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Performance enhancement of a vapor compression cooling system: an application of POE/Al_2O_3

Buhar sıkıştırmalı soğutma sisteminin performans iyileştirmesi: POE/Al_2O_3 uygulaması

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Performance Enhancement of a Vapor Compression Cooling System: An Application of POE/Al_2O_3

Highlights

- *Nano-lubricant in the form of Al_2O_3/POE was prepared using Triton X-100 as a surfactant.*
- *Nano-lubricants were prepared in 0.5% and 1.0% nanoparticle mass fraction.*
- *0.5% by weight of surfactant was used in the suspension.*
- *The highest coefficient of performance was obtained at 0.5% nanoparticle mass fraction.*
- *The coefficient of performance was increased by 18.27% with the use of nano-lubricant.*

Graphical Abstract

In this experimental study, nano-lubricants in different mass fractions were prepared. The prepared nano-lubricants were tested in the vapor compression cooling system.

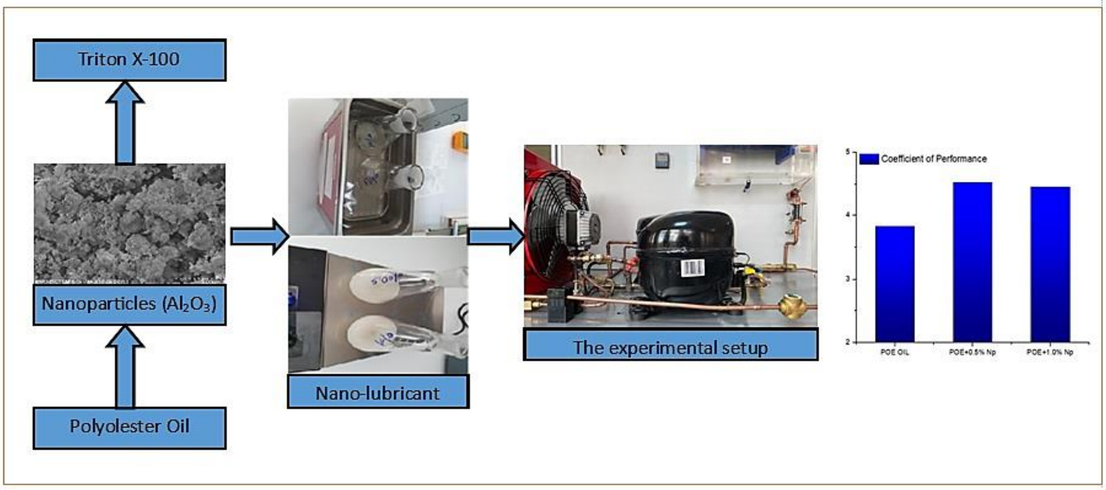

Figure. Graphical Abstract

Aim

The aim of the experimental study is to increase the efficiency of the vapor compression refrigeration cycle. For this purpose, nano-lubricant was used as the working fluid in the compressor. In the experiments, it was desired to improve the coefficient of performance of the system.

Design & Methodology

While preparing the nano-lubricant, Al_2O_3 nanoparticles and Triton X-100 surfactant were added into the base liquid polyolester. The suspension was mixed in an ultrasonic water bath and magnetic stirrer. Vapor compression cooling system was used in the experiments.

Originality

The use of surfactants in nano-lubricant studies has not been encountered much. In this study, agglomeration was prevented by using surfactant material in suspension. This study shows that, POE/ Al_2O_3/TX-100 nano-lubricant can be used as a compressor oil.

Findings

In this study, it was determined that the heat transfer properties of nano-lubricants are better than pure POE. There was 18.26% increase in COP and 12.53% decrease in compressor work.

Conclusion

According to the test results, it shows that the nano-lubricants work in harmony and safely with the refrigerant. In addition, it was concluded that nano-lubricants work more efficiently in the vapor compression refrigeration cycle than pure oil.

Declaration of Ethical Standards

The authors of this article declare that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.

Buhar Sıkıştırmalı Soğutma Sisteminin Performans İyileştirmesi: POE/Al_2O_3 Uygulaması

Araştırma Makalesi / Research Article

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ÖZ

Deneysel olarak gerçekleştirilen bu çalışmada bir soğutma sisteminde kompresör yağı yerine nanoyağlayıcı kullanımının sonuçları incelenmiştir. Çalışmada incelenen soğutma sisteminde, R134a soğutucu akışkanı kullanılmıştır. Kompresör yağı olarak polyol ester (POE) baz sıvısı ile birlikte, alüminyum oksit (Al_2O_3) nanopartiküllerinden hazırlanan nanoyağlayıcı değerlendirilmiştir. POE yağına %0,5 ve %1,0 oranlarında Al_2O_3 nanopartikülleri karıştırılarak oluşturulan nanoyağlayıcılar ile deneyler gerçekleştirilmiştir. Ayrıca, oluşturulan nanoyağlayıcı içerisinde homojen bir dağılım sağlamak amacıyla süspansiyonda ağırlıkça %0,5 oranında triton X-100 (TX-100) yüzey aktif malzemesi kullanılmıştır. Deneyler sonucunda soğutma sistemi için en yüksek soğutma tesir katsayısı (STK) değeri %0,5 Al_2O_3 ve %0,5 TX-100 konsantrasyonunda elde edilmiştir. Saf POE yağı ile yapılan deneylere göre COP değeri %18,27 kadar arttırılmıştır. Kompresörün çekmiş olduğu güç değeri de %0,5 Al_2O_3 ve %0,5 TX-100 konsantrasyonunda %12,53 kadar azaltılmıştır.

Anahtar Kelimeler: Soğutma çevrimi, nanoyağlayıcı, Al_2O_3, triton X-100, COP.

Performance Enhancement of a Vapor Compression Cooling System: An Application of POE/Al_2O_3

ABSTRACT

In this experimental study, the results of utilizing a nano-lubricant in place of compressor work fluid in a refrigeration system were examined. R134a refrigerant was utilized in the refrigeration system. Polyol ester (POE) was used as a base fluid and a nano-lubricant prepared from alumina oxide (Al_2O_3) nanoparticles was utilized. The experiments were carried out separately with nano-lubricants created by mixing Al_2O_3 nanoparticles in the ratios of 0.5% and 1.0% into POE oil. Additionally, 0.5% triton X-100 (TX-100) surfactant was utilized in the nano-lubricant in order to ensure a homogeneous dispersion in the suspension. As a result of the experiments, the highest coefficient of performance (COP) value for the cooling system was obtained at the concentrations of 0.5% Al_2O_3 and 0.5% TX-100. In the experiments with pure POE oil, the COP value was increased by 18.27%. The power value drawn by the compressor was reduced by 12.53% at the concentrations of 0.5% Al_2O_3 and 0.5% TX-100.

Keywords: Cooling cycle, nano-lubricant, Al_2O_3, triton X-100, COP.

1.INTRODUCTION

In today's technology, energy is an extremely important concept. With the developments in it today, we need technology for several purposes. We still provide most of our energy from fossil resources. It is known that the use of fossil fuels harms the environment. Moreover, the deposit life of fossil resources is decreasing day by day. For these reasons, the concepts of renewable energy resources and energy efficiency have become popular. In terms of energy efficiency, the energy we use in the industry and in our daily lives has a high rate [1]. We use cooling devices for many purposes in the industry and in our daily lives. Compressors consume almost all of the energy in these cooling devices. The most effective method for ensuring energy efficiency was seen as interventions that may be made on compressor oils [2]. In addition to using energy efficiently, this use also has an environmental dimension. While CO_2 emissions from energy use have remained constant since 2014, total greenhouse gas emission continue to enhancement, according the UNEP reports. According to the UNEP 2015 reports, the emission index for 2015 was 52.7 gigatons of carbon dioxide ($GtCO_2$). This rate increased by 8.7 $GtCO_2$ in comparison to the 2014 UNEP reports. According to UNEP reports, if these values continue to increase this way, there will be values far above the targets for 2020 reports [3]. For all these reasons, the environmental effects of a refrigerant escaping from systems should also be accounted for in terms of refrigeration systems. According to the International Montreal Protocol, production of components affecting the ozone layer has been taken under control. Additionally, it has become imperative to use refrigeration systems in the least harmful way to the environment. C. S. Jwo et al. (2012) conducted efficiency studies on the compressor in a cooling machine operating with the R134a refrigerant in their experimental studies. They examined the heat transfer properties of the system by utilizing a nano-lubricant in place of POE oil in the

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compressor. They used POE oil as the base liquid while preparing the nano-lubricant. They stated that they carried out their experiments by providing a homogeneous mixture by putting nanoparticles in 0.05%, 0.1% and 2.0% concentrations into the POE oil. The authors indicated that the best results were obtained with the nano-lubricant prepared using 0.1% nanoparticles, consequently their experimental works. They also realized that power consumption decreased by 2.4% [4]. Lau J. F. et al. (2015) reported in their experiments that they examined the performance of a home-type refrigerator using isobutane and graphite nano-lubricants as the working fluid. In their experimental studies, the authors stated that they used graphite nanoparticles in 0.0%, 0.05%, 0.1%, 2.0% and 0.5% mass fractions. For this reasons, they stated that the power consumption of the refrigerator decreased by 0.15% at a concentration of 0.1%. In the study, they reported a decrease in evaporator temperature, condenser temperature, discharge pressure, discharge temperature, suction pressure and compressor temperature when they used the nano-lubricant. They reported that the withdrawal time for the refrigerator also decreased by 15.22% with the use of the nano-lubricant [5]. Narayanasarma S. and Biju T. Kazhiveli (2019) created a POE/SiO_2 nano-lubricant by mixing SiO_2 nanoparticles into POE oil to ensure energy efficiency in a refrigeration system. They indicated that the thermal conductivity and viscosity of the POE oil increased with an enhancement in the mass of SiO_2. In the experiments, they concluded that 0.1% and 0.15% of SiO_2 nanoparticles performed better in tribological studies. The authors reported that the thermal, rheological, tribological properties, corrosion, oxidative stability and environmental friendliness of the nano-lubricant created by addition of SiO_2 nanoparticles into POE oil in their studies were emphasized. The study also reported that the thermal conductivity rate increased by 10.89% in the viscosity index for a 0.2% nanoparticle concentration at 85 °C [6]. Lin L. et al. (2017) actualized an experimental research on the effect of TiO_2 nanoparticles added into the compressor oil in the refrigerant gas - oil mix during the drying of the refrigerant. They stated that, while using the nano-lubricant in place of working oil in the refrigeration machine, some of the nanoparticles in the nano-lubricant circulated in the refrigerant. The authors stated that they also used TiO_2/R141b/NM56 as nano-sensor-oil mixture, and experiments were carried out in the fat mass fraction in the range of 5-20% and in the nanoparticle mass fraction in the range of 0.2-1.0%. According to the results of the experiment, they observed that the mixture-oil migration rate changed in the range of 0.388-0.969. According to the results of the study, as the oil-mass fraction increased, the mixture-oil migration rate increased. They stated that, as the oil-mass fraction increased from 5% to 20%, the mixture-oil migration rate increased from 0.616 to 0.953 [7]. Sanukrishna S. and Jose Prakash M. (2018) studied the thermal and rheological behavior of a TiO_2 / PAG nano-lubricant for a cooling system. According to the experimental results, the thermal conductivity and viscosity increased with the increase in the volume fractions for the nano-lubricant. However, they determined that thermal conductivity and viscosity values decreased with increasing temperature. They reported that unlike other nanofluids, thermal conductivity in nano-lubricants decreases as the temperature enhancements too much. They emphasized that the viscosity enhancement for the same volume concentrations is higher than thermal conductivity [8]. Padmanabhan V. and Palanisamy S. (2012) reported that, in their vapor compression refrigeration system, they added nanoparticles to the compressor oil and examined their reversibility experimentally. Initially, they operated the system with the R134a refrigerant. They used TiO_2-added MO (Mineral oil) at a concentration of 0.1 g / L in place of POE compressor oil in the cooling machine. The authors also reported that they performed their experiments using the R436A and R436B refrigerants instead of the R134a refrigerant. According to the results of the experiment, when the nano-lubricant was used, the COP value increased in the system. They also reported that the R436A and R436B refrigerants used in the system have less damage to the ozone layer [9]. Cremaschi et al. (2014) drew attention to heat transfer and pressure losses in vapor compression cycles. They reported that heat transfer and pressure losses may occur because some of the compressor oil will circulate with the cooler liqued in the refrigeration cycle. As a reason for these losses, they showed excessive lubrication that may occur in heat exchangers. To reduce these losses, they mixed nanoparticles into the compressor oil and used nano-lubricants in the system. They determined that, when the nanoparticle was mixed into the compressor oil, the heat transfer properties of the oil would improve. In the experiments, they used POE oil as the base liquid and Al_2O_3 as the nanoparticle while creating the nano-lubricant. R410A was used as the refrigerant for the refrigeration machine. The authors indicated that the specific heat of the nano-lubricant was lower than that of POE oil in the range of 0 °C to 20 °C. For this reasons, they concluded that thermal conductivity was 1.1 times higher at 5 °C and 1.4 times higher at 40 °C [10]. Pico D. et al. (2019) in their experimental studies, they created a nano-lubricant from POE oil with diamonds. They aimed to increase the heat transfer rate by using nano-lubricant in the cooling cycle. Additionally, Pico D. et al. stated that they aimed to increase the system COP and decrease power consumption. In experimental studies, they used POE oil as the base fluid for the nanofluid. The authors added diamond nanoparticles in 0.1% and 0.5% mass fractions into the POE oil. In the study, when diamond nanoparticles were used as lubricating additives, they experimentally examined the main parameters such as cooling capacity, power consumption, performance coefficient and compressor temperatures. According to the experimental results, the coefficient of performance increased by 0.1% and 0.5% for the mass fractions of 4% and 8%, respectively. According to the results, the compressor outlet temperature was reduced by approximately 4 ^{0}C [11]. Depend on convection and heat transfer for cooling systems, thermal properties can be improved in the system by differentiation of flow style, limit terms or interactions of the thermal features of the fluid. In this study, in order to improve the thermophysical features of the fluid, experiments were carried out with nanoscale, which was formed by mixing metal oxide (Al_2O_3) particles to POE oil used as the compressor oil. In order to prevent agglomeration when metal oxide particles were mixed into the oil, surfactant material was also used in a certain mass fraction. TX-100 was used as the surfactant. With the use of the surfactant material, the nano-lubricant was provided to have a more hydrophobic and homogeneous distribution.

2.MATERIAL and METHOD

2.1 Preparation of Nano-Lubricant

Approximately 100 ml of POE oil was removed from the compressor in the cooling test apparatus where the tests were carried out. For this reason, a nano-lubricant was prepared in the same area. POE oil was used as the base liquid for the nano-lubricant. POE oil can work in accordance with the R134a refrigerant we use for the refrigeration cycle [12]. Experiments were carried out in different nanoparticle mass fractions by mixing Al_2O_3 (*99.5+%, 18 nm, gamma, hydrophilic – Nanografi*) nanoparticles of approximately 18 nm into the POE oil at 0.5% and 1.0% concentrations. The TX-100 surfactant was used for each concentration in the 0.5% mass fraction suitable as a result of different trials. The size and content analyses of the Al_2O_3 nanoparticles were carried out. SEM image for the Al_2O_3 nanoparticles were provided in Figure 1.

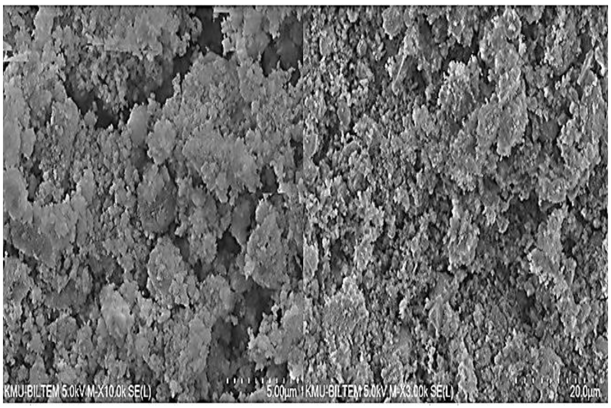
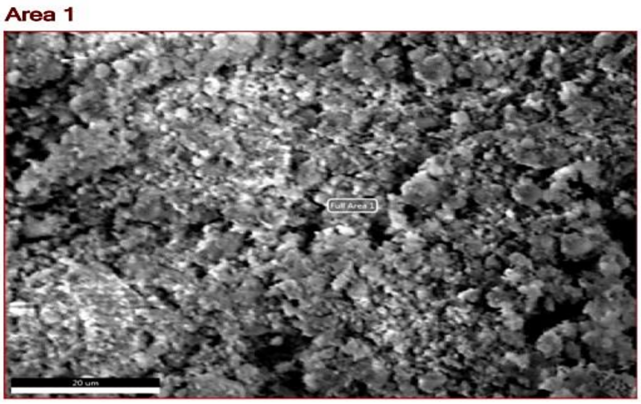


Figure 1. SEM analysis for Al_2O_3 nanoparticles

EDAX-APEX analyses were also performed on the SEM device for the Al_2O_3 nanoparticles. According to the results of this analysis, Al_2O_3 nanoparticles we used in nano-lubricant preparation contained 58.63% "Al" by weight and 41.37% "O" by weight. In Figure 2, EDAX analyses were given for the Al_2O_3 nanoparticles.



Smart Quant Results

Element	Weight %	Atomic %	Error %
mustafa akkaya edx | AlO | Area 1 | Full Area 1			
O K	41.37	54.34	6.68
AlK	58.63	45.66	4.05

Figure 2. EDAX/APEX analysis for Al_2O_3 nanoparticles

Another analysis for the nanoparticles was conducted with X-ray Diffraction (XRD) The peaks for the metal oxide particles were clearly visible as a result of this analysis. XRD analysis for the Al_2O_3 nanoparticles was given in Figure 3. In the literature, there are peaks called Al (111) in the range of 35-40 degrees, Al (200) in the range of 40-50 degrees, Al (221) in the range of 60-70 degrees and peaks called Al (311) in the range of 75-80 degrees. [13].

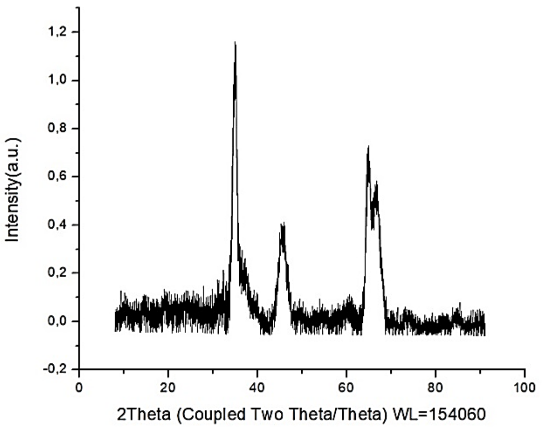


Figure 3. XRD analysis for Al_2O_3 nanoparticles

2.2 Experimental Design and Experiments

As a test device (*Deneysan*), a refrigeration cycle device consisting of a compressor, evaporator, condenser, expansion valve and capillary copper pipes were used as the connection elements. The temperatures of the compressor, evaporator and condenser were measured with Pt100-type thermocouples. R134a was used as the refrigerant for the refrigeration cycle, and the refrigerant was charged to the system by up to 350 g refrigerant flow rate was measured with the help of a flowmeter located in the system. Photograph of the experimental setup was shown at Figure 4.

Figure 4. Photograph of the experimental setup

Al_2O_3 nanoparticles of 0.5% and 1.0% were used in the experiments, and the results were examined by conducting experiments with three different nano-lubricants. After each experiment, the nano-lubricant utilized as the working fluid was drained from the compressor, and after the nano-lubricant was drained, the compressor was cleaned with nitrogen gas. In order to test the repeatability, the experiments were carried out in three different measurements and their averages were taken. 350g of the R134a refrigerant was charged to the system after the compressor work fluid was changed before each measurement.

2.3 Uncertainty Analysis

In an experimental study, it is important that the measurement instruments that are use operate in the correct calibration and are adjusted as accurately as the measurement. In this experimental study, Pt100 type thermocouples were used for temperature measurements, while Refco mr-205-ds / mr-305-ds style manometers were utilized for pressure measurements. The general uncertainty of the measured data for the experimental setups was calculated as follows[14,15]:

$$W_F \left\{ \begin{matrix} \left(\frac{dF}{dX_1}W_1\right)^2 + \left(\frac{dF}{dX_2}W_2\right)^2 + \\ \ldots\left(\frac{dF}{dX_n}W_n\right)^2 \end{matrix} \right\}^{1/2} \qquad [1]$$

The uncertainty analysis for thermocouples used in the experimental setup was calculated as follows[14]:

$$W_R = \left\{ \begin{matrix} \left(W_{T.c.accuracy}\right)^2 + \left(W_{T.c.junctions}\right)^2 + \\ \left(W_{reading}\right)^2 \end{matrix} \right\}^{1/2}$$

$W_R = \{(1)^2 + (1)^2 + (0.1)^2\}^{1/2} = 1.4177$

The uncertainty analysis for the flowmeter in the test setup was calculated as follows[14]:

$$W_R = \left\{\left(W_{flowmeter}\right)^2 + \left(W_{reading}\right)^2\right\}^{1/2}$$

$W_R = \{(0.1)^2 + (0.1)^2\}^{1/2} = 0.1414$

Uncertainty analysis for the pressure sensors in the test setup was calculated as follows:

$$W_R = \left\{\left(W_{Pressure\ gauge}\right)^2 + \left(W_{reading}\right)^2\right\}^{\frac{1}{2}}$$

$W_R = \{(0.016)^2 + (0.1)^2\}^{1/2} = 0.101$

3.RESULTS and DISCUSSION

Refrigeration cycle machines generally operate between the two specific pressure levels, between the low and high pressure levels according to the ideal cooling cycle. For the results obtained experimentally, ideal vapor compression cycle calculations were used. A compressor was considered isentropic according to the ideal cycle with vapor compression. According to the cycle, the refrigerant enters the compressor as saturated steam and exits as a superheated steam. Additionally, the refrigerant exits the condenser from the condenser as a saturated liquid. The enthalpy values of the state changes for the refrigerant were read from the tables related to the refrigerant R134a. According to the calculations made in the evaporator, together with the heat taken from the cooled environment, the amount of heat required to start the compressor was calculated with the following formula[16]:

$$\dot{Q}_L = \dot{m}(h_1 - h_4) \quad [2]$$

$$\dot{W}_C = \dot{m}(h_2 - h_1) \quad [3]$$

The m value for the formula is mass flow, and it is measured in the experiment setup in kg/h by the flowmeter. The h_1 value is the enthalpy value corresponding to the temperature at the evaporator outlet from the saturated steam table for the refrigerant, and it is determined as kJ/h, while the h_4 value is the enthalpy equivalent of the temperature value at the compressor outlet from the superheated steam table for refrigerant R134a in kJ/h according to the high pressure value;

With these values, the coefficient of performance for the refrigeration machine was also calculated with the following formula [16]:

$$COP = \frac{\dot{Q}_L}{\dot{W}_C} \quad [4]$$

The data in Table 1 were obtained experimentally utilizing the nano-lubricant obtained in varied rate concentrations by using POE/Al_2O_3/TX-100 as compressor work fluid in the refrigeration cycle.

Table 1. Test results for the refrigeration system

MEASUREMENTS	***POE OIL***	***0.5% Al_2O_3***	***1.0% Al_2O_3***
Compressor in. temp. (°C)	17.83	23.90	25.93
Compressor out. temp. (°C)	69.80	62.30	63.86
Evaporator in. temp. (°C)	15.20	20.50	22.26
Evaporator out. temp. (°C)	17.83	23.90	25.93
Condenser in. temp. (°C)	69.80	62.30	63.86
Condenser out. temp. (°C)	31.50	22.50	23.86
Heat absorbed from the cooled environment (kJ/h)	123.32	127.52	126.70
Compressor Work (kJ/h)	32.14	28.11	28.39
COP	3.83	4.53	4.46

To achieve energy efficiency in a refrigeration cycle, the work done by the compressor should be reduced, because almost all the power consumed for the cooling cycle was consumed by the compressor. For this reason, a nano-lubricant was used instead of pure POE oil by interfering with the POE oil in the compressor. Heat transfer features were improved while using nano-lubricant instead of POE oil. The outlet temperature of the compressor was also lowered by 7.5 °C and 5.94 °C for the 0.5% and 1.0% nanoparticle concentrations, respectively. The drop in the compressor outlet temperature means that the power consumed by the compressor also decreases. According to the results, compressor work was determined as 28.11 kJ/h when 0.5% Al_2O_3 was used and as 28.39 kJ/h when 1.0% Al_2O_3 was used. Since the compressor outlet temperatures decreased, the work done by the compressor in both concentrations decreased. In Figure 5, changes in the work done by the compressor for different concentrations were presented.

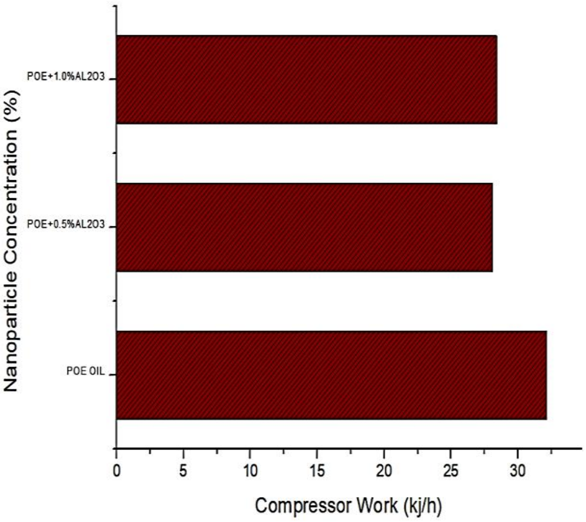


Figure 5. Changes in compressor work for nanoparticles used in different concentrations

In the refrigeration machine, heat absorbed from the cooled environment by the evaporator was also examined for the nano-lubricants of different concentrations. While there was 100 ml of POE oil in the compressor, heat absorbed from the cooled environment by the evaporator was 123.32 kJ/h. While utilizing the nano-lubricant at 0.5% and 1.0% concentrations in place of POE oil in the compressor, the amount of heat drawn by the evaporator was determined as 127.52 kJ/h and 126.70 kJ/h, respectively. The amount of heat removed from the evaporator was higher at the 0.5% Al_2O_3 nanoparticle concentration. TX-100 surface active agent in 0.5% mass fraction was used in both nano-lubricants. The amount of heat drawn from the environment by the evaporator for the nano-lubricants formed in varied concentrations in the refrigeration cycle was shown in Figure 6.

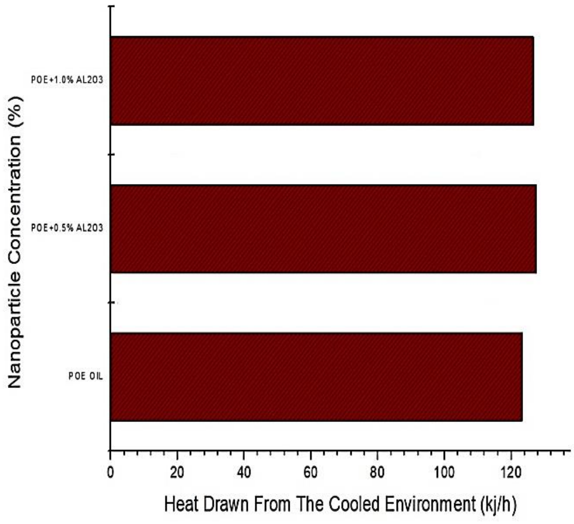


Figure 6. The Amount of heat taken from the evaporator for nanoparticles used in different concentrations

The change in the coefficient of performance for the nano-lubricants formed at varied concentrations were also investigated. COP values increased while using the base liquid POE oil in place of POE oil in the cooling machine, Al_2O_3 as the nanoparticle and TX-100 as the surfactant. The COP values were calculated as 4.53 and 4.46, respectively, for the nano-lubricants prepared at 0.5% and 1.0% nanoparticle concentrations according to the experimental results. In Figure 7, changes were given for the COP values.

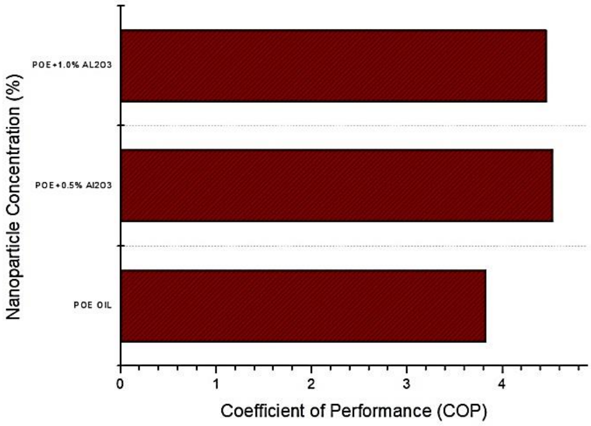


Figure 7. Analysis of COP value for nano-lubricants used in different concentrations

4. CONCLUSION

In this experimental study, the compressor oil was modified in order to use a cooling machine more efficiently. Nano-lubricant consisting of POE / Al_2O_3 / TX-100 was used instead of regular compressor oil. The following results were obtained from the experiments:

i. R134a refrigerant worked in harmony with the POE oil operated in the compressor.
ii. When the prepared nano-lubricant was operated in the compressor, it worked safely in the system.
iii. Al_2O_3 metal oxide nanoparticles in the POE oil were shown to increase the heat transfer properties of the compressor work fluid. The importance of the size of the nanoparticle used while preparing the nano-lubricant was seen as a result of the experiments.
iv. While Al_2O_3 nanoparticles were at a concentration of 1.0%, there were a few collapses in the nano-lubricant, and this affected the results.
v. TX-100 was used as a surfactant. As a result of different trials, it was determined that the 0.5% mass fraction was suitable for the surfactant. When the surfactant material was used, a more homogeneous distribution was formed in the nano-lubricant. It was also shown to prevent lumps that may occur in the nano-lubricant.
vi. The use of nano-lubricant in the compressor did not cause any wear or physical effect on the compressor.
vii. While the experimental setup normally becomes stable when run for about 25 minutes, it was observed that this time was prolonged when the nano-lubricant was used.
viii. The best results for the cooling cycle were achieved when Al_2O_3 and 0.5% TX-100 surfactant were used

in a 0.5% mass fraction. The job done by the compressor was reduced by 12.53% in comparison to pure POE oil. The COP value for the system was enhancemented by 18.27% for the same concentration.

ACKNOLWEDGMENTS

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NOMENCLATURE

$\dot{Q}_L$	*Useful removed heat from the system*
$\dot{W}_C$	*Compressor work*
$\dot{m}$	*Mass flow rate [g/s]*
T	*Temperature [K]*
Al	*Alumina*
O	*Oxide*

ABBREVIATIONS LIST

POE	*Polyolester*
AL_2O_3	*Alumina Oxide*
TX-100	*Triton X-100*
COP	*Coefficient of Performance*
XRD	*X-Ray Diffraction*

DECLARATION OF ETHICAL STANDARDS

The author(s) of this article declare that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.

AUTHORS' CONTRIBUTIONS

Mustafa AKKAYA : Performed the experiments and analyzed the results. Writing the manuscript.

Tayfun MENLİK: Analysed the results. Reviewing and editing the manuscript.

Adnan SÖZEN : Analysed the results. Reviewing the manuscript.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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