

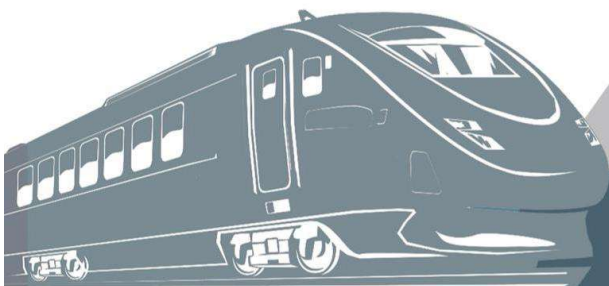
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ЕНЕРГОЕФЕКТИВНІСТЬ НА ТРАНСПОРТІ

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Збірник містить тези доповідей науковців вищих навчальних закладів України та інших країн, підприємств транспортної та будівельної галузі за наступними напрямками: енергоефективність рухомого складу та перевезень, енергозберігаючі будівельні матеріали та конструкції, енергоменеджмент рухомого складу та споруд транспортної інфраструктури, ресурсо- та енергозбереження на транспорті

ЗМІСТ

Секція

ЕНЕРГОЕФЕКТИВНІСТЬ РУХОМОГО СКЛАДУ ТА ПЕРЕВЕЗЕНЬ

УЗАГАЛЬНЕНИЙ ФУНКЦІОНАЛЬНО-СТАТИСТИЧНИЙ КРИТЕРІЙ ОЦІНКИ ЕФЕКТИВНОСТІ ПРОЦЕСУ І СИСТЕМИ АВТОМАТИЧ- НОГО УПРАВЛІННЯ	
О.І. Акімов, Ю.О. Акімова, В.В. Панченко, М.М. Одегов.....	11
МЕТОДИ ОБЧИСЛЕННЯ ПОХИБКИ РОЗРІЗНЕННЯ ІНФОРМАЦІЙНИХ СИГНАЛІВ	
О.М. Ананьєва, М.М. Бабаєв, В.С. Блиндюк, М.Г. Давиденко.....	13
ВИЗНАЧЕННЯ ПАРАМЕТРІВ ПРИСТРОЮ ДЛЯ АВТОМАТИЧНОЇ ДЕКОМПРЕСІЇ ЦИЛІНДРІВ ТЕПЛОЕНЕРГЕТИЧНОЇ УСТАНОВКИ	
С.В. Бобрицький, О.О. Аулін, О.О. Анацький, Ю.В. Жовтий, П.В. Черненко.....	14
РОЗРОБКА ІМІТАЦІЙНОЇ МОДЕЛІ БОРТОВОГО НАКОПИЧУВАЧА ЕНЕРГІЇ ТЯГОВОГО РУХОМОГО СКЛАДУ НА БАЗІ СУПЕРКОНДЕНСАТОРІВ	
С.Г. Буряковський, А.С. Маслій, Д.П. Помазан.....	15
ОРГАНІЗАЦІЯ СИСТЕМИ УПРАВЛІННЯ ПРОЕКТАМИ В ПРОЦЕСІ ЕКСПЛУАТАЦІЇ ТЕХНІЧНИХ ЗАСОБІВ НА ОСНОВІ СИСТЕМНОГО ПІДХОДУ	
Г.М. Голуб, І.І. Кульбовський, П.О. Скок, О.А. Шумейко.....	17
РОЗВ'ЯЗАННЯ ЛІНІЙНОГО ДИФЕРЕНЦІАЛЬНОГО РІВНЯННЯ З КУСКОВО-НЕПЕРЕРВНИМИ КОЕФІЦІЄНТАМИ У ТЯГОВИХ РОЗРАХУНКАХ	
О.В. Казанко, О.Є. Пенкіна, М.М. Одегов	18
МОДЕРНІЗАЦІЯ ТЯГОВИХ ДВИГУНІВ ЕЛЕКТРОПОЇЗДІВ ПРИМІСЬКОГО СПОЛУЧЕННЯ	
Н.П. Карпенко, М.М. Одегов	20
ПІДХІД ДО ВИЗНАЧЕННЯ ЕФЕКТИВНИХ ЗАХОДІВ ПІДВИЩЕННЯ ЯКОСТІ РОБОТИ ЗАЛІЗНИЧНОГО ТРАНСПОРТУ МЕТАЛУРГІЙНОГО ПІДПРИЄМСТВА	
О.В. Кіріцева, О.В. Клецька, Г.Л. Новак	23
ПОКРАЩЕННЯ ТЕХНОЛОГІЇ РОБОТИ З ЗЕРНОВИМИ ВАНТАЖАМИ НА ОСНОВІ РЕСУРСОЗБЕРЕЖЕННЯ	
А.О. Ковальов, С.М. Продащук, А.Л. Кравець, Д.І. Мкртичян, М.В. Продащук.....	25
ОБГРУНТУВАННЯ ВПРОВАДЖЕННЯ В ЕКСПЛУАТАЦІЮ ДВОПО- ВЕРХОВИХ ПАСАЖИРСЬКИХ ВАГОНІВ ДЛЯ НІЧНИХ ПОЇЗДІВ З ТОЧКИ ЗОРУ ЕНЕРГОЕФЕКТИВНОСТІ ПЕРЕВЕЗЕНЬ	
О.М. Красноштан.....	26

ВИПРОБУВАННЯ НА ВОГНЕСТІЙКІСТЬ ЗАЛІЗОБЕТОННИХ КОНСТРУКЦІЙ: ІСТОРІЯ, СУЧАСНИЙ СТАН ТА ПРОБЛЕМИ, ПЕРСПЕКТИВИ РОЗВИТКУ С.Л. Фомін, І.А. Плахотникова, С.В. Бутенко, С.М. Колесніков.....	112
ВДОСКОНАЛЕННЯ МЕТОДИКИ ОЦІНКИ ЙМОВІРНОСТІ БЕЗВІДМОВНОЇ РОБОТИ ЗАЛІЗОБЕТОННИХ БАЛОК, ПІДСИЛЕНИХ ПРИ ДІЇ НАВАНТАЖЕННЯ Р.Є. Хміль, Р.Ю. Титаренко, Я.З. Бліхарський, П.І. Вегера.....	113
ЕНЕРГОМЕНЕДЖМЕНТ ПО ВПРОВАДЖЕННЮ СИСТЕМИ ВИСОКОШВИДКІСНОЇ ЗАЛІЗНИЦІ А.О. Шевченко, О.О. Матвієнко, В.А. Лютий, В.Г. Мануйленко, Н.О. Муригіна.....	115
ТЕОРЕТИЧНІ ОСНОВИ РОЗРАХУНКУ НЕСУЧОЇ ЗДАТНОСТІ СТАТИЧНО НЕВИЗНАЧУВАНИХ ЗАЛІЗОБЕТОННИХ БАЛОК ТА ЇХ ЕКСПЕРИМЕНТАЛЬНІ ДОСЛІДЖЕННЯ О.А. Шкурупій, П.Б. Митрофанов, Ю.О. Давиденко, О.Г. Горб	118

Секція

РЕСУРСО- ТА ЕНЕРГОЗБЕРЕЖЕННЯ НА ТРАНСПОРТІ

CONTROL OF THE TEMPERATURE REGIME OF THE ROAD LEAF USING A SOLAR COLLECTOR Jamil Guliyev , Javanshir Guliyev.....	120
SIMULATION MODELING OF THE AUTOMOBILE BRAKING SYSTEM PERFORMANCE G. Viselga, , Ev. Ugnenko, E. Uzhviieva, O. Tymchenko, N. Sorochuk	123
ДОСЛІДЖЕННЯ ВПЛИВУ КОНЦЕНТРАЦІЇ РІДКОКРИСТАЛІЧНОЇ ПРИСАДКИ НА ТРИБОЛОГІЧНІ ВЛАСТИВОСТІ ІНДУСТРІАЛЬНИХ ОЛИВ Н.М. Аношкіна, О.С. Харківський	124
РЕСУРСОЗБЕРІГАЮЧІ ТЕХНОЛОГІЇ ПРИ ВИГОТОВЛЕННІ АРМОВАНИХ ПЛАСТИКІВ ДЛЯ АВТОТРАНСПОРТНИХ ЗАСОБІВ П.А. Білим, А.С. Рогозін, П.М. Фірсов, С.М. Золотов.....	126
ОСНОВНІ НАПРЯМКИ ЕНЕРГОЗБЕРЕЖЕННЯ НА ЗАЛІЗНИЧНОМУ ТРАНСПОРТІ Ф. Буреш.....	128
МОДЕЛЮВАННЯ ЗМІНИ РЕОЛОГІЧНИХ ВЛАСТИВОСТЕЙ СТРУКТУРИ СПОЛУЧЕНИХ МАТЕРІАЛІВ У ТРИБОСИСТЕМІ А.В. Войтов, К.А. Фененко, О.М. Фененко.....	130
ЕКСПЕРИМЕНТАЛЬНІ ДОСЛІДЖЕННЯ ПРОПУСКНОЇ ЗДАТНОСТІ РОЗПОДІЛЬНИХ СИСТЕМ ПЛАНЕТАРНИХ ГІДРОМОТОРІВ	

Секція
РЕСУРСО- ТА ЕНЕРГОЗБЕРЕЖЕННЯ НА ТРАНСПОРТІ

UDK 625.7/8

**CONTROL OF THE TEMPERATURE REGIME OF THE ROAD SLAB
USING A SOLAR COLLECTOR**

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The road should provide comfortable and safe driving, contribute to the least impact of changes in weather conditions and provide the highest coefficient of tire-road adhesion. All these requirements must be taken into account in the design, construction and operation of roads. Therefore, the road should be equipped with a device or system to prevent ice in winter, reduce the drying time of the slab after rain and maintain the hardness of the surface in hot weather. On dangerous sections of roads, ascents and descents, at intersections, airfield strips, etc. such equipment should be installed. The thermal condition of the road surface should be considered the main operational indicator that ensures proper transportation and traffic safety.

Currently, there are a number of proposals to support the issue under consideration. All of them have significant drawbacks and therefore are not widely used in practice. Known device [1] for heating road surfaces, which is a plate, inside which there are channels with heating elements of a heating cable. The slab is hydraulically and electrically insulated and its bottom base is thermally insulated. When voltage is applied to the electric cable, the road surface heats up.

The main disadvantages of this device are high maintenance and repair costs and low reliability. In the event of a cable or electrical connection failure, laborious work is required to open and remove part of the coating. The efficiency of heating various parts of the heating surface of the coating is associated with the peculiarities of heat transfer from the heating cable and is uneven. In addition, cooling of the road surface in this device is generally impossible.

Japanese patent [2] device for heating the road surface, has a plate inside which there are heating elements made of plastic pipes. A non-freezing working agent circulates inside the pipes in the form of a liquid. The lower base of the slab is thermally insulated. The device, in addition, includes a heat exchanger and a source of forced circulation in the form of a high-pressure pump, located off the road surface. The heat exchanger is built into the hot water supply system, and when the non-freezing working agent circulates through the heat exchanger, it heats up, correspondingly increasing the temperature of the plastic pipes inside the plate and heating the road surface. The main disadvantages of the known device are high operating costs with a low coefficient of heat use. In addition, it cannot be used to cool the road surface.

Another known device, [3] is intended to solve the issue under consideration, consists of a plate with a body, inside which there are heated elements in the form of

a system of pipes with liquid circulation in it. A high pressure pump and heat exchanger are located off the road surface. The device, when pumping a working agent through a heat exchanger-reservoir, heats it up and it, distilling it with a pump of a system of pipes laid under the roadbed, changes its temperature. The device allows cooling the road surface during hot weather. The main disadvantage of the known device is the impossibility of reaching a road surface temperature of a higher level than the temperature of the water in a nearby reservoir. In harsh winter conditions, this temperature may not be sufficient to prevent icing. In addition, the operation of the device depends on the presence of a reservoir near the road surface, with non-freezing water and temperature fluctuations in it. In the absence of a reservoir, the operation of the device is impossible.

In order to realize the independence of the road temperature control system from external heat exchangers (for example, reservoirs), the proposed device [4] contains a plate with a body insulated from the base side. A heating element is located inside the housing, which circulates an anti-freeze working agent. The device also has a source of forced circulation of the working agent and a heat exchanger. However, unlike the closest analogue, the plate body is sealed, the heat exchanger is located inside the body, and a throttle heat generator (elements) is used as a heating element. The source of the forced circulation of the non-freezing working agent in the hot season is the gas compressor. As a result of the forced circulation of the non-freezing working agent, the road surface is heated and cooled. A characteristic drawback of this device is its complexity, inefficiency and unreliability in operation, not the ability to use it without electrical energy.

In the device developed by us, the control of the temperature regime of the roadbed uses the principle of operation of the solar heat supply device and the cooling system of the internal combustion engine (ICE). Thermal solar energy is based on the use of devices and equipment that convert solar radiation into thermal energy. The heat from solar radiation can also be used to cool and heat the roadway. However, in this case, it is necessary to provide equipment in this system intended in the internal combustion engine for the cooling system of which a certain most favorable thermal regime is maintained and thereby allows protection against hypothermia and overheating.

When illuminating roads in some countries, including the United States, they began to block automobile roads with special plates (solar collectors) with glazing made with a special reinforcing method. In this case, the asphalt concrete road surface plays the role of a solar energy receiver and, as indicated in [3], these solar panels can withstand a load equal to the pressure of the wheels of a 40 ton truck. Also in this work, the ease of repair is noted, i.e. if any of the panels breaks, then there is no need to dismantle the entire section of the road, it is enough to remove only the faulty plate with the collector. Taking into account the achieved, and taking into account that in modern low-temperature heat supply systems (to), used to convert solar energy into low-potential heat, it is advisable to use a solar collector (SC) with a trap, the operating principle of which is described in [5]. This device is a solar collector through which the coolant circulates. The structure of the SC is thermally insulated from the back and glazed from the front.

The use of conventional flat SCs and tube-shaped vacuum SCs under cloudy weather conditions and at night breaks down their operating mode. Under these conditions, the coolant, due to the fact that the water instead of heating, on the contrary, is cooled, the system should have a SC panel with accumulating substances (bitumen), hydrogen gas, with a low pressure of paraffins, etc. Thus, in order to eliminate the disadvantages of conventional SCs, an active solar heat supply system, we propose to use it for the device under development described in [6], which is called a flat SC with a heat trap operating on the basis of hydrogen gas.

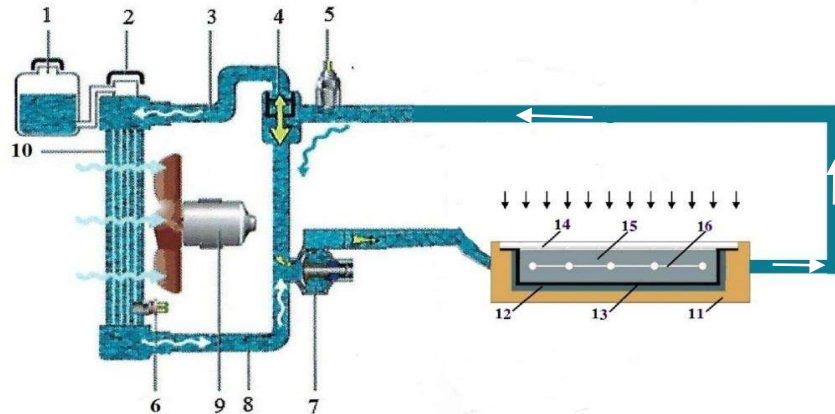


Fig 1. Schematic diagram of the device for controlling the temperature regime of the roadway using the SC: 1 - expansion tank; 2 - fuel neck; 3 - inlet pipe; 4 - thermostat; 5 - temperature sensor entering the liquid cooling system; 6 - the radiator liquid temperature sensor; 7 - pump; 8 - exhaust pipe; 9 - fan; 10 - radiator, 11 - sc case with trap, 12 - insulating thermal layer; 13 - sealing gasket, 14 - transparent coating (glass); 15 - layer of bitumen and kira; 16 - pipes through which the coolant circulates (non-freezing liquid).

The use of the developed device will make it possible to obtain an economic effect by increasing the service life of the road surface, reducing the consumption of freeing roads, from ice without using salt and sand mixtures, cooling and heating of asphalt reduce overall surface wear, eliminate the effect of salt on the environment, reduce transport safety, traffic jams and etc.

Let's consider the principle of operation of the device developed by us for maintaining the temperature regime of the road surface.

This device serves to maintain an optimal thermal regime of the roadway by means of controlled heat removal from the hottest road surfaces. To control the temperature regime of the roadway, a feature of the cooling system is used, a device that consists in a known method of maintaining the required temperature provided by a two-valve thermostat. When the temperature of the roadway is below optimal and it is required to warm up the surface, then the lower thermostat valve is closed and the cooling of the anti-freeze liquid coming from the SC pipes does not pass through the radiator. In this case, the heated liquid, up to a certain temperature in the SC, does not pass through the radiator. In this case, the liquid is heated by light radiation or heat accumulated in the SC trap and, with the help of a pump, circulates in a small circuit. The liquid leaving the SC tube passes to the upper thermostat valve and enters the pump again. As a result of the circulation of liquid in this part, the roadbed warms up quickly.

When the road surface is very hot, the upper thermostat valve is closed, the lower one is open. In this case, most of the liquid enters the radiator, is cooled in it, and then through the pipelines and through the open bottom valve of the thermostat enters the pump. A radiator is a heat exchanger in which heat is transferred to a liquid by an air stream.

The thermostat is an automatic valve that accelerates the heating of the frozen roadway and regulates, within certain limits, the amount of liquid passing through the radiator and the SC panel. It is installed at the outlet of the liquid (heat carrier) from the SC. A thermostat with a solid filler, a mixture of cerazine (oil truck), with copper powder, has a stem that is connected by a rocker with a damper (valve). When the road surface needs to be warmed up, the damper is open and the coolant (heat carrier) does not enter the radiator. When cerazine is heated, it melts, its volume increases, and by moving the stem, the valve opens. The liquid begins to circulate through the radiator (large circulation circle). Thus, as a result of the forced circulation of the anti-freezing agent through the SC with the trap, the road surface is heated or cooled. The technical result is an increase in efficiency, reliability and independence from power sources.

[1] RF patent №2114240, class. C 1/6 E 01, C 11/26, 31.01 1997

[2] Japanese patent No. 55-19322, cl. E 01, C 11/26, publ. 1980

[3] RF patent No. 2060316, class. C1, 6 E 01, C 11/24, E 01, D 19/22 J 3/00 01/20/1999

[4] https://findpatent.ru/img_show/8361976.html

[5] Salamov O.M., Garibov A.A. Salmanova F.A. Heat trap flat solar collector. Patent of the Republic of Azerbaijan, I 2014 0081, AR SM and PDK, 31.03.2014

[6] Salamov O.M., Hasanov V.H. Heat trap flat solar collector. Patent of the Republic of Azerbaijan No. I 2015 0087, AR SM and PDK, 16.12.2015

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SIMULATION MODELING OF THE AUTOMOBILE BRAKING SYSTEM PERFORMANCE

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Traffic participators' safety relies heavily on effectiveness of vehicle braking system. Thus, braking system design is essential when designing a new vehicle. Modeling of the functionality of the designed system is one of the most important phases of design. Time and material expenses for imitational modeling are always less than actually producing maquettes and conducting experiments on them. Experiments should prove theoretical abstracts stated while modeling. Thus, the imitational model should be well designed and adequate [1].

When modeling a braking system, one should synthesize the synergy between different physical elements and systems – the linear and rotational movement of mechanical parts, the work of hydraulic system and its synergy with brake fluid, automatic electric control circuits based on microcontrollers [1].

MatLab allows to synthesize such imitational models with good accuracy and fast speed of experiment conducting. The developer of such a model can optimize the