

Tidal Current Turbine and Related Development Problems for Indonesia

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Abstract. Tidal Current Turbine will be an important device of renewable energy in the upcoming decades. Hydro energy, wind energy and solar energy will mostly utilized in Indonesia in order to fulfill the energy of remote villages and remote islands and optimizing the domestic energy availability. Regarding the small scale field research conducted in the year 2012 and 2013 in Indonesia, transmission system and low rpm alternator are encountered as a significant problems in order to develop the hydro and wind turbine engine. Both parts are not yet produced locally in Indonesia. Domestic production in step-up gear transmission system of ratio 1 : 30 to 1 : 60 and low rpm alternator will fundamentally required to gain creativity in the country.

Introduction

Regarding the report of International Hydropower Association 2010, the world electric consumption of the renewable energy is totally 23% which consist of hydropower energy is 17%, Wind energy is 4% and the rest are Solar energy, Geothermal energy and Bio-energy[1]. Indonesian domestic policy stating that the consumption of energy of new and renewable energy should cover more than 5% of the total energy consumption in the year 2025.

Tabel 1: Indonesian Energy Consumption Rate at Present and Consumption Projections in The Year 2025

No:	Energy Specifications	Present Consumption Rate *)	Consumption Rate Projection in the Year 2025 **)
1	Oil	47.5%	20%
2	Gas	26.5%	30%
3	Coal	24.3%	33%
4	Biofuel	-	> 5%
5	Geothermal	2.45%	> 5%
6	New and Renewable Energy	1.7%	> 5%
7	Others	-	> 2%

Source: [2, 3]

Hydropower seems important for Indonesia regarding the huge energy hidden in the Indonesian straits and waters. According to the data in Table 2, the Indonesian hydro energy is about one-third of total ASEAN hydropower potential. From the potential of 76625 MW hydro energy only 5420 MW out of it already utilized. So, the utilization and the plan to develop the hydro energy apparatus in Indonesia in the future is completely possible.

Table 2: ASEAN Hydropower potential and installed capacity (MW)

Countries	Installed hydro capacity in 2000	Hydro potential
Brunei	0	0
Cambodia	0	8600
Indonesia	5420	76625
Laos	636	20042
Malaysia	2184	25000
Myanmar	457	5600
Philippines	1650	9150
Singapore	0	0
Thailand	2808	7000
Vietnam	4758	15600
ASEAN	17913	202417

Source: [5, 6, 12]

The world is seriously mentioned the hydroelectricity in accordance with the global warming and with regard to the free greenhouse gases power generation. Hydropower-rich states such as China, Russia, India and Brazil, hydropower construction in phases served to promote industrialization.[11] The following table shows how big is the share of hydropower of the total electric capacity of the countries.

Table 3: The world large hydroelectric producers as at 2009.

	Annual national hydroelectric production (TWh)	% of total capacity
China	652.00	22.25
Canada	369.50	61.12
Brazil	363.80	85.56
Russia	167.00	17.64
Norway	140.50	98.25
Venezuela	85.96	69.20
Japan	69.20	7.21
Sweden	65.50	44.34

Source: [4]

Tidal Current Energy

Tidal energy could be become electric power by the use of water level differentiation and by tidal current when ebb and when high tide. The tide energy of the first means is normally produced by dam barrages construction and the second means is produced by tidal current turbine. Tidal current turbine at present draw much attention regarding the huge power hide in the flowing water when high tide and ebb with the possibility of applying the more than one turbine in series.[7,8,9]

Dam barrages is tend to prevent in accordance with the high construction cost, the extensive environment effect and high social cost .e.g Kedung Ombo dam construction in Central Java, in nineteenth eighties in Indonesia. As much as 5268 families should be relocated and 37 villages from three districts are inundated. The same things in a bigger scale also happen when construct Aswan Dam in Egypt in the year 1960-1970. The structure is 2325 meter long, 111 meter high over the original river bed and the surface area 6000 km² and more than 100 000 people relocated.[13].

From the point of view of low social impact, low financial and free greenhouse gases product the tidal current energy become interesting and take much attention years late. The experiments conducted in England and Canada show tidal current turbine of 12 meters diameter produce power of about 2 MW, relatively low power output, but the advantage of tidal current turbine is the turbine could installed in series or in parallel to the flow. For example, as much as 300 units of Lunar Energy Tidal Turbine is being installed at the South Korean beach.[8]

From these realities we realize that we need to learn much. The potential of power hide in straits and Indonesian waters are wait to harnessed. China, Japan and Korea are countries which a step ahead in tidal current turbine implementation in Asia.

Renewable Energy Development and Related Problems for Indonesia

Self experience in developing the construction and the manufacturing the small scale tidal current turbine, we found two basic problems to be solved permanently in order to facilitate the development of the wind turbine and tidal current turbine in Indonesia in the coming years. The problems are, *Firstly*, the already made step-up transmission system and *Secondly*, the availability of Low RPM alternator. [9, 10, 14]

The development of hydro energy and wind energy apparatus clearly need the already made step-up transmission system, to transmit and to step-up the revolution of the turbine to the optimum rpm of alternator. It realized that the revolution of wind turbine and hydro turbine in nature is relatively low. Learning from the previous experiment the required transmission increment ratio is of about 30 to 60 times of turbine shaft revolution. As far as I know, it is not easy or even not found the already made step-up transmission system in the local market and on online market. Mostly the available gear transmission is step-down transmission system, which cannot operate contrary. On the other hand, the making of gear transmission system is not simple. It need the precise technology and the precise equipment and the skilled operator, so the ready for use gear transmission much required. In addition to the corrosiveness of the atmosphere where the wind turbine and hydro turbine operates, the need of corrosion resistance of all materials involved in the construction is also important factor.

The low rpm alternator is required to simplify the gear transmission system. Low gear ratio will reduce the gear teeth and simplifying the stages. The simple transmission system will effect the compactness, the light weight and the though of the construction to operate in the long term safely. The low rpm alternator from the theoretical point of view could produced by adding the pole, but to make it work effectively and efficiently it needs more engineering discussion and needs experts of various fields of science.

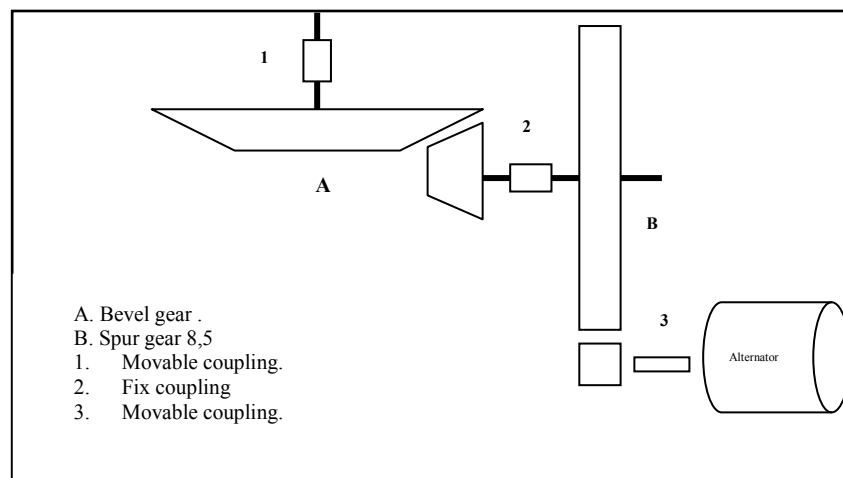


Figure 1: My experiment gears assembly. [10]

As a reference, the tranmission system used at my previous experiment is a set of gear of two stages with three couplings as shown in Figure 1. The first stage is a pair of bevel gear with the ratio of revolution increment is 1:5. The second stage is a pair of spur gear with the ratio of revolution

increment is 1:8.5. So the total revolution increment at the output is 42.5 [10,14]. The connection between shafts is movable couplings. The movable couplings are used to anticipate the misalignment and the eccentricity between shafts as a consequence of simple tools and lack of experience in manufacturing. The first stage of gear is originally taken from hand bore tool and the second stage of gear is originally taken from hand grinding machine. Both pair of gears are arranged and assembled as shown in the figure. The alternator used in the experiment could produce electricity of 100 W of 12 Volt at 450 Rpm. The alternator is imported from China.[10,14] As long as the experiments performed, the bevel gear broken twice time, and out of its bearing position four times. It realize that this occurrence is related to the base design of the gears originally not for turbine.

Conclusions

From the above mentioned and discussions we can conclude that to facilitate the domestic development of the hydro turbine and wind turbine, it needs to produce the ready used step-up gear box and the high efficiency low rpm alternator. Regarding the corrosiveness of the environment where the apparatus to operate, it is hoped that all materials involved in the hydro turbine and wind turbine apparatus are resist to corrosion.

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