Application of response surface methodology in optimization of automotive air-conditioning performance operating with SiO_2 /PAG nanolubricant

A. A. M. Redhwan[ac]; W. H. Azmi[ab]; G. Najafi[d]; M. Z. Sharif[a]; N. N. M. Zawawi[a]

[a] Faculty of Mechanical Engineering Universiti Malaysia Pahang, Pekan, Malaysia

[b] Automotive Engineering Centre, Universiti Malaysia Pahang, Pekan, Malaysia

[c] Faculty of Manufacturing Engineering TechnologyTATI University College Kemaman Malaysia

[d] Tarbiat Modares UniversityTehranIran

ABSTRACT

The effect of compressor speed, initial refrigerant charge and volume concentrations of SiO_2/PAG nanolubricant on the performance of automotive air-conditioning (AAC) system are investigated in this study. Response surface method (RSM) was used in designing the experimental work and is based on face composite design. The developed quadratic models from RSM were helpful to envisage the response parameters namely heat absorbs, compressor works, and coefficient of performance (COP) to identify the significant relations between the input factors and the responses. The results depicted that adding SiO_2 nanoparticle into PAG lubricant will enhance the COP of AAC. Optimization of independent variables was performed using the desirability approach of the RSM with the goal of maximizing the heat absorb and COP, consequently, minimizing the compressor work. The results revealed that the optimal condition with a high desirability of 73.4% for the compressor speed of 900 rpm, refrigerant charge of 95 g and volume concentration of 0.07%. At this condition, the AAC system operated with 193.99, 23.28 kJ kg^{-1} and 8.27, respectively, for heat absorb, compressor work and COP. DoE based on RSM was capable of optimizing the significant parameters which affect AAC performance.

KEYWORDS:

Nanolubricant; Heat absorb; Compressor work; COP; Response surface method