Секция «Международная экономика в современных условиях (на английском языке)»

The study of energy recovery on the sectors of the Russian Railway

Научный руководитель – Глотова Александра Валерьевна

Новикова Анастасия Вячеславовна

Student (bachelor)

Филиал МГУ имени М.В.Ломоносова в г. Севастополе, Факультет компьютерной математики, Кафедра прикладной математики, Севастополь, Россия

E-mail: telez140502@gmail.com

Energy is the most important source on our planet needed for human activities and industries' performance. Energy is a key issue in the fields of transportation and delivery systems. Supply and delivery companies provide products and energy resources such as coal, gas, oil [1]. It should be noticed, that energy spent on transportation can be saved or accumulated via regeneration methods. The purpose of the study is to evaluate the efficiency of recovery systems within the Russian Railways sectors. The tasks of the research are: 1) to analyze the popularity of railway transportation in Russia, 2) to consider the ways of saving energy using recovery methods for electric locomotives, 3) to define the term regeneration and its feasibility on the Russian Railway sectors.

Railway transportation is still in high demand, because it is not so time-consuming or expensive compared to other modes. Car shipping may be slow due to traffic jams or other obstacles. Maritime shipping is relatively cheap, but is restricted by weather or seasonal conditions, that is why, some routes may be available only in summer. Thus, the most widely-spread and convenient is railway transport [2]. Table 1 presents the comparison of rail, air and road transportation options.

The most common and suitable for various cargo types way is the railway method of transportation.

Energy conservation is aimed at the saving of our planet's resources to reduce their consumption [2]. Regeneration (or recuperation) is used to achieve this goal. This factor proves that the topic of the study is relevant concerning the efficiency of railway transportation systems.

Action radius is regarded as a key parameter for any vehicle and especially for electric ones. This type of transport needs large batteries - accumulators. But it is strenuous to supply all electrical devices with such components. Moreover, it is impossible to make an eternal battery: the higher the charge, the more is the battery weight [5]. That is why, the need for new solutions and technologies is obvious. One of the attempts to reduce energy consumption is to save it on the move. This is the fundamental issues of the recovery systems concept. So, recovery or regeneration is the renewal or restoring parts of materials or energy for re-use in the same technological process [4].

We will consider the use of regeneration on the example of an electric locomotive. The principle of the electric energy recovery system can be described as following: when an electric locomotive decelerates, its power unit is disconnected from the power source (battery) and switches into generator mode, generating autonomously the energy. Electrical energy passes to the battery, increasing its charge [4]. Thus, during braking, some part of the energy is accumulated for the next start of the electric locomotive.

Considering the issues of efficiency and feasibility of this method, we will analyze the Moscow Railway (Moscow Railway) and the recovery systems on this section of the Russian Railways. In March 2020, the volume of electricity released for train traction by traction substations providing power to the MCC contact network, was about 5.44 million kWh [3]. At the same time, the amount of electricity consumed for train traction, measured by on-board electricity

metering devices of Lastochka electric trains, was 7.25 million kWh, and the amount of electricity returned to the contact network was 2.56 million kWh. In April, respectively - 4.92 million kWh, 6.99 million kWh and 2.61 million kWh. Thus, the efficiency of regenerative braking is obvious - more electricity is spent on train traction than is consumed from traction substations.

To calculate the efficiency of recovery, we set that the energy received in March 2020 was equal to 5.44 million kWh, at the same time, the Swallow requires 7.25 million kWh. It turns out, that the energy required is 1,81 more than the energy preserved. With the help of regenerative braking, 2.56 million kWh is saved. Thus, the efficiency is 70%, which is a significant part for the entire energy of the stations.

The study proves the popularity and cost-efficiency of the rail transportation in Russia. The method of recovery used in electric locomotives' operation on parts of Russian Railways helps to reduce energy consumption in the respective field.

References

1) 1. Мазнев А.С., Степанская О.А., Шатнев О.И. Системы рекуперации энергии торможения электроподвижного состава на городском транспорте Санкт-Петербурга // Современные технологии – транспорту. М, 2017. С. 69–70.
2) 2. Москалев Ю.В., Карабанов М.А. Повышение энергоэффективности системы тягового электроснабжения постоянного тока железных дорог с применением накопителей энергии // Транспортная энергетика. М, 2013. С. 55–56.
3) 3. Рекуперация электроэнергии на РЖД. URL: https://sdelanounas.ru/
4) 4. Уральская магистраль URL: https://gudok.ru/
5) 5. Рекуперативное торможение URL: https://autogeek.com.ua/

Illustrations

Shipping method	International	Inter-regional	Types of cargo delivered					
			Regular	Hazardous	Perishable	Bulky	Live-stock	Non-standard
Railway	+	+	+	+	+	+	+	+
Air	+	+	+	-	+	+	+/-	-
Auto	+/-	+	+	+	-	-	-	+/-

Рис. 1. Table 1 - Comparison of transportation modes' options