Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 129 (2015) 140 – 144

Procedia Engineering

www.elsevier.com/locate/procedia

International Conference on Industrial Engineering

The research of influence characteristics of heat-storage material on thermodynamic process in heat storage, installed in system of waste-heat recovery of internal combustion engines

Raznoshinskaia A.V.*

38Б - 40 Let Pobedy Str., Apt 82, Chelyabinsk, Russia. 454021

Abstract

The article outlines the results of the research of influence characteristics of heat-storage material on thermodynamic process in heat storage, installed in system of waste-heat recovery of internal combustion engines. It is shown that the highest average temperature and dampening effect among 4 analyzed heat-storage materials is reached by means of utilization of tripartite eutectic mixture $7NaNO_3/40$, $NaNO_2/53\ KNO_3$ and $LiNO_3$, due to appropriate thermophysical properties.

Peer-review under responsibility of the organizing committee of the International Conference on Industrial Engineering (ICIE-2015)

Keywords: internal combustion engine, exhaust gases, heat storage of transition curve, heat-storage material, thermophysical properties, temperature, temperature variations.

1. The research of influence characteristics of heat-storage material on thermodynamic process in heat storage.

The article outlines the results of the research of influence characteristics of heat-storage material on thermodynamic process in heat storage, installed in system of waste-heat recovery of internal combustion engines. It is shown that the highest average temperature and dampening effect among 4 analyzed heat-storage materials is reached by means of utilization of tripartite eutectic mixture $7NaNO_3/40$, $NaNO_2/53\ KNO_3$ and $LiNO_3$, due to appropriate thermophysical properties.

* Corresponding author *. Tel.: +7-951-810-24-11.
E-mail address: razn.alena1@yandex.ru

Peer-review under responsibility of the organizing committee of the International Conference on Industrial Engineering (ICIE-2015)
doi:10.1016/j.proeng.2015.12.022

During last years the humanity witnesses the dramatic boost of automobiles. Thus, due to the analytic centre "Alfastrakhovanie", the number of registered cars has grown twice for the last 10 years. Motor park increase leads to augmentation of influence on the environment. Main ecological problems of car utilization are: high toxicity of exhaust gases, heat and noise pollution, natural energy resources depletion. It is extremely important to introduce new technologies in auto industry to decrease the harmful influence of exhaust gases on the atmosphere in the future.

It is a well-known fact that up to 45% of heat energy, generated by an engine is extracted into the atmosphere with exhaust gases. There are groundbreaking reserves of amplification of engine performance in case of energy utilization by systems based on the Stirling engines, steam engines, gas turbines, thermoelectric generators, air expansion machines, etc.

The operation of waste treatment plants and oxidation catalyst demand stable and high temperature of air inflow, regardless engine operating condition [1,2]. However the temperature of exhaust gases of conventional engines changes in wide range depending on engine operating condition. So, on the basis of the research it is proven that the temperature of exhaust gases of KamAZ-740 engine on different engine operating conditions varies from 80 to 650 C [3].

It is possible to lower the oscillatory amplitude of the exhaust gases temperature by means of installation in car exhaust system device, containing heat-storage material of transition curve.

The device can be named as damper of temperature variations of exhaust gases.

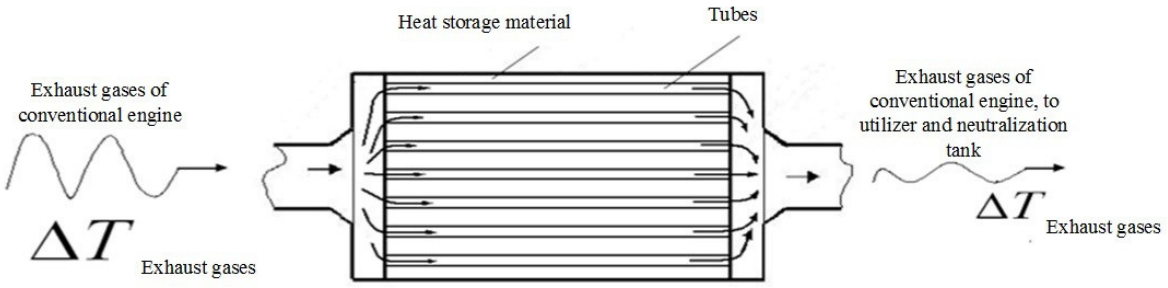

Fig.1. Damper of temperature variations of exhaust gases.

Dampers of temperature variations of exhaust gases of shell and tube type with transition curve are the most acceptable for the target implementation. The construction of damper of temperature variations of exhaust gases consists of frame with built in metal tubes, conducting exhaust gases of internal combustion engine. The space between the tubes is heat-storage material of phase transition.

In case the temperature of exhaust gases, flowing through the vibration damper is higher than the heat-retaining material's then the emission of heat takes place, consequently the temperature falls down. If exhaust gas is cooler than the heat-storage material, it gives some warmth to gas, boosting their temperature. Thus, damping vibrations of exhaust gases temperature takes place, flowing through the device.

The main structural component of damper of temperature variations – is heat storage material. Thus, the paramount priority is to choose the most suitable one.

It is worthwhile to choose substances for heat storage material, which are not degradable in smelting and not dissolvable in spill water. They are crystallizing as separate crystals, featuring comfortable melting temperature from the exploitation point of view, high definitions of latent heat of transition curve, heat conduction coefficiency and specific heater in solid and liquid phases, low price, sufficient level of safety during operation, etc. Optional limitations connected with the damper construction are possible [4].

New materials are offered by now, providing approximately any level of melting temperature within the range of exhaust gases temperatures. Salinas and bases – are the most numerable and investigated substances for heat storage. They are used for heat accumulation for both exhaust gases and chemical reactor of oxidation catalyst. Moreover in the original form, binary and trinary systems of salinas and bases, the melting temperature can be more suitable. Finally, the price of such composed substance is much lower than the pure one, as it consists of the composition of expensive and cheap substances [5].