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Analyzing Load Fluctuation of Main Engine and Generators on Training Ship

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1. Introduction

This paper discuss expected functions and characteristics of new training ship which can be used for navigation training, fishery training and marine science investigation. It's indispensable that the ship has sufficient performance to implement the conventional training and the investigation. In addition, saving fuel oil consumption is also an important request. To satisfy these requests, various propulsion systems including conventional system, electric propulsion system and hybrid propulsion system should be compared and evaluated. The evaluation has to be done on the basis of concrete data. Accordingly, it's necessary to figure out characteristics of the ship operation especially load ratio of main engine and generator in the conventional training ship.

Authors continuously measured several navigation data of shaft horse power, generator power, thruster electric power in Sioji-Maru and Seiyo-Maru for several months. Both ships belong to Tokyo Univ. of Marine Science and Technology. This paper shows some analized results of the measured data on the actual navigation trainings and oceanographic investigation in both ships. Measuring data includes the output power of main engine and generator on 22 navigations and 78 days. However the main engine run for 72 days, because the ship need to be anchoring depending on the contents of training and the investigation. Figure 1 and figure 2 show line diagrams of propulsion system and AC electric power system which are installed in Shioji-Maru and Seiyo-Maru, respectively.

2. Trend of propulsion power

Figure 3 shows the measured propulsion power and its percentage of integrated time in Shioji-Maru and Seiyo-Maru.

As is clear from this, the propulsion power of Shioji-Maru and Seiyo-Maru are mainly under 50%. These trends show that it is required to save fuel oil consumption by reducing navigation speed in both training ships. Consequently, saving fuel is a matter of concern for even operators in education sector. The small bar graphs which are indicated on the left side of figure 3 show percentage of idling time in all navigation time. In Shioji-Maru, idling time of navigation is about 4% in all navigation time. During the idling condition, clutch A is

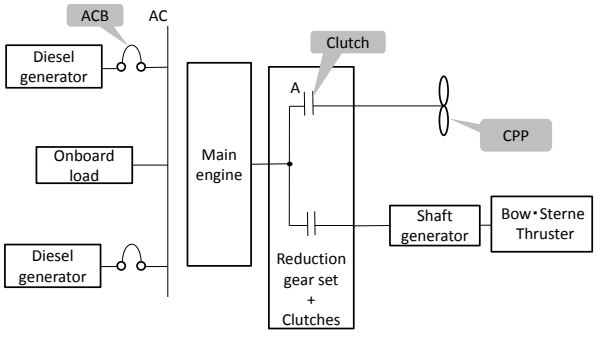

Fig.1 System design of Shioji-Maru

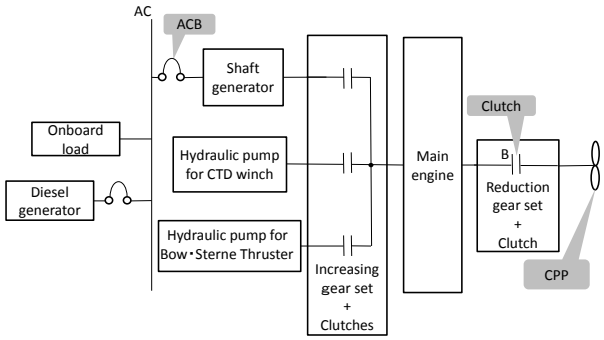

Fig.2 System design of Seiyo-Maru

kept to be ON state and CPP blade angle is neutral position (refer to fig. 1). Therefore, the fuel oil consumption is not negligible although no propulsion power is required. However the ship have to be able to move immediately to avoid collision with other ship if its necessary, because some navigation training is conducted at narrow sea area and near the course. Thus, idling is inevitable for safe operation.

In Seiyo-Maru, idling time of navigation reaches to almost 17% in all navigation time. While the ship is idling, the investigation of sea water is implemented by using CTD (Conductivity Temperature Depth) in wide open sea. Accordingly, there are no possibilities that navigation of other ships are disturbed. But, the main engine keep running in idling state just in case. The clutch B is made OFF in the idling state (see figure 2). Fuel oil consumption per unit time of Seiyo-Maru is less than Shioji-Maru. But, the idling time is long in Seiyo-Maru. So the impact which is given to fuel oil consumption of whole navigation is not negligible. Therefore, it is desirable that the training ship has performance to move immediately if necessary even when the propulsion power is zero, and to save fuel oil at idling state.

3. Trend of generator's load

Figure 4 shows the measured generator load factor and its percentage of integrated time in Shioji-Maru and Seiyo-Maru.

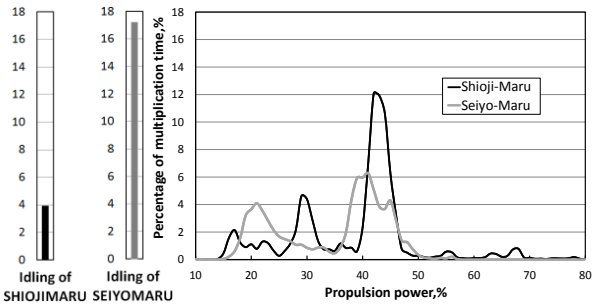

Fig.3 Propulsion power and its percentage of integrated time in Shioji-Maru and Seiyo-Maru

The generator load factor of both ships rarely exceed 50%. In addition, the load factor of generator in anchorage is clearly less than in navigation. It is clarified that the time which both ships lie at anchor reaches to over 68% in all navigation time. Consequently, anchorage time becomes long, because they cannot afford night navigation due to manning problem. The fuel oil consumption per unit time is little because onboard demand at anchorage is low. But, it will give big influence to the total fuel oil consumption, because the anchorage time is long. Accordingly, it is expected that the saving fuel can be achieved by improving efficiency of power system at anchorage.

4. Summary

In this paper, it is revealed that the main engine and generator in training ship run mainly at low to middle load rate. In addition, it's necessary to operate main engine in idling state depending on the contents of training and the investigation. It is required that the training ship has performance to move immediately if necessary even when propulsion power is zero, and to save fuel oil consumption. Improving efficiency of power system at anchorage, it can be expected to save the total fuel oil consumption, because anchorage time is long.

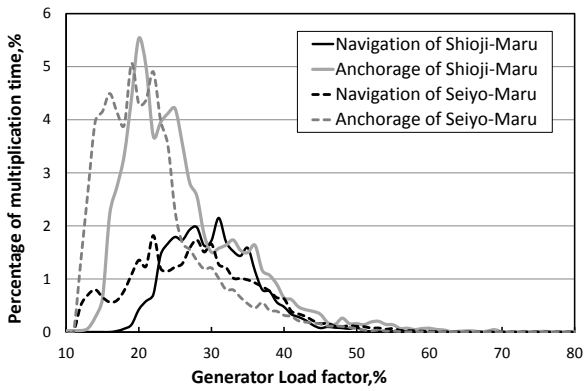

Fig.4 Generator load factor and its percentage of integrated time in Shioji-Maru and Seiyo-Maru