

Development of a System to Support Energy Saving Train Operation

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A means to reduce energy consumption in train operation is to develop efficient methods to run trains. This can be achieved rather simply without changing rolling stock equipment or train schedule. To support discussions on such train operating methods, we are now developing a system to demonstrate alternative train operation methods featuring reduced energy consumption.

1. Train operation and energy consumption

For trains running between stations, the current method of train operation (timing of acceleration, coasting and braking) solely relies on the experience and judgment of train drivers. Just as driving automobiles differs from person to person, so does the operation of trains. A diagram called a train performance curve is normally used to analyze the performance of running trains. These illustrate the movement of a train according to the method of operation, with the X-axis representing distance and the Y-axis train velocity. Figure 1 shows two train performance curves obtained by running a train in a certain section by two different methods. This Figure indicates that the running time is the same with the two methods, but the quantity of consumed energy differs significantly. This proves that we can reduce the quantity of energy used for train operation by developing appropriate methods to operate trains.

2. Evaluation of energy consumption based on the theory of train operation

Consideration of train operation methods with reduced energy consumption requires the following simulation and evaluation:

(1) Simulation of different methods of train operation,

(2) Evaluation of the energy consumption for these different train operation methods.

To simulate train operation, we can apply the theory of train operation to dynamically calculate a train performance curve under the specified train operating method while considering track and rolling stock conditions.

After determining the running conditions of the train at various points with the aid of train performance curves, we can link them with the train's energy consumption data to subsequently calculate the quantity thereof. In this manner, we have developed a system to evaluate the quantity of energy consumption based on the theory of train operation. See Fig. 2.

3. Search for energy saving methods of train operation

We are now developing a system to search for methods of train operation with smaller quantities of energy consumption by applying the above-mentioned system to evaluate the quantity of energy consumption. As a prerequisite to do so, however, we have to consider the running time between stations to ensure that trains shall run according to the time schedule set forth on train schedule.

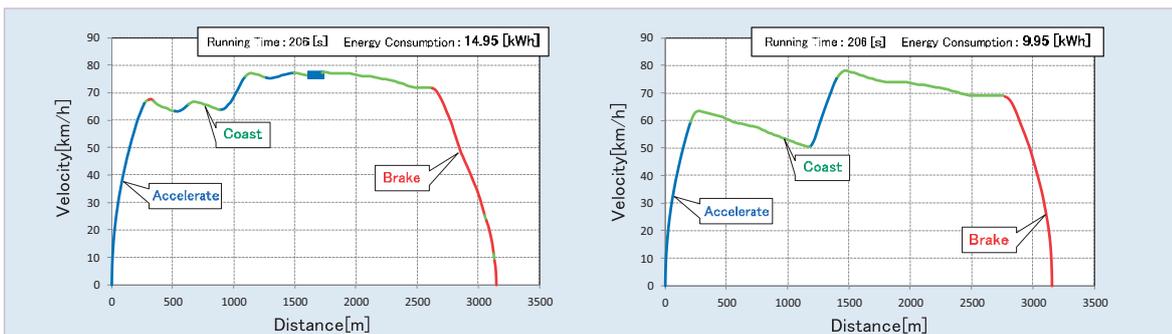


Fig. 1 Train operating methods and quantities of energy consumption

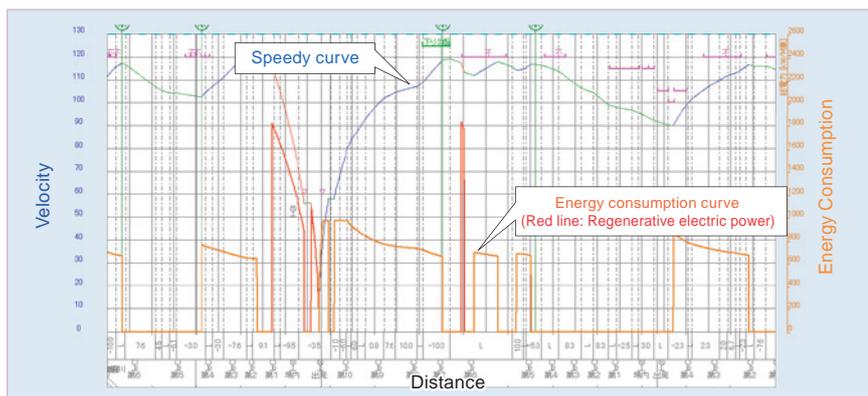


Fig. 2 The system to evaluate the quantity of energy consumption