Alattabi, AW, Harris, CB, Al Khaddar, RM and Alzeyadi, A

The Relationship between Operating Condition and Sludge Wasting of an Aerobic Suspension Sequencing Batch Reactor (ASSBR) Treating Phenolic Wastewater

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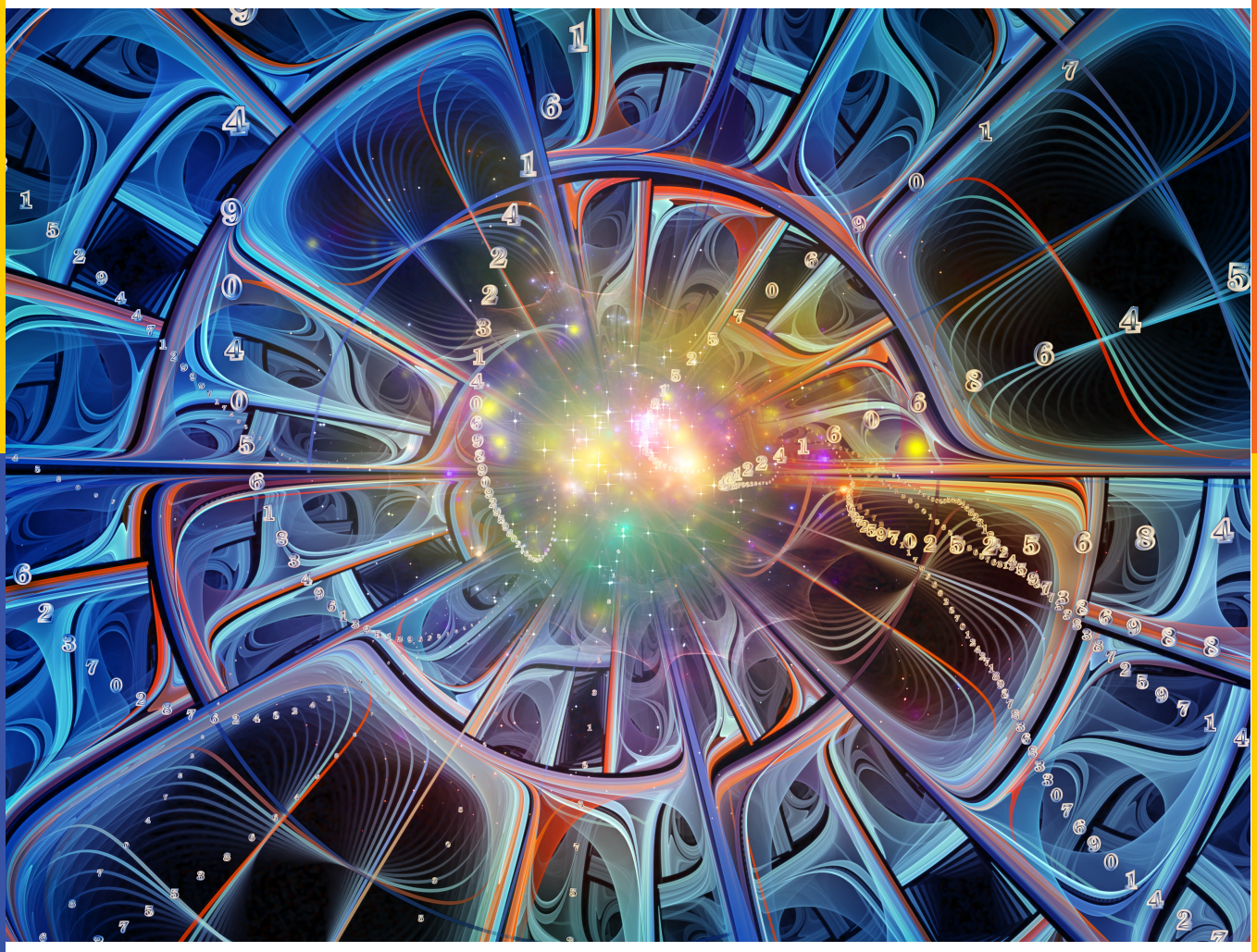
The Second BUiD Doctoral Research Conference



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BDRC 2016

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The 2nd BUiD Doctoral Research Conference

BDRC 2016

The British University in Dubai, 14th May 2016

Conference Proceedings

Extended Abstracts and Conference Papers

Introduction

The Annual BUiD Doctoral Research Conference took place for the second year on the 14th of May 2016. The conference included submissions from both Doctoral and Masters students from the British University in Dubai and UAE based universities, including Manipal University and Heriot-Watt University. In addition, there were a large number of submissions from several UK based universities including universities from the UK Alliance. Students from Cardiff University, the University of Glasgow and Liverpool John Moores University participated and presented at the conference, as well as students from the University of Rome and Skolkovo (Moscow School of Management).

Over 100 students attended the conference, with 74 participating students from local and international universities. Keynote speaker, Professor Ghassan Aouad, President of Applied Science University in Bahrain, presented on the "Art and Science of doing a PhD." Dr. Maureen Farrell from the University of Glasgow, one of BUiD's UK associate universities, gave a second keynote speech in the morning on the topic of "Journeys with Children's Literature: Research with impact."

The conference included a range of themes from several disciplines to ensure that all students who are studying a wide range of doctoral research topics can participate in the conference. The themes adopted in this year's conference included: Innovation, Sustainability, Business, Project Management, IT, Engineering, Law and Education.

Students from both BUiD and UK Associate universities reviewed papers to gain experience and practice for their future academic activities. Academics from the University of Glasgow and the University of Manchester were also present on the day to support the conference.

Six best paper awards were given to the best submissions, which included 2 from Education, 1 from Business & Law and 3 from Engineering & IT. This year, all participating students were given the option to decide whether or not to be included in the BDRC 2016 published conference proceedings.

BDRC 2016 Editors

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The 2nd BUiD Annual Doctoral Research Conference 2016

8:30 – 9:00	***Registration***
9:00-9:15	***Welcome and Introduction***
9:15 - 10:15	***Keynote Presentation: "The Art and Science of Doing a PhD."*** *Prof. Ghassan Aouad, President of Applied Science University (ASU), Bahrain.*
10:15 - 11:00	***Keynote Presentation 2: "Journeys with Children's Literature: Research with impact."*** *Dr. Maureen Farrell, University of Glasgow, UK.*

Session	Time	Auditorium Engineering & IT Chair: Prof. Halim Boussebaine		CR1 Full Research Proposal Closed Session Chair: Prof. Ashly Pinnington		CR 2 Education Chair: Dr. Solomon David		CR3 Engineering & IT Chair: Prof. Bassam Abu-Hijleh	
		Presenter	**Discussant**	**Presenter**	**Discussant**	**Presenter**	**Discussant**	**Presenter**	**Discussant**
1 **11:15 - 13:15**	11:15 –11:35	**Ibrahim Nasser (BUID)**	**Eyad Megdadi (BUID)**	**Shireen Chaya (BUiD)**		**Roeia Thabet (BUiD)**	**Doaa Mostafa (BUiD)**	**Hamdy Elsayed (BUiD)**	**Shaikha Abdool (BUiD)**
	11:35 – 11:55	**Eyad Megdadi (BUID)**	**Ibrahim Nasser (BUID)**	**Samih Yehia (BUID)**		**Doaa Mostafa (BUiD)**	**Roeia Thabet (BUiD)**	**Alya Harbi (BUiD)**	**Shaikha Abdool (BUiD)**
	11:55 – 12:15	**Noha Amer (BUiD)**	**Jimoh Kareem (SKEMA)**	**Mohamed AlDhanhani (BUiD)**		**Senthilnathan Ramakrishnan (BUID)**	**Ashok Iyer (Cardiff University)**	**Alya Harbi/ Shaikha Abdool (BUiD)**	**Hanadi AlSuwaidi (BUiD)**
	12:15 – 12:35	**Jimoh Kareem (SKEMA)**	**Noha Amer (BUiD)**	**Fatma AlHashimi (BUID)**		**Heba Daraghmeh (BUiD)**	**Lara Abdallah (BUiD)**	**Hanadi AlSuwaidi (BUiD)**	**Hamdy Elsayed (BUiD)**
	12:35 – 12:55	**Muna Ali (BUiD)**	**Maitha AlHameli (BUiD)**	**Nawfal Ghani (BUiD)**		**Khawla Al-Shehi (BUiD)**	**Rania Amaireh (BUiD)**	**Alia Marjan (BUID)**	**Evgeny Plaksenkov (SKOLKOVO)**
	12:55 – 13:15	**Maitha AlHameli (BUID)**	**Muna Ali (BUiD)**	**Ebtihal Al-Tamimi (BUiD)**		**Lara Abdallah (BUiD)**	**Heba Daraghmeh (BUiD)**	**Evgeny Plaksenkov (SKOLKOVO)**	**Alia Marjan (BUID)**

13:15 – 14:15 Lunch & Prayers

Session	Time	Auditorium Engineering & IT Chair: Prof. Julian Dow		CR 1 Business & Law Chair: Dr. Abba Kolo		CR 2 Education Chair: Dr. Lang Wanphet		C3 E-Sessions Chair: Student Organizing Committee	
		Presenter	Discussant	Presenter	Discussant	Presenter	Discussant	Presenter	Discussant
2 14:15 – 16:35	14:15 – 14:35	Alya Harbi (BUiD)	Shaikha Abdool (BUiD)	Rajesh Pai (Manipal University)	Nada Rabie (BUiD)	Mohammed Assaf (BUiD)	Hannah Wilson (Liverpool John Moores University)	Khalid Hashim (Liverpool John Moores University	Ameer Jebur (Liverpool John Moores University)
	14:35 – 14:55	Shaikha Abdool (BUiD)	Alya Harbi (BUiD)	Gabriele Capogna (University of Rome)	Ruslan Ibraev (SKOLKOVO)	Yan Zengh (University of Glasgow)	Susanne Abou Ghaida (University of Glasgow)	Hayder Shanbara (Liverpool John Moores University)	Anmar Dulaimi (Liverpool John Moores University
	14:55 – 15:15	Shaikha Abdool (BUiD)	Alya Harbi (BUiD)	Christine Unterhitzenberger (Liverpool John Moores University)	Nadia Mohammed (BUiD MBA)	Susanne Abou Ghaida (University of Glasgow)	Yan Zengh (University of Glasgow)	Hassnen Jafer (Liverpool John Moores University)	Ali Al-Attabi (Liverpool John Moores University)
	15:15 – 15:35	Ala'a Abuhejleh (BUiD)	Bertug Ozarisoy (Cardiff University)	Nada Rabie (BUiD)	Rajesh Pai (Manipal University)	Nesrin Tantawy (BUiD)	Fatema Huzefa (BUiD)	Ameer Jebur (Liverpool John Moores University)	Khalid Hashim (Liverpool John Moores University
	15:35 – 15:55	Issam Ezzeddine (Heriot-Watt University)	Marwan Abu Ebeid (Heriot-Watt University)	Ruslan Ibraev (SKOLKOVO)	Gabriele Capogna (University of Rome)	Fatema Huzefa (BUiD)	Nesrin Tantawy (BUiD)	Anmar Dulaimi (Liverpool John Moores University	Hayder Shanbara (Liverpool John Moores University)
	15:55-16:15	Shireen Chaya (BUiD)	Sundus Sherief (BUiD)	Nadia Mohammed (BUiD MBA)	Christine Unterhitzenberger (Liverpool John Moores University)	Hannah Wilson (Liverpool John Moores University)	Mohammed Assaf (BUiD)	Ali Al- Attabi (Liverpool John Moores University)	Hassnen Jafer (Liverpool John Moores University)
	16:15 – 16:35	Bertug Ozarisoy (Cardiff University)	Sundus Sherief (BUiD)					Ali Al-Zeyadi (Liverpool John Moores University)	Christine Unterhitzenberger (Liverpool John Moores University

Session	Time	Auditorium Education Chair: Dr. Lang Wanphet		CR 1 Full Research Proposal Closed Session Chair: Prof. Paul Gardiner		CR 2 Full Research Proposal Closed Session Chair: Prof. Julian Dow		CR3 Engineering & IT Chair: Prof. Halim Boussebaine	
		Presenter	Discussant	Presenter	Discussant	Presenter	Discussant	Presenter	Discussant
3 16:35 - 18:15	16:35– 16:55	Rania Amaireh (BUiD)	Khawla Al-Shehi (BUiD)	Ayesha Al Janahi (BUiD)		Bhavana Nair (BUiD)		Ashok Iyer (Cardiff University)	Sundus Sherief (BUiD)
	16:55 – 17:15	Auditorium Engineering & IT Chair: Dr. Lang Wanphet		Sulaiman Shebli (BUID)		Lolowa AlMarzouqi (BUiD)		Nawal Rashed Al Hassani (BUiD)	Christine Unterhitzenberger

									(Liverpool John Moores University
	17:15 – 17:35	Fuad Al Attar (BUID)	Ibrahim Nasser (BUiD)	Yacoub Petro (BUiD)		Fatima Abazar (BUiD)		Marwan Abu Ebeid (Heriot-Watt University)	Issam Ezzeddine (Heriot-Watt University)
	17:35 – 17:55	Fuad Al Attar (BUID	David Kantro (BUiD)	Sundus Sherief (BUiD)		Nooreya Alobeidli (BUiD)		Hoor Riadh (BUiD)	Aseel Hussein (BUiD)
	17: 55 – 18:15	David Kantro (BUiD)	Fuad Al Attar (BUID)	Jumah Al Mazroue i (BUiD)		Reena Rajivan (BUiD)		Huda Al Suwaidi (BUID)	Christine Unterhitzen berger (Liverpool John Moores University)
18:15		***Awards Ceremony & Farewells***							

The Relationship between Operating Condition and Sludge Wasting of an Aerobic Suspension Sequencing Batch Reactor (ASSBR) Treating Phenolic Wastewater

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Abstract

Petroleum refinery wastewater (PRW) can be considered as one of the most significant sources of aquatic environmental pollution. It consists of oil and grease along with many other toxic organic pollutants. In recent years, a new technique has been implemented using different types of membranes and sequencing batch reactors (SBRs) to treat PRW. SBR is a fill-and-draw type sludge system which operates in time instead of space. Many researchers have optimised SBRs' operating conditions to obtain maximum removal of undesired wastewater pollutants. This technique has gained more importance mainly because of its essential flexibility in cycle time. It can handle shock loads, requires less area for operation and is easy to operate. However, bulking sludge or discharging floating or settled sludge during the draw or decant phases occur with some SBR configurations, which is a problem in the SBR system. The main aim of this study is to develop an innovative design for the SBR, optimising the process variables to result in a more robust and efficient process. Several experimental tests will be developed to determine the removal percentages of chemical oxygen demand (COD), biochemical oxygen demand (BOD), phenol and nitrogen compounds from synthetic PRW. Furthermore, the dissolved oxygen (DO), pH, temperature and oxidation-reduction potential (ORP) of the SBR system will be monitored online to ensure that there is a good environment for the microorganisms to biodegrade the organic matter effectively.

Keywords: Hydraulic retention time, Petroleum refinery wastewater, Phenol, Sequencing batch reactor.

Introduction

Petroleum refinery wastewater (PRW) is a refractory wastewater containing organic and inorganic constituents, and complex aromatics [1]. Crude oil consists of suspended solids, organic and inorganic compounds containing salts, and water-soluble metals. To remove contaminants, crude oil undergoes a

desalting process using large quantities of water; however, the desalting process might cause plugging, corrosion and fouling of equipment [2]. In general, compounds in PRW consist of dispersed and dissolved oil, and dissolved formation minerals [3], [4]. Oil is a mixture of hydrocarbons such as BTEX, polyaromatic hydrocarbons (PAHs) and phenol [2], while dissolved formation minerals are inorganic compounds, which consist of anions and cations including heavy metals [2]-[5].

The traditional treatment methods for refinery wastewater are physicochemical, mechanical and biological [6]. One of the alternatives to the conventional activated sludge process is a sequencing batch reactor (SBR). The SBR is an activated sludge process (ASP) wastewater treatment technology. It has been successfully used in the treatment of both industrial and municipal wastewater [7]. In addition, the SBR is a fill-and-draw type sludge system which operates in time instead of space. In a single tank, the SBR performs equalisation, neutralisation, biological treatments and secondary sedimentation via a timed control sequence [8]. The USEPA state that the SBR operation system has five basic operating modes – Fill, React, Settle, Draw and Idle [9]. Mainly due to its unique single tank design and ease of use in industry, the uptake of SBR technology has increased over recent years. Many researchers have optimised its operating conditions to obtain maximum removal of undesired wastewater compounds. The difference between the SBR system and a conventional activated sludge system is that the SBR includes all treatment units in a single tank, while, in the latter, these units require separate basins.

Hydraulic retention time (HRT) is one of the most significant parameters in biological treatment as it can affect the degree of treatment of the important pollution parameters. Leong et al. [10] stated that, via SBR, complete phenol removal has been reached with a 12-hour cycle. In addition, Thakur, Deo Mall and Srivastava [11] studied the effect of HRT and filling time on simultaneous biodegradation of phenol, resorcinol and catechol. The results showed that an increase in HRT from 0.625 d to 1.25 d caused an increase in the COD, phenol, resorcinol and catechol removal efficiencies.

Moreover, Thakur, Srivastava and Mall [12] used SBR to reduce the organic matter present in petroleum refinery wastewater; a variation of HRT (0.56-3.33d) was used under instantaneous fill mode, and the results showed that the removal efficiency of COD and TOC was 77% and 79% respectively. Furthermore, in another study [13], SBR with periodic HRT showed better performance than SBR with long HRT.

The aim of this study is to determine the relationship between HRT and sludge characteristics in the modified SBR system by studying different HRTs (8, 12, 18 and 24 hrs) and determine its impact on sludge characteristics and effluent quality.

Materials and methods

Experimental set-up of SBR

In this research, four identical reactors will be used in the SBR system, R1, R2, R3 and R4. Each has a 5L capacity. All of the reactors will be filled with 3-4L of synthetic wastewater containing undesirable chemicals, and 1-2L of bacteria (biomass) will be added to each reactor for biological wastewater treatment. The treatment reactors will be equipped with four electronic sensors (probes) to measure the

parameters of pH, dissolved oxygen (DO), temperature and oxidation-reduction potential (ORP). The configuration of one of the four SBR reactors used in this research is shown in Fig. 1.

The system will operate within (8-24) hours HRT, and the samples will be taken and analysed from the treatment reactors (R1, R2, R3 and R4) for influent and effluent respectively.

Synthetic wastewater

The synthetic wastewater contains a mixture of chemicals, as shown in Table 1. The wastewater will be changed daily for each reactor with the mentioned concentrations. It is expected that the added chemicals will have a strong effect and lead to changes in the water quality. The bacteria will start their activities when the aeration and chemicals are available.

The bacteria (biomass) are a mixed culture of sewage-activated sludge, which will be brought from Liverpool Wastewater Treatment Works, Sandon Docks, Liverpool, UK.

Research methodology

The flow shown in Fig. 2 describes the methodology of sampling and testing water quality parameters. It will start by taking the sample from the reactors after adding the synthetic wastewater and analysing phenol, BOD, COD, ammonia-nitrogen (NH_3-N), nitrate-nitrogen (NO_3-N) and nitrite-nitrogen (NO_2-N). After adding the synthetic wastewater to the treatment reactors, the LabVIEW software will start to record the DO, pH, temperature and ORP data and save it to the computer. After completing the treatment of each reactor, an effluent sample should be taken and analysed again to find the removal rates of phenol, BOD, COD, NH_3-N, NO_3-N and NO_2-N, and to find the sludge volume index (SVI) and mixed liquor suspended solid (MLSS) to study the sludge characteristics and to evaluate the SBR system.

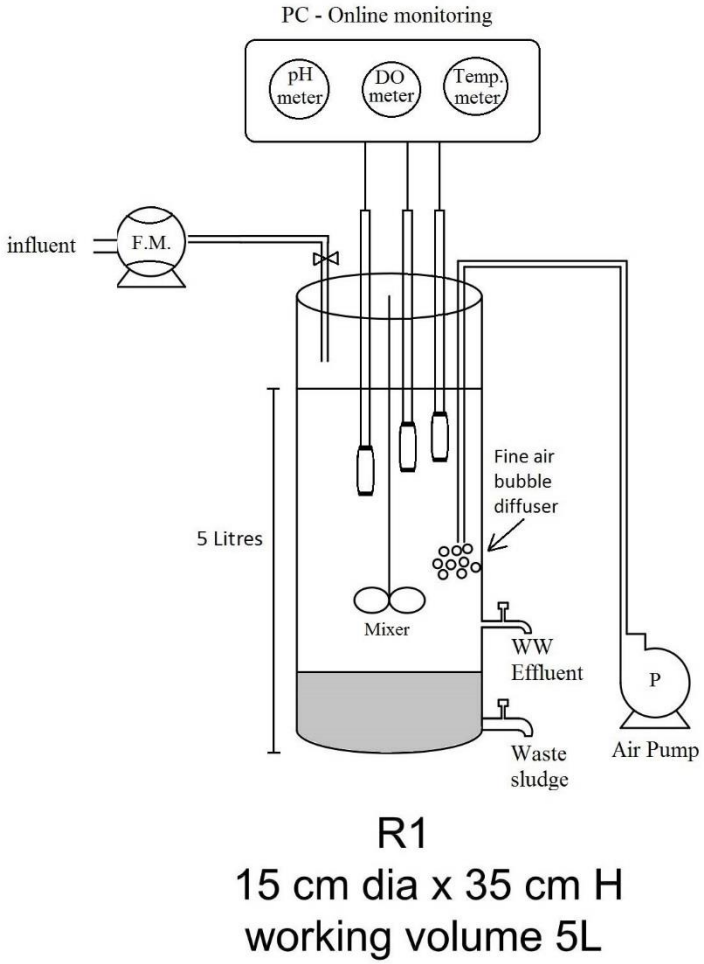

Fig. 1 The configuration of R1, one of the identical laboratory SBRs (R1, R2, R3 and R4)

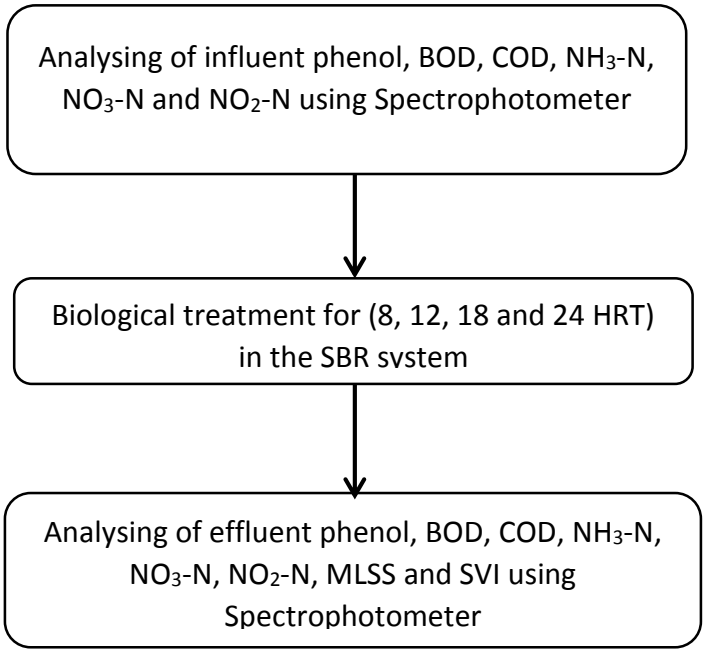

Fig. 2 The methodology for sampling and testing water quality parameters

Expected results

This research project expects to save the operation costs and improve the sludge characteristics as well as to enhance the effluent quality by finding the relationship between the operating conditions and sludge characteristics, and its impact on the treatment efficiency of PRW.

Table 1: Compositions of the synthetic wastewater

Chemicals	Compositions of the synthetic wastewater
Glucose, Sigma-Aldrich, UK	500 mg/l
Magnesium Sulphate Heptahydrate, Sigma-Aldrich, UK	5 mg/l
Sodium Bicarbonate, Sigma-Aldrich, UK	200 mg/l
Monobasic Potassium Phosphate, Sigma-Aldrich, UK	5.7 mg/l
Ammonium Chloride, Sigma-Aldrich, UK	25 mg/l
Phenol, Sigma-Aldrich, UK	20 – 2000 mg/l
Calcium Chloride Dihydrate, Sigma-Aldrich, UK	0.15 mg/l
Iron(III) Chloride Hexahydrate, Sigma-Aldrich, UK	1.5 mg/l

Acknowledgment

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References

Diya'uddeen, B. H., Rahim Pouran, S., Abdul Aziz, A. R., Nashwan, S. M., Wan Daud, W. M. A. & Shaaban, M. G., Hybrid of Fenton and sequencing batch reactor for petroleum refinery wastewater treatment. *Journal of Industrial and Engineering Chemistry,* 25, 186-191, 2015.

Ishak, S., Ahmed, A. M. & Isa, M. H., Refinery wastewater biological treatment: A short review. *Journal of Scientific & Industrial Research,* 71, 251–256, 2012.

Ma, F. & Guo, J. B., Application of bio-augmentation to improve the activated sludge system into the contact oxidation system treating. *Petrochemical Wastewater Bioresource Technology,* 100, 597–602, 2009.

Razi, A. F., Pendashteh, A., Chuah, A. L., Radiah, D. A. B., Sayed, S. M. & Zainal, Z. A., Review of technologies for oil and gas produced water treatment. *Journal of Hazardous Materials,* 170, 530-551, 2009.

Khaing, T-H., Li, J., Li, Y., Wai, N. & Wong, F. S., Feasibility study on petrochemical wastewater treatment and reuse using a novel submerged membrane distillation bioreactor. *Separation and Purification Technology,* 74, 138–143, 2010.

El-Naas, M. H., Alhaija, M. A. & Al-Zuhair, S., Evaluation of a three-step process for the treatment of petroleum refinery wastewater. *Journal of Environmental Chemical Engineering,* 2(1), 56-62, 2014.

Bagheri, M., S. A., M., Ehteshami, M. & Bagheri, Z., Modeling of a sequencing batch reactor treating municipal wastewater using multi-layer perceptron and radial basis function artificial neural networks. *Process Safety and Environmental Protection,* 93, 111–123, 2015.

Alattabi, A. W. N., Abdullah, S. R. R. & Hasan, H. A., Effects of initial organic loading and pharmaceutical compounds on the removal of COD, Ibuprofen and Ketoprofen in SBR. *Integrated Journal of Engineering Research and Technology,* 2(1), 88-100, 2015.

USEPA, *Wastewater technology fact sheet: Sequencing batch reactors*. Washington, DC: US Environmental Protection Agency*,* 1999.

Leong, M. L., Lee, K. M., Lai, S. O. & Ooi, S. O., Sludge characteristics and performances of the sequencing batch reactor at differences influent phenol concentrations. *Desalination,* 270, 181-187, 2011.

Thakur, C., Deo Mall, I. & Srivastava, V. C., Effect of Hydraulic Retention Time and Filling Time on Simultaneous Biodegradation of Phenol, Resorcinol and Catechol in a Sequencing Batch Reactor. *Archives of Environmental Protection*, 39(2), 69-80, 2013.

Thakur, C., Srivastava, V. C. & Mall, I. D., Aerobic degradation of petroleum refinery wastewater in sequential batch reactor. *J Environ Sci Health A Tox Hazard Subst Environ Eng,* 49(12), 1436-44, 2014.

Rodriguez-Caballero, A., Aymerich, I., Marques, R., Poch, M. & Pijuan, M., Minimizing N_2O emissions and carbon footprint on a full-scale activated sludge sequencing batch reactor. *Water Res,* 71, 1-10, 2015.

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