

題 目: Study on Characteristics of Tidal Current Energy and Ocean Environmental Pollution at
Indonesia Archipelago

(インドネシア島嶼域における潮流エネルギー特性と海洋環境汚染に関する研究)

氏 名 SHADE RAHMAWATI

Environmental issues, especially about renewable energy and ocean pollution, at Indonesia archipelago are very important to be the basic of marine development decision. However, there are limited data and researches that have been conducted to discuss about those problem from whole area to specific potential area in Indonesia archipelago. After conducting this study, the main conclusions drawn are summarized as following.

1. Indonesian archipelago is chosen as it is one of the largest tidal current resource in the world. Investigation on tidal current characteristics and its energy potential shows that the tidal current velocity is relatively high in narrow straits at Maluku islands and Nusa Tenggara islands. In particular, Lombok Strait is the most notable location with the maximum tidal current velocity, 4m/s. The narrow straits at Nusa Tenggara islands can produce more than 2.8m/s for tidal current and more than 12kW/m² for tidal current energy. In the northern and the southern part of Halmahera island, the resultant tidal current kinetic power also produces about 5kW/m².
2. In order to harvest the tidal current energy in Indonesia and distribute it to local communities, a small-sized HAT 10kW class with the diameter 2.2m, was theoretically and numerically designed and optimized considering the specific tidal-current at the archipelago areas, and also velocity field around the designed turbine and pressure distribution on it were examined. The designed turbine can generate electric power for more than one hundred people at Lombok strait. The power distribution produced by the designed turbine was mapped by using the estimated power curve at Maluku islands and Nusa Tenggara islands.
3. For country with active aquaculture such as Indonesia and Japan, small-sized tidal current turbine can be combined with Fish Aggregating Device (FAD). In this study, a mooring type of FAD with horizontal and vertical axis turbine was designed and optimized to reduce fluid force and motion. In Indonesian archipelago area, designed turbines are expected to generate about 220W in Bali strait and 700W in Lombok strait due to high current velocity, which adequate to support marine sensor systems.
4. Study on hydrogen sulfide reduction in order to recover ocean environment by utilizing steelmaking slag has been conducted using Eulerian-Lagrangian model with ocean circulation model to consider fluid-particle interaction and advection-diffusion of dissolved sulfide. The numerical results demonstrated that steelmaking slag can control advection-diffusion of concentration of DO and H₂S which is highly toxic. Accordingly, steelmaking slag could improve organically enriched sea bottom in enclosed sea area.
5. Preliminary assessment of ocean pollution effect on fishery and aquaculture was taken for Indonesian archipelago. By considering tidal current flow in different monsoon season, Pb (lead) distributions in Sunda Strait were estimated and spatial effects on algae were predicted. Water elevation was validated by field data and Pb concentration also confirmed by previous research. In 5km radius from main source of Pb concentration, algae photosynthesis rate was nearly 0%, and threaten its living ability. High concentration of SS could also decreased algae photosynthesis rate because of less sunlight penetration.