผู้ประเมินผลงานให้ตีพิมพ์ในวารสารวิทยาศาสตร์และเทคโนโลยีปีที่ 25 ฉบับที่ 1 (มกราคม-มีนาคม) 2560 เรียบร้อยแล้ว

จึงเรียนมาเพื่อโปรดทราบ

ขอแสดงความนับถือ

(รองศาสตราจารย์ ดร. ธีระชัย ธนานันต์)

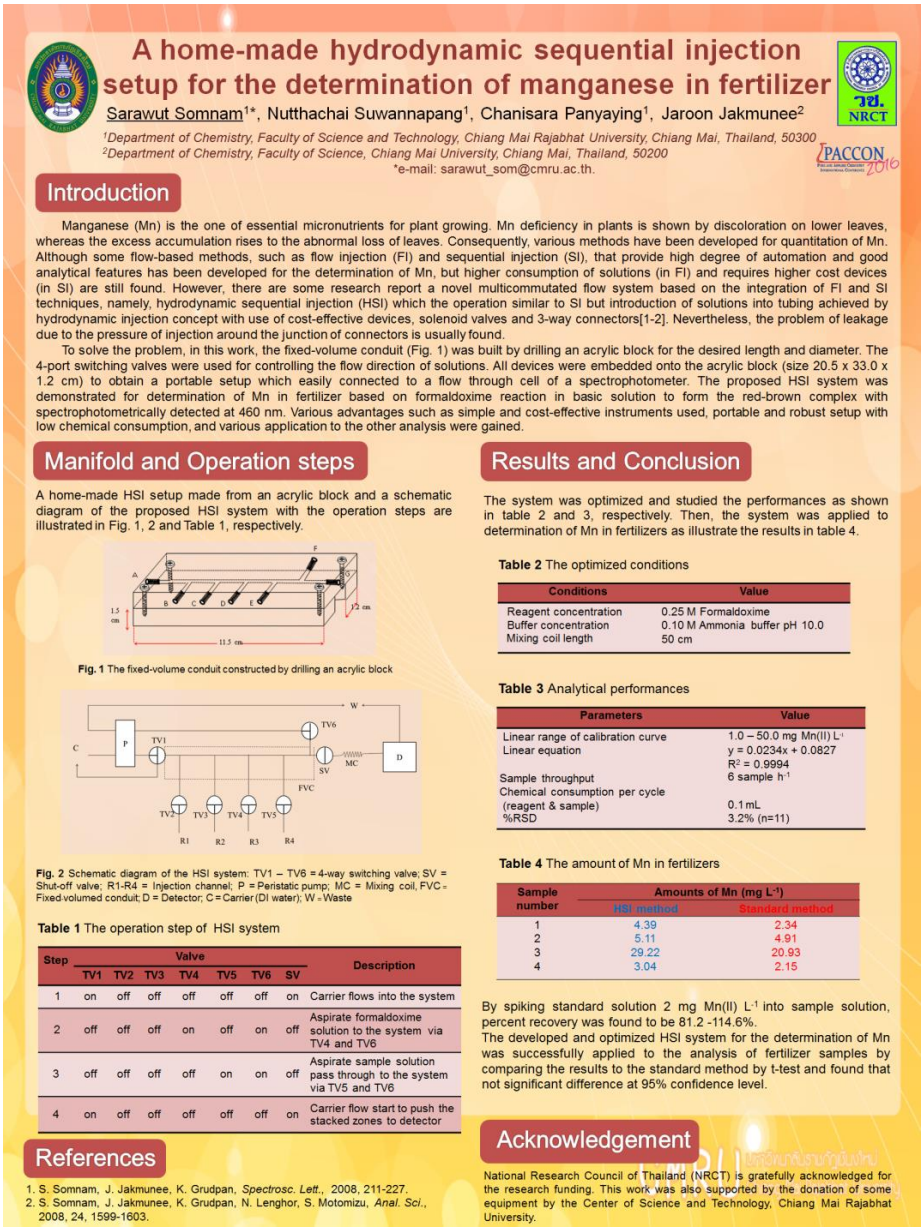
บรรณาธิการวารสารวิทยาศาสตร์และเทคโนโลยี

2. การนำเสนอผลงานในที่ประชุมทางวิชาการ

2.1 การประชุม Pure and Applied Chemistry International Conference 2016 (PACCON2016)

นำเสนอในรูปแบบโปสเตอร์ ระหว่างวันที่ 9-11 กุมภาพันธ์ 2559 ณ ศูนย์การประชุมแห่งชาติไบเทคบางนา จ.กรุงเทพ ในหัวข้อเรื่อง

1) A home-made hydrodynamic sequential injection setup for the determination of manganese in fertilizer



A home-made hydrodynamic sequential injection setup for the determination of manganese in fertilizer

Sarawut Somnam[1]*, Nutthachai Suwannapang[1], Chanisara Panyaying[1], Jaroon Jakmunee[2]

[1]Department of Chemistry, Faculty of Science and Technology, Chiang Mai Rajabhat University, Chiang Mai, Thailand, 50300
[2]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand, 50200
*e-mail: sarawut_som@cmru.ac.th.

Introduction

Manganese (Mn) is the one of essential micronutrients for plant growing. Mn deficiency in plants is shown by discoloration on lower leaves, whereas the excess accumulation rises to the abnormal loss of leaves. Consequently, various methods have been developed for quantitation of Mn. Although some flow-based methods, such as flow injection (FI) and sequential injection (SI), that provide high degree of automation and good analytical features has been developed for the determination of Mn, but higher consumption of solutions (in FI) and requires higher cost devices (in SI) are still found. However, there are some research report a novel multicommutated flow system based on the integration of FI and SI techniques, namely, hydrodynamic sequential injection (HSI) which the operation similar to SI but introduction of solutions into tubing achieved by hydrodynamic injection concept with use of cost-effective devices, solenoid valves and 3-way connectors[1-2]. Nevertheless, the problem of leakage due to the pressure of injection around the junction of connectors is usually found.

To solve the problem, in this work, the fixed-volume conduit (Fig. 1) was built by drilling an acrylic block for the desired length and diameter. The 4-port switching valves were used for controlling the flow direction of solutions. All devices were embedded onto the acrylic block (size 20.5 x 33.0 x 1.2 cm) to obtain a portable setup which easily connected to a flow through cell of a spectrophotometer. The proposed HSI system was demonstrated for determination of Mn in fertilizer based on formaldoxime reaction in basic solution to form the red-brown complex with spectrophotometrically detected at 460 nm. Various advantages such as simple and cost-effective instruments used, portable and robust setup with low chemical consumption, and various application to the other analysis were gained.

Manifold and Operation steps

A home-made HSI setup made from an acrylic block and a schematic diagram of the proposed HSI system with the operation steps are illustrated in Fig. 1, 2 and Table 1, respectively.

Fig. 1 The fixed-volume conduit constructed by drilling an acrylic block

Fig. 2 Schematic diagram of the HSI system: TV1 – TV6 = 4-way switching valve; SV = Shut-off valve; R1-R4 = Injection channel; P = Peristatic pump; MC = Mixing coil, FVC = Fixed-volumed conduit; D = Detector; C = Carrier (DI water); W = Waste

Table 1 The operation step of HSI system

Step	Valve							Description
	TV1	TV2	TV3	TV4	TV5	TV6	SV	
1	on	off	off	off	off	off	on	Carrier flows into the system
2	off	off	off	on	off	on	off	Aspirate formaldoxime solution to the system via TV4 and TV6
3	off	off	off	off	on	on	off	Aspirate sample solution pass through to the system via TV5 and TV6
4	on	off	off	off	off	off	on	Carrier flow start to push the stacked zones to detector

Results and Conclusion

The system was optimized and studied the performances as shown in table 2 and 3, respectively. Then, the system was applied to determination of Mn in fertilizers as illustrate the results in table 4.

Table 2 The optimized conditions

Conditions	Value
Reagent concentration	0.25 M Formaldoxime
Buffer concentration	0.10 M Ammonia buffer pH 10.0
Mixing coil length	50 cm

Table 3 Analytical performances

Parameters	Value
Linear range of calibration curve	1.0 – 50.0 mg Mn(II) L^{-1}
Linear equation	y = 0.0234x + 0.0827
	R^2 = 0.9994
Sample throughput	6 sample h^{-1}
Chemical consumption per cycle (reagent & sample)	0.1 mL
%RSD	3.2% (n=11)

Table 4 The amount of Mn in fertilizers

Sample number	Amounts of Mn (mg L^{-1})	
	HSI method	Standard method
1	4.39	2.34
2	5.11	4.91
3	29.22	20.93
4	3.04	2.15

By spiking standard solution 2 mg Mn(II) L^{-1} into sample solution, percent recovery was found to be 81.2 -114.6%.
The developed and optimized HSI system for the determination of Mn was successfully applied to the analysis of fertilizer samples by comparing the results to the standard method by t-test and found that not significant difference at 95% confidence level.

References

1. S. Somnam, J. Jakmunee, K. Grudpan, *Spectrosc. Lett.*, 2008, 211-227.
2. S. Somnam, J. Jakmunee, K. Grudpan, N. Lenghor, S. Motomizu, *Anal. Sci.*, 2008, 24, 1599-1603.

Acknowledgement

National Research Council of Thailand (NRCT) is gratefully acknowledged for the research funding. This work was also supported by the donation of some equipment by the Center of Science and Technology, Chiang Mai Rajabhat University.

2) The determination of total iron in fertilizer and soil using a cost-effective hydrodynamic sequential injection setup

A home-made hydrodynamic sequential injection setup for the determination of manganese in fertilizer

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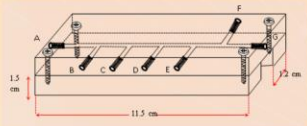

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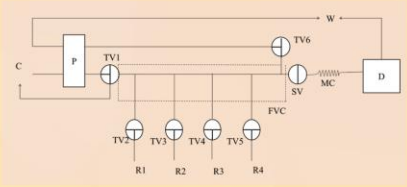

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2.2 การประชุม International Conference on Chemistry and Environmental Science Research 2016 (ICCESR 2016)

นำเสนอในรูปแบบโปสเตอร์ ระหว่างวันที่ 2-3 พฤศจิกายน 2559 ณ Park Royal Penang Resort ประเทศมาเลเซีย ในหัวข้อเรื่อง Development of a single hydrodynamic sequential injection system for the determination of various plant nutrients