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## About the Journal



### History of Jurnal Teknologi

Jurnal Teknologi was first published in April 1977, then known as Teknolog. Its publications, however, only began to take off on regular basis in 1992.

The publication of Jurnal Teknologi aims to be the forum for academics and practitioners to write and publish their latest work. Specifically, the journal serves to disseminate to the public results of current and on-going research projects conducted by UTM academics in various fields.

As the journal continues to grow, starting from June 1999, with volume No. 30, Jurnal Teknologi was revamped. The journal now comes in a set of six series (A-F), published twice a year (June and December). Each series specifically focuses on specialized fields: A (Manufacturing, Advanced Materials, Energy, and Transport); B (Construction, Design, and Planning); C (Science and Mathematics); D (Electronics, Control, Communication, and Information Technology); E (Management, Education, and Social Sciences) and F (Environment and Process Technology).

Starting from year 2010, six series of Jurnal Teknologi were merged into two series known as; Jurnal Teknologi (Science and Engineering) and Jurnal Teknologi (Social Sciences). Published online six time a year (January, March, May, July, September and November). On 2016, Jurnal Teknologi (Sciences and Engineering) will be published every month. However, under new management, Jurnal Teknologi

(Science and Engineering) will be published online six time a year (January, March, May, July, September and November) on 2017.

On 2014, Jurnal Teknologi (Sciences & Engineering) has been separated from Jurnal Teknologi (Social Sciences). Jurnal Teknologi (Social Sciences) is now known as Sains Humanika.

Jurnal Teknologi (Sciences & Engineering) is now indexed by **SCOPUS**.

## Focus and Scope

Jurnal Teknologi (Sciences & Engineering) is an international research journal and invites contributions of original and novel fundamental research. The journal aims to provide an international forum for the presentation of original fundamental research, interpretative reviews and discussion of new developments in the area of Mathematics, Natural Sciences and Applied Mathematics and Natural Sciences.

Papers which describe novel theory and its application to practice are welcome, as are those which illustrate the transfer of multi-disciplinary techniques from other disciplines. Reports of carefully executed experimental work, which is soundly interpreted are also welcome. The overall focus is on original and rigorous research results which have generic significance.

Jurnal Teknologi (Sciences & Engineering) invites manuscripts based on original research in any area of Mathematics, Natural Sciences (Biological Sciences, Physical Sciences: Physics, Chemistry, Astronomy, Earth Science), Applied Mathematics and Natural Sciences (Building Physics, Mechanical Engineering, Chemical Engineering, Civil Engineering, Material Science, Bioechnology, Medical Engineering), Electrical Engineering.

Jurnal Teknologi (Sciences & Engineering) does not limit itself to a single perspective or approach, but seeks to represent the diversity of the aforementioned field.

Comments and Proposals: Jurnal Teknologi (Sciences & Engineering) is interested in receiving comments/feedback on this and our other journals and welcome publication proposals for books, electronic products, new journals and co-operation for existing journals.

## Peer Review Process

Jurnal Teknologi uses Plagiarism Detection Software – Turnitin® to screen for plagiarism before publication. This journal operates a conventional double-blind reviewing policy in which the author and reviewer's name is always concealed from both parties. Authors should present their papers honestly without fabrication, falsification, plagiarism or inappropriate data manipulation. Submitted papers are evaluated by anonymous referees based on knowledge contribution, originality, relevance and presentation. Papers will be sent for anonymous review by at least two (2) reviewers who will either be members of the Editorial Board or others of similar standing in the field. In order to shorten the review process and respond quickly to authors, the Editors may triage a submission and come to a decision without sending the paper for external review. The Editor shall inform the authors of the results of the review in less than 10 weeks. The Editors' decision is final and no correspondence can be entered into concerning manuscripts considered unsuitable for publication in this journal. All correspondence, including notification of the Editors' decision and requests for revisions, will be sent by email.

Special issues and/or conference proceedings may have different peer review procedures involving, for example, Guest Editors, conference organisers or scientific committees. Authors contributing to these projects may receive full details of the peer review process on request from the editorial office.

## Publication Frequency

*Jurnal Teknologi* is published online with a frequency of Six (6) issues per year (January, March, May, July, September and November).

## Open Access Policy

This journal provides immediate open access to its content on the principle that making research freely available to the public supports a greater global exchange of knowledge.

## Sponsors



Universiti Teknologi Malaysia (UTM) is a leading innovation-driven entrepreneurial research university in engineering science and technology located both in Kuala Lumpur, the capital city of Malaysia and Johor Bahru, the southern city in Iskandar Malaysia, which is a vibrant economic corridor in the south of Peninsular Malaysia.

With a strength of more than 2,000 academic staff, of which more than 200 are foreign graduate faculty members, UTM continuously strives to develop and enhance quality academic and professional programmes of international standard and global recognition. The student population consists of more than 11,000 full-time undergraduate students, more than 6,000 enrolled on distance learning programmes as part-time students and more than 9,000 postgraduate students in various fields of specialisation. Out of this, more than 3,000 are foreign students.

UTM's mission is to lead in the development of creative and innovative human capital and advanced technologies that will contribute to the nations wealth creation. This is in line with the aspiration of the country towards becoming a knowledge-based, innovation-led economy grounded in creativity and innovation with high value creation. Through a strategic transformation of its organizational structure, UTM is focused in creating a vibrant academic culture and fertile intellectual ecosystem that inspire creativity and innovation.

Innovation is thus central to its core value, with the innovation culture permeated across all dimensions of the university including teaching and learning, research and development, writing and publication, management and administration, staff and student development, consultancy and professional services and also university social responsibility. Innovation is expedited by the university community through concerted effort and strong team spirit with shared mission and purpose.

UTM has also established a reputation for innovative education and leading-edge, proven by becoming the three-time winner for the National Intellectual Property Award for organization category. A stimulating research culture exists in UTM through 11 Research Alliances (RA) in strategic disciplines namely Sustainability, Infocomm, Water, Cybernetics, Biotech, Construction, Materials & Manufacturing, K-Economy, Energy, Transportation and Nanotechnology. In addition there are 28 Centres of Excellence (CoE) in addition to academic faculties to service technological education and research needs of the university.

UTM is also actively engaged in research collaboration with renowned institutions such as Harvard University, MIT, University of Oxford, Imperial College of London, University of Cambridge, Tokyo University and Meiji University on areas of mutual interests. To facilitate further engagement and networking in academic and research undertakings, international satellite offices have been established in Tokyo, and already in the pipeline are plans to establish satellite offices in Doha (Qatar), Madinah (Saudi Arabia), and in Boston (USA).

UTM is thus renowned for being at the forefront of engineering and technological knowledge and expertise, contributing to the technical and professional workforce of the nation since 1904. Being a graduate-focused university, UTM has the highest number of postgraduate enrolment in engineering and technology, which is one of the important components in contributing towards the development of an innovation-led economy. Having produced more than 200,000 technical graduates and qualified professionals over the years, UTM has earned its place as Malaysia's premier university in engineering and technology which inspires creativity and innovation.

- [Universiti Teknologi Malaysia](https://www.utm.my/jurnalteknologi)

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## Database Indexing

 <b>Journal Citation Reports™ 2023</b>
<b>Journal Impact Factor™ (JIF)</b>
<b>2022</b>
<b>0.7</b>
<b>Category:</b> Engineering, Multidisciplinary
JCR SUBSCRIPTION ACTIVE 



**1.5** 2022  
CiteScore

39th percentile  
Powered by **Scopus**



## Submission Guide

Editorial Workflow in OJS 3 - Module 3 - Submitting an Artic...



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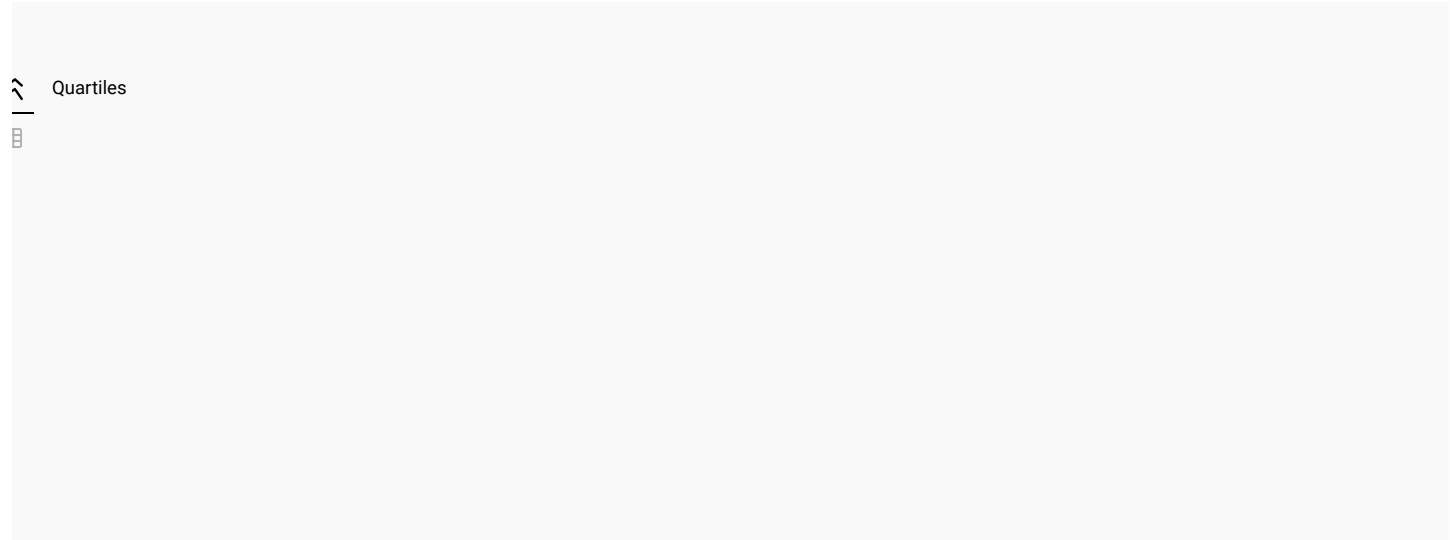
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PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION
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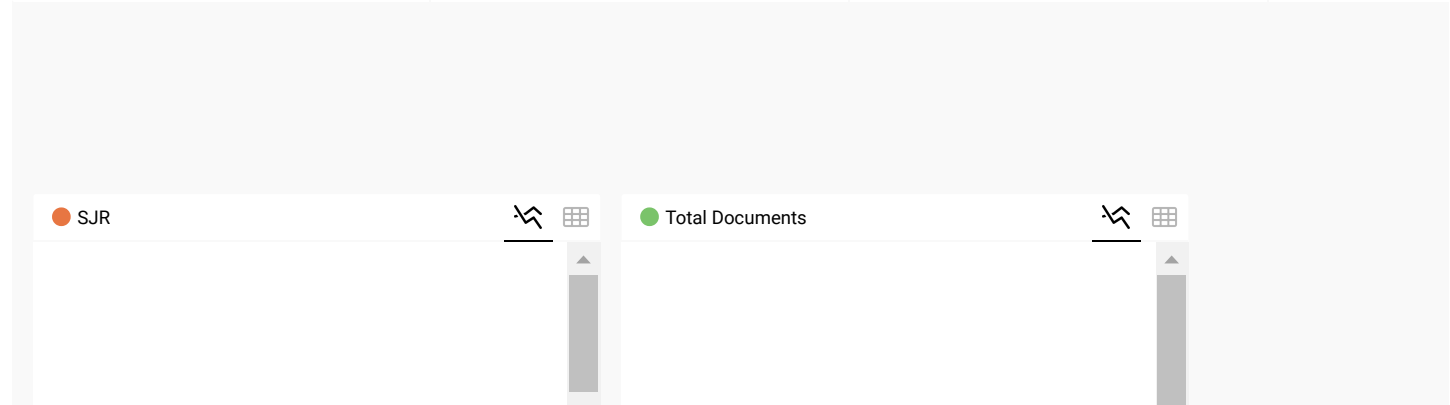
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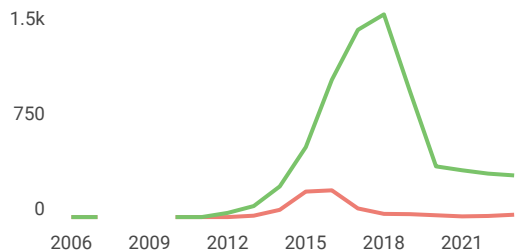
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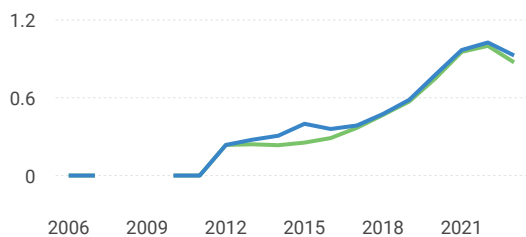
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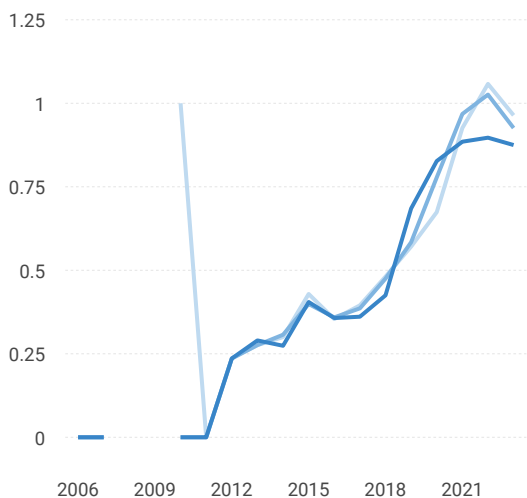
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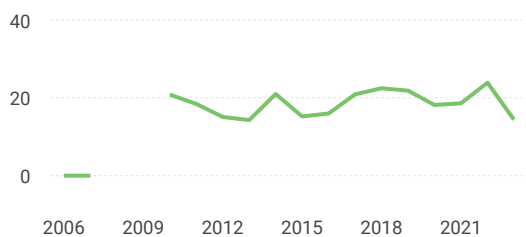
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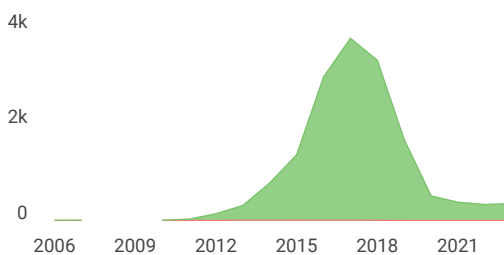
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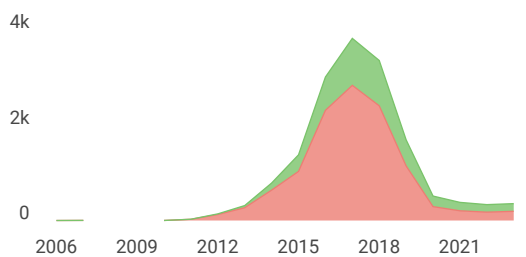
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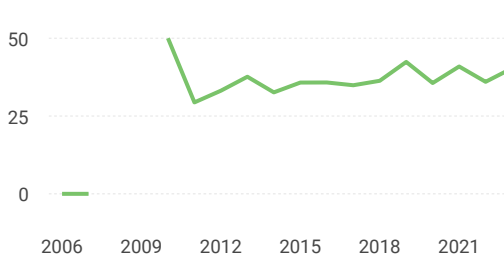
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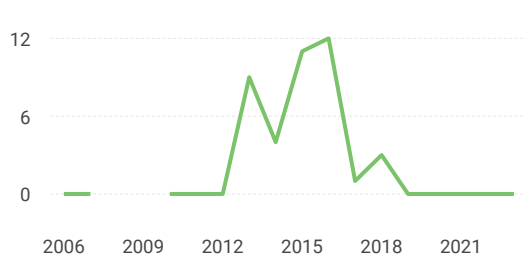
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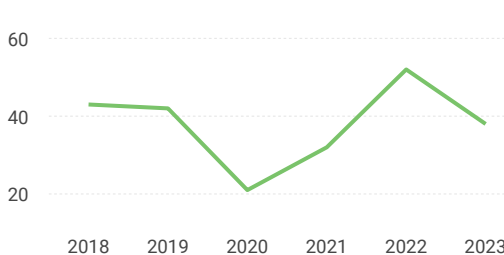
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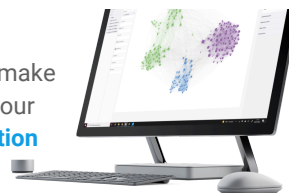
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**Ami Nazifah** 10 months ago

What is the Quadrant and ISI Impact Factor Journal for Jurnal Teknologi on 2018?

← reply



**Melanie Ortiz** 9 months ago

SCImago Team

Dear Ami, thank you very much for your comment. SCImago Journal and Country Rank uses Scopus data, our impact indicator is the SJR (Check it above). We suggest you consult the Journal Citation Report for other indicators (like Impact Factor) with a Web of Science data source. Best Regards, SCImago Team



**hajar** 2 years ago

how long it takes to accept or not a submission ?

← reply



**Melanie Ortiz** 2 years ago

SCImago Team

Dear Hajar,  
Thank you for contacting us.  
We suggest you visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.  
Best Regards, SCImago Team

**Isa** 2 years ago

I am really disappointed to have submitted my work to this j. They have behaved very badly, in a way that is absolutely inconsistent with their rating. 9 months have passed since the submission, during which they have never responded to any request for clarification about the long review process. The e-mails to the editor in chief bounce and there is no way to get clarification of any kind. The feeling is that of an absolute lack of professionalism. My co-authors and I are in the process of withdrawing the work. Treating in this way an article written by colleagues and that has required months and months of work is truly a sad, disrespectful and not worthy attitude of those involved in research. Never again

reply

**Syarifah Fazilah Yuhari** 4 years ago

Hello, I'm Syarifah, here I want to ask a favor questions about publication in term of:

- Scope of paper
- publication fee (2021)
- format

Thank you for your intention

reply

**majeed** 4 years ago

<https://journals.utm.my/jurnalteknologi/about/submissions>

**Melanie Ortiz** 4 years ago

SCImago Team

Dear Syarifah,  
thank you for contacting us.  
Unfortunately, we cannot help you with your request, we suggest you visit the journal's homepage or contact the journal's editorial staff, so they could inform you more deeply.  
Best Regards, SCImago Team

**eko supriyadi** 4 years ago

I have a problem with this journal, for example, my manuscript is stored in the Turnitin repository and experienced rejection by this journal.. Other authors may consider using this journal to submit his manuscript. hopefully, the editor of a technology journal considers this issue..thx

reply

**Melanie Ortiz** 4 years ago

SCImago Team

Dear Eko, thanks for your participation! Best Regards, SCImago Team





**Aramesh** 4 years ago

Dear Madam/Sir,

I have been reviewer for this journal and I am writing to you to request a letter that confirmed it and mentioned how many paper I evaluated.

Best regards,  
Dr.Seif

← reply



**Melanie Ortiz** 4 years ago

SCImago Team

Dear Aramesh,  
thank you for contacting us.

We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.

Unfortunately, we cannot help you with your request, we suggest you contact the journal's editorial staff , so they could inform you more deeply.

Best Regards, SCImago Team



**Kharimatul Fachriah** 4 years ago

World you like to give me the price for manuscript?

← reply



**Melanie Ortiz** 4 years ago

SCImago Team

Dear Kharimatul,  
thank you for contacting us.

We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.

Unfortunately, we cannot help you with your request, we suggest you visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.

Best Regards, SCImago Team



**Rakhman Sarwono** 4 years ago

Thanks

← reply

R

**Rakhman Sarwono** 4 years ago

I want to ask about my paper  
No. P: 14565  
What is going on with my paper

Thank you

← reply

**Melanie Ortiz** 4 years ago

SCImago Team

Dear Rakhman,  
thank you for contacting us.  
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Best Regards, SCImago Team

F

**FAKHRUL ANUAR AZIZ** 4 years ago

Saya masih menunggu maklumat tentang kertas kerja yang dijanjikan untuk masuk ke JURNAL ini. Saya hantar ke ADVCIT 2015, KRABI. Sampai saat ini saya tak dapat info apa-apa dari jurnal ini. Harap pihak tuan bertindak segera. Sila hubungi saya melalui emel yang disertakan.

← reply

**Melanie Ortiz** 4 years ago

SCImago Team

Dear Fakhru,

thank you for contacting us.

We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.

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Best Regards, SCImago Team

S

**S.A** 5 years ago

I am willing to submit a manuscript in "Journal Teknologi" but the website of the journal doesn't work properly.

I have tried several times to submit, but all the time I received an error message! Would you please kindly let me know how can I submit my manuscript in this journal?

Thank you very much. I remain

← reply

B

**bimal patel** 4 years ago

Even I am getting same problem. I think one more journal with same name available but with different ISSN

**Melanie Ortiz** 5 years ago

SCImago Team

Dear Sir/Madam,  
thank you for contacting us.  
Unfortunately, we cannot help you with your request, we suggest you contact the journal's editorial staff, so they could inform you more deeply.  
Best Regards, SCImago Team

J

**Jasim Humadi Hassen** 5 years ago

I send two manuscripts for publication in this journal a year ago and the journal rejected them. We published them in other journals. On doing plagiarism the report says that they submitted to your journal and show 90% plagiarism. They are still there on the database of the journal as archived. How to delete them. I wrote to the journal but no answer.

[← reply](#)

Z

**Zeena** 2 years ago

Hi dear Sir  
Can you please inform me the other journal address to publish my paper  
Thank you so much

M

**mosa** 5 years ago

It was the same case that has been commented in this page for 10 months ago. Maybe the scimago will help to contact the journal to solve the problem.

J

**Jasim Humadi Hassen** 5 years ago

Dear Melanie Ortiz

Please do not tell me to contact the journal, simply they do not answer. You should find a solution. What is your role if you can't solve a problem like this?

Regards

**Melanie Ortiz** 5 years ago

SCImago Team

Dear Jasim,

SCImago Journal & Country Rank is a portal with scientometric indicators of

journals indexed in Elsevier/Scopus. We always try to help our users regarding different issues, however, this is not our responsibility. We are committed to help decision-making through scientometric indicators.

Best Regards, SCImago Team



**Melanie Ortiz** 5 years ago

SCImago Team

Dear Jasim,  
thank you for contacting us.  
Unfortunately, we cannot help you with your request, we suggest you to contact another member of the editorial staff , so they could inform you more deeply.  
Best Regards, SCImago Team



**wahyu budianto** 5 years ago

Is it for the Knowledge Management Evaluation Model journal system to improve the Performance of Case Study Employees at PT PLN (Persero)

← reply



**Melanie Ortiz** 5 years ago

SCImago Team

Dear Wahyu,  
Could you please expand a little bit your comment? Best Regards, SCImago Team



**Bayu ardiansah** 5 years ago

Jurnal Teknologi provides online submission to every manuscript.  
All activities should be done through online. After submission, you will get notification. Once submitted (during review process), authors will not be able to retract the paper (may be this is ethical), and not allowed to submit manuscript to other journals until review process has been done (got notification of acceptance/rejection/revision).

In my case (<https://jurnalteknologi.utm.my/index.php/jurnalteknologi/article/view/13243>) , all process need about 5 months waiting. And it no problems.  
Probably, 1 month is very short to wait. Ans note that, this is journal from scientific community (by UTM), non provit organization, so they will do carefully, and may be, need longer review process..  
Hope this explanation help.

← reply



**Susilawati** 5 years ago

We submitted the manuscript on Jurnal Teknologi, however, after 1 month waiting, we did not get any notification. So, we withdraw the manuscript and send it to another journal. However, that another journal found that our similarity index was 97% since Jurnal Teknologi save our work on

their Turnitin database as student paper of UTM Repository...What??? We are not even students from UTM!! So, another journal rejected our paper due to that occasion, they suggested us to remove our paper first from UTM database. However, Jurnal Teknologi does not want to delete it (maybe they forget the Turnitin ID of checking), even when we ask for the ID, and the funny things that UTM Turnitin operator also ask us to request the ID from Jurnal Teknologi UTM, still Jurnal Teknologi does not want to give the ID. We just want to get the ID and remove it!! It seems like we need to paraphrase everything.....Therefore I report this here, so anyone who wants to submit to Jurnal Teknologi can consider my experience, and ask the editor first not to save the manuscript to their Turnitin Database.

← reply



**Jasim Humadi Hassen** 5 years ago

I have the same problem. Did you find a solution?

Regards



**hisham** 5 years ago

there are much more good journal where you can submit your manuscript rather than submitting to this journal!!!!



**A Razali** 5 years ago

Thank you for sharing the tips.



**Melanie Ortiz** 5 years ago

SCImago Team

Dear Razali, thanks for your participation! Best Regards, SCImago Team



**Bayu ardiansah** 5 years ago

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Vol. 69 No. 6: Special Issue on Current and Emerging Trends in Technology, Science and Engineering Vol. 3

## Vol. 69 No. 6: Special Issue on Current and Emerging Trends in Technology, Science and Engineering Vol. 3

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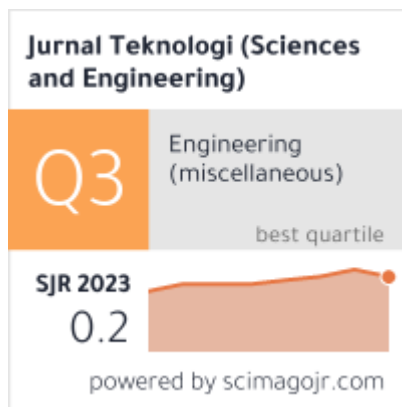


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# Improving Performance of Water Treatment on Oxidation Ditch Using Modification of Reactor Hydrodynamic

Rositayanti Hadisoebroto<sup>a</sup>, Idris Maxdoni Kamil<sup>a\*</sup>, Suprihanto Notodarmojo<sup>a</sup>, Yazid Bindar<sup>b</sup>

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## Graphical abstract



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**Keywords:** Hydraulic aspect; computer simulation; wastewater treatment plant

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## 1.0 INTRODUCTION

Untreated waste water is potent to pollute land and water, whether ground and surface water. One of objectives on Millennium Development Goal is Goal 7 which is to ensure environmental sustainability. As a country that embraces this Goal, Indonesia is committed to ensure that 50% of its people will have water and sanitation access in 2015. That is why the government put a long term vision to reach the goal. Waste water management system in Indonesia is usually on-site system using individual septic tank in household. But unfortunately, many of them have permeable construction, so its overflow and effluent have potential to pollute the environment. There are also off-site systems in some cities, which are usually based on biological treatment of activated sludge. The kinds of activated sludge system are oxidation ditch, oxidation pond, aerated lagoon and stabilization pond. Through wastewater treatment plant, access of proper sanitation could improve.

Oxidation ditch is a modification of activated sludge which was firstly constructed in 1940 [1] and since then, it has been replicated in many countries, including Indonesia. In comparing with conventional activated sludge, oxidation ditch have longer time detention and enhancement possibility to remove nitrate, nitrite and phosphate [2]. Optimization could be done by

improving biochemical process performance and design modification by field observatory, laboratory experiment and computation. Through computational simulation, design modification with hydrodynamics simulation in reactor could be done with many variations of construction to obtain optimal design.

Factors that influence the treatment performance consist of main factors and supporting factors. The main factors are organic loading (waste water influent), solid accumulation, dissolved oxygen level, while the supporting factors are mixing, biological characteristic, equipment enhancement (inlet, outlet, and aeration equipment).

Biological treatment process is an option in domestic wastewater treatment [3], mainly because of wastewater characteristic, beside the financial factor and operational simplicity. Unfortunately, because of this easiness, optimization is rarely done. If any, it only focuses on biological and biochemical aspects inside microorganisms [4]. On the other side, hydraulic and physical aspects in treatment unit have greatly improved the performance. Besides, design of wastewater treatment plant is usually based on design criteria resulted from four-season country, which has different climate characteristic than two-season country as in Indonesia.

Research on hydraulic and physic aspects in laboratory scale and field observatory could be done using tracer studies [5, 6]. However, there is another method that is common in optimizing treatment performance which is modeling the hydrodynamic and chemical removal using computer simulation, i.e. *Computational Fluid Dynamics (CFD)*. The wastewater treatment unit is considers as a reactor. CFD application in many fields shows many advantages in easiness, accuracy, applicable to follow nature phenomena in chemical-physic process, as in medical, aviation, ocean movement, land movement and industrial processes, while the example of application on environmental engineering is ground water pollution [7], surface water [8], water treatment [9], and waste water treatment [10].

To get the optimal design of wastewater treatment, the hydraulic and physic aspect of a research is needed. The research adopted the oxidation ditch as a reactor with CFD application. Initially, a mathematical model of the hydrodynamics and kinetics in wastewater treatment reactor is needed. Subsequently, computer simulation with reactor modification focuses on inlet-outlet and aerator arrangement.

## 2.0 REVIEW ON OXIDATION DITCH UNIT

Oxidation ditch was first build by Pasveer in Texel in 1940 and in Vorschoten, Netherland in 1954 [1]. The application is then widely expanded to other parts of the world, especially where excess land is available. Some of the strengths of this unit include easiness to operate and maintain, high removal efficiency, tolerable to shock loading variation without influencing effluent quality, sludge production relatively small, control easiness by change rotor rotation, efficient in energy, nitrification and denitrification process can easily occur with *biological oxygen demand* (BOD) removal efficiency up to 85-90%. Oxidation ditch can be categorized as advanced aeration activated sludge that could remove organic parameter and even nitrogen-phosphor [2]. Typical form of oxidation ditch unit that was firstly introduced as shown in Figure 1 [1].

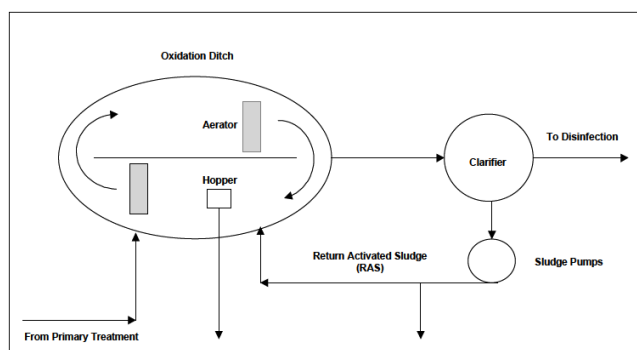


Figure 1 Typical oxidation ditch system [1]

There are two kinds of oxidation system [11, 12], which are carrousel system (Figure 2) and orbal system (Figure 3). Wastewater treatment plant (WWTP) in Indonesia that adopts the oxidation ditch system can be found at the Tanah Tinggi WWTP in Tangerang. Table 1 shows laboratory analysis result of influent and effluent of the WWTP [12]. The table indicates the lack of Government performance, comparing with effluent standard of Government Decree No. 82/2001 with regards to Water Environmental Quality Management and Water Pollution Control.

Table 1 Laboratory analysis of water influent and effluent quality on oxidation ditch WWTP Tanah Tinggi Feb 18<sup>th</sup> 2011 [12]

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BOD	mg/L	12	156	28
COD	mg/L	100	117	45

\*Based on Government Decree No. 82/2001 with regards to Water Environmental Quality Management and Water Pollution Control



Figure 2 Oxidation ditch unit in WWTP Jababeka [11]



Figure 3 Oxidation ditch unit in WWTP Tanah Tinggi [12]

## 3.0 REVIEW ON REACTOR HYDRODYNAMIC

The most common hydrodynamic study is tracer study, as conducted buy Mendez-Romero in 2011 [13]. The tracer study usually gives good result, but there is a constraint in scaling-up and scaling-down implementation because of some parameter values that are outside the experimental parameter values. However, this constraint can be overcome by using computer simulation.

The correlation between hydrodynamic aspect and microorganism activities can be shown in the mathematical modeling of the dispersive flow [14]. The mathematical model can be developed using computational methods to observe the increment of oxygen supply in oxidation ditch reactor. A model can be built based on various types of oxygen supply: diffuser [15], up aerator spray [16], bottom aerator spray (along reactor) [17], and surface aerator [18].

## 4.0 REVIEW ON COMPUTATIONAL FLUID DYNAMIC

Computational Fluid Dynamic (CFD) Model has been applied in many fields, including environmental engineering. Specifically, CFD is use to model process kinetics, transfer oxygen,



modification on treatment unit and hydrodynamic in various water treatment [19-22]. Computer simulated CFD can be applied in channeling activated sludge reactor [15-17] and expanded granular sludge bed reactor [10]. According to Huang *et al.*, combination of CFD model and kinetics of reaction was more accurate and make sense than kinetic model in biological system modeling [20]. Therefore the research focus on hydrodynamic aspects and kinetic reaction in oxidation ditch reactor is needed to get the optimal design of oxidation ditch water treatment unit.

## 5.0 EXPERIMENTAL

### 5.1 Reactor Design

Based on a review of past studies and from field observation, we built reactor design to conduct a tracer study (Figure 4).

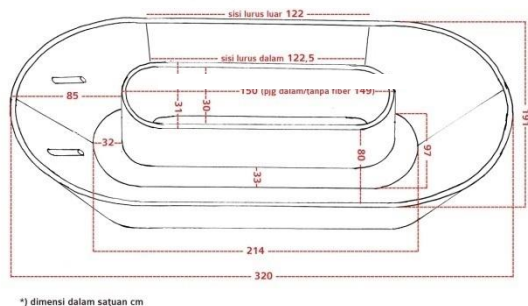


Figure 4 Oxidation ditch reactor in laboratory scale

The dimensions of the reactor were based on the following design criteria: wall slope of 45° and the inlet velocity is 1 m/sec. The equations used for computer simulation are continuity equation and momentum Equation [10]:

$$\frac{\partial U_i}{\partial x_i} = 0;$$

$$\frac{\partial}{\partial x_j} (U_i U_j) = -\frac{1}{\rho} \frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j} \left[ \gamma t \left( \frac{\partial U_i}{\partial x_j} + \frac{\partial U_j}{\partial x_i} \right) \right]$$

Where :

- U = velocity in x-direction (m/sec)
- P = pressure force
- X = distance (m)

Media in the simulation is liquid (water).

## 6.0 RESULTS AND DISCUSSION

The 2D simulation on reactor surface shows the results as illustrated in Figures 5-7.

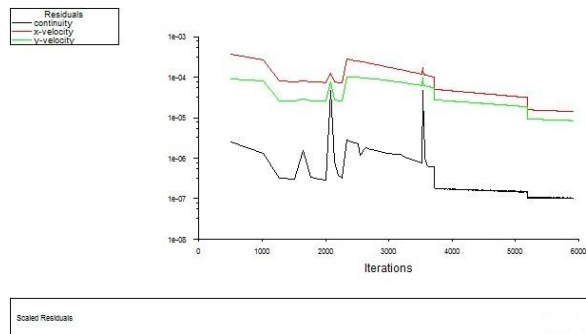


Figure 5 Residual statistic of 2D simulation

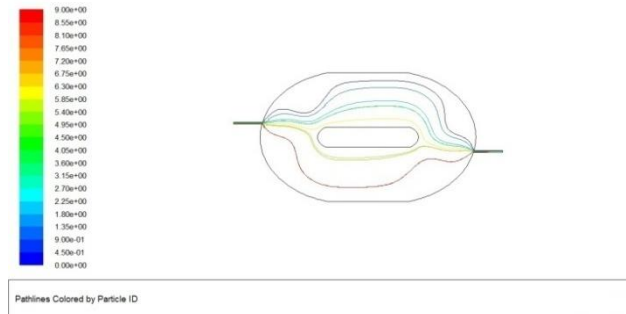


Figure 6 Pathline of 2D simulation

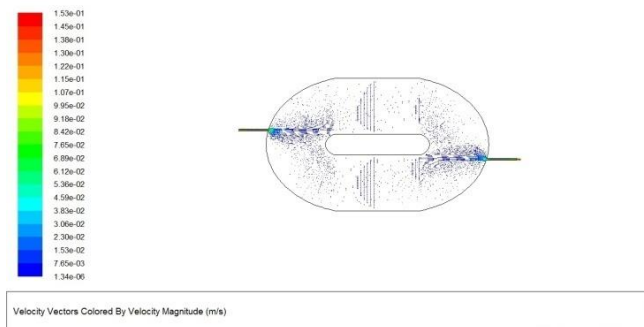


Figure 7 Vector velocity of 2D simulation

Figure 5 shows that the simulation converges after 5000 iterations. In Figures 6 and 7, it is known that there is some dead zone in part of the reactor. Figure 6 shows that the dead zone especially occurred in reactor outer bank, while figure 7 shows that the fastest flows occurred around the inlet and outlet. The existence of the dead zone, i.e., when the water appears to be “stuck” and must be avoided since it influences the biochemical process in the reactor. This will decrease the treatment performance in the reactor. To reduce the dead zone, methods recommended include the modification of inlet and outlet configuration as well as installment of an aerator [18]. The aerator main role is to supply the oxygen into thus reactor thus increasing the water flow and making faster flow velocity.

## 7.0 CONCLUSIONS AND RECOMMENDATIONS

From the computer simulation, there is dead zone in the reactor that could affect the reactor treatment performance. To increase the performance, the modification of inlet and outlet configuration as well as aerator installation could be considered. Yet this



computer simulation must be compared with the results of the experiment in laboratory scale using a tracer study. The computer simulation itself must be run in multi-phase media, which are fluid-solid-air simulation.

### Acknowledgement

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*by Dewan Riset & Pengabdian kepada Masyarakat*

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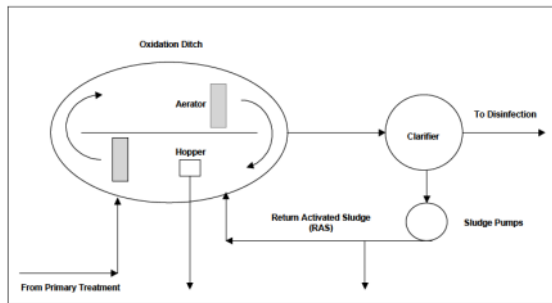


Figure 1 Typical oxidation ditch system [1]

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pH	-	5 – 9	7,3	7,4
TSS	mg/L	20	98	30
BOD	mg/L	12	156	28
COD	mg/L	100	117	45

\*Based on Government Decree No. 82/2001 with regards to Water Environmental Quality Management and Water Pollution Control



Figure 2 Oxidation ditch unit in WWTP Jababeka [11]



Figure 3 Oxidation ditch unit in WWTP Tanah Tinggi [12]

## 3.0 REVIEW ON REACTOR HYDRODYNAMIC

The most common hydrodynamic study is tracer study, as conducted by Mendez-Romero in 2011 [13]. The tracer study usually gives good result, but there is a constraint in scaling-up and scaling-down implementation because of some parameter values that are outside the experimental parameter values. However, this constraint can be overcome by using computer simulation.

The correlation between hydrodynamic aspect and microorganism activities can be shown in the mathematical modeling of the dispersive flow [14]. The mathematical model can be developed using computational methods to observe the increment of oxygen supply in oxidation ditch reactor. A model can be built based on various types of oxygen supply: diffuser [15], up aerator spray [16], bottom aerator spray (along reactor) [17], and surface aerator [18].

## 4.0 REVIEW ON COMPUTATIONAL FLUID DYNAMIC

Computational Fluid Dynamic (CFD) Model has been applied in many fields, including environmental engineering. Specifically, CFD is use to model process kinetics, transfer oxygen,

modification on treatment unit and hydrodynamic in various water treatment [19–22]. Computer simulated CFD can be applied in channeling activated sludge reactor [15–17] and expanded granular sludge bed reactor [10]. According to Huang *et al.*, combination of CFD model and kinetics of reaction was more accurate and make sense than kinetic model in biological system modeling [20]. Therefore the research focus on hydrodynamic aspects and kinetic reaction in oxidation ditch reactor is needed to get the optimal design of oxidation ditch water treatment unit.

## 5.0 EXPERIMENTAL

### 5.1 Reactor Design

Based on a review of past studies and from field observation, we built reactor design to conduct a tracer study (Figure 4).

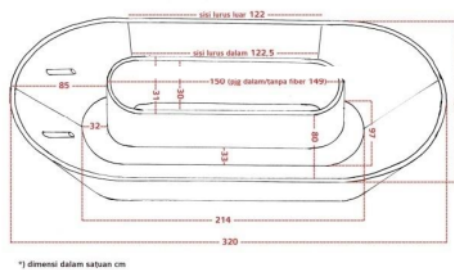


Figure 4 Oxidation ditch reactor in laboratory scale

The dimensions of the reactor were based on the following design criteria: wall slope of 45° and the inlet velocity is 1 m/sec. The equations used for computer simulation are continuity equation and momentum Equation [10]:

$$\frac{\partial U_i}{\partial x_i} = 0;$$

$$\frac{\partial}{\partial x_j} (U_i U_j) = -\frac{1}{\rho} \frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j} \left[ \mu \left( \frac{\partial U_i}{\partial x_j} + \frac{\partial U_j}{\partial x_i} \right) \right]$$

Where :

- U = velocity in x-direction (m/sec)
- P = pressure force
- X = distance (m)

Media in the simulation is liquid (water).

## 6.0 RESULTS AND DISCUSSION

The 2D simulation on reactor surface shows the results as illustrated in Figures 5–7.

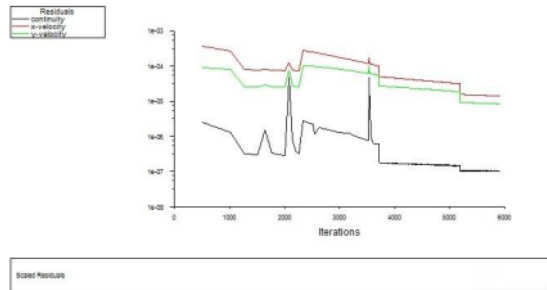


Figure 5 Residual statistic of 2D simulation



Figure 6 Pathline of 2D simulation

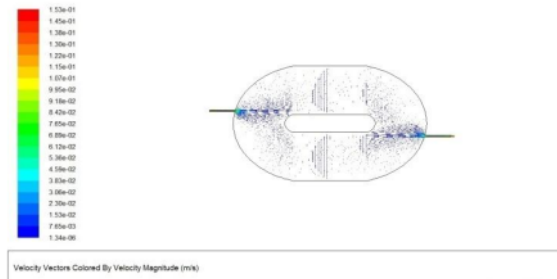


Figure 7 Vector velocity of 2D simulation

Figure 5 shows that the simulation converges after 5000 iterations. In Figures 6 and 7, it is known that there is some dead zone in part of the reactor. Figure 6 shows that the dead zone especially occurred in reactor outer bank, while figure 7 shows that the fastest flows occurred around the inlet and outlet. The existence of the dead zone, i.e., when the water appears to be “stuck” and must be avoided since it influences the biochemical process in the reactor. This will decrease the treatment performance in the reactor. To reduce the dead zone, methods recommended include the modification of inlet and outlet configuration as well as installment of an aerator [18]. The aerator main role is to supply the oxygen into thus reactor thus increasing the water flow and making faster flow velocity.

## 7.0 CONCLUSIONS AND RECOMMENDATIONS

From the computer simulation, there is dead zone in the reactor that could affect the reactor treatment performance. To increase the performance, the modification of inlet and outlet configuration as well as aerator installation could be considered. Yet this



computer simulation must be compared with the results of the experiment in laboratory scale using a tracer study. The computer simulation itself must be run in multi-phase media, which are fluid-solid-air simulation.

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