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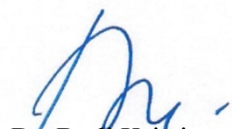
Dear colleagues,

On behalf of the Committees, It is our great pleasure to welcome you to Solo for International Conference on Engineering, Science and Nanotechnology 2016 (ICESNANO 2016) held at The Alana Hotel & Convention Center - Solo, INDONESIA on August 3 (Wed) ~ 5 (Fri), 2016. The joint committee between Mechanical Engineering Department, Sebelas Maret University (UNS) and Microelectronics & Nanotechnology - Shamsuddin Research Centre or MiNT-SRC, Universiti Tun Hussein Onn Malaysia (UTHM) are very proud to be performing the first ICESNANO 2016. In this year, the conference theme is “*Empowering innovation in engineering, science and nanotechnology*”. This conference aims to communicate and distribute knowledge of fundamental and applied research in the field of engineering, science and nanotechnology. It also provides the premier interdisciplinary forum for participants to present and discuss the most recent innovations and practical challenges in this field.

We are very proud and honored to have a welcoming and opening speech by Prof. Dr. Ravik Karsidi, M.S. (Rector of UNS) and Prof. Datuk Dr. Mohd Noh Dalimin (Vice-chancellor of UTHM), respectively. We would like to great thank the keynote speakers given by Prof. Abdul Latif Ahmad (Universiti Sains Malaysia), Prof. Akio Miyara (Saga University) and Assoc Prof. Takahiko Miyazaki (Kyushu University), who will present their recent work and will give new insights and ideas to the conference participants. The committees are very grateful to the invited speakers, i.e. Assoc Prof. Keishi Kariya (Saga University), Dr. Koichi Nakaso (Kyushu University), Prof. Masaya Ichimura (Nagoya Institute of Technology), Prof. Dr. Dwi Aries Himawanto (Sebelas Maret University) and Dr. Ir. Astu Unadi, M.Eng. (Director of ICAERD, Indonesian Center for Agricultural Engineering Research and Development - Ministry of Agriculture) who present their innovative works.

The organization of ICESNANO 2016 is very much a team effort. I want to especially thank all the members of the conference committee, who have carried out a huge and complicated workload. I also wish to acknowledge the members of the scientific committee, who had the arduous task of peer review process for a lot of the submitted abstracts. I also wish to thank the Ministries of Research, Technology, and Higher Education Republic of Indonesia for an international conference grant. We are also very grateful to our sponsors and exhibitors i.e. Preston Shipyard Sdn. Bhd., REI, and PT. Horiba Indonesia. Finally, let me wish you are going to enjoy this exciting conference regarding both its academic and social programs.

Kind regards,



Dr. Budi Kristiawan
Conference Chair, ICESNANO 2016 Solo, INDONESIA
August, 3rd 2016

Welcome !



Welcome all scientists, researchers, and students to our event, ICESNANO 2016. This International Conference on Engineering, Science and Nanotechnology will be held in Solo, Indonesia on 3 – 5 August 2016. ICESNANO 2016 constitutes the joint seminar between Sebelas Maret University (UNS) Indonesia and Universiti Tun Hussein Onn (UTHM) Malaysia in the field of engineering, science and nanotechnology.

In this event, our conference theme is “empowering innovation in engineering, science and nanotechnology”.

The conference program will consist of pre-conference workshops, plenary/keynote speeches, invited sessions as well as oral sessions. This conference aims to communicate and distribute knowledge of fundamental and applied research in the field of engineering, science and nanotechnology.

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Sediment Characteristic on Hydropower Plant Bakaru, South Sulawesi

Firman^{1,a)}, A.M. Shiddiq Yunus^{1,b)} and M. Yusuf Yunus^{1,c)}

¹*Mechanical Engineering Department, Politeknik Negeri Ujung Pandang, Makassar, Indonesia 90245*

^{a)}Corresponding author: firmananoor@yahoo.com

^{b)}shiddiq_96@yahoo.com.sg

^{c)}yusuf200880@gmail.com

Abstract. This research is aimed to determine the distributed sediment composition and its size particle impact on flow profile in the pipe. The sediment sample is collected from Hydropower Plant's dam located at Bakaru Sulawesi Selatan. The sample is dried in the oven then steered up using a screen with 0.25; 0.5; and 0.75 mm. Sediment identification is measured using Fourier Transform Infrared Spectrophotometer (FTIR) and X-Ray Fluorescence Spectrophotometer (XRF). The assessment of flow type in the pipe with five flow rate variation for every single sediment diameter is assessed in Fluid Measurement Laboratory under Mechanical Engineering Department, State Polytechnic of Ujung Pandang. As a result of steered up processed, it is obtained that the sediment distribution with diameter of $\phi = 0.25$ mm is 55.80%; for $\phi = 0.5$ mm is 7.91%; and $\phi = 0.75$ mm is 36.29%. From FTIR test, it is obtained the spectra with wave number of 466.77; 536.14; 644.22; 694.37; 788.89; 912.33; 1006.77; 1031.92; and 105.21 cm^{-1} . From XRF assessment, it can be obtained that composition of SiO_2 is 53.64%, Al_2O_3 is 22.93%, Fe_2O_3 is 9.24%, MgO is 4.0%, K_2O is 3.84%, Na_2O is 2.4%, CaO is 1.71%, and TiO_2 is 1.06%. From the flow profile assessment, it obtains Reynolds number is lesser than 500 for these three particle diameters variation. It can be concluded that sediment characteristic consists of fine sand about 55.80% and coarse sand about 44.20%, where SiO_2 dominates it by about 53.64% where flow in the pipe shown the laminar type.

INTRODUCTION

Bakaru Hydropower Plant (BHPP) is a runoff river type hydropower where water that is used for generating power is obtained from damming up the river. The dammed river is Sungai Mamasa that the stream-up is located at Mamasa District of West Sulawesi. The capacity of Bakaru Hydropower Plant is 2 x 63 MW supplies power to part of South and West Sulawesi.

Bakaru Hydropower Plant supports development progress of many sectors in South Sulawesi for example various industries from small to large scale industries, education, health and other economic activities. This condition should be maintained to improve the quality of life for most of the society in South Sulawesi.

Besides positive impact on economics life, BHPP is also affecting the environment where sediment deposit is increased at the Dam of Bakaru Hydropower Plant. Research that was conducted by PLN in June 2005 concluded that sediment volume is significantly increased from 0 m^3 in 1990 to 6.331.400 m^3 in 2005 [1]. Laboratory test shows that at the Dam of BHPP consist of coarse sand and fine sand [2]. Coarse sand is containing SiO_2 55.30 – 99.87% and the rest Fe_2O_3 , Al_2O_3 , TiO_2 , etc. [3]. The rapid increase of sediment is causing a serious damage to turbine component so-called moving blades. Consequently, maintenance interval becomes shorter (4 years) where according to the manual book of Hydropower Operation, the maintenance interval is in the range of 8 to 10 years. Therefore, with shorter maintenance period, the maintenance cost will also be increased and could lead to hydropower shutdown when the damage is extremely serious.

High concentration of sediment could cause abrasion and erosion at some water turbines [4]. The statement mentioned that abrasion and erosion not solely occur in the environment but also on water turbines. Moreover, besides high concentration of sediment, sediment size will also contribute to micro-erosion of the runner of the turbines [5]. Therefore, concentration and size of the sediment are two things that significantly contribute to the water turbine damage.

Erosion on turbine blades is not only caused by cavities but also caused by particle coalition on the surface of turbine blades [6]. Damage on turbine's blades as the cavity is usually caused by steam vesicles that occur due to low pressure on the turbine's blades. In general, there are four zones where cavities occur at Francis turbine blades [4] where these cavities affect the efficiency of the turbine [8]. Besides, three factors influence on turbine blades

damage; concentration, size and particle energy when to collide the turbine's blades. These three factors are also affecting the flow profile of the sediment that is entering the turbine. It can be said that laminar flow profile is Reynolds Number, $Re < 500$ and turbulence if $Re > 2000$ [7]. This statement shows that the damage of turbine blades is strongly related to the flow profile of the sediment. These entire phenomena show the complexity of the factors that contribute to the turbine's blades damage.

In these zones, pressure decrease due to vortex flow around the turbine's blades. The cavity occurs not only caused by the dropped pressure of water flow in the four zones but also caused by particle concentration, the higher the particle intensity, the higher potency of cavity [9]. Besides cavity, the damage around the four zones, could also caused by erosion that occurs due to particle collision with the surface of turbine's blades.

Erosion on turbine's blades can cause system efficiency decrease [10]. From the information above that the runner damage of water turbine can be caused by abrasion, erosion, and cavity. Besides, it also affected by concentration and size of sediment particles. This information shows that it is very important to identify the cause and the influence of the runner damage of water turbine. Therefore, it is necessary to conduct an introduction research regarding a characteristic of sediment at Bakaru hydropower plant that continued by depth research about the influence of sediment on the moving blade damage of water turbine. The research is important because it is related to the electric power supply in South and West Sulawesi. This research aims to determine the particle and composition of sediment at Bakaru Hydropower Plant. Moreover, in this research, profile flow in the pipe will also be determined with various size of the particle.

EXPERIMENTAL METHOD

Sediment sample is collected in three different points at the Dam of BHPP for 10 kg each. The samples are dried using an electric oven. The dried sediment then steer up using a screen with diameter hole of 0.25 mm; 0.50 mm; and 0.75 mm. to identify the sediment, Fourier Transform Infrared Spectrophotometer (FTIR) Shimadzu is used. Each 50 gram of particle with diameter of 0.25 mm; dan 0.5 mm; and 0.75 mm are tested using XRF (X-Ray Fluorescence Spectrophotometer) Bruker S2 Ranger to determine silicon oxide and other oxide particles. The velocity of flow profile also varies from 1 m³/s, 2 m³/s, 3 m³/s, 4 m³/s, and 5 m³/s for every single diameter of 0.25 mm; 0.5 mm; and 0.75 mm. All these experiments are conducted at Fluid and Thermal Measurement Laboratory, Energy Conversion Study Program, Mechanical Engineering Department, State Polytechnic of Ujung Pandang

RESULTS AND DISCUSSION

From steering up the sediment particle, it is obtained that the composition of fine sand is 55.80% where 44.20% is coarse sand (as shown in Figure 1). This result is confirmed the results that obtained in [2]. The high composition of coarse sand by about 44.20% shows that the sediment composition is potential to cause a serious damage to turbine's blades.

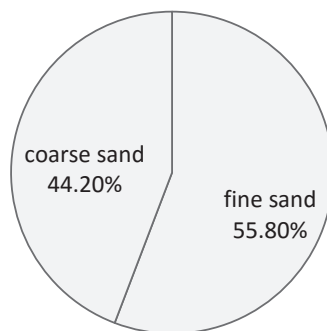


FIGURE 1. Sediment composition

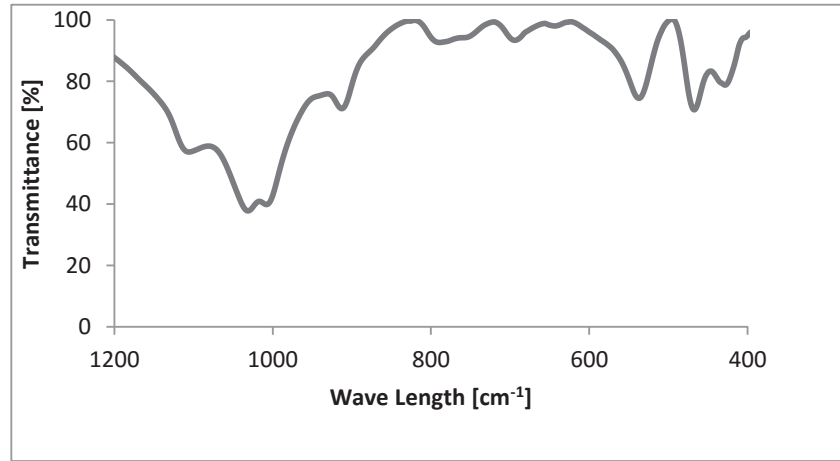


FIGURE 2. FTIR Test result Spectra of sediment

From Figure 2, it can be seen that the result of FTIR test spectra is 466.77 cm^{-1} indicating Aluminum oxide (Al_2O_3), 536.14 cm^{-1} indicating Titanium dioxide (TiO_2), 694.37 cm^{-1} indicating Ferric oxide (Fe_2O_3), 788.89 cm^{-1} indicating Magnesium oxide (MgO), and spectra 1031.92 cm^{-1} indicating Silicon oxide (SiO_2).

TABLE 1. XRF sediment test result

Formula	Concentration [%]	Formula	Concentration [%]
SiO_2	53.64	CaO	1.71
Al_2O_3	22.93	TiO_2	1.06
Fe_2O_3	9.24	P_2O_5	0.32
MgO	4.0	SO_3	0.19
K_2O	3.84	MnO	0.15
Na_2O	2.4	Cr_2O_3	0.05

Table 1 shows the results of XRF test and obtains composition of SiO_2 53.64%, Al_2O_3 22.93%, Fe_2O_3 9.24%, MgO 4.0%, K_2O 3.84%, Na_2O 2.4%, CaO 1.71%, and TiO_2 1.06%. Data shows that concentration of Silicon oxide (SiO_2) is 53.64%, lower compare to the concentration of SiO_2 according to [3] that is in the range from 55.30 – 99.87%. Although the concentration of SiO_2 is only 53.64%, it is significantly enough to cause serious damage on turbine's blades. These problems could occur if the characteristic of SiO_2 is harder than turbine's blade material. Other components such as Fe_2O_3 , Al_2O_3 , TiO_2 , etc. that are contained in the coarse sand is still complied with requirements mentioned in [3]. The concentration of TiO_2 although small (1.06%), still potential to cause damage on the turbine's blade because Titanium is harder than the material of turbine's blade.

From flow profile test, Reynolds Number is obtained from 22 to 31 for each diameter variation of the particle; 0.25 mm, 0.50 mm, dan 0.75 mm. The test result shows that $\text{Re} < 500$ where according to the flow profile it can be categorized as laminar type [7].

CONCLUSION

It can be concluded that sediment characteristic consists of fine sand about 55.80% and coarse sand about 44.20%, where SiO_2 dominates it by about 53.64% where flow in the pipe shown the laminar type.

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