

General characteristic of technological lubricating cooling liquids in metal cutting process

EO Umarov¹, UT Mardonov²

¹ PhD Researcher, Department of Material science, faculty of mechanic, Tashkent State Technical University named Islam Karimov, Almazar, Tashkent, Uzbekistan

² Professor, Department of Mechanical Engineering, Machine Construction faculty, Tashkent State Technical University named Islam Karimov, Almazar district, Tashkent, Uzbekistan

Abstract

In this article, the authors provide clear information about the importance and application of lubricating cooling liquids in metal cutting process. They analyze the most cited papers and literature, moreover, use the data which has been taken from their experiments. In addition, they give accurate data about beneficial sides about using lubricating cooling liquids in machining process.

Keywords: metal cutting, technological process, cooling, lubricating, lubricating cooling liquids

Introduction

Technological lubricating cooling liquids (TLCL) are systems with a complex composition of many components [6, 7, 8, 9, 10, 12]. The main purpose of them is to use machine tools in the circulating systems for machining metal parts in order to reduce wear of cutting tools, lubricate work areas, remove heat from parts and tools, which as a result leads to improved machine performance and increased quality and accuracy of machined details. In addition to above-mentioned functions in the course of machining of details of lubricoolant provide also washing away of abrasive dust and washing off of shaving, promote protection of the processed details, operating parts and nodes of the equipment from corrosion [5; 7; 11], and also participate in improvement of sanitary and hygienic conditions in workplaces [1; 3; 4; 8]. Technological lubricating cooling liquids, Technological

cutting fluids, the production of which is carried out on an industrial scale, are divided into two classes [2], on a water and oil basis (Figure 1.1). The manufacture of aqueous TLCL is carried out by mixing the main phase from distilled water with concentrates of the corresponding additives [2]. Water-based TLCL have the following advantages: higher cooling ability, non-flammability, absence or low content of substances harmful to the health of personnel, low cost of the main components of the solution. Along with the advantages listed above, aqueous TLCL also have a number of characteristic disadvantages, which are determined by the properties of the base: these are high volatility and more mediocre lubricating properties, which limits their applicability in severe and especially difficult machining conditions [2; 12].

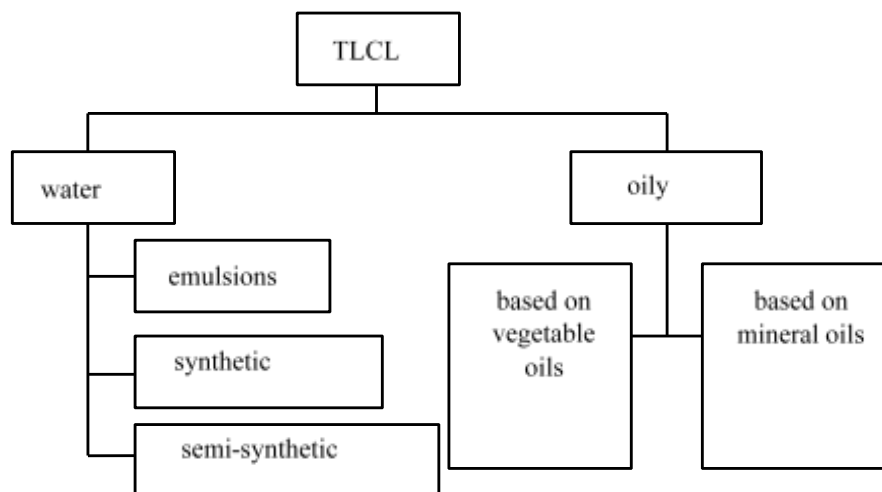


Fig 1: Classification of technological lubricating cooling liquids

TLCL on an oil basis arrive in a look, ready for application, represent a basis from mineral or vegetable oils to which a number of functional additives, such as anti-wear, antifricition, anti-seize, the inhibitors of oxidation or

corrosion washing additives against foaming and so forth is in most cases added. Presence of good lubricant properties at this class of liquids defines the directions them applicability – at heavy and especially heavy modes of

machining, especially with big depths and low cutting speeds. This class of TLCL as well as water, is not deprived of a number of shortcomings: it is the high price of a basis, low indicators on refrigerating capacity and also inflammability [2; 12]. Multi-purpose TLCL on an oil basis can perform the TLCL functions at the same time and be working fluid for hydraulic drives [11]. With an increase in consumption of TLCL and toughening of treatment regimes,

increased requirements are imposed on lubricants, and the specialization of fluids oriented to specific technological operations is growing [2].

The effectiveness of TLCL in technological aspects can be determined by its functional features during machining (Figure 1.2)

Lubricating, dispersing, cooling and washing [2, 5, 12].

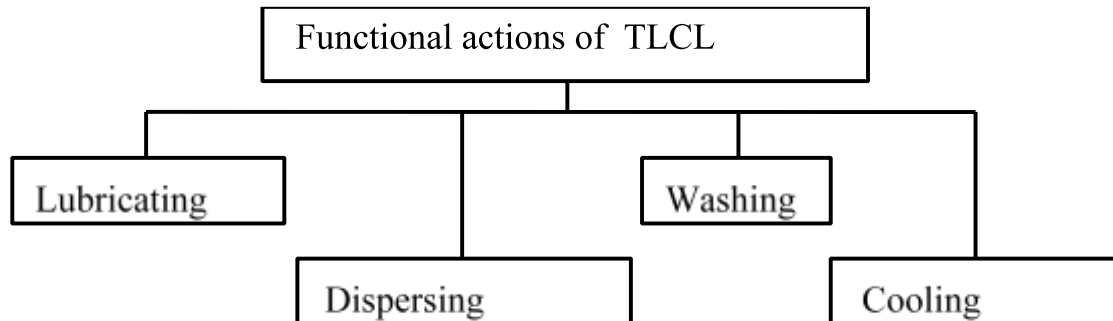


Fig 2: Functional actions of TLCL

Lubricating properties of TLCL are determined by the presence of shielding and antifricion properties that are formed due to the appearance of secondary structures (films) between the cutting tool and the surface of the work-piece to prevent direct contact of the surfaces of the processed material and the cutting tool [2, 12].

The dispersing effect of TLCL is determined by the ability to influence the facilitation of the technological process of interaction between the cutting tool and the cutting surface of the work-piece, which consists in facilitating the deformation and destruction of metals with the formation of new surfaces [2, 6]. The presence of surfactants that make up the TLCL during the cutting process contributes to the nucleation and development of micro-cracks in the treated surface, which consists in the penetration of polar surfactant molecules into micro-cracks and the formation of additional prop pants at their edges, resulting in an increase in the fragility of the material and its subsequent destruction.

The laws of heat transfer determine the cooling properties of TLCL. When cutting, heat is removed from the heated surfaces of the work-pieces and tools by the medium mainly by convective heat transfer, the intensity of which is estimated by the average heat transfer coefficient on the surfaces streamlined by the jets of the cooling medium. The value of the heat transfer coefficient depends on the state of the surface, the cutting mode, the flow velocity and the thermos-physical properties of the TLCL. At the same time, the most important are indicators of the thermal conductivity of the liquid, its flow rate, heat capacity and density, as well as the viscosity and the difference between the temperatures of the cooled surface and air in the production room.

During mechanical processing of metals by cutting, the cutting tool is exposed to the greatest thermal loads, while the presence of a TLCL flow in the working area does not eliminate the heating of the tool, but contributes to a significant reduction in its heating area [6].

The washing properties of the TLCL are determined by ensuring the continuous removal from the working zone of cutting of the products of the technological process (chips) and waste (wear), and in the case of grinding, by preventing the buildup of waste on granules of abrasive material [6].

Conclusion

According to given data above, it clear that utilizing lubricating cooling liquids in machining process is very effective and beneficial. Lubricating cooing liquids can help to increase the accuracy, clearance and roughness of machining surface and also improve the wear resistance of cutting tool. There are many types of lubricoolats and it is very useful to conduct new experiment on using lubricating cooling liquids in metal cutting process. The authors has conducted same useful experiments on using lubricating cooling liquids in different condition and indications from those experiments showed that cooling liquids have a great effect of the accuracy of machining surfaces.

References

1. Baltrukova TB. Nauchnie problemi kompleksnoy gigenicheskoy otsenki proizvodstva smazochno-oxlajdayushix texnologicheskix sredstv / T. B. Baltrukova [Scientific problems of a comprehensive hygienic assessment of the production of cutting lubricants / T. B. Baltrukova]. – SPb.: Nestor, 1998.
2. Bulijev EM. Texnologicheskoe obespechenie mashinostroitelnix proizvodstv smazochno-oxlajdayushimi jidkostyami: dis.... d-ra texn. nauk: 05.02.08, 05.03.01 / Bulijev Evgeniy Mixaylovich. – Ulyanovsk [Technological support of machine-building production with cutting fluids: dis.... Dr. tech. Sciences: 05.02.08, 05.03.01 / Bulyzhev Evgeniy Mihaylovich. - Ulyanovsk], 2003, 429.
3. Vasilev AV. Vozdeystvie smazivayushix oxlajdayushix jidkostey v usloviyax predpriyatiy mashinostroeniya i metodi ego snijeniya /A. V. Vasilev, L. R. Xamidullova // Izvestiya Samarskogo nauchnogo sentra RAN[The effect of lubricating coolants in engineering enterprises and methods for its reduction / A. V. Vasiliev, L. R. Khamidullova // Bulletin of the Samara Scientific Center of the Russian Academy of Sciences]. 2006; 4(18):1171-1176.
4. Vasilev AV. Monitoring toksicheskogo vozdeystviya otrabotavshix smazochno-oxlajdayushix jidkostey s ispolzovaniem biologicheskix test-ob'ektov[Monitoring the toxic effects of spent cutting fluids using biological

- test objects] / A. V. Vasilev, L. R. Xamidullova, V. V. Zabolotskix // Izvestiya Samarskogo nauchnogo sentra RAN. 2012; 14(1):6.
5. Vinogradova IE. Prisdki k. maslam dlya snijeniya treniya i iznosa [Oil additives to reduce friction and wear] / I. E. Vinogradova. – M.: Gostoptexizdat, 1963, 112.
 6. Klushin MI. Oxlajdenie i smazka raspilennimi jidkostyami pri rezanii metallov [Cooling and lubrication with atomized fluids for metal cutting] / M. I. Klushin, V. M. Tixonov, D. N. Troskaya. – Gorkiy: VolgoVyatskoe izd-vo, 1966, 124.
 7. Latishev VN. Povishenie effektivnosti SOJ [Improving Coolant Efficiency] / V. N. Latishev. – M.: Mashinostroenie, 1985, 64.
 8. Pankin AV. Izgotovlenie i primeneniye novix oxlajdayushch-smazivayushchix jidkostey [Production and use of new coolants and lubricants] / A. V. Pankin, D. N. Burdov. – M. Mashinostroenie, 1964, 176-104. Pekker, I. I. Fizicheskoe modelirovaniye elektromagnitnix mexanizmov [Physical modeling of electromagnetic mechanisms] / I. I. Pekker. – M. Energiya, 1969, 64.
 9. Smazochno-oxlajdayushchie tekhnologicheskie sredstva dlya obrabotki metallov rezaniem. – 2-e izd., pererab. i dop / pod obsh. red. S. G. Entelisa, E. M. Berlinera [Lubricating and cooling technological means for metal cutting. - 2nd ed., Revised. and additional / under total. ed. S. G. Entelis, E. M. Berliner]. – M: Mashinostroenie, 1995, 496.
 10. Tekhnologicheskie svoystva novix SOJ dlya obrabotki rezaniem / pod red. M. I. Klushina [Technological properties of new cutting fluids for cutting / ed. M. I. Klushina]. – M: Mashinostroenie, 1979, 192.
 11. Xamidullova LR. Klassifikatsiya negativnogo vozdeystviya smazochnooxlajdayushchix jidkostey na cheloveka i biosferu i metodov ego snijeniya [Classification of the negative impact of cutting fluids on humans and the biosphere and methods for its reduction]
 12. Xudobin LV. Teknika primeneniya smazochno-oxlajdayushchix sredstv v metalloobrabotke [Technique for the use of cutting lubricants in metalworking] / L. V. Xudobin, E. G. Berdichevskiy. – M. Mashinostroenie, 1977, 189.
 13. Umarov EO, Abduraxmonov KhZ, Mardonov UT, Dustmurodov DR. Studying the influence of magnetic and eletromagnetic field on fluids https://www.ijert.org/paper-details.php?paper_id=141747
 14. Umarov TU, Mardonov UT, Khasanov OA, Sh.O. Ozodova, B.D. Yusupov. Research of the variation of firmness of pointed drills by method of simulation modeling of process of wear <https://www.psychosocial.com/article/PR201298/12155/>