

Development of hybrid electric propulsion systems for ships

Degree programme: Master of Science in Engineering | Specialisation: Energy and Environment

Thesis advisor: Prof. Andrea Vezzini

Expert: Alois Müller

External project partner: Jetboat Interlaken AG, Interlaken

The trend towards energy-efficient drives has also taken hold in shipping. With this master thesis, the topic powertrain was worked up in ships and different applications were investigated. Concepts for a hybrid electric respectively purely electric drive were created and assessed. In cooperation with the project partners, two applications were examined in detail. The results can now be used for the possible implementation.

1

Project Leila

A charter company from Kauai is arranging tourist tours. A bigger tour is in planning, which goes around the island Kauai and is about 150 km long. The current boat Leila is not able to do it, but it's possible with the other boat, called Holo. The tours producing high operating costs. The company's goal is to safe operating costs and make the boat environmental friendlier through less CO₂-emissions. The goal is to develop a propulsion which meets the needs of the company. And with a cost overview is to show, if the propulsion is making economically sense.

Result

After analyzing the tour profiles of Leila and Holo, an energy balance was calculated. The today's trip of Holo is comparable to the new planned trip. A concept of a parallel hybrid-electric propulsion is made and the costs overview as well. The result shows there are high investment costs and low operation costs savings. One of the main costs is the battery. The Kauai Island produces its electricity with oil. This rises the price for electricity above the price of oil. The company is interested to produce its electricity by themselves, therefore a calculation of the PV-Array is made.

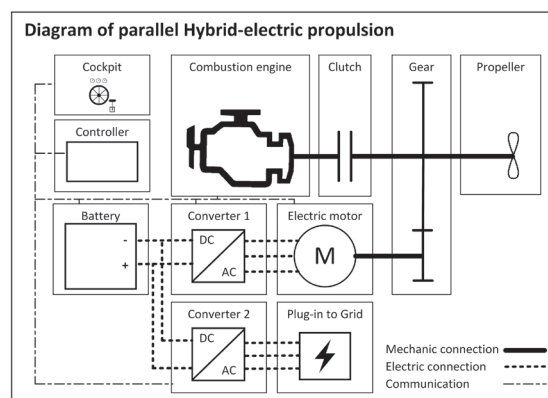


Diagram of parallel Hybrid-electric propulsion for Leila

Outlook

The decision of the company is, that they are going to build the new boat in 2020. The construction foresees a hybrid-electric propulsion. But the first version will have a combustion engine only. The project is determined by the company's financial, and they want to see more economical benefits before they invest for a hybrid-electric propulsion. The master student and a boat builder of this company developed another boat, which is less powered.

Project Jetboat

A company aims to electrify its boats. The jetboat is used on Lake Brienz for one-hour speed trips. The project objective is to check whether it is possible to convert the existing Jetboat to an electric. A feasibility study will examine this objective. It includes the answering of the technical questions and an accounting of the costs. If possible, a request to the Swiss Federal Office of Energy's Promotion Fund needs to be written.

Result

The first investigation, the reconstruction of today's jetboat showed is not possible, if the requirements should be reached. Mainly the weight of the battery exceeds the existing drive's replacement weight of 620 kg. On the construction, it is not possible to change anything on the hull. The jetboat experiences a very high torsion during the 360° spins, therefore the entire hull is reinforced with struts like a grid. These conditions make a conversion only possible if the drive is being replaceable 1:1. The electric drive has a factor of 2.2 better efficiency than the combustion engine.

Outlook

The company asks for a second investigation, a concept for a new Jetboat. This needs transport more passengers on one trip. A Swiss boat builder company is asked to work in collaboration. If a positive decision is made for the project, a prototype has to be produced and tested in the next 2 years.



Christoph Giger

christoph.giger@bluewin.ch