

THE IMPORTANCE OF HYDRO-MECHANICAL RESEARCH AND DEVELOPMENT FOR SOLUTION

(KEPENTINGAN HIDRO-MEKANIKAL UNTUK PENYELESAIAN DALAM PENYELIDIKAN DAN PEMBANGUNAN)

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Received 17 March 2021: Accepted 25 May 2021: Available online 1 September 2021

Abstract

The importance of the principles of sustainable development is increasing in the development of hydro mechanical and electrical engineering. Most projects or developments rely on hydro mechanical functionality to complement a system. There are many categories of hydro mechanical including hydro mechanical for agricultural drainage, hydro mechanical for water supply, hydro mechanical for water disaster, hydro mechanical for generating power electricity and more. Besides, most of the research and development is designed in line with hydro mechanical scale in direction of environment protection from pollution and worst case scenario.

Keywords: Mechanical engineering, sustainable development, electrical engineering, project cycle, environment

Introduction

There are many resources could be harvest from the environment include hydraulic resources. The energy sources of hydraulic are not just from surface water such as river water, lake water and marine water, but it's possible could be a part of the environment such as water falls, digestion, heat transfer and more. The hydraulic energy resources could be potential from wastewater, sewage, rain water and thermal water (Augusto et al., 2009). The conversion process required hydro mechanical approaches step by step. The hydro mechanical had evolved from ancient times to modern times.

Along 11th Malaysian Plan, hydro mechanical research and development had contributed water to energy conversion through bio digester system, ram pump system and rain power apprentice using piezoelectric concept (Dewi & Andang, 2010). Others hydro mechanical research and development are bio flocculants lake water treatment system, auto sand filtration for lake water treatment, de-sludge pumping system, solar pumping system for lake water circulation, micro aeration system and rain water harvesting filtering system (Mashhadi et al., 2016). In line with hydrodynamics parameters such as ocean wave or current, river flow rate or velocity, waste water characteristic, fluid density and others environmental natural resources, many applications of mechanical concept could potential been involved from apprentices' scale to real commercialized scale (Rashwan et al., 2003).

River flows potential created energy and ocean wave also potential created energy by applying the concept of kinetic conversion and pressured conversion by mechanical design medium producing continuous energy (Taylor, 2014). Hydrokinetic energy from flowing water in open channels has the potential to support local electricity needs with lower regulatory or capital investment than impounding water with more conventional means (Taylor et al., 2012).

Electricity rates are on the rise and electricity usage is increasing following the changing lifestyle of the community along the coast and along the river. Whereas in some places such as Pulau Tinggi in Johor, there is still no electricity supply as it is located far from the country's electricity supply grid (Wang et al., 2007). Contaminated water from rice husk, sewage and food waste is increasingly contributing to the release of methane gas which contributes to the impact of climate change. Some of the hydro mechanical research programmed had been done for energy harvesting since 2015 at Hydraulic and Instrumentation Laboratory (Yakout et al., 2015). It's had been continued along 11th Malaysian Plan until 2019 in upgrading hydro mechanical design, develop and at different sites study. The objectives of the hydro mechanical research and development is to produce innovation solution in order to assure sustainable development growth (SDG) encountering the climate change impact for the community of coastal line, river bank and remote area.

Material and Methods

Hydraulic and Instrumentation Laboratory had conducted some categories of apprentice hydro mechanical studies, which are: (a) renewable energy harvesting from wastewater; (b) renewable energy harvesting from rainwater power system; (c) renewable energy with coastal waves interaction using N-CODE innovation products; and (d) renewable energy harvesting by river flow interactions using NPMH.

Results

Results of pilot study of renewable energy harvesting from contaminated wastewater based on bio digester concept.

Many type of wastewater could be a sources to bio digester processed. Some study had been made to design and developed NAHRIM Innovative Bio Digester System (NIBS) where using zoo animal waste and sewage as in Figure 1 and Figure 2. Both designs had performed less than 12 Volts power generation in short of time. The accessed of waste scheduled had contributing a generation performance of both NIBS design. One of the lack of the design is segregating low and optimum quality of waste which produce methane gas as fuel burner.

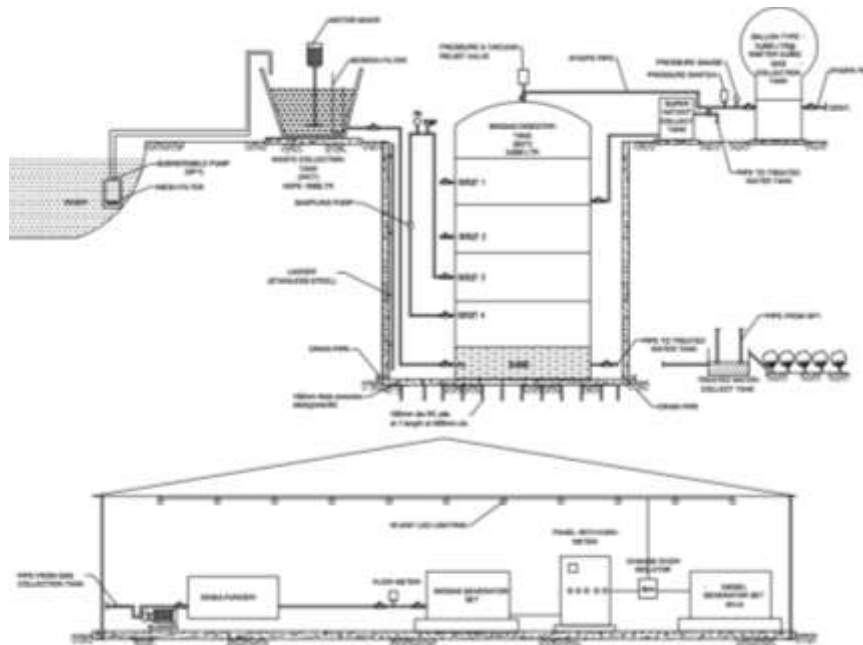


Figure 1: Design of the development of NAHRIM Innovative Bio Digester System (NIBS) using zoo animal waste

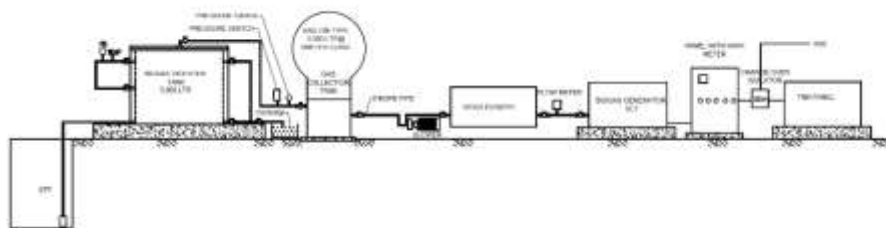


Figure 2: Design of the development of NAHRIM Innovative Bio Digester System (NIBS) using sewage.

Results of pilot study of renewable energy harvesting from rainwater power system

Laboratory tested design had found that the rain droplets could possible generated power at small amount. The capacity of the energy harvesting is according to the size of piezoelectric plate size. However, further study shall be done for having long period of droplets in order to have continuous energy harvesting. Figure 3 is the laboratory testing for the simulation of rain droplets.



Figure 3: A Hydro mechanical design for rain water droplets toward piezoelectric plate.

Results of pilot study of renewable energy with coastal waves interaction using N-CODE innovation products.

The N-CODE design had been laboratory tested and site tested, performed stable in power generating for in period of the high tide for about 8 hours in a day. The maximum power generated at average of 4 Volts at constant wave height.



Figure 4: A real design of N-CODE tested at Pulau Tinggi, Johor

Results of pilot study of renewable energy harvesting by river flow interactions using NPMH

The NPMH design had been study since 2019 for the first model. The first power generated at average of 3 Volts at constant river velocity tested at Hydraulic and Instrumentation Laboratory. This design is capable too.

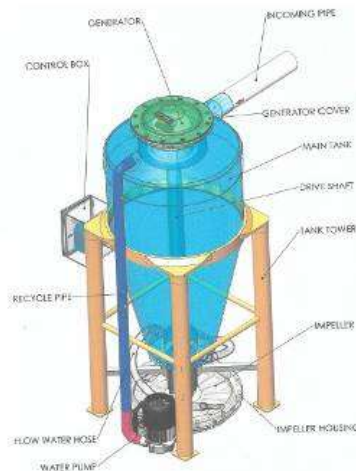


Figure 5: A fundamental design of NPMH Version 1.0

Discussion

In this study, few designs had been tested in order to see the energy harvesting concept from NAHRIM Innovative Bio Digester System (NIBS), Rainwater Power System (RPS), NAHRIM's Coastal Defense and Energy Generator (N-CODE), and NAHRIM's Portable Mini Hydropower (NPMH). In terms of time of testing, further procedures had to be impose for long terms result for establishing performed designed. From all the hydro mechanical design, some findings meet the objectives whereas NIBS shows that waste could generate electricity, N-CODE could have harvested energy from the movement of ocean wave, NPMH could harvest energy from the river velocity and RPS at large size could possible harvesting electricity from the rain water droplets.

The hydro mechanical design is much depending on hydrodynamic characteristic. N-CODE which design for ocean energy harvesting depend much on tide period. Different to NPMH whereas according to river flows at every second. The RPS is too much depending on rain period. However, the sources of water droplets could be extending to the sources of waterfalls droplets which drop every second. The NIBS performance is too depending on biological period whereas production of methane as combustion gases according to both aerobic or anaerobic digestion. All studies show that hydrodynamic factors play significant influence factors for any hydro mechanical design product. Further studies related to hydrodynamic factors at laboratory testing area simulated and at real site test area for 365 days or more could performed stable hydro mechanical innovative product design.

Conclusions

There are so many further studies for innovation design improvisation. However, along 11th Malaysian Plan, most innovation had just begun design conceptual and small scale apprentice application. Medium and long terms resources with knowledgeable collaboration could possible fine tuning improvement in method of testing scenario for both physical and numerical testing.

Continuous hydrodynamic consideration shall be a database for enhancing hydro mechanical research and development. Real on site testing had been found contributing the significant findings and results of performance and require hydro mechanical testing procedures.

In design hydro mechanical, automation could possibly be applied in the process of routine feeding of the agricultural waste similar to the sewage drainage system from residential to the integrated sewage treatment plant with a bio digester operational system. Further study could possibly on the evolution of industrial revolutionary (IR) from IR3.0 to IR4.0 and beyond.

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