IJDIAS International Journal of Discoveries and Innovations in Applied Sciences
| e-ISSN: 2792-3983 | www.openaccessjournals.eu | Volume: 3 Issue: 5

Possibility of Regeneration of Used Low-Freezing Liquids

Ravshan Khakimov
Cand. Sc., acting professor of the Tashkent State Transport University, Republic of Uzbekistan, Tashkent

Dmitriy Ayrapetov
Assistant of Tashkent State Transport University, Republic of Uzbekistan, Tashkent

Abstract:

One of the reasons for frequent breakdowns of a car engine is its overheating, which is caused by the unsatisfactory state of low-freezing fluids, which must be changed in a timely manner, but every year thousands of tons of ethylene glycol are simply poured into the sewer. Ethylene glycol and its solutions are toxic. Compared to light petroleum products, they cause poisoning only when ingested. Therefore, studies on the regeneration of low-freezing liquids are appropriate and relevant from an environmental and economic point of view.

There are various ways to regenerate low-freezing liquids, however, they are all very laborious and energy-consuming. The purpose of this work is to develop a method for the regeneration of low-freezing liquids with the maximum reduction in energy and labor costs.

Keywords: Low-freezing liquids, Antifreeze, boiling point, crystallization temperature, engine, cooling system, anti-corrosion properties.

Introduction

One of the main and common causes of engine breakdowns, most often leading to a major overhaul, is overheating. This is due to trends in the shift of engine operation to the upper temperature limit, a decrease in the volume of the coolant, and an acceleration of heat transfer processes due to an increase in fluid circulation [1,2,3,4]. On the other hand, engines are subject to more and more "strict" requirements for low-freezing liquids, which accordingly affects their availability and cost, which contributes to the emergence of a large number of counterfeit products. All this can lead to rational and modern storage and operation of vehicles [5].

Antifreeze solutions based on water (antifreeze) are known in nature and are widely used, in most cases antifreezes are used for cooling, for example, in internal combustion engines, cooling systems in production, etc. [6]. It is also advisable to use antifreeze for heating: heating systems of railway cars, cars, residential buildings. The composition of antifreezes includes salts of inorganic and organic acids, alcohols, glycols, glycerin, acids and bases, amino acids and other compounds [7,8].

At the beginning of the 20th century, the first low-freezing coolant appeared, called "antifreeze", which was made on the basis of glycerin. Such a coolant was a mixture of water and glycerin in a ratio of 35:65, had a freezing point of minus 40 ° C, and a boiling point of 290 ° C. The disadvantages of this antifreeze were high viscosity and insufficient fluidity. In the 1930s, ethylene glycol became the basis of coolants. In 1937, ethylene glycol-based coolants practically replaced glycerin and methanol. A mixture of ethylene glycol with water is highly corrosive and tends to foam, so it is necessary to add various kinds of additives to the coolant [9,10,11]. Ethylene glycol antifreezes, which have been used for many years, have proven themselves as coolants, but they

have a number of significant disadvantages: high toxicity, fire hazard [12-14], explosion hazard, high viscosity at low temperatures, increase in freezing point during concentration.

As of January 1, 2021, 2 million 767 thousand 126 cars were registered in the Republic of Uzbekistan, of which 467,176 cars were registered in Tashkent. Each of the vehicles for their operation requires a large amount of fuel, lubricants and technical fluids, including low-freezing ones, such as antifreeze. According to the requirements, antifreezes are recommended to be changed at least once every 2 years, or after 30 - 45 thousand km of the car's run.

According to statistics in the Republic of Uzbekistan in 2017, there was about 114.7 million tons of waste, of which 42.8 million tons of toxic waste subject to mandatory processing. Therefore, consistent work is being carried out in the country in the field of environmental protection, improvement of sanitary and ecological situation [15,16,17].

Ethylene glycol solution belongs to the third hazard class [18], is capable of harming the environment, is toxic to humans, and ignites at temperatures above 120 degrees. Therefore, the disposal of antifreeze based on ethylene glycol solution from the heating system is carried out according to environmental and safety standards [6,18].

However, even despite the high toxicity of antifreezes, some organizations, such as car parks, services and replacement posts, gas stations, to save money, independently pump low-freezing ethylene glycols from the cooling and heating systems and pour it into the nearby area into the soil or wastewater [19,20 ,21]. Toxic components enter the soil and accumulate, causing damage to the environment. It is forbidden to drain the used liquid into the sewer: when the used antifreeze comes into contact with the sewer pipes, metal corrosion can begin, which in a short time can lead to pipe breaks, and also forms components hazardous to health and the environment.

Methods: study of the physical and chemical properties of spent low-freezing liquids; search for the optimal regeneration method, testing the low-freezing liquid before and after regeneration for density, freezing point, crystallization onset temperature, rubber swelling and corrosive effect, ethylene glycol content, determining the most effective component and quantitative composition of ethylene glycol and additives in the obtained low-freezing liquid.

A sample of spent antifreeze was taken in the 2nd bus depot in Tashkent, from the Isuzu NP-37 bus after 80 thousand km. mileage (Fig. 1) Brand of antifreeze "Antifreeze ISUZU Genuine", red. The purpose of choosing a specific antifreeze was that usually, the composition of the studied coolants (antifreezes) includes monoethylene glycol (or ethylene glycol), distilled water, a complex of functional additives (especially anti-corrosion ones) dye, i.e. because the composition between different brands of antifreeze differs slightly, it was chosen from the bus in which regular replacement takes place, due to its frequent replacement. In this scientific study, it was not important to study a large sample, the essence was to develop a regeneration method and test it in nature.

IJDIAS International Journal of Discoveries and Innovations in Applied Sciences
| e-ISSN: 2792-3983 | www.openaccessjournals.eu | Volume: 3 Issue: 5

Fig. 1. Sample of waste antifreeze

At the beginning, an analysis of the used antifreeze was made (Table 1)

Table 1. The results of the physico-chemical parameters of antifreeze before regeneration

The name of indicators	Waste antifreeze
Colour	Cloudy red
Density at 20 ° C g / cm³	1,065
Freezing temperature, ° C	-33
Ethylene glycol content,%	47

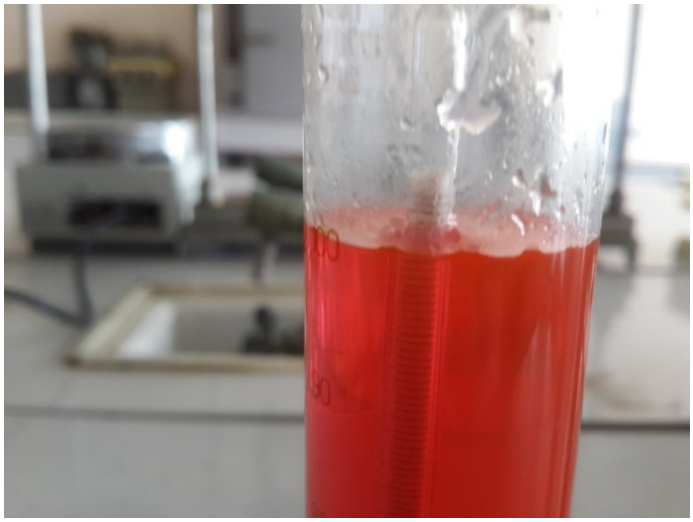

Fig. 2. Determination of the density of antifreeze

According to the results of the analyzes, it can be seen from the table that the appearance was determined visually: the antifreeze had a dirty red color, cloudy and with a slight coating on the surface of the oil. Also, according to GOSTs, we determined the density, freezing point and% of ethylene glycol, according to the results of the research, we can state that the antifreeze is of poor quality. According to literary sources, tk. the composition of antifreezes of various brands

practically does not differ in composition (only due to the presence of a different kind of additive package) it was not important to research several brands of antifreezes.

The aim of the scientific research was to develop a regeneration method and to test it in nature, i.e. on a specific sample of "ISUZU Genuine Antifreeze".

For further experiments, it was necessary to prepare a filtration device, which would make it possible to determine mechanical impurities and at the same time obtain a transparent liquid for the next tests.

Conclusion

The subject of the publication of a scientific article is the development of a method for the regeneration of antifreezes by filtration and distillation.

The principle of regeneration of spent antifreeze is that at the beginning, the used antifreeze was separated from oil and mechanical impurities by settling, for 5 days at a temperature of 40-45 ° C and filtered through paper filters, then the antifreeze purified in this way was subjected to distillation. Further research results will be published in future independent studies.

Thus, the possibility of regeneration of low-freezing liquid waste only at one ATP will significantly improve the environmental situation, because antifreeze is a very toxic liquid, it eliminates the need to drain it into the sewer and contaminate the soil, and from an economic point of view, because. at one of the workshops of the ATP, you can organize a workshop for the regeneration of antifreeze, and not buy it at an inflated price.

References

1. Кувшинов, А.Н. Русяев А.В., Буянкин Д.Ю. Исследование причин перегрева в системах охлаждения двигателей внутреннего сгорания // Техника и оборудование для села. - 2017. - № 11. – С. 8-11.
2. Повышение надежности работы двигателя за счет правильного подбора антифриза / В.С. Пономаренко // 64-я научно-техническая конференция гоу "сибади" в рамках юбилейного международного конгресса "креативные подходы в образовательной, научной и производственной деятельности", посвященного 80-летию академии Материалы конференции. Министерство образования и науки РФ, ГОУ ВПО «Сибирская государственная автомобильно-дорожная академия (СибАДИ)». – Омск. - 2010. – С. 41–47.
3. Изучение физических свойств антифризов / А.Н. Кувшинов, О.А. Кувшинова, Д.С. Шаляева, В.С. Кувшинов // E-Scio. – 2021. – Т. 54. – № 3. – С. 195-202. URL: https://cyberleninka.ru/article/n/izuchenie-fizicheskih-svoystv-antifrizov
4. Оптимизация состава автомобильного антифриза / С.Г. Курень, А.Д. Дьяченко, Н.А. Сокол, С.С. Вассель // Advanced Engineering Research. – 2008. – №2. – С. 203-209. URL: https://cyberleninka.ru/article/n/optimizatsiya-sostava-avtomobilnogo-antifriza
5. Собиржонов А., Ниязова Г.П., Айрапетов Д.А. Современное состояние межсезонного хранения сельскохозяйственной техники // Проблемы современной науки и образования 2022. № 3 (172). С 11-15. DOI: 10.24411/2304-2338-2022-10301
6. Stefl, B. A., George, K. F., & Staff, U. Antifreezes and Deicing Fluids. In Kirk-Othmer // Encyclopedia of Chemical Technology . John Wiley & Sons, Inc. – 2014. – P. 1–21. URL: https://doi.org/10.1002/0471238961.0114200919200506.a01.pub2

7. An Analysis of Various Cooling Liquids in a Two-Cylinder Single-Stage Piston Hybrid Power Machine with Fluid Flow Due to Vacuum at Suction Based on Experimental Results / V.E. Shcherba, G.S. Averyanov, S.A. Korneev, S.V. Korneev, A.Y. Ovsyannikov, D.A. Ritter // BMSTU Journal of Mechanical Engineering. – 2020. – № 12. – P. 40-49. URL: doi: 10.18698/0536-1044-2020-12-40-49
8. Обзор российского рынка охлаждающих низкозамерзающих жидкостей / Н. Ю. Башкирцева, О.Ю. Сладовская, Ю.С. Овчинникова, А.А. Сибгатуллин // Вестник Казанского технологического университета. – 2012. – №18. – С. 163-165. URL: https://cyberleninka.ru/article/n/obzor-rossiyskogo-rynka-ohlazhdayuschih-nizkozamerzayuschih-zhidkostey.
9. Федосова М.Е., Шишкин А.И. Разработка рецептуры автомобильного антифриза на основе водного раствора, очищенного биоглицерина // Актуальные проблемы гуманитарных и естественных наук. - 2016. - №12-1 – С. 28-35. URL: https://cyberleninka.ru/article/n/razrabotka-retseptury-avtomobilnogo-antifriza-na-osnove-vodnogo-rastvora-ochischennogo-bioglitserina.
10. Taylor J. Glycerin gets the green light for use in US engine coolants 16 April 2012 Source:ICIS Chemical Business URL: http://www.icis.com/resources/news/2012/04/16/9549969/glycerin-gets-the-green-light-foruse-in-us-engine-coolants/
11. Abutolib Sobirjonov, Zebo X. Alimova, Gulkhayo P. Niyazova, Dmitriy A. Ayrapetov, Ruslan B. Siddikov. Prevention of corrosion and accelerated wear of agricultural machinery // Ilkogretim Online - Elementary Education Online, 2021; Vol 20 (Issue 5): pp. 7482-7486 doi:10.17051/ilkonline.2021.05.848 URL: https://ilkogretim-online.org/index.php?mno=83048
12. Елисеев Ю.Н. Показатели пожарной опасности охлаждающих жидкостей автомобиля // Пожарная безопасность: проблемы и перспективы. - 2013. - №1 (4). – С. 277-279. URL: https://cyberleninka.ru/article/n/pokazateli-pozharnoy-opasnosti-ohlazhdayuschih-zhidkostey-avtomobilya.
13. Shadimetov Y., Ayrapetov D., Ergashev B. Transport, ecology and health International Journal of Advanced Research in Science, Engineering and Technology Vol. 8, Issue 4, April 2021 http://www.ijarset.com/upload/2021/april/33-botir-28.PDF
14. Shadimetov, Y., & Ayrapetov, D. (2021). “GREEN BELT IN ARALKUM” INNOVATIVE ASPECTS. PROJECT PROPOSAL. Конференции. https://doi.org/10.47100/conferences.v1i1.354
15. Указ Президента Республики Узбекистан № УП-5863 от 30.10.2019 «Об утверждении концепции охраны окружающей среды Республики Узбекистан до 2030 года». г. Ташкент – 2019. - 72 с. URL: https://lex.uz/docs/4574010
16. Барханаджян А.Л., Хакимов Р.М., Ибрагимов Б.Д., Собирова Д.К., Абдукаримова Г.У., & Айрапетов Д.А. Проблема использования отходов лакокрасочных материалов, и их утилизация // Известия Томского политехнического университета Инжиниринг георесурсов. 2020, №331(9), С. 179–185. [Электронный ресурс]. Режим доступа: http://izvestiya.tpu.ru/archive/article/view/2821/.
17. Шадиметов Ю.Ш., Айрапетов Д.А. Актуальные проблемы охраны окружающей среды и рационального природопользования в Республике Узбекистан // ЗАМЕТКИ УЧЕНОГО №12/2022 С. 225-230

18. ГОСТ 12.1.005-88. Система стандартов безопасности труда. Общие санитарно-гигиенические требования к воздуху рабочей зоны [Текст]. – Москва: Министерством здравоохранения СССР, 1988. – 50 с.
19. Sequential episodes of ethylene glycol poisoning in the same person / J. P. Sugunaraj, L.K. Thakur, K.K. Jha, I.D. Bucaloiu // British Medical Journal. - 2017. URL: https://doi.org/10.1136/bcr-2017-220108
20. Барханаджян А.Л., Хакимов Р.М., Ибрагимов Б.Д., Вафаев О., Айрапетов Д.А. Антикоррозионная защита металлических деталей транспортной техники полимерным покрытием на основе эпоксиуретана // CHEMISTRY AND CHEMICAL ENGINEERING: Vol. 2021 : No. 3, Article 8. 46-49pp.
21. Khakimov, R., & Ayrapetov, D. (2023). Development of a method for the regeneration of used low-freezing liquids. ISJ Theoretical & Applied Science, 04 (120), 239-243. Soi: http://s-o-i.org/1.1/TAS-04-120-45 Doi: https://dx.doi.org/10.15863/TAS