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ANALYSIS OF ENVIRONMENTAL ASPECTS OF COLLANT-CUTTING FLUIDS APPLICATION

Prozorova M.A., student
Scientific supervisor Zelianukha A.V.
Foreign language consultant Slesaryonok E.V.
Belarusian National University of Technology, Belarus

The paper examines the ecological aspects of applying coolant-cutting fluids for mechanical processing of metals and alloys.

Keywords: coolant-cutting fluids, mechanical processing of metals, environmental aspects.

Coolant-cutting fluids (CCF) occupy an important place in mechanical engineering. They represent special compounds designed to improve cutting, drilling, milling and other types of processing. Among the advantages of using cooling lubricants it is possible to underline the following: preventing overheating of parts, improving the quality of metalworking, as well as reducing equipment wear. Multifunctionality makes coolant-cutting fluids a versatile solution for various processes at mechanical engineering and metallurgical enterprises.

According to their composition and properties, coolant-cutting fluids are divided into two main categories: oil-based fluids and water-soluble cooling fluids. Oil-based cutting fluids typically contain about 70-90% of mineral oils, and additives for various functional purposes are also added. Their advantages over other cutting fluids include excellent lubricating properties; however they also have some drawbacks such as limited cooling capacity and rapid evaporation.

Water-soluble cooling fluids being more widely used include emulsifying (emulsols), semi-synthetic and synthetic cutting fluids.

The composition of emulsifying coolant-cutting fluids is represented by a mixture of mineral oils, emulsifiers, corrosion inhibitors, biocides and various additives. Low bioresistance and stability, rapid depletion and loss of anti-corrosion properties can be assigned to their drawbacks.

The basis of the composition of synthetic coolant-cutting fluids are water-soluble polymers or surfactant compositions, mineral oils are not present. Their properties include versatile application, a fairly long service life, and high anti-corrosion properties.

Semi-synthetic coolant-cutting fluids contain mineral oils. They account for about 10-30% of the composition. Their lubricating properties are much better than that of synthetic coolant-cutting fluids. It should also be noted that semi-synthetic coolant-cutting fluids are more resistant to biodeterioration than emulsols.

The service life of coolant-cutting solutions, as a rule, ranges from two weeks to several months. It depends on the concentration of mechanical impurities in the coolant, and the addition of bactericidal components increases its share.

However, it should be stressed that the application of coolant-cutting fluids is accompanied by a number of vital environmental aspects. First of all, the application of coolant-cutting fluids during the mechanical processing of metals leads to the formation of finely dispersed oil aerosol and products of its thermal decomposition. The amount of pollutants is primarily affected by the shape and size of the workpiece, the processing mode, the consumption and methods of supplying the cutting fluid. Table 1 shows the specific emissions of oil and emulsifier aerosols during mechanical processing of metals using coolant-cutting fluids [1].

As can be seen from Table 1, the largest amount of emulsol is released during metal processing on grinding machines with oil cooling.

Environmental aspects can also include the formation of spent coolant-cutting fluids, which require addressing issues of their further handling. According to the waste classifier of the Republic of Belarus, "sludge after settling of coolant-cutting fluids" is classified under code 5470800 and has hazard class 4 [2].

Coolant-cutting fluids, despite their importance in production processes, represent a significant environmental burden. Ensuring effective wastewater treatment, as well as the use of environmentally friendly alternatives, is an important strategy for reducing the negative impact on the environment.

Table 1 - Specific emissions of oil and emulsifier aerosols during mechanical processing of metals using coolant-cutting fluids

Name of the technological process		The amount of emulsol released into the atmosphere, 10^{-2} g/h per 1 kW of machine power
Metal processing on turning, drilling, milling, planing, drawing, thread rolling, boring machines	oil cooling	2,02
	cooling by emulsion with emulsol content less than 3%	0,18
	cooling by emulsion with emulsol content from 3 to 10%	0,16
Metal processing on grinding machines	oil cooling	28,8
	cooling by emulsion with emulsol content less than 3%	0,37
	cooling by emulsion with emulsol content from 3 to 10%	3,73

As a rule, wastewater treatment involves several stages. The first stage is receiving and averaging wastewater for further clarification. Then, free oil is removed, which minimizes the content of oily contaminants. The next stage involves filtration

and chip cleaning, aimed at solving the problem of mechanical contaminants. Ultrafiltration cleaning, using membrane technologies, allows for the removal of small particles.

In conclusion, it is to underline that in order to reduce significantly the negative impact of coolant-cutting fluids on the environment and downgrade the environmental load, it is vitally important to focus primarily on the development and implementation of environmentally friendly coolant-cutting fluids. Research being conducted in the field of creating fluids based on natural components and biodegradable substances will help reduce toxicity and improve environmental properties. An important stage is considered to be the implementation of cutting fluid reuse systems, which involves the use of technologies for the recycling and reuse of fluids at production stages. This will significantly minimize the consumption of new coolant-cutting fluids and reduce the amount of waste generated. In addition, it is necessary to improve wastewater treatment systems. Modernization of existing systems, the use of modern membrane technologies and active reagents for the removal of mechanical and chemical contaminants will increase the efficiency of cleaning. Thus, an integrated approach to issues related to the use of cutting fluids will reduce the load on environmental components.

Literature:

1. ТКП 17.08-02-2006 (02120) Охрана окружающей среды и природопользование. Атмосфера. Выбросы загрязняющих веществ в атмосферный воздух. Правила расчета выбросов при сварке, резке, механической обработке металлов. – Мн., 2006. – 46 с.

2. Классификатор отходов, образующихся в Республике Беларусь, утв. постановлением Министерством природных ресурсов и охраны окружающей среды Республики Беларусь от 8 ноября 2007 г. № 85.

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ОЦЕНКА ПРОСТРАНСТВЕННО-ВРЕМЕННОЙ ИЗМЕНЧИВОСТИ ВЕТРОВОГО РЕЖИМА ТЕРРИТОРИИ БЕЛОРУССКОГО ПОЛЕСЬЯ

Протасевич А.С., аспирант кафедры природообустройства
Научный руководитель Мешик О.П.
Учреждение образования «Брестский государственный технический университет», Беларусь

В работе рассматривается ветровой режим на территории Белорусского Полесья. В качестве исходных данных используются данные метеорологических наблюдений по 7 метеостанциям исследуемой территории за репрезентативный период с 1966 по 2020 гг. Дана оценка пространственно-временной изменчивости ветрового режима территории Белорусского Полесья.