RESEARCH PARKS

INTERNATIONAL JOURNAL ON ORANGE TECHNOLOGY

https://journals.researchparks.org/index.php/IJOT e-ISSN: 2615-8140 | p-ISSN: 2615-7071

Volume: 03 Issue: 12 |Dec 2021

Effect of Magnetic Field on the Properties of Flowing Lubricating Cooling Liquids used in Manufacturing Process

Erkin Odilov, Ma'murjonov Dilshod

Faculty of Mechanic, Tashkent state technical university, Tashkent, Uzbekistan

Umidjon Mardonov

Faculty of Machine construction, Tashkent state technical university, Tashkent, Uzbekistan

---***---

Annotation: In this paper, the effect of magnetic field on cooling liquids, which are used in the heat treatment process in manufacturing, was studied. We chose three different lubricating cooling liquids that are commonly used in local manufacturing factories to conduct the experiment. Three main properties of these lubricoolants such as boiling point and kinematic viscosity were analyzed after magnetizing them. The article shows the results of these comparisons and analyze the magnetic field influence on different types of fluids.

Keywords: Boiling point, cutting, liquid, magnetic field, manufacture

Introduction

There are many scientific works about the effect of magnetic field on the physical and chemical properties of water. When magnetic field effects on liquids they become magnetized liquids. V.E Nikolskiy [1] analytically and experimentally investigated the influence of magnetic and electric fields with tension gradient in the direction of the movement of the contacting gas-liquid phases. F.L Rashid and his colleague [2] presented an investigation of water evaporation through magnetic field of 0.5 T, which was located at different location of tested water height (water-air interface, water mid-height, and bottom). M. Amiri and A.A Dadkhah [3] investigated whether or not a physical water treatment reduces the surface tension of water as reported in some scientific literature. V.N Tritigin et al. [4] studied the influence on the microflora of water-oiled lubricating cooling liquid of a weak electromagnetic pulse field. I.M Ageev [5] has noted that one of the hypotheses explaining the effect of a weak magnetic field on biological objects is a change of water properties which is their part. S.M Hassan and R.A Rahmon's study [6] is a step towards gaining a better understanding of the effect of magnetism on water properties and on the biology of culture organisms, such as the brine shrimp, A. salina. Christian Baresel and others [7] have taken the concept of water treatment by functionalized magnetic particles one step forward by integrating the technology into a complete proof of concept, which included the preparation of surface-modified beads, their use as highly selective adsorbents for heavy metals ions (Zinc, Nickel), and their performance in terms of magnetic separation. U.T. Mardonov et al. studied the effect of magnetic field on the dynamic viscosity coefficient of flowing water, they found that the dynamic viscosity coefficient of water changed after magnetization [8].

The effect of magnetic field on liquids is still a controversial issue, and there are a lack of researches about that. Almost all of the researches about magnetic field effect on liquids were conducted on water and the majority of those researches used in the agriculture field and using this issue in the manufacturing process would have a great advantage.

Although many researches about the influence of magnetic field on some parameters of water have been reported from many studies, no scientific works analyzed the effect of magnetic field on cooling liquids used in heat treatment process. Especially the effect on kinematic viscosity and boiling point are the most important parameters of cooling liquids used in the heat treatment. Analyzing the influence of magnetic fields on the properties of lubricants would help to increase the efficiency of machining and increase the hardness of the metal. The purpose of this

INTERNATIONAL JOURNAL ON ORANGE TECHNOLOGY
https://journals.researchparks.org/index.php/IJOT e-ISSN: 2615-8140 | p-ISSN: 2615-7071
Volume: 03 Issue: 12 | Dec 2021

research work is to study the effect of magnetic field on these two properties of lubricating cooling liquids such as boiling point (heating from room temperature until liquids boil) and kinematic viscosity. In addition, we examined the influence of the magnetic field strength magnetization effect.

METHODS AND MATERIALS

The first liquid(liquid-1) is industrial oil I-40A represents refined distillates and residual oils or their mixtures without additives. They are used in machines and mechanisms of industrial equipment, the operating conditions of which do not impose special requirements on the antioxidant and anticorrosive properties of oils. They can also be used as hydraulic fluids.. The second liquid, liquid-2 was an industrial hydraulic oil I-20A is a purified distillate or residual base oil or a mixture of them without additives. The grease is intended for use in industrial machines and mechanisms that do not impose high requirements for anti-corrosion properties, for the oxidative stability of technical fluids. The main characteristics of the I-20A oil are established by GOST 20799-88.

The magnetizing equipment UMD-1 was used for magnetizing liquids, the equipment consisted of 8 magnets, and the size of each magnet was 120x80x16(length, width, height) with a minimum strength of 40 mT. The details of UMD-1 magnetizing equipment are given in Fig. 1.

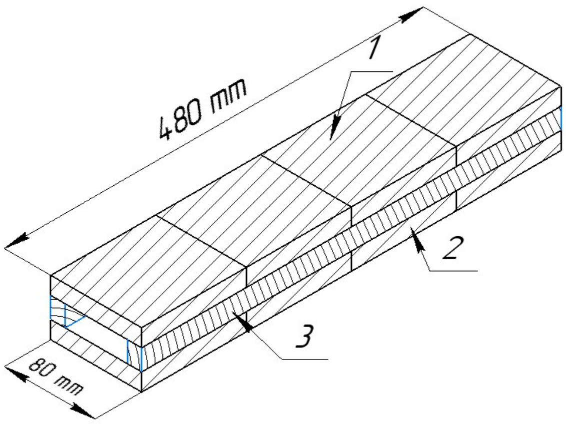

Fig. 1. UMD-1 magnetizing equipment. 1 – Magnets on the top, 2 – magnets below, 3 – wooden part for separation.

The magnetic field strength, magnetizing condition, and velocity of liquids were considered as three influential factors that affected the changes caused by the magnetic field[9, 10]. Therefore, all of the experiments have been conducted in the same laboratory condition and the specification of the laboratory condition is given in table 1.

Table 1: Example system technical data (table title)

Item	Value
Atmospheric pressure	770 mmHg
Humidity	80%
Height above sea level	440 meter
Flowing speed of liquid	0.4 m/s
Diameter of the PVC	10 m

RESULTS

Effect of magnetic field on the boiling point of cooling liquids

The digital thermometer recorded the boiling of three different liquids. As we said above, three different liquids were analyzed under the influence magnetic field with three different magnetic field strengths (40 mT, 60 mT, and 80 mT). Then, we analyzed the effect of the magnetic field with different MFS on flowing liquids. After 30 minutes of magnetizing under each magnetic field strength in the same laboratory condition, which is specified in table 1, we obtained the following results given in Fig. 2.

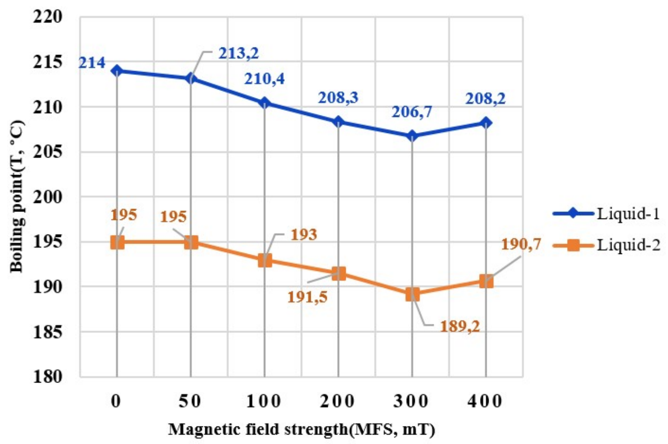

Fig. 2. The boiling point of not-magnetized and magnetized(in the flowing condition) liquids.

https://journals.researchparks.org/index.php/IJOT e-ISSN: 2615-8140 | p-ISSN: 2615-7071

Volume: 03 Issue: 12 |Dec 2021

The boiling point is one of the main physical parameters of fluids and its value might be changed under the effect of the magnetic field. The boiling point of liquids depends on the condition and other parameters of liquids such as atmosphere and properties of fluids. As can be seen in Fig. 2, the boiling point of magnetized liquids are getting lower related to magnetic field strength. As we increase the magnetic field strength, the boiling point of liquids decreased (Fig. 2). The difference between boiling point of not magnetized and magnetized fluids (in the flowing condition) under the 300 mT of magnetic field strength were 208.2 ^{0}C for liquid-1, 190.7 ^{0}C for liquid-2, respectively. In addition, it is interesting to note that the higher the magnetic field strength the lower the boiling point of liquids. The lowest boiling point of liquids were determined at 300 mT magnetic field strength.

Effect of magnetic field on the kinematic viscosity coefficient of lubricating cooling liquids

Few papers have been published about the effect of magnetic field on water but no articles about the kinematic viscosity coefficient of lubricoolant under the effect of the magnetic field have been published. Viscosity coefficient is one of the important properties of lubricating cooling liquids used in the heat treatment. Analyzing the effect of magnetic field on that parameter of liquids will help to increase the efficiency of the manufacturing process. In our laboratory condition, we used the VPJ-4 measuring device to record the results. It is a commonly used device in our country.

Following the previous experiment, or more accurately, influenced the magnetic field on flowing liquids. UMD-1 magnetizing device was used to magnetize the flowing liquids. Lubricating cooling liquids passed through UMD-1 magnetizing device with 0.4 m/s. The diameter of the pipe, which was used to pass flowing liquid through UMD-1, was 10 mm. After 30 minutes of the magnetizing process, we measured the kinematic viscosity of liquids and the result are given in Fig. 3.

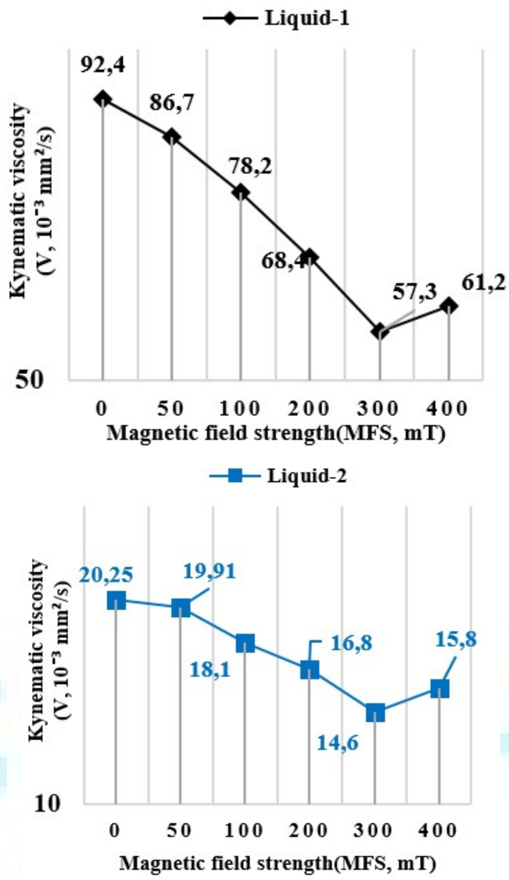

Fig. 3. Viscosity coefficient of not magnetized and magnetized (in flowing condition) liquids in different magnetic field strengths.

Results given in Fig. 3 show that a magnetic field can cause to decrease the viscosity coefficient of flowing liquids. Moreover, the viscosity coefficient of flowing liquids depends on the magnetic field strength, because as we increase the strength of the magnetic field kinematic viscosity of liquids decreases according to magnetic field strength. We can see that the lowest viscosity coefficient was determined under the influence of the highest magnetic field strength (300 mT). Comparisons show that the value between the not magnetized and magnetized under the highest MFS were 35.1 mm^2/s for liquid-1, 5.65 mm^2/s for liquid-2 respectively.

It was also found that the effect of magnetic field on flowing and not flowing liquids depend on the properties of liquids. It is clear from the numbers obtained in Fig.2 and Fig. 3 that liquid-1 has been

https://journals.researchparks.org/index.php/IJOT e-ISSN: 2615-8140 | p-ISSN: 2615-7071
Volume: 03 Issue: 12 |Dec 2021

affected by the magnetic field more than the other the liquid. Liquid-1 had the least change among three liquids after magnetization.

DISCUSSION

The experiment we have done suggests that some parameters of liquids such as boiling point and kinematic viscosity have changed by magnetic field. The boiling point results are consistent with reports in the literature that the boiling point of water increase after magnetic field treatment [11]. It is essential to point out that in our research we studied three different liquids including water and the results are more applicable for other types of liquids. We can assure that magnetic field treatment decreases the boiling point of any liquids with respect to their magnetic field strength. In addition, the effect of magnetic field on kinematic viscosity of liquids were investigated in this study. A decrease in the viscosity coefficient after magnetic field treatment have been found. Also, it has been explored that, the effect of magnetic field on liquids depends on the properties of fluids, or more accurately, in the same laboratory condition and same magnetic field strength, magnetic field influence were different on various liquids. It is worth noting that the influence of magnetic field on liquid depends on what kind of chemical elements are dissolved in the liquid. Moreover, the maximal change in all of the experiments was obtained at 300 mT of magnetic field strength.

Obtained results are very influential in the heat treatment process because the changes in these parameters of liquids have an impact on the hardness of treated steel. The influence of magnetized cooling liquids on the hardness of steel helps to increase the efficiency in the machining process and saves the energy [8].

However, this issue about magnetic field treatment of liquids remains controversial. Complete understanding of the influence of magnetic fields on fluids has a great impact on agriculture, industry, and other fields [12-14]. Some scientists are working on the issue of magnetic field treatment of water, but there lack of researches on this issue, especially the magnetic field effect on different liquids.

CONCLUSION

The results that we were obtained in the laboratory experiment showed that there was an increase in the density of liquids when they were affected by the magnetic field and it depended on the magnetic field strength. In addition, it was found that kinematic viscosity and boiling point of experimented liquids were decreased after magnetic field treatment. The influence of the magnetic field on the boiling point of dissolved liquids were about 1.5 times higher than liquid 2.

REFERENCES

1. V.Ye Nikolskiy i drugie, "Primenenie elektromagnitnyx poley dlya intensifikatsii teplomassoobmena v sovмещennyx gazojidkostnyx protsessax[Application of electromagnetic fields to intensify heat and mass transfer in combined gas-liquid processes], " Vostochno-Yevropeyskiy jurnal peredovyx texnologiy, 2017, 3/8(87), pp. 1729-3774. https://media.neliti.com/media/publications/307213-application-of-electromagnetic-fields-fo-6a3064eb.pdf

2. FL Rashid, NM Hassan. "Increasing water evaporation rate by magnetic field", International science and Investigation Journal, 2013; 2: 61-68p. http://isijournal.info/journals/index.php/ISIJ/article/view/12

3. M.C Amiri, Ali A Dadkhah. "On reduction in the surface tension of water due to magnetic treatment, " Colloids and Surfaces A: physicochemical and engineering aspects, 2006; 278(1-3):252-55. https://doi.org/10.1016/j.colsurfa.2005.12.046

4. V. N. Tyrtygin, N. A. Sobgayda, V. L. Potexa, I. G. Shayxiev, Yu. A. Makarova., "Vliyanie elektromagnitnogo impulsnogo polya na mikrofloru smazochno-oxlajdayущey jidkosti[Influence of the electromagnetic pulse field on the microflora of the cutting fluid], " Vestnik Kazanskogo texnologicheskogo universiteta, 2013, issue 3, volume 16. https://cyberleninka.ru/article/n/vliyanie-

elektromagnitnogo-impulsnogo-polya-na-mikrofloru-smazochno-ohlazhdayuschey-zhidkosti/viewer

5. I.M Ageev, G.G Shishkin, S. Yeskin., "Izuchenie Vliyaniya Nizkochastotnogo Magnitnogo Polya Na Vodu[Study of the Effect of Low Frequency Magnetic Field on Water]" n.d. https://docplayer.ru/31202250-Izuchenie-vliyaniya-nizkochastotnogo-magnitnogo-polya-na-vodu.html
6. S.M Hassan, Ridzwan Abdul Rahman. "Effects of exposure to magnetic field on water properties and Hatchability of Artemia Salina". 2016; 11(11):416-23. www.arpnjournals.com
7. Christian Baresel et al. "Functionalized magnetic particles for water treatment" Heliyon. 2019; 5(8):e02325. https://doi.org/10.1016/j.heliyon.2019.e02325
8. Umarov E.O., Mardonov U.T., Shoazimova U.Kh., "Influence of the Magnetic Field on the Viscosity Coefficient of Lubricoolant that is used in the Cutting Proces, " International Journal of Mechatronics and Applied Mechanics, 2020, Issue 8, Vol. II. pp. 144-149 https://www.doi.org/10.17683/ijomam/issue8.50
9. Liu B, Gao B, Xu X, et al., "The combined use of magnetic field and iron-based complex in advanced treatment of pulp and paper wastewater, " Chem Eng J 2011; 178(1): pp. 232–238. https://doi.org/10.1016/j.cej.2 011.10.058
10. Manyà JJ, Jr MJA, Kinoshita CK, et al., "Specific heat capacity of pure water at 4.0MPa between 298.15 and 465.65 K, " Ind Eng Chem Res 2011;50(10): pp. 6470–6484. https://doi.org/10.1021/ie102462g
11. Youkai Wang, Huinan Wei, Zhuangwen Li, "Effect of magnetic field on the physical properties of water, " Results in Physics 8 (2018), pp. 262–267. https://doi.org/10.1016/j.rinp.2017.12.022
12. X Wang Y, Zhang B, Gong Z, et al., "The effect of a static magnetic field on the hydrogen bonding in water using frictional experiments, " J Mol Struct 2013; 1052(11): pp. 102–104. https://doi.org/10.1016/j.molstruc. 2013.08.021
13. Cai R, Yang H, He J, et al. The effects of magnetic fields on water molecular hydrogen bonds. J Mol Struct 2009; 938(1–3):15–9. https://doi.org/10.1016/j.molstruc.2009.08.037
14. Toledo EJL, Ramalho TC, Magriotis ZM., "Influence of magnetic field on physical–chemical properties of the liquid water: insights from experimental and theoretical models. " J Mol Struct 2008; 888(1–3):409–15. https://doi.org/10.1016/j.molstruc.2008.01.010