

[REVISI HASIL PENILAIAN SEBELUMNYA]

- Pada penilaian sebelumnya, 5 seminar internasional dinilai sebagai seminar nasional karena tidak melampirkan bukti jumlah peserta minimal 4 negara.
- Sehingga, 3 prosiding seminar nasional tidak dapat dinilai karena sudah melampaui batas maksimum 25% dari kebutuhan angka kredit untuk jurnal nasional dan prosiding nasional.
- Maka dari itu, kami melampirkan bukti tambahan untuk menunjukkan bahwa seminar internasional tersebut diikuti oleh minimal 4 negara. Sehingga, kami bisa memasukkan KUM untuk Seminar Nasional pada penilaian tersebut.

1. Nama Seminar/Konferensi/Simposium: The 2nd International Seminar on Civil and Environmental Engineering (**ISCEE 2021**), Penyelenggara: IPB University, Indonesia, Waktu Pelaksanaan Seminar/Konferensi/Simposium: 6th-8th September 2021, ISBN/ISSN: 17551307

Peserta dari 6 negara: **Indonesia, India, Japan, Iraq, Nigeria and Colombia**

INDIA

Link: <https://iopscience.iop.org/article/10.1088/1755-1315/871/1/012003/pdf>

The screenshot shows a web browser window with multiple tabs. The active tab is displaying a PDF document from IOP Publishing. The document title is "Contribution of higher modes in the dynamic response of reinforced concrete member subjected to blast" by Anita Bhatt¹, P Bhargava¹, and P Maheshwari¹. The authors' affiliation is the Department of Civil Engineering, IIT Roorkee, Roorkee, India 247667. The abstract discusses the dynamic response of reinforced concrete structures under blast load, mentioning P-I curves, SDOF analysis, and higher modes of vibration. The introduction states that blast loads are a major concern for designers due to terrorist activities and military actions.

JAPAN

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/871/1/012020/pdf>

Open Access proceedings Journal of Physics: Conference series 2 / 10 | 100%

Microstructure and physical properties of combined plastic-cementitious artificial aggregate

RA Sumarsono^{1,2*}, Anisah², A N T Utami², M Wilfadz², and A Permana²

¹PhD student of Department of Civil Engineering, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Japan 113-8656
²Department of Civil Engineering, Universitas Negeri Jakarta, Jl. Rawamangun Muka, Jakarta Timur, Indonesia 13220

*E-mail: ririt2021@g.ecc.u-tokyo.ac.jp

Abstract. Over the years, the availability of natural construction material has been critical. Plastic has been taken into consideration for replacement of natural aggregate; however, the result is not satisfying. Furthermore, some cementitious materials are also proposed for the artificial aggregate due to its mineral, but the production process is high energy consumption. The idea of combining plastic and cementitious material in terms of polyethylene terephthalate (PET) and diatomaceous earth soil (DE) is proposed in this paper. Henceforth, the artificial aggregate is named as PETOM (PET and DE) and DIAHPET (PET, HDPE, and DE). Molten blending for both PET and DE with various proportion at 325°C has resulted in new type of artificial aggregate with gross surface especially DIAHPET. Further investigation using Scanning Electron Microscope (SEM), the microstructure of PETOM with greater diatomite serves more pores, but DIAHPET is astonishingly dense with sheer pores. Specific gravity of PETOM and DIAHPET is 1.31-1.46 gr/cm³ and 1.12-1.25 gr/cm³, respectively. The density value directs to the lightweight aggregate category with the highest value of 843 kg/m³. The highest compressive strength of PETOM and DIAHPET aggregate gained is 9 MPa and 7 MPa, consecutively. These plastic-based aggregates are feasible for coarse aggregate of lightweight concrete.

1. Introduction
Scarcity of material composition of concrete such as aggregate and cement has been identified in some countries. The awareness of not exploiting and dredging the natural resources leads to many efforts of using waste material as the substitute for concrete material composition so that the preservation of the ecosystem can be sustainable [1]. Understanding that concrete primarily consists of cement, coarse aggregate, fine aggregate, and water, some approaches done in concrete engineering have been widely developed for proposing alternatives for these concrete material compositions. Current evidently

IRAQ

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/871/1/012004/pdf>

ISCEE 2021 IOP Publishing
IOP Conf. Series: Earth and Environmental Science 871 (2021) 012004 doi:10.1088/1755-1315/871/1/012004

Corrosion rate of reinforced concrete incorporating recycled concrete aggregates

B M Ameen^{1*} and B Al-Numan¹

¹Department of Civil Engineering, Tishk International University, Erbil, Iraq 46001

*E-mail: bnar.abubakir@tiu.edu.iq

Abstract. One of the main strategies to reduce environmental impact of the concrete industry is to recycle/reuse waste materials. However, one of the unknown aspects of recycled aggregate concretes is their durability in harsh environments. This study presents research work on the mechanical and durability properties of concrete incorporating recycled aggregate. Recycled aggregate was made by crushing the demolished concrete from a building site in Erbil. Six types of concrete mixtures were tested: concrete made entirely with natural aggregate as control concrete, and five types of concrete made with natural fine and recycled coarse aggregate (20%, 40%, 60%, 80%, and 100% replacement of coarse recycled aggregate). Superplasticizer was used to reduce water/cement ratio. Two tests were performed, including compressive strengths test and electrical resistivity test under chloride-contaminated environments, which indirectly measures corrosion rate of concrete. The results show that electrical resistivity decreases with increasing incorporation level of RCA. Regarding corrosion tests, the ER of 100%RCA concrete was about 57% of the corresponding ER of the control specimen. However, 49% reduction for control specimen and a 42.29% reduction for 100% RCA concrete under natural chloride attack. In addition, the chloride attack does not affect the compressive strength of recycled aggregate concrete.

1. Introduction
As sustainability matter, reusing of wasted materials in the construction industry is more crucial nowadays. The advantage of reusing demolished concrete comprises less pollution, limiting landfill space, and reserving natural aggregate resources. The concrete's strength and electrical resistivity are affected by the contents of the concrete, especially coarse and fine aggregates that make up most of the

NIGERIA

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/871/1/012054/pdf>

The screenshot shows a PDF document viewer displaying the title page of an article. The browser tabs include 'WhatsApp', 'Menu Administrasi Sistem Penil...', 'pdf', 'Dashboard PAK Unhas', and 'artikel-1684117532-AIP_Kata...'. The address bar shows the URL 'iopscience.iop.org/article/10.1088/1755-1315/871/1/012054/pdf'. The document header includes 'JSCEE 2021', 'IOP Publishing', and 'IOP Conf. Series: Earth and Environmental Science 871 (2021) 012054 doi:10.1088/1755-1315/871/1/012054'. The title is 'Adequacy of cement and lime stabilized marine clay as a replacement for laterite'. The authors are 'E C Amanamba¹, A C Ekeleme¹, C Chioke², and C Okam³'. The affiliations are: ¹Department of Civil Engineering, Abia State University, Uturu, Abia State, Nigeria, 441101; ²Department of Building and Woodwork Technology Education, Federal College of Education (Technical), Umuze, Nigeria 423101; ³Department of Civil Engineering, Gregory University, Uturu, Abia State, Nigeria 441101. The email is 'enr.namba@gmail.com'. The abstract discusses the possibility of getting good pavement material from marine clay stabilized with cement and lime. The introduction states that with the increasing demand for road transportation in Nigeria, there has been a consequent increase in the supply of same; construction of new alignments and rehabilitation of failed pavements. These

COLOMBIA

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/871/1/012008/pdf>

The screenshot shows a PDF document viewer displaying the title page of an article. The browser tabs include 'WhatsApp', 'Menu Administrasi Sistem Penil...', 'pdf', 'Dashboard PAK Unhas', and 'artikel-1684117532-AIP_Kata...'. The address bar shows the URL 'iopscience.iop.org/article/10.1088/1755-1315/871/1/012008/pdf'. The document header includes 'JSCEE 2021', 'IOP Publishing', and 'IOP Conf. Series: Earth and Environmental Science 871 (2021) 012008 doi:10.1088/1755-1315/871/1/012008'. The title is 'State of regulation and implementation of energy and water-saving measures in buildings in Colombia'. The authors are 'A M Rodríguez¹, A C R Fernández², L V Rojas¹, F P Palma¹ and A B Oliveros¹'. The affiliations are: ¹Civil and Environmental Department, Universidad de la Costa, Barranquilla, Colombia 080001; ²Law Department, Universidad Sergio Arboleda, Santa Marta, Colombia Cl. 74#14-14. The email is 'amattos@cuc.edu.co'. The abstract analyzes the status of compliance with 'Resolución 0549 de 2015', which regulates the parameters of sustainable construction in buildings in Colombia, in terms of energy and water consumption. The introduction states that the primary purpose of a building is to improve people's quality of life. According to CONPES 3919 [1], a sustainable building is a broad concept that encompasses the rational use of natural resources and offers its users spaces that have a positive impact on their health, happiness, and wellbeing; through rich and healthy environments that respect the environment, ecosystems, and biodiversity. These buildings must be suited to the variability and conditions of the climatic zone in their geographic location; energy

2. Nama Seminar/Konferensi/Simposium: The 3rd International Conference on Civil and Environmental Engineering (ICCEE 2019), Penyelenggara: Civil Engineering Department, Hasanuddin University, Waktu Pelaksanaan Seminar/Konferensi/Simposium: 29–30 August 2019, Bali, Indonesia, ISBN/ISSN: 17551307

Peserta dari 8 negara: Indonesia, Malaysia, USA, Marocco, Turkey, Nepal, Japan, South Africa

MALAYSIA

Link: <https://iopscience.iop.org/article/10.1088/1755-1315/419/1/012003/pdf>

ICCEE 2019 IOP Publishing
IOP Conf. Series: Earth and Environmental Science 419 (2020) 012003 doi:10.1088/1755-1315/419/1/012003

Evaluation of factors contributing to wave-in-deck using pushover analysis for fixed jacket structures

N C Yee¹, A E Kajuputra² and L A Pangestu³

¹ Civil and Environmental Engineering Department, Universiti Teknologi PETRONAS, 32610, Perak, Malaysia
² Department of Civil Engineering, University of Canterbury, Christchurch, New Zealand
³ Engineering Department, McDermott Asia Pacific Sdn Bhd, Kuala Lumpur, Malaysia

E-mail: yee@gmail.com

Abstract. Wave in deck (WID) phenomenon of a wave hitting on the topside for fixed jacket platforms at shallow water condition has been reported as a notable risk to the workability and reliability of these structures. When hydrocarbon from the seabed is extracted for an extended period of time, there might be a reduction in pressure, which allows subsidence to happen. A platform experiencing subsidence promotes the decrease in air gaps, which eventually allows the waves to attack the bottom decks. The impact of the WID generates additional loads to the structure and therefore increases the values of the moment arms. Higher moment arms trigger instability in terms of overturning, which eventually decreases the reserve strength ratio (RSR) values of the structure. The mechanics of WIDs, however, are still not well understood and have not been fully incorporated into the design codes and standards. Therefore, there is a need to revisit the current design codes and standards for platform design optimization. This paper aims at evaluating the effect of RSR values due to WID on four-legged jacket platforms in Malaysia. Base shear values with regards to calibration and modifications of wave characteristics are obtained by numerical simulations. Correspondingly, pushover analysis was conducted to retrieve the RSR. The effects of the contributing factors, namely wave height, wave period, and water depth with regards to the RSR and base shear values, are expected to be analyzed and thoroughly discussed. The work illustrated in this paper is important in optimizing the design life of the existing and aging offshore structures. Outcomes of this research are expected to provide an additional evaluation of the WID mechanics and, in return, contribute to the current mitigation strategies in

USA

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/419/1/012011/pdf>

ICCEE 2019 IOP Publishing
IOP Conf. Series: Earth and Environmental Science 419 (2020) 012011 doi:10.1088/1755-1315/419/1/012011

Assessment of tsunami risk to offshore platforms in Indonesia archipelago

A Y Baeda¹ and G P Carayannis²

¹ Ocean Engineering Department, Universitas Hasanuddin, Gowa, Indonesia
² former Director of International Tsunami Information Center (ITIC), USA

E-mail: baeda@eng.unhas.ac.id

Abstract. Earthquakes are unpredictable natural disasters that need to be taken into serious consideration in the design criteria of offshore platforms, particularly in regions of high seismicity. The Indonesia Archipelago is characterized by extensive zones of seismic activity where large earthquakes can be extremely dangerous to the safety and reliable performance of offshore platforms. Tsunamis generated by the larger earthquakes in the region present an additional extreme danger to offshore oil production and need to be assessed and considered in the design criteria of offshore platforms.

1. Offshore platforms; design loads and forces
Proper siting and design of an offshore oil platform must take into consideration all the environmental criteria and all available oceanographic and meteorological data. Such information includes: storm wave heights and wave periods; storm wind speeds and gust conditions; tides; swells; ocean bottom scouring or slides; currents; icing conditions; earthquakes, etc. The most important design considerations for an offshore oil platform are the storm wind and the storm wave loading the structure will be subjected to during its service life [1,2].

2. Tsunamis; causes, nature, and damages
Tsunamis are long water waves (with wave periods of 5 to 60 min., or even longer) generated

MAROCCO, TURKEY, NEPAL

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/419/1/012015/pdf>

ICCEE 2019 IOP Publishing
IOP Conf. Series: Earth and Environmental Science **419** (2020) 012015 doi:10.1088/1755-1315/419/1/012015

An easy method for barchan dunes automatic extraction from multispectral satellite data

A Aydda¹, O F Althwaynee² and B Pokharel³

¹Department of Geology, Faculty of Sciences, Ibn Zohr University, Agadir, Morocco
²Department of Real Estate Development and Management, Faculty of Applied Sciences, Ankara University, Ankara, Turkey
³Tri-Chandra Multiple Campus, Nepal

E-mail: ayddaali@gmail.com

Abstract. This work presents an easy method for barchan dunes automatic extraction from multispectral satellite data. The proposed method based on unsupervised classifications of commonly used bands for sand dunes mapping in literature. First, the collected data were atmospherically and spatially enhanced. Moreover, each selected band (band ratio or redness index or crust index) were filtered using low-pass (3x3) filter and transformed with original image (non-filtered) by using principal component analysis (PCA). Additionally, the classifications were achieved for each selected band by using three different algorithms (K-means, Expectation Maximization (EM), and IsoData) after data transformation. Eventually, the obtained maps were segmented and compared with natural colour image. The results indicate that unsupervised classification of crust index selected band, which achieved by IsoData algorithm, presents high performance for barchan dunes detection.

1. Introduction
Studying dunes activity contributes to the understanding sand encroachment evolution and therefore desertification phenomenon [1,3]. Their study can also provide indice about climate evolution [4,7].

2 / 10 | 100% | Show all

29°C Berawan | 11:10 AM 5/15/2023

JAPAN

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/419/1/012021/pdf>

ICCEE 2019 IOP Publishing
IOP Conf. Series: Earth and Environmental Science **419** (2020) 012021 doi:10.1088/1755-1315/419/1/012021

Utilization of geospatial information for recovery and rehabilitation from the northern Kyushu heavy rainfall disaster in July 2017

N Kameyama¹, Y Mitani¹, H Taniguchi¹ and Y Okajima¹

¹Department of Civil Engineering, Graduate School of Engineering, Kyushu, Japan University, 744 Motoooka, Nishi-ku, Fukuoka 819-0395, Japan

E-mail: kameyama.naoki.660@s.kyushu-u.ac.jp

Abstract. Unexpected torrential rains have occurred recently due to global warming. There is "limits of public help" in such a disaster. Therefore, "self-help" and "mutual help" become more important to protect lives. Improving these helps enhances disaster resilience. The purpose of this research is to propose initiatives utilizing geospatial information in recovery and rehabilitation phases and to indicate the effects of using geospatial information in the initiatives. The initiatives have conducted for rehabilitation in Toho village, which was damaged by the Northern Kyushu Heavy Rainfall Disaster in July 2017. One initiative is formulating a rehabilitation plan. Meetings are held to reflect residents' opinions to the plan; using the map is useful to collect and share the opinions. Residents could discuss concrete future visions by using a map, and the rehabilitation plan reflected the opinions of residents could be published. The other initiative is Risk Communication. Many kinds of geospatial information are collected in it, and the Risk Map is published. The map shows the dangerous places and evacuation sites, and residents could understand their location, then the map enhanced disaster resilience.

Open Access proceedings Journal of Physics: Conference series | 2 / 11 | 100% | Show all

30°C Mendekati rekor | 11:11 AM 5/15/2023

SOUTH AFRICA

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/419/1/012022/pdf>

Open Access proceedings Journal of Physics: Conference series 2 / 9 | 100% +

ICCEE 2019 IOP Publishing
IOP Conf. Series: Earth and Environmental Science 419 (2020) 012022 doi:10.1088/1755-1315/419/1/012022

Classification of air pollutants API Inter-Correlation using decision tree algorithms

O F Althuwaynee¹, A L Balogun², A Aydda³ and T Gumbo⁴

¹Department of Real Estate Development and Management, Faculty of Applied Sciences, Ankara University, Ankara, Turkey
²Geospatial Analysis and Modelling Research (GAMR) Group, Department of Civil and Environmental Engineering, Universiti Teknologi PETRONAS (UTP), Malaysia
³Department of Geology, Faculty of Sciences, Ibn Zohr University, Agadir, Morocco
⁴Dept. of town and regional planning, University of Johannesburg, Gauteng, South Africa

E-mail: geospatial63@gmail.com

Abstract. The automated classification of ambient air pollutants is an important task in air pollution hazards assessment and life quality research. Faced with various classification algorithms, environmental scientists should select the most appropriate method according to their requirements and data availability. This study describes several types of Decision Tree algorithms for finding the inter-correlation between dominant air pollution index (API) for PM10 percentile values and four other air pollutants such as Sulphur Dioxide (SO₂), Ozone (O₃), Nitrogen Dioxide (NO₂) and Carbon monoxide (CO), in addition to two other meteorological parameters: ambient temperature and humidity, using 22 months records of active air monitoring station in Penang island (northern Malaysia). Classification analysis for the PM10 API was then performed using non-linear Decision Trees within the R programming environment including: Boosted C5.0, Random Forest, PART, and Naive Bayes tree (NBtree). This is in addition to rpart and tree algorithms, which were used to plot the classification trees. The classification

Pengangkatan Peg...pdf Pengangkatan Peg...pdf Buku Nikah.pdf combinepdf.pdf combinepdf (1).pdf Show all

30°C Terasa lebih panas Search 11:13 AM 5/15/2023

3. Nama Seminar/Konferensi/Simposium: The 3rd EPI International Conference on Science and Engineering 2019 (EICSE2019), Penyelenggara: Fakultas Teknik Universitas Hasanuddin, Waktu Pelaksanaan Seminar/Konferensi/Simposium: 24-25 September 2019, South Sulawesi, Indonesia, ISBN/ISSN: 17578981

Peserta dari 7 negara: Indonesia, Palestine, Malaysia, Canada, Korea, Nigeria, Japan

PALESTINE, MALAYSIA, CANADA, KOREA

LINK: <https://iopscience.iop.org/article/10.1088/1757-899X/875/1/012021/pdf>

The screenshot shows a web browser window with multiple tabs. The active tab is titled 'IOP Open Access p...' and displays the article page. The browser's address bar shows the URL: <https://iopscience.iop.org/article/10.1088/1757-899X/875/1/012021/pdf>. The page content includes the title 'Appraisal of Indoor Microbial Pollutants at University Research Labs and Offices under Mediterranean Climate', authors 'E Y Abed¹, W A Madhoun^{1,2,*}, A A Elmanama³, H Kim⁴, X Xu⁴, and F C Ros⁵', and an abstract. The abstract discusses a study on bacterial and fungal growth in indoor environments, comparing levels in university laboratories and offices in Gaza City. It mentions that 48 out of 65 samples (73.8%) exceeded WHO standards for bacterial load, and 9 samples (13.8%) exceeded WHO standards for fungal concentration. The highest bacterial load was found in an IUG with 80.8% due to its old existence, while the lowest was at an AQU with 61.5% due to less lab and lab activities.

NIGERIA

LINK: <https://iopscience.iop.org/article/10.1088/1757-899X/875/1/012022/pdf>

The screenshot shows a web browser window with multiple tabs. The active tab is titled 'IOP Open Access proci...' and displays the article page. The browser's address bar shows the URL: <https://iopscience.iop.org/article/10.1088/1757-899X/875/1/012022/pdf>. The page content includes the title 'Impact Assessment of Traffic Emission on the Respiratory System of Non-Smoking Traffic Policemen in Palestine', authors 'W A Madhoun^{1,2,*}, E Salem³, A Eljedi³, H A Isiyaka⁴, and F C Ros⁵', and an abstract. The abstract describes a study on the effects of prolonged exposure to vehicular emissions on non-smoking traffic police in the northern Gaza Governorate. It mentions that samples of atmospheric pollutants (PM₁₀, CO, and CO₂) were collected alongside respiratory data. The study found a strong association between air pollution and respiratory disease, with a p-value of 0.027 at a significance level of 0.05. It notes that 20 out of 25 non-smoking traffic policemen had upper respiratory tract infection, 15 had frequent cough, 6 had shortness of breathing, and 25 had eye irritation.

JAPAN

LINK: <https://iopscience.iop.org/article/10.1088/1757-899X/875/1/012091/pdf>

The screenshot shows a Microsoft Word document titled "Dahlia Patah - ISERTMN - Copy" displayed in a web browser. The document content includes the following text:

The 3rd EPI International Conference on Science and Engineering 2019 (EICSE2019) IOP Publishing
IOP Conf. Series: Materials Science and Engineering **875** (2020) 012091 doi:10.1088/1757-899X/875/1/012091

Effects of Mineral Admixtures on Pore Structure and Compressive Strength of Mortar Contaminated Chloride

D Patah^{1*}, H Hamada², and A Dasar¹

¹Department of Civil Engineering, Universitas Sulawesi Barat, Majene, Indonesia
²Department of Civil and Structural Engineering, Kyushu University, Japan

*Email: dahlipatah@unsulbar.ac.id

Abstract. This study evaluates the mechanical properties of performance fly ash, silica fume, metakaolin and blast furnace slag mortars due to contaminated chloride. The compressive strength and pore structures at water-to-binder ratios of 0.4, 0.5 and 0.6 are investigated. The result, in general, showed mineral admixtures mortar contaminated chloride improved compressive strength and porosity but different rates depending on their binder type.

1. Introduction

The pore structure of concrete includes air voids, capillary pores, and gel pores. As one of the important characteristics of concrete materials, pore structure possesses an important role determining its mechanical, durability and transmissive characteristics [1, 2]. Pore structure parameters such as porosity, pore size distribution and so on are progressively employed to evaluate permeability, frost resistance, carbonation resistance and physical strength of concrete [3-5].

In order to improve the performance of concrete capable of withstanding serious environmental conditions, mineral admixture including industrial by-products such as blast-furnace slag, fly ash and silica fume are commonly used in combination with OPC in concrete for many applications because

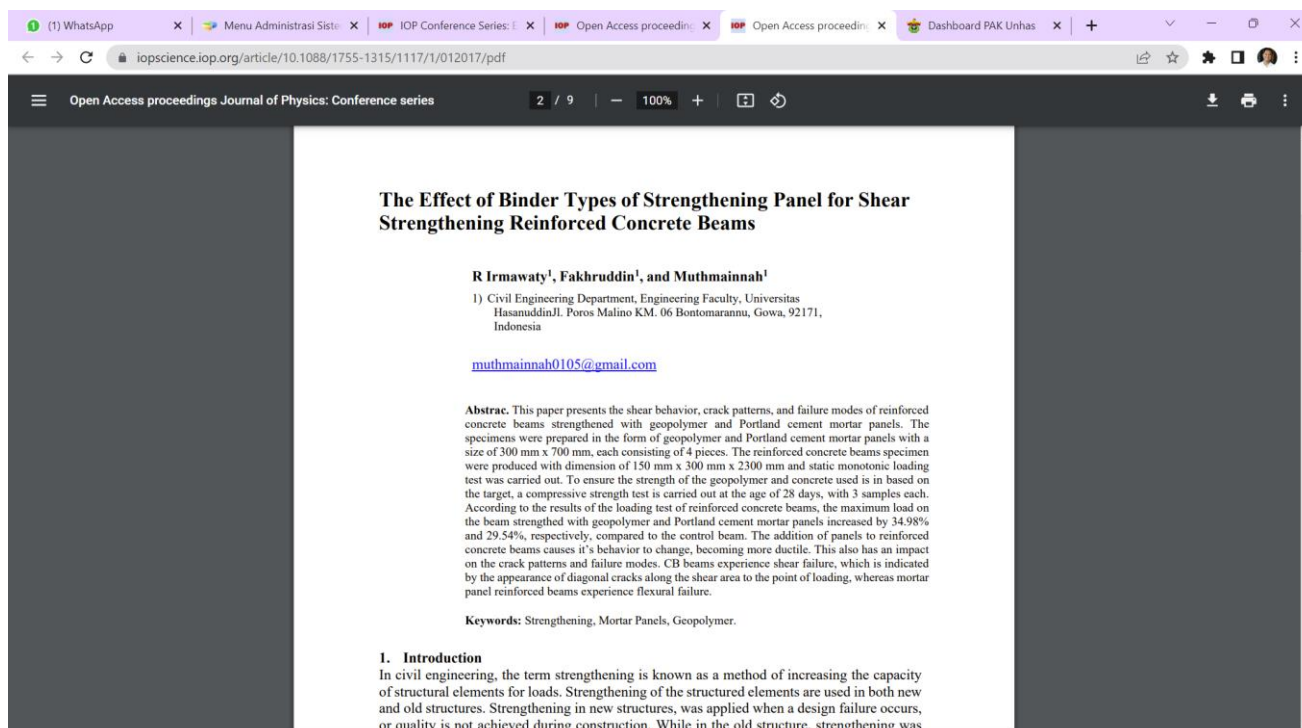
The browser's taskbar at the bottom shows several open PDF files: "Pengangkatan Peg...pdf", "Buku Nikah.pdf", "combinepdf.pdf", and "combinepdf (1).pdf". The system tray indicates a temperature of 30°C in Berawan and the date/time as 11:26 AM on 5/15/2023.

4. Nama Seminar/Konferensi/Simposium: **4th International Conference on Civil and Environmental Engineering**, Penyelenggara: Dept. of Civil Engineering & Dept. of Environmental Engineering Universitas Hasanuddin, Waktu Pelaksanaan Seminar/Konferensi/Simposium: 03/08/2022, ISBN/ISSN: 17551307

Peserta dari 4 negara: **Indonesia, United Kingdom, Japan, Cambodia**

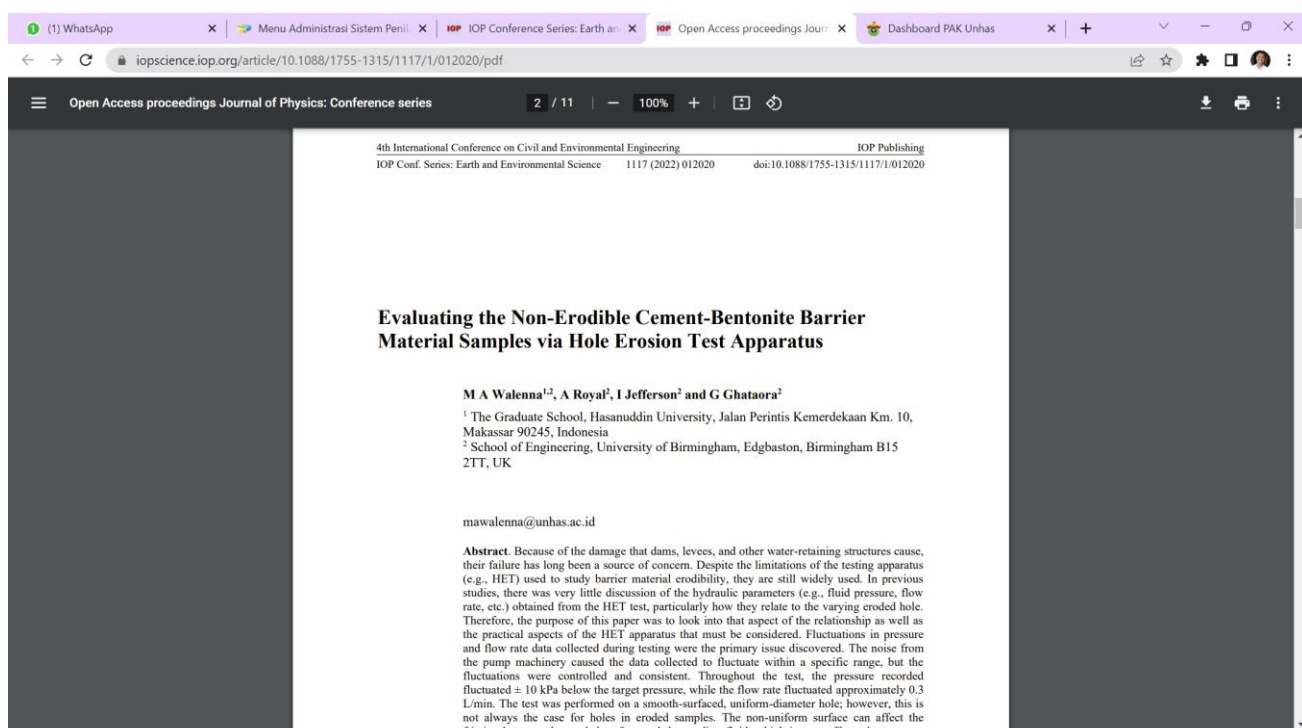
INDONESIA

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/1117/1/012017/pdf>



UNITED KINGDOM

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/1117/1/012020/pdf>



JAPAN

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/1117/1/012044/pdf>

4th International Conference on Civil and Environmental Engineering IOP Publishing
IOP Conf. Series: Earth and Environmental Science 1117 (2022) 012044 doi:10.1088/1755-1315/1117/1/012044

Analysis of hydrochemical parameters and dissolved zinc interaction by using PHREEQC simulation

H Alimuddin¹, P Andarani², K Yokota³, T Inoue³, M N Nguyen¹

¹ Department of Environmental Engineering, Universitas Hasanuddin, South Sulawesi 90245 Indonesia
² Department of Environmental Engineering, Diponegoro University, Central Java 50275 Indonesia
³ Department of Architecture and Civil Engineering, Toyohashi University of Technology, Aichi 441-8580 Japan

Email: hardianti@unhas.ac.id

Abstract: Zinc is frequently reacting with inorganic species in water to form zinc species. Thus, the chemical speciation of Zinc in the aquatic environment has become a significant concern nowadays due to its adverse effect on humans and its potential toxicity in the water system. In this study, to investigate the interaction between dissolved zinc and hydro-chemical factors and to estimate the Zn speciation form, samples of river water were collected spatially from the Umeda River mainstream and tributaries in different seasons for one year. The hydrochemistry and dissolved zinc pollution characteristics of the samples were analyzed. Zn speciation was assessed by PHREEQC simulation. The result show that the main form of Zn speciation was Zinc free ion (Zn^{2+}) in all seasons. However, in summer and spring season, the $ZnCO_3$ and $ZnOH^+$ concentration was higher than the other season. These speciation form may be attributed to the activities around the river in different season according to the similarities in downstream and upstream areas by the hierarchical cluster analysis result.

1. Introduction

The concentration of Zinc in rivers is essential for the aquatic organism. However, the excess zinc concentration can also cause toxicity to the aquatic environment. This concentration may originate from natural sources or human activities [1]. Based on the toxicity in aquatic environment, the Ministry of the Environment Government of Japan established the Environmental Quality Standards (EQS) relating to water pollution for total zinc concentration should be below 0.03 mg/L in 2003.

CAMBODIA

LINK: <https://iopscience.iop.org/article/10.1088/1755-1315/1117/1/012059/pdf>

4th International Conference on Civil and Environmental Engineering IOP Publishing
IOP Conf. Series: Earth and Environmental Science 1117 (2022) 012059 doi:10.1088/1755-1315/1117/1/012059

Concrete Pile Defect Identification: Insights from Cross-Hole Sonic Logging and High Strain Dynamic Pile Test

Chungyeon Ly^{1*}, Chandoeun Eng², Muoy Yi Heng³, Phanny Yos⁴

^{1,2,3,4} Faculty of Geo-resources and Geotechnical Engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, Phnom Penh, Cambodia
⁴ Research Innovation Center, Institute of Technology of Cambodia, Materials Science and Structure, Institute of Technology of Cambodia

Corresponding author: chungyeon_ly@gsc.ite.edu.kh

Abstract. This paper aims to identify the types of defects, location of defects, size of defects, and capacity of five concrete piles using a High strain dynamic pile test and Cross-hole sonic logging test. In this study, Cross-Hole Sonic Logging method (CSL) is a potent quality-control tool that exclusively detects much smaller flaws with high accuracy with utilizing velocity and first arrival time (FAT) from ultrasonic waves to find out the integrity of the drill shaft. From CSL test, the bearing capacity needs to be calculated manually using a waterfall diagram and soil profile. Moreover, the high strain dynamic pile test is used to identify integrity and bearing capacity of concrete pile via resistance analysis down to the pile and split of the base to shaft resistance when only pile head measurements are taken then using Case Method and CAPWAP analysis. Through this analysis, the bearing capacity can be interpreted; the Beta (damage factor) is applied to estimate location and size of the defect in the concrete pile. Based on the result of CSL test for three concrete piles, P01, P04, and P10, indicated that P01 and P04 are "Good" pile integrity with the bearing capacity of 4583kN and 6600kN, while P10 showed as "Potential defect at depth 9.25m to 10.25m" of pile integrity with bearing capacity of 6600kN. Furthermore, High strain dynamic pile test of two concrete piles, P2E and P2P, showed that the integrity category is "OK" with bearing capacity 9896kN.

5. Nama Seminar/Konferensi/Simposium: **The 4th EPI International Conference on Science and Engineering (EICSE) 2020**, Penyelenggara Seminar/Konferensi/Simposium: Fakultas Teknik Universitas Hasanuddin, Waktu Pelaksanaan Seminar/Konferensi/Simposium: 6-7 Oktober 2020, ISBN/ISSN: 0094243X

Peserta dari 4 negara: **Indonesia, Japan, Malaysia, Togo**

JAPAN

LINK: <https://pubs.aip.org/aip/acp/article/2543/1/060018/2829271/FEM-analysis-for-in-plane-vibration-of-rectangular>

The screenshot shows the article page for 'FEM analysis for in-plane vibration of rectangular plates with point supports' by Yoshihiro Narita. The article is from Volume 2543, Issue 1, published on November 16, 2022. The author's affiliation is the Faculty of Science and Engineering, Yamato University, Suita, Osaka, Japan. The abstract describes the free vibration of rectangular plates with point supports, considering various displacements and energies. The article is available for citation on Reprints and Permissions, Cite, This Site, PubMed, and Google Scholar. The page also features a 'View Metrics' button, a 'Citing Articles Via' section with a Google Scholar link, and an advertisement for 'AIP Advances' with a 'Learn more' link. The 'REFERENCES' section lists one reference: N.S. Bardell and R.S. Langley, *J. Sound Vib.* 191, 459–467 (1996).

MALAYSIA

LINK: <https://pubs.aip.org/aip/acp/article/2543/1/080014/2829362/Computational-investigation-into-resistance>

The screenshot shows the article page for 'Computational investigation into resistance characteristics of a full-scale pusher-barge system' by Ahmad Fitriadhy et al. The article is from Volume 2543, Issue 1, published on November 16, 2022. The authors are from the Program of Naval Architecture, Faculty of Ocean Engineering Technology and Informatics, Universiti Malaysia Terengganu, Malaysia. The abstract discusses the resistance of a pusher-barge system in calm water, using Computational Fluid Dynamics (CFD) to predict total resistance. The article is available for citation on Reprints and Permissions, Cite, This Site, PubMed, and Google Scholar. The page also features a 'View Metrics' button, a 'Citing Articles Via' section with a Google Scholar link, and an advertisement for 'Applied Physics Letters' with guest editors and a 'Submit Today!' link. The 'REFERENCES' section lists one reference: Ahmad Fitriadhy et al., 'Computational investigation into resistance characteristics of a full-scale pusher-barge system'.

TOGO

LINK: <https://pubs.aip.org/aip/acp/article/2543/1/070002/2829379/New-approximate-analytical-solutions-for-time-step>

The screenshot shows the AIP Publishing website interface. At the top, there is a navigation bar with 'AIP Publishing' logo, a search bar, and links for 'Advanced Search' and 'Citation Search'. Below this is a secondary navigation bar with 'HOME', 'BROWSE', 'FOR AUTHORS', 'FOR ORGANIZERS', and 'ABOUT'. The main content area features the article 'New approximate analytical solutions for time-step models of vaporizing droplets' by Kwassi Anani, published on November 16, 2022. The article is categorized as a 'RESEARCH ARTICLE'. A sidebar on the left displays the 'AIP Conference Proceedings' logo and information about the '4th EPI International Conference on Science and Engineering (EICSE) 2020'. A right sidebar includes a 'View Metrics' button and a 'Citing Articles Via' section with a 'Google Scholar' link. A large advertisement for 'APL Energy' is visible at the bottom right, promoting 'First Articles Now Online!'. The browser's address bar shows the URL: 'pubs.aip.org/aip/acp/article/2543/1/070002/2829379/New-approximate-analytical-solutions-for-time-step'. The taskbar at the bottom shows the system tray with a temperature of 29°C in Berawan and the date 5/15/2023.

INDONESIA (PAPER SENDIRI)

LINK: <https://pubs.aip.org/aip/acp/article/2543/1/030013/2829258/FEM-analysis-of-hybrid-composite-beams-made-of>

The screenshot shows the AIP Publishing website interface for a different article. The navigation and secondary navigation bars are identical to the previous screenshot. The main content area features the article 'FEM analysis of hybrid composite beams made of normal concrete and foamed concrete' by Fakhruddin, Muhammad Wihardi Tjaronge, Muhammad Akbar Caronge, and Lsmunandar Mughtar, published on November 16, 2022. The article is categorized as a 'RESEARCH ARTICLE'. A sidebar on the left displays the 'AIP Conference Proceedings' logo and information about the '4th EPI International Conference on Science and Engineering (EICSE) 2020'. A right sidebar includes a 'View Metrics' button and a 'Citing Articles Via' section with a 'Google Scholar' link. A large advertisement for 'APL Energy' is visible at the bottom right, promoting 'No Article Processing Charges (APCs) through 2023'. The browser's address bar shows the URL: 'pubs.aip.org/aip/acp/article/2543/1/030013/2829258/FEM-analysis-of-hybrid-composite-beams-made-of'. The taskbar at the bottom shows the system tray with a temperature of 29°C in Berawan and the date 5/15/2023.

Prosiding

**SIMPOSIUM NASIONAL
TEKNOLOGI INFRASTRUKTUR
Abad ke-21**

Volume 1, Januari 2021



**SIMPOSIUM NASIONAL
TEKNOLOGI INFRASTRUKTUR**

**Inovasi Teknologi Infrastruktur
Menuju Masyarakat yang Maju dan Tangguh**

25-26 Januari 2021

**Departemen Teknik Sipil dan Lingkungan
Fakultas Teknik
Universitas Gadjah Mada**

Diselenggarakan oleh:



Bersama dengan:



KATA PENGANTAR

Puji dan syukur kehadirat Tuhan Yang Maha Esa atas segala rahmat dan karunia-Nya sehingga Prosiding “Simposium Nasional Teknologi Infrastruktur (SNTI) Abad 21” ini berhasil diterbitkan. Prosiding ini merupakan kumpulan makalah pada Simposium Nasional Teknologi Infrastruktur (SNTI) yang diselenggarakan pada tanggal 25-26 Januari 2021.

Seiring berkembangnya pembangunan infrastruktur Indonesia, tujuan seminar ini adalah sebagai media diskusi juga untuk meningkatkan kontribusi para akademisi dan profesional dalam pengembangan teknologi infrastruktur yang terintegrasi, berdayaguna, dan berwawasan lingkungan. Terdapat banyak sumber bencana yang mengancam berbagai wilayah Indonesia sehingga upaya mitigasi dan pemulihan pasca bencana melalui pengembangan sistem dan infrastruktur adalah hal sensial yang perlu dilakukan dengan didukung pengetahuan teknologi yang holistik dan mudah diterapkan.

“Simposium Nasional Teknologi Infrastruktur (SNTI) Abad 21”, mengajak kalangan untuk berbagi pengetahuan tentang ide, temuan, capaian, dan inovasi teknologi infrastruktur yang bermanfaat untuk mencapai kesejahteraan dan ketahanan bencana masyarakat Indonesia. Dalam hal ini, akademisi, praktisi, dan industri dalam bidang Teknik Sipil dan Lingkungan memiliki peran untuk menyelesaikan permasalahan tersebut.

Terima kasih kami sampaikan kepada semua penulis yang telah menyumbangkan makalahnya dalam prosiding ini. Terima kasih pula kami sampaikan kepada seluruh dosen dan mahasiswa Departemen Teknik Sipil dan Lingkungan, Fakultas Teknik, Universitas Gadjah Mada yang telah terlibat dalam perencanaan dan penyelenggaraan seminar serta telah bekerja keras dalam pembuatan prosiding ini, baik dari segi naskah maupun tampilan yang disajikan secara apik. Kami mengucapkan mohon maaf bila terdapat kekeliruan dalam penerbitan prosiding ini. Kami berharap, seminar dan prosiding ini dapat berguna dan memberikan manfaat bagi banyak pihak, baik untuk sekarang maupun waktu yang akan datang.

Yogyakarta, Januari 2021

Ketua Panitia

Angga Fajar Setiawan, S.T., M.Eng., Ph.D.

STRUKTUR KEPANITIAAN

PENANGGUNG JAWAB : Prof. Dr. Ir. Joko Sujono, M.Eng.

PENGARAH :

- 1) Ir. Ali Awaludin, S.T., M.Eng., Ph.D.
- 2) Prof. Ir. Hrc. Priyosulistyo, M.Sc., Ph.D.
- 3) Prof. Ir. Sigit Priyanto, M.Sc.
- 4) Dr. Ir. Istiarto, M.Eng.
- 5) Dr. Ir. Budi Kamulyan, M.Eng.
- 6) Dr. Ir. Ahmad Rifa'i, M.T.

PANITIA PELAKSANA :

Ketua : Angga Fajar Setiawan, S.T., M.Eng., Ph.D.

Sekretaris : Endita Prima Ari Pertiwi, S.T., M.Eng., Ph.D.

Komite Paper :

- 1) Ashar Saputra, S.T., M.T., Ph.D.
- 2) Arief Setiawan Budi Nugroho, S.T., M.Eng., Ph.D.
- 3) Imam Muthohar, S.T., M.Eng., Ph.D.
- 4) Dr. Inggar Septia Irawati, S.T., M.Eng.
- 5) Intan Supraba, S.T., M.Sc., Ph.D.
- 6) Dr. Eng. Muhammad Zudhy Irawan, S.T., M.T.
- 7) Fikri Faris, S.T., M.Eng., Ph.D.
- 8) Johan Syafri Mahathir Ahmad, S.T., M.Eng., Ph.D.
- 9) Dr.Eng. Sito Ismanti, S.T., M.Eng.
- 10) Karlina, S.T., M.Eng., Ph.D.

Acara :

- 1) Ni Nepi Nyoman Marleni, S.T., M.Sc., Ph.D.
- 2) Tantri Nastiti Handayani, S.T., M.Eng., Ph.D.
- 3) M. Rizka Fahmi Amrozi, S.T., M.Sc., Ph.D.
- 4) Kartika Nur Rahma Putri, S.T., M.T.
- 5) Nurul Alvia Istiqomah, S.T., M.S

DEWAN REDAKSI

:

- 1) Arief Setiawan B. N., S.T., M.Eng., Ph.D.
- 2) Dr. Inggar Septhia Irawati, S.T., M.T.
- 3) Intan Supraba, S.T., M.Sc., Ph.D.
- 4) Angga Fajar Setiawan, S.T., M.Eng., Ph.D.
- 5) Endita Prima Ari Pratiwi, S.T., M.Eng., Ph.D.
- 6) Johan Syafri Mahatir, S.T., M.Eng., Ph.D.
- 7) Dr. Eng. Sito Ismanti, S.T., M.Eng.
- 8) Karlina, S.T., M.Eng., Ph.D.
- 9) Rizka Fahmi Amrozi, S.T., M.Sc., Ph.D.
- 10) Ashar Saputra, S.T., M.T., Ph.D.
- 11) Ali Awaludin, S.T., M.Eng., Ph.D.
- 12) Imam Muthohar, S.T., M.Eng., Ph.D.
- 13) Fikri Faris, S.T., M.Eng., Ph.D.
- 14) Dr. Eng. Muhammad Zudhy Irawan, S.T., M.T.
- 15) Ni Nyoman Nepi Marleni, S.T., M.Sc., Ph.D.
- 16) Tantri Nastiti Handayani, S.T., M.Sc., Ph.D.
- 17) Kartika Nur Rahma Putri, S.T., M.T.
- 18) Nurul Alvia Istiqomah, S.T., M.Sc.
- 19) Dr.Eng.Ir.Eka Juliafad, ST.,M.Eng.,IPM
- 20) Dr. Eng. Nevy Sandra, ST, M.Eng
- 21) Dr. Gusta Gunawan, S.T., M.T.
- 22) Ade Sri Wahyuni, S.T., M.Eng., Ph.D.
- 23) Lindung Zalbuin Mase, S.T., M.Eng., Ph.D.
- 24) Dr. Lisa Oksri Nelfia, ST, MT, MSc
- 25) Dr. Ir. Bambang Endro Yuwono, MS
- 26) Dr. Eng. Rita Irmawaty, S.T., M.T.
- 27) Dr. Eng. Fakhruddin, ST, MT
- 28) Dr. Chusnul Arif, STP., M.Si
- 29) Dr. Eng. Heriansyah Putra, S.Pd., M.Eng
- 30) Nidiasari, S.T.,M.T
- 31) Rina Yuliet, S.T.,M.T

- 32) Budijanto Widjaja, Ph.D
- 33) Dr. Eng. Mia Wimala
- 34) Helmy Hermawan Tjahjanto, Ph.D.
- 35) Dr.-Ing. Bobby Minola Ginting
- 36) Tri Basuki Joewono, Ph.D.
- 37) Ir. Hera Widyastuti, M.T., Ph.D.
- 38) Dr. Eng. Januarti Jaya Ekaputri, S.T., M.T.
- 39) Bambang Piscesa, S.T., M.T., Ph.D.
- 40) Dr. Yudhi Lastiasih, S.T., M.T.
- 41) Dr. Techn. Umboro Lasminto, S.T., M.T
- 42) I Putu Gustave Suryantara Pariartha, S.T., M. Eng., Ph.D
- 43) Ir. Teddy Theryo, MSCE, PE
- 44) Hartanto Wibowo, S. T., M. A. Sc., Ph. D, P. E.
- 45) Dr. Rijalul Fikri
- 46) Chandra Setyawan, S.Tp., M.Eng., Ph.D
- 47) Dr. Faizal Wira Rohmat
- 48) Neil Andika, S.T., M.Sc.
- 49) Prayogo Afang Prayitno, S.T., M.Eng
- 50) Raihan Pasha Isheka, S.T., M. Sc.



SIMPOSIUM NASIONAL
TEKNOLOGI INFRASTRUKTUR

Departemen Teknik Sipil dan Lingkungan
Fakultas Teknik
Universitas Gadjah Mada

ISBN 978-623-91262-1-6 (no.jil.lengkap EPUB)



9 786239 126216

ISBN 978-623-91262-2-3 (jil.1 EPUB)



9 786239 126223

DAFTAR ISI

KATA PENGANTAR	iii
STRUKTUR KEPANITIAAN	iv
DAFTAR ISI	vii
 TEMA 1 – GREEN INFRASTRUCTURE AND MATERIAL ENGINEERING	
Inovasi Beton Ringan dengan Limbah <i>Styrofoam</i> dan <i>Fly Ash</i> T. B. H. Suntadi, C. Octavianus, E. D. Widjaja	1
Perilaku Mekanik dan Ketahanan Beton Berbahan Pasir <i>Slag Nikel</i> dan <i>Fly Ash</i> T. Priono, R. Irmawaty, Fakhruddin	6
Pengujian Variasi Tipe Sambungan dengan Perekat Labur terhadap Kuat Geser Balok Bambu Laminasi H. B. B. Kuncoro, Z. Darwis, D. Alwan	12
Pemanfaatan Material Limbah <i>Plastic Optical Fiber (POF)</i> dalam Campuran Beton Normal Sesuai SNI 7656:2012 P. R. Putrianti, A. A. Setiawan, P. Melati. R., N. Lyvia	19
Analisa Kekuatan Sambungan pada Sistem Komposit LVL Kayu Nangka dengan Beton Pracetak D. P. Sari, R. Wanara, Zulfiadi	24
Pengaruh Penambahan Abu Batu Sebagai Pengisi sebagai Pengisi terhadap Kuat Tekan dan Pola Kerusakan pada Beton Tanpa Pasir A. Setiawan, S. Winarno	29
Compressive and Tensile Creep of Glued-Laminated Bamboo Ngudiyono, B. Suhendro, A. Awaludin, A. Triwiyono	35
Kinerja Bekisting Sistem (PERI) pada Pekerjaan Struktur Bunker Ruang Teleterapi <i>Linear Accelerator (LINAC)</i> : (Studi pada Rumah Sakit Umum Daerah Mangusada Badung) I. G. L. B. Eratodi, A. Triwiyono	41

Perilaku Mekanik dan Ketahanan Beton Berbahan Pasir Slag Nikel dan *Fly Ash*

T. Priono*, R. Irmawaty, Fakhruddin

Departemen Teknik Sipil, Universitas Hasanuddin, Makassar, INDONESIA

*Corresponding author: d11116012teguh@gmail.com

INTISARI

Isu pemanasan global dan lingkungan menjadi tujuan utama untuk membatasi penggunaan semen maupun agregat alam dalam produksi mortar dan beton, sehingga dibutuhkan material yang ramah lingkungan sebagai gantinya. Salah satu material yang diusulkan adalah penggunaan *fly ash* sebagai pengganti sebagian semen dan pasir slag sebagai agregat halus. Tujuan dari penelitian ini untuk mengkaji penggunaan pasir slag nikel dan *fly ash* sebagai material substitusi terhadap perilaku mekanik beton dan mengevaluasi ketahanan beton terhadap penetrasi klorida dengan metode sorptiviti. Metode yang digunakan adalah eksperimental murni dengan variasi pada persentase penggunaan pasir slag nikel dan *fly ash* dengan faktor air semen (FAS) 25% dan 45%. Pengujian yang dilakukan berupa pengujian mekanik (kuat tekan dan modulus elastisitas, kuat tarik belah, kuat lentur), serta pengujian sorptiviti beton. Diperoleh hasil yang menunjukkan bahwa kekuatan mekanik beton tertinggi dari variasi OPC-GNS50 pada kedua variasi FAS (25% dan 45%). Hal ini membuktikan bahwa penggunaan parsial pasir slag dan variasi penambahan *fly ash* berkontribusi pada peningkatan kekuatan beton. Pengujian sorptiviti memberikan hasil yang relevan dengan kuat tekan, dimana beton OPC-GNS50 memiliki ketahanan yang baik terhadap penetrasi klorida.

Kata kunci: Slag Nikel, *Fly Ash*, Perilaku Mekanik, Sorptiviti.

1 PENDAHULUAN

Bahan bangunan yang terbentuk dari campuran semen, agregat kasar, agregat halus dan air ini memiliki daya tarik yang cukup besar dalam penggunaannya. Bahan dasar pembuatan beton seperti agregat merupakan sumber daya yang mudah diperoleh dan banyak tersedia di alam dengan pemeliharaan yang mudah. Semakin pesatnya pertumbuhan pengetahuan di bidang konstruksi diperlukan suatu material sebagai bahan campuran beton yang memiliki keunggulan yang lebih baik dibandingkan bahan yang sudah ada selama ini. Selain itu bahan tersebut harus memiliki beberapa keuntungan seperti bentuk yang dapat menyesuaikan kebutuhan, biaya yang lebih ekonomis, kecepatan pelaksanaan konstruksi, serta ramah lingkungan.

Kebutuhan beton yang semakin tinggi, mendorong teknokrat beton untuk terus mengkaji peningkatan kinerja beton dengan memanfaatkan limbah industri seperti *fly ash*, *blast-furnace slag*, *rice husk ash* dalam produksi beton. Isu *global warming* dan lingkungan menjadi tujuan utama untuk membatasi penggunaan semen maupun agregat alam dalam produksi mortar dan beton. Menurut Malhotra, V.M., (2002) produksi satu ton semen membebaskan sekitar satu ton CO₂ ke atmosfer. Tahun 2016, produksi semen dunia menghasilkan sekitar 2,2 miliar ton CO₂, setara dengan kontribusi sekitar 8 % terhadap emisi gas karbon dioksida (CO₂) dunia (Rogers, L., 2018). Penggunaan *fly ash* dapat mengurangi limbah industri dan emisi gas karbon dioksida.

Indonesia hingga saat ini memiliki 17 juta ton slag nikel. Jumlah tersebut dihasilkan dari sejumlah smelter dalam negeri, antara lain PT Antam Tbk., PT MSP, IMIP Group, Vitue Dragon, dan PT Vale Indonesia. Namun hanya 10% saja yang telah dimanfaatkan untuk aplikasi konstruksi. Sedangkan hingga tahun 2022, ditargetkan akan ada 60 smelter dari Izin Usaha Pertambangan Operasi Produksi Khusus (Saefulhak Y, 2019). *The Daily Records Jakarta* menyatakan bahwa Indonesia saat ini berada di urutan kelima terbesar dunia sebagai penghasil batu bara dengan perkiraan produksi 386 juta ton setiap tahun. PLTU diperkirakan sekitar 86% sebagai pengguna batu bara yang menghasilkan *fly ash* sebagai limbah hasil pembakaran. Slag nikel adalah salah satu jenis sisa dari proses industri yaitu dari proses peleburan biji nikel setelah melalui proses pembakaran dan penyaringan. Dari Proses peleburan biji nikel tersebut menghasilkan limbah berupa slag yang jumlahnya sangat besar dan dapat berpotensi menimbulkan masalah lingkungan serta gangguan kesehatan pada masyarakat. Banyaknya limbah buangan yang berupa slag nikel kini harus ditangani atau dimanfaatkan dengan benar sehingga dapat bermanfaat bagi masyarakat.

Sebagai limbah buangan hasil pengolahan biji nikel, selama ini slag nikel hanya digunakan sebagai bahan timbunan oleh masyarakat dan dianggap tidak memiliki manfaat lagi. Namun secara fisik, slag nikel menyerupai agregat yang dapat digunakan untuk bahan agregat dalam campuran beton. Berdasarkan latar belakang tersebut, maka perilaku mekanik dan ketahanan beton berbahan pasir slag nikel dan *fly ash* akan didiskusikan lebih dalam.

2 METODOLOGI PENELITIAN

2.1 Benda Uji

Benda uji berupa beton silinder (diameter 100 mm dan tinggi 200 mm) dan balok dengan ukuran 100 x 100 x 400 mm. Total benda uji yang digunakan adalah 144 buah yang terbagi menjadi 72 silinder untuk pengujian kuat tekan pada umur 3, 7 dan 28 hari, 24 silinder untuk pengujian tarik belah pada umur 28 hari, 24 balok untuk pengujian kuat lentur pada umur 28 hari, dan 8 silinder beton untuk pengujian sorptiviti yang di potong menjadi 3 bagian yang sama.

Pembuatan benda uji meliputi beton normal, beton dengan substitusi pasir slag sebagai pengganti parsial agregat halus, dan beton dengan substitusi *fly Ash* sebagai pengganti parsial semen. Dengan variasi untuk pasir slag adalah 50% dari berat agregat halus, sedangkan variasi *fly Ash* adalah 15% dan 30% terhadap berat semen, dengan faktor air semen masing masing variasi 25% dan 45%.

2.2 Mix Design Beton

Komposisi campuran beton disajikan pada Tabel 1 dan 2 dengan faktor air semen 25% dan 45% dengan nilai *slump* rencana sebesar 12 ± 2 cm.

3 HASIL DAN PEMBAHASAN

3.1 *Slump*

Slump test dilakukan untuk mengetahui tingkat kekentalan adukan beton, yang menggambarkan kemudahan pengerjaan (*workability*) beton. Adapun hasil dari pengujian *slump* disajikan pada Tabel 3. Nilai *slump* meningkat seiring dengan peningkatan volume *fly ash*, sehingga mampu memperbaiki sifat *workability* beton. Semua variasi campuran memenuhi target *slump* sebesar 12 ± 2 cm.

Tabel 1. Komposisi campuran beton (kg/m^3) dengan FAS 45%.

Bahan	OPC-Pasir	OPC-GNS50	FA15-GNS50	FA30-GNS50
Air	175,00	175,00	175,00	175,00
Semen	388,89	388,89	330,56	272,22
<i>Fly ash</i>	-	-	40,74	81,48
Pasir	603,88	440,97	440,97	440,97
Pasir Slag	-	440,97	440,97	440,97
Batu Pecah	1090,34	940,90	940,90	940,90
Viscocrete 3115N	1,17	1,17	1,17	1,17

Tabel 2. Komposisi campuran beton (kg/m^3) dengan FAS 25%.

Bahan	OPC-Pasir	OPC-GNS50	FA15-GNS50	FA30-GNS50
Air	175,00	175,00	175,00	175,00
Semen	700,00	700,00	595,00	490,00
<i>Fly ash</i>	-	-	73,33	146,67
Pasir	513,72	375,14	375,14	375,14
Pasir Slag	-	375,14	375,14	375,14
Batu Pecah	927,56	800,43	800,43	800,43
Viscocrete 3115N	2,10	2,10	2,10	2,10

Tabel 3. Hasil pengukuran nilai *slump*.

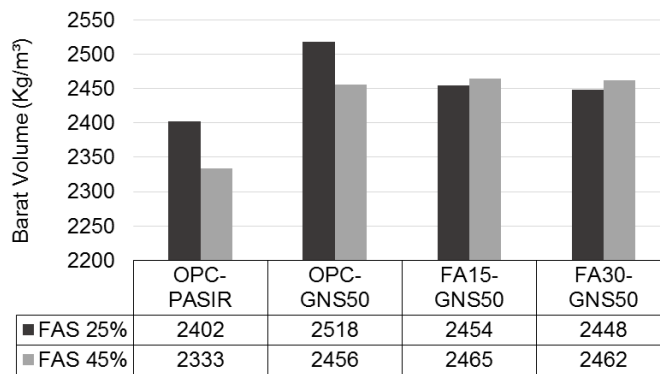
Sampel	FAS	<i>Slump</i> (cm)	FAS	<i>Slump</i> (cm)
OPC-PASIR		12		11,5
OPC-GNS50		13		12
FA15-GNS50	45%	14	25%	13
FA30-GNS50		14,5		14

3.2 Berat Volume

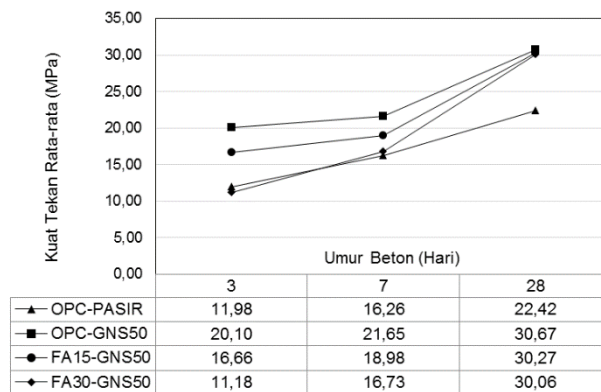
Pemeriksaan berat volume beton dilakukan pada beton yang berumur 28 hari. Adapun hasil pemeriksaan berat volume beton rata-rata ditampilkan pada Gambar 1. Dari Gambar 1 dapat disimpulkan bahwa untuk beton dengan FAS 45% variasi FA15-GNS50 dan variasi OPC-GNS50 FAS 25% memiliki berat volume yang paling besar. Berat volume yang terkecil dari variasi OPC-Pasir dengan FAS 45% dan 25%, hal ini dikarenakan berat volume dari pasir slag nikel lebih besar dibandingkan pasir sungai. Secara keseluruhan, beton dengan pasir slag dan penambahan *fly ash* beratnya cenderung konstan, tidak dipengaruhi oleh faktor air semen.

3.3 Kuat Tekan Beton

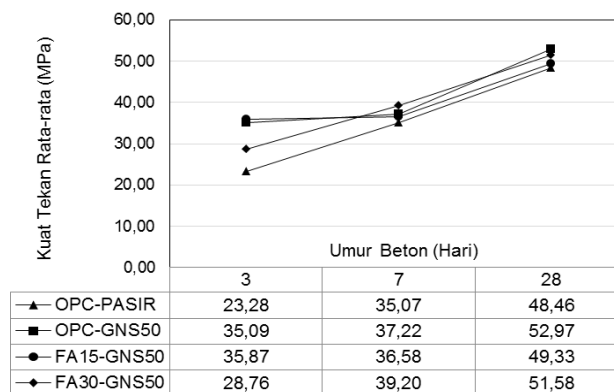
Pengujian kuat tekan beton dilakukan pada umur 3, 7, dan 28 hari dengan benda uji silinder (diameter 100 mm, tinggi 200 mm), hasilnya disajikan pada Gambar 2 dan 3. Gambar 2 dan 3 memperlihatkan peningkatan kuat tekan seiring dengan bertambahnya umur untuk setiap variasi benda uji. Pada umur 28 hari, nilai kuat tekan semua variasi hampir sama, dengan kekuatan tertinggi diperoleh pada variasi OPC-GNS50 dan kuat tekan terendah pada variasi OPC-Pasir.



Gambar 1. Berat volume beton dengan FAS 25% dan 45%.



Gambar 2. Kuat Tekan Rata-rata Beton dengan FAS 45%.



Gambar 3. Kuat tekan rata-rata beton dengan FAS 25%.

3.4 Modulus Elastisitas Beton

Pengujian modulus elastisitas beton dilakukan pada silinder berukuran 100 mm dan tinggi 200 mm. Tipikal grafik hubungan tegangan regangan dari berbagai variasi beton diwakili oleh Gambar 4. Nilai modulus elastisitas disajikan pada Tabel 4. Dari Tabel 4 terlihat bahwa beton OPC-GNS50 memiliki nilai modulus elastisitas terbesar dan beton OPC-Pasir dengan nilai modulus elastisitas terkecil pada umur 28 hari. Besar nilai modulus elastisitas sejalan dengan nilai kuat tekan beton.

3.5 Kuat Tarik Beton

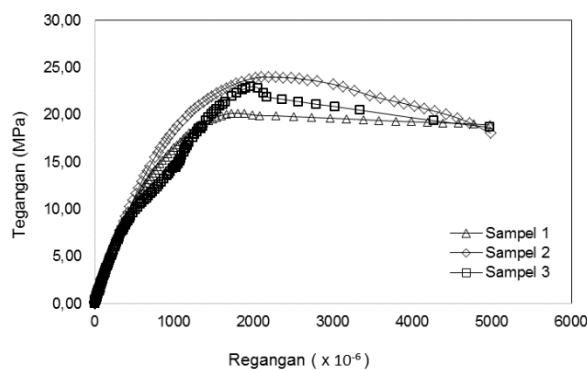
Pengujian kuat tarik belah mengacu pada SNI 03-2491-2002. Pengujian dilakukan pada umur 28 hari dan hasilnya disajikan pada Tabel 5. Terlihat bahwa beton dengan FAS 45% variasi FA15-GNS50 memiliki nilai kuat tarik belah yang terbesar, sedangkan untuk FAS 25% kuat tarik belah terbesar dicapai oleh variasi OPC-GNS50.

3.6 Kuat Lentur Beton

Hasil pengujian kuat lentur pada umur 28 hari ditampilkan pada Tabel 5. Nilai kuat lentur terbesar diperoleh pada beton FAS 45% variasi OPC-GNS50 dan pada FAS 25% variasi OPC-GNS50. Secara keseluruhan terlihat bahwa nilai kuat lentur beton FAS 45% lebih kecil di banding beton FAS 25%.

3.7 Sorptiviti

Pengujian sorptiviti beton dilakukan pada umur 28 hari dengan menggunakan silinder berdiameter 100 mm dan tinggi 50 mm dimana pengujian ini terbagi atas 2 yaitu *initial absorption* yang diamati pada hari pertama perendaman dan *secondary absorption* yang diamati pada hari kedua hingga hari ketujuh. Pengujian sorptiviti mengacu pada ASTM C 1585 – 04. Adapun hasil pengujian sorptiviti beton disajikan pada Gambar 5 dan 6.



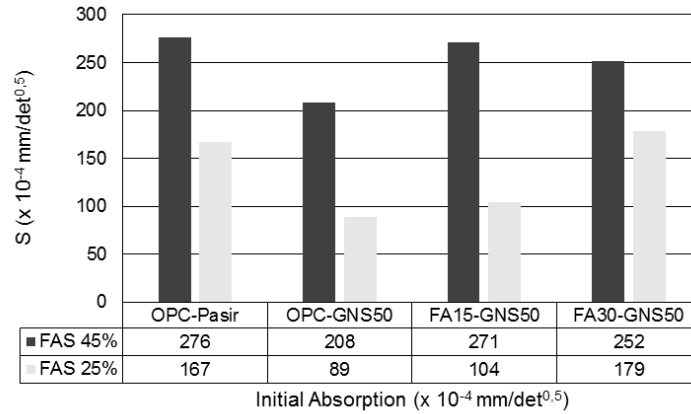
Gambar 4. Hubungan tegangan-regangan beton OPC-Pasir (FAS 45%).

Tabel 4. Nilai modulus elastisitas beton

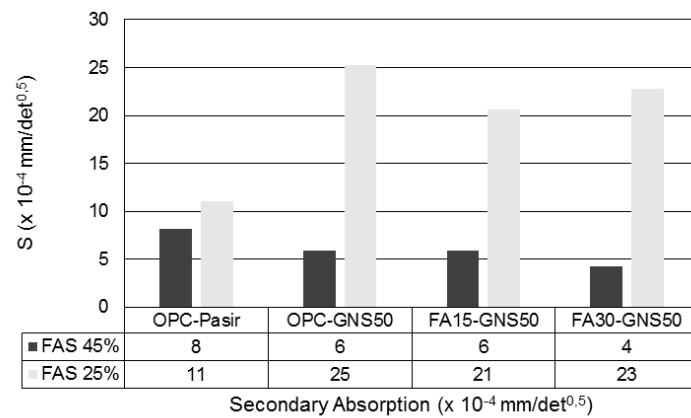
Sampel	Modulus Elastisitas (N/mm ²)	
	FAS 45%	FAS 25%
OPC-PASIR	23212,09	35148,45
OPC-GNS50	29670,80	38618,49
FA15-GNS50	29475,06	36552,78
FA30-GNS50	29186,96	37580,97

Tabel 5. Nilai kuat tarik belah dan kuat lentur

Sampel	Kuat Tarik Belah (N/mm ²)		Kuat Lentur (N/mm ²)	
	FAS 45%	FAS 25%	FAS 45%	FAS 25%
OPC-PASIR	3,26	4,04	4,09	5,06
OPC-GNS50	3,73	4,98	4,46	5,33
FA15-GNS50	4,25	4,60	4,22	4,69
FA30-GNS50	3,67	4,05	4,39	4,75



Gambar 5. Initial Absorption.



Gambar 6. Secondary Absorption.

Dari Gambar 5 terlihat bahwa beton FAS 45% untuk variasi OPC-Pasir memiliki tingkat penyerapan yang tinggi dibanding variasi lainnya, sedangkan pada beton FAS 25% untuk variasi FA30-GNS50 memiliki tingkat penyerapan yang tinggi dibanding variasi lainnya. Hal ini menunjukkan bahwa *initial absorption* dipengaruhi oleh mutu beton, semakin tinggi mutu beton, maka semakin kecil pula tingkat penyerapannya. Sorptiviti beton yang kecil memberi indikasi bahwa beton memiliki jumlah pori yang sedikit atau dengan kata lain permeabilitas rendah. Hal ini akan memberi dampak terhadap peningkatan ketahanan beton terhadap penetrasi klorida.

Sedangkan pada Gambar 6 di peroleh hasil bahwa pada beton FAS 45% untuk variasi OPC-Pasir memiliki tingkat penyerapan yang lebih tinggi dibanding variasi lainnya, sedangkan pada beton FAS 25% untuk variasi OPC-GNS50 memiliki tingkat penyerapan tinggi dibanding variasi lainnya. Pada *secondary absorption*, kebalikan dari *initial absorption*, pada tahap *initial absorption* butuh waktu lama agar zat cair dapat menembus pori-pori beton, jika sudah menembus pori-pori beton, maka pada tahap *secondary absorption* tingkat penyerapan menjadi lebih rendah, dapat dilihat pada beton OPC-Pasir yang telah jenuh pada tahap *initial absorption*, sehingga tingkat penyerapan pada tahap *secondary absorption* sudah rendah.

4 KESIMPULAN

Berdasarkan uraian di atas, maka dapat ditarik kesimpulan sebagai berikut:

1. Penggunaan *fly ash* dan pasir slag nikel sebagai pengganti sebagian semen dan pasir sungai, secara signifikan memperbaiki perilaku mekanik beton sebagai berikut:
 - a. Kuat tekan meningkat sebesar 36,8% dan 9,0% masing-masing pada FAS 0,45 dan 0,25 terhadap OPC-Pasir, dengan kuat tekan tertinggi pada beton OPC-GNS50 disusul oleh FA30-GNS50.
 - b. Modulus elastisitas beton meningkat sebesar 6-19% pada FAS 0,45.
 - c. Kuat tarik belah meningkat 12-30% pada FAS 0,45 dengan nilai tertinggi dicapai oleh beton FA15-GNS50.

- d. Kuat lentur meningkat 3-6% pada FAS 0,45 dengan nilai tertinggi dicapai oleh beton OPC-GNS50, disusul oleh FA30-GNS50 dan FA15-GNS50.
2. Ketahanan beton terhadap penetrasi klorida *dengan metode sorptivity* diperoleh hasil sebagai berikut:
 - a. Pada *initial absorption*, beton OPC-Pasir dengan kuat tekan terendah, menunjukkan tren nilai penyerapan yang tertinggi pada kedua FAS. Sedangkan beton OPC-GNS50 menunjukkan tren nilai penyerapan tertinggi pada *secondary absorption*.
 - b. Nilai penyerapan yang tinggi pada tahap *initial absorption* dikarenakan beton membutuhkan waktu yang cepat untuk mencapai kondisi jenuh, sedangkan pada tahap *secondary absorption* memberikan hasil yang berbanding terbalik dengan tahap *initial absorption*. Beton OPC-GNS50 memiliki ketahanan yang baik terhadap penetrasi klorida.

REFERENSI

ASTM. (2004) *ASTM C 1585-04 Standard Test Method for Measurement of Rate of Absorption of Water by Hydraulic-Cement Concretes*, ASTM Internasional, West Conshohocken, United States.

BSN. (2002). *SNI 03-2491-2002 tentang Metode Pengujian Kuat Tarik Belah Beton*, Badan Standardisasi Nasional, Jakarta, Indonesia.

Malhotra, V.M., (2002). "Introduction - sustainable development and concrete technology", *ACI Concrete International*, 24 (7), p. 22.

Rogers, L., (2018). "Climate change: The Massive CO₂ Emitter You May Not Know About". (<https://www.bbc.com/news/science-environment-46455844>). (Accessed 10 October 2018)

Saefulhak, Y., (2019). "ESDM: Pengolahan slag sisa Smelter masih terkendala regulasi limbah B3. Direktur Pembinaan dan Pengusahaan Mineral Kementerian ESDM", <https://industri.kontan.co.id/news/esdm-pengolahan-slag-sisa-smelter-masih-terkendala-regulasi-limbah-b3>. , (Accessed 2 August 2019)