e-ISSN : 2987-0836 DOI : https://doi.org/10.59585/ijhs

Publish : Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage : https://jurnal.agdosi.com/index.php/IJHS/index
Volume 1 | Number 4 | Desember 2023 |

Performance of Waste Water Treatment Plans in Hospitals : Literature Review

Heri Shatriadi Candra Putra[1], Norhashima Abd Rashid[2], Faridah Mohd Said[3]

[1] Student Ph.D. Health Science, Faculty Medicine, Lincoln University College, Malaysia
[2] Lecturer Ph.D. Biomedical Sciences, Faculty of Applied Sciences, Lincoln University College, Malaysia
[3] Lecturer Ph.D. In Nursing, Faculty Medicine, Lincoln University College, Malaysia

Abstract

Introduction: Hospitalrecyclingwhich cannot function normally and there are calculation errors in thewater mass balanceTo minimize the impact of waste water on environmental pollution, an evaluation of the IPAL unit is carried out. The aim of this research is to evaluate the IPAL and provide suggestions related to optimizing wastewater treatment at Hospital to improve wastewater removal performance. **Material and Methods:** This study refers to design criteria and quality standards based on literature review with PICO Analysis and evaluation of existing conditions using secondary and primary data. Based on the results of the Wastewater Treatment Plant (WWTP) evaluation, it was found that the waste water discharge was 166.3 m3/day, had an efficiency that was in the very efficient and efficient category in processing waste water pollutant parameters so that the waste water treatment process ran well, and there was equalization of the first and second settling tanks. , activated sludge, trickling filter, filtration, disinfection and recycling did not meet the design criteria so recalculations were carried out.. **Results:** The solution provided is to tighten monitoring and testing of the condition of the quality of wastewater coming out of the WWTP unit by changing the sampling test method, re-measuring the quality of influent wastewater, improving the workings of the IPAL unit according to the applicable Standart Operation Procedure (SOP). **Conclusion:** After evaluating the waste water treatment unit, conclusions can be drawn, among others, based on the results of water quality tests and the work performance of the waste water quality parameters. The waste water quality parameter degradation efficiency is very effective, effective and quite effective and all parameters tested are in accordance with applicable quality standards.

International Journal of Health Sciences is licensed under a Creative Commons Attribution 4.0 International License

e-ISSN : 2987-0836 DOI : https://doi.org/10.59585/ijhs

Publish : Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage : https://jurnal.agdosi.com/index.php/IJHS/index
Volume 1 | Number 4 | Desember 2023 |

Keywords: Evaluation, Hospital WWTP, Effectiveness, Design Criteria, Influent, Effluent

Corresponding Author : Heri Shatriadi Candra Putra
Email : heriscp79@gmail.com

1. Introduction

The increase in the number of health facilities and the number of hospital causes an increase in the amount of waste water produced, so the risk of environmental pollution will be higher due to a decrease in the quality of hospital waste water. In an effort to minimize the impact of hospital wastewater and to create a healthy and comfortable environment, the government requires every health service facility to provide wastewater treatment facilities that comply with standards and meet quality standards. (Kemenkes RI, 2020) Management of hospital wastewater, especially medical waste, requires special treatment before it is channeled to final disposal. Good management of medical waste is very important to minimize the risk of disease transmission.

Waste water is a residue resulting from the production process in liquid form which is no longer useful and must be managed before being discharged into the environmental agency's system so as not to cause pollution and reduce environmental quality. (Naeemah & Wong, 2023) Hospital waste water is all liquid waste originating from the process of all hospital activities, which includes: domestic waste water, namely waste water from hospitals which contains many pathogenic microorganisms, toxic and radioactive chemicals and blood which is dangerous for humans. health and the environment which can be handled through IPAL. (Amin et al., 2023) The composition and characteristics of hospital wastewater are quite specific and have quite a large impact requiring special handling. (Ajala et al., 2022)

Therefore, proper management is needed based on the composition and characteristics of waste water to minimize the level of contamination of waste water. Based on the theory above, evaluation of hospital wastewater treatment installations (IPAL) needs to be carried out to analyze the level and quality of wastewater treatment and make further

International Journal of Health Sciences is licensed under a Creative Commons Attribution 4.0 International License

e-ISSN : 2987-0836 DOI : https://doi.org/10.59585/ijhs
Publish : Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage : https://jurnal.agdosi.com/index.php/IJHS/index
Volume 1 | Number 4 | Desember 2023 |

improvement efforts if necessary. In Indonesia, the condition of hospital wastewater processing and management is very worrying, namely only 36% of hospitals have Wastewater Treatment Plants (IPAL). The remaining 64% of wastewater is discharged directly into receiving water bodies without prior treatment or using infiltration wells. (Pariente et al., 2022) Since the initial establishment of Hospital At this time there is a tubrecyclingwhich cannot function normally and there are calculation errors in the water mass balance.Therefore, an evaluation is needed related to good and appropriate IPAL performance to find out how optimal and efficient the IPAL's performance is in treating waste water.

With an optimal and efficient IPAL system, the waste water discharged (effluent) by the IPAL can meet the quality standards that have been determined, so that the waste water can be safely channeled into the environment or rivers without endangering living things. and pollute water bodies and reduce environmental quality. Apart from that, the evaluation carried out was by comparing the waste water discharge entering the IPAL with the capacity of the waste water processing discharge at the IPAL and comparing the calculation results of the waste water processing units contained in the IPAL with design criteria from various literature. (Ali et al., 2023) The expected result of this evaluation is to increase the efficiency and effectiveness of the IPAL. The purpose of this research is to evaluate the Waste Water Treatment Plant (IPAL) system and provide suggestions regarding the optimization of waste water treatment technology at Hospital Meanwhile, the aim of this research is to identify and analyze the characteristics of wastewater influent and effluent produced by the IPAL of Hospital Waste (WWTP) at Hospital which supports aspectsresources and recovery IPAL Hospital.

2. Research Method

Research Design, Setting, and Sample

This research was conducted at the Waste Water Treatment Plant (IPAL) at Hospital. Evaluation of the performance of IPAL Hospital design criteria selected from various literature, calculating wastewater treatment efficiency, comparing and planning

International Journal of Health Sciences is licensed under a Creative Commons Attribution 4.0 International License

Publish : Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage : https://jurnal.agdosi.com/index.php/IJHS/index
Volume 1 | Number 4 | Desember 2023 |

units resources and recovery in existing conditions in order to treat waste water by PICO Analysis.

Measurement and Data Collection

The research began with a field survey, literature study, hypothesis determination, data collection for the evaluation process in the form of primary data and secondary data, recapitulation or data collection, evaluation of each operational unit and process unit, calculation and planning of the effectiveness of the IPAL. Other additional data collected included photos of all processing units in the WWTP of Hospital. Assumptions from the secondary data of the WWTP of Hospital inlets and outlets IPAL, waste water quality inspection data at the inlet and outlet of IPAL hospital.

Data Analytics

To discuss the evaluation carried out in this study, it was carried out by comparing data from hospital wasttewater quality tests with applicable quality standards and the results of dimensional calculations from data on the existing condition of the wastewater treatment unit with design criteria from various literature sources and unit planning.resources and recoveryin existing conditions so that it can process waste water into clean water for watering plants. The following are the results of the evaluation of the wastewater treatment unit at the IPAL Hospital.

3. Results And Discussions

1. Performance of IPAL

Based on the analysis data for one month, the efficiency percentage (%) can be calculated from the biological processing unit, namely activated sludge which consists of an aeration tank and a settling tank in reducing organic matter.

Table 1. Efficiency (%) TSS parameters(Preisi Goni, Isri R. Mangangka, 2021)

Date and month	influent aeration tank (mg/L)	tank effluent precipitator (mg/L)	Efficiency (%)	(*)Standard Efficiency
22 June	333	48	86	50-60%

International Journal of Health Sciences is licensed under a Creative Commons Attribution 4.0 International License

e-ISSN : 2987-0836 DOI : https://doi.org/10.59585/ijhs

Publish : Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage : https://jurnal.agdosi.com/index.php/IJHS/index
Volume 1 | Number 4 | Desember 2023 |

3 July	220	164	25	50-65%
9 July	300	64	79	50-65%
22 July	58	56	3	50-65%
Average	227,83	83	64	50-65%

Based on Table 1, efficiency (%) of TSS parameters, the average efficiency for 1 month is obtained in the settling tank by 64%. If compared with efficiency standards, then inclmeet the efficiency range. However, this average efficiency cannot be used as a reference because on April 2 and April 16 the TSS efficiency was still below the efficiency standard.

Table 2. Efficiency (%) BOD parameters(Basoeki et al., 2018)(Preisi Goni, Isri R. Mangangka, 2021)

Date and month	Tub influent Aeration (mg/L)	tank effluent precipitator (mg/L)	Efficiency (%)	(*)Standard Efficiency
22 June	197.31	136	31	85-90%
3 July	80.78	64.68	14	85-90%
9 July	109.47	100.60	8.1	85-90%
22 July	237.97	115.19	51.6	85-90%
Average	156.38	105.37	26.13	85-90%

Based on Table 2, the efficiency (%) of BOD parameters is obtained by the average efficiency for 1 month on activated sludge it is 26.13% so when compared with efficiency standards Metcalf and Eddy (2004), namely 85-90%, then the performance of the IPAL unit is not running smoothly optimal in reducing organic matter.

2. Performance Wastewater Treatment Unit Dimensions
   1. Barscreen

Table 3 shows the barscreen unit operating parameters(Custodio et al., 2022)

Number	Parameter	Design criteria	Mark	Unit	Information
1	Flow velocity as it passes through bar screen	0.3-0.6	0.5	m/s	In accordance

International Journal of Health Sciences is licensed under a Creative Commons Attribution 4.0 International License

e-ISSN : 2987-0836 DOI : https://doi.org/10.59585/ijhs

Publish : Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage : https://jurnal.agdosi.com/index.php/IJHS/index
Volume 1 | Number 4 | Desember 2023 |

2	Press loss through stem (HL)	<150	5.5	m^3	In accordance
3	Hydraulic radius (R)	-	35.58	m	-

Based on the calculations above, all unit parametersbar screenin WWTP Hospital meets the requirements according to the design criteria. Hence the dimensions of the unitbar screenis appropriate and does not need to be revised.

2. Disinfection Tub

Based on existing condition data.then the dimensional calculation results obtained from the evaluation of the disinfection tank at the WWTP are attached to Table 4.

Table 4. Disinfection bath unit operating parameters(Khan et al., 2022)

Number	Parameter	Design criteria	Unit	Condition Existing	Results Evaluation
1	Debit	-	m3/day	166.3	166.3
2	Depth	-	m	0.4	0.3
3	Long	-	m	0.7	1.9
4	Wide	-	m	0.6	0.2
5	Horizontal Speed	2-4.5	m/min	1,408	2
6	Contact Time	15-45	minute	34.48	15

Based on the calculations above, the initial dimensions of the filtration tank at WWTP Hospital are obtained, namely length x width x height (0.7 m x 0.6 m x 0.4 m). Meanwhile, from the results of the recalculation, the dimensions of the filtration tank unit after the recalculation were carried out were 2.05 m x 0.205 m x 0.208 m.

3. Unit Planning Resources and Recovery

Anaerobic digester with fixed dome type (fixed dome) which is built by excavating the ground and then making it with bricks, sand and cement in the form of an airtight cavity and has a domelike structure (half a sphere). This type was

International Journal of Health Sciences is licensed under a Creative Commons Attribution 4.0 International License

e-ISSN : 2987-0836 DOI : https://doi.org/10.59585/ijhs

Publish : Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage : https://jurnal.agdosi.com/index.php/IJHS/index
Volume 1 | Number 4 | Desember 2023 |

developed in China so it is also called the dome type.(Isnaeni, 2022) At the top or called a fixed dome (fixed dome), gas collects in this section and at the bottom there is a digester as a place to digest waste water. Results of planning on the unit resources and recovery can be seen at Table 5.

Table 5. Anaerobic digester planning parameters(Renfrew et al., 2022) (Bijekar et al., 2022)

Parameter	Unit	Mark
TSS	kg/ m^3	166.3
Q waste water	m^3/day	0.022
V dome Tota	m^3	0.275
V biofilter media	m^3	27.5
Overall Volume (Dome + biofilter media)	m^3	27.125
Detention Time (Td)	O'cloc	3.914
Long	m	3
Wide	m	1.5
Depth	m	6

Based on the planning of the anaerobic digester unit, the dimensions are length x width x height (3m x 1.5 m x 6 m). The addition of an anaerobic digester unit functions to recover a certain amount of methane gas (CH4) which is produced by converting around 40% - 60% of organic solids into methane (CH4) and carbon dioxide (CO2) the resulting processed water can be used for watering plants, washing activities andflushing.

4. Conclusion

The average efficiency of BOD parameters is 26.13%, COD is 29%, PO4 is 13%, NH3 is 26% and TSS is 64%, which is still below the efficiency standard of 85-90% and TSS is 50-65% but the efficiency for TSS cannot be used as a reference. The BOD/COD ratio for each IPAL unit has met the ideal ratio of between 0.5-1 so that waste water is biodegradable.

After evaluating the waste water treatment unit, conclusions can be drawn, among others, based on the results of water quality tests and the work performance of the waste

International Journal of Health Sciences is licensed under a Creative Commons Attribution 4.0 International License

Publish : Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage : https://jurnal.agdosi.com/index.php/IJHS/index
Volume 1 | Number 4 | Desember 2023 |

water quality parameters. The waste water quality parameter degradation efficiency is very effective, effective and quite effective and all parameters tested are in accordance with applicable quality standards. In Regulation No. 69 of 2013 concerning waste water quality standards for or/and ongoing processing businesses, in IPAL there are equalization tanks (TAR), first settling tanks (PST), activated sludge, tankstrickling filter, filtration unit, disinfection unit and tub recyclingdoes not meet the design criteria so it is necessary to readjust the dimensions of the unit so that it complies with the given design criteria, and add unitsresourcesAndrecoverynamely an anaerobic digester so that processing takes place more optimally.

5. Compliance with ethical standards

Acknowledgements

The authors would like to express their gratitude to everyone who participated in this piece of research. Institutional leadership in the facilitation of research assistance for the advancement of health research for the benefit of the general public.

Disclosure of conflict of interest

There is no potential for any stakeholder to have a conflict of interest in this research.

Statement of informed consent

In our capacity as writers, every action we perform constitutes a joint agreement or consent.

References

Ajala, O. J., Tijani, J. O., Salau, R. B., Abdulkareem, A. S., & Aremu, O. S. (2022). A review of emerging micro-pollutants in hospital wastewater: Environmental fate and remediation options. *Results in Engineering*, *16*(July), 100671. https://doi.org/10.1016/j.rineng.2022.100671

Ali, M. K., Hastri, E. D., & Rachman, A. M. I. (2023). Asas Pencemar Membayar (Polluter Pays Principle): Bentuk Pertanggungjawaban Hukum Pelaku Usaha yang Melanggar Baku Mutu Air Limbah. *Jurnal Panah Keadilan*, *2*(1), 52–68.

Amin, M., Harahap, R., & Pelawi, Z. (2023). Rancang Bangun Sistem Kendali Dan Monitoring Sistem Pengolahan Air Limbah Berbasis PLC. *Journal of Electrical Technology*, *8*(2), 43–48.

International Journal of Health Sciences is licensed under a Creative Commons Attribution 4.0 International License

Publish : Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage : https://jurnal.agdosi.com/index.php/IJHS/index
Volume 1 | Number 4 | Desember 2023 |

Basoeki, S., Putrawan, I. M., & Setiawati, S. (2018). Hospital Environmental Performance Comparison in Waste Management in Jakarta. *Jurnal Green Growth Dan Manajemen Lingkungan*, *7*(1), 70–90. https://doi.org/10.21009/jgg.071.05

Bijekar, S., Padariya, H. D., Yadav, V. K., Gacem, A., Hasan, M. A., Awwad, N. S., Yadav, K. K., Islam, S., Park, S., & Jeon, B. H. (2022). The State of the Art and Emerging Trends in the Wastewater Treatment in Developing Nations. *Water (Switzerland)*, *14*(16), 1–19. https://doi.org/10.3390/w14162537

Custodio, M., Cuadrado-Campó, W., Peñaloza, R., Vicuña-Orihuela, C., Torres-Gutiérrez, E., & Orellana, E. (2022). Treatment of Hospital Wastewater Using Activated Sludge with Extended Aeration. *Journal of Ecological Engineering*, *23*(11), 24–32. https://doi.org/10.12911/22998993/152991

Isnaeni, D. A. (2022). Observasi Lapangan, Karakteristik Fisik Limbah Cair, Analisis COD, Analisis (TS, TSS, dan TDS), dan Analisis (BOD dan DO) Pada Limbah Tahu Industri XYZ di Yogyakarta. *Teknologi Pangan*, *December*, 1–14. https://www.researchgate.net/publication/366713499

Kemenkes RI. (2020). Indikator Program Kesehatan Masyarakat dalam RPJMN dan Rentra Kementerian Kesehatan 2020-2024. In *Katalog Dalam Terbitan. Kementerian Kesehatan RI*. https://kesmas.kemkes.go.id/assets/uploads/contents/attachments/ef5bb48f4aaae60ebb724caf1c534a24.pdf

Khan, N. A., Bokhari, A., Mubashir, M., Klemeš, J. J., El Morabet, R., Khan, R. A., Alsubih, M., Azam, M., Saqib, S., Mukhtar, A., Koyande, A., & Show, P. L. (2022). Treatment of Hospital wastewater with submerged aerobic fixed film reactor coupled with tube-settler. *Chemosphere*, *286*(May 2021). https://doi.org/10.1016/j.chemosphere.2021.131838

Naeemah, A. J., & Wong, K. Y. (2023). Selection methods of lean management tools: a review. *International Journal of Productivity and Performance Management*, *72*(4), 1077–1110. https://doi.org/10.1108/IJPPM-04-2021-0198

Pariente, M. I., Segura, Y., Álvarez-Torrellas, S., Casas, J. A., de Pedro, Z. M., Diaz, E., García, J., López-Muñoz, M. J., Marugán, J., Mohedano, A. F., Molina, R., Munoz, M., Pablos, C., Perdigón-Melón, J. A., Petre, A. L., Rodríguez, J. J., Tobajas, M., & Martínez, F. (2022). Critical review of technologies for the on-site treatment of hospital wastewater: From conventional to combined advanced processes. *Journal of Environmental Management*, *320*(July). https://doi.org/10.1016/j.jenvman.2022.115769

Preisi Goni, Isri R. Mangangka, O. B. A. S. (2021). Evaluasi Kinerja Instalasi Pengolahan Air Limbah (IPAL) Rumah Sakit Umum Pusat Prof. Dr. R. D. Kandou Manado. *Tekno*, *19*(77), 35–40.

Renfrew, D., Vasilaki, V., McLeod, A., Lake, A., Danishvar, S., & Katsou, E. (2022). Where is the greatest potential for resource recovery in wastewater treatment plants? *Water Research*, *220*(April), 118673. https://doi.org/10.1016/j.watres.2022.118673

International Journal of Health Sciences is licensed under a Creative Commons Attribution 4.0 International License