

NOVEL LUBRICANT COMPRESSOR FOR AUTOMOTIVE AIR CONDITIONING SYSTEM



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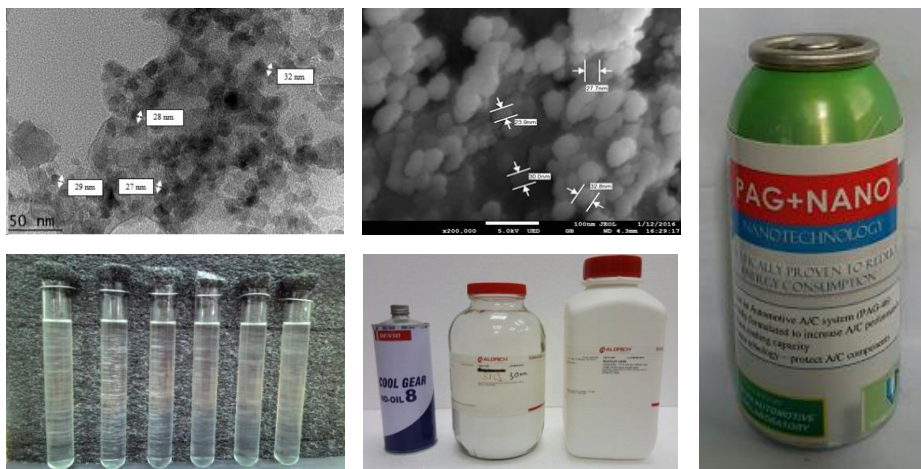
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Background



- Outside Temperature increase – Global warming, El-Nino, etc.
 - Cooling capacity reduce – Compressor work increase
 - Automotive Air Conditioning (AAC) – increase fuel Consumption up to 20% & Greenhouse gas NO_x (80%) & CO (70%)
 - Current AAC system is been optimized but still could not cope with today's weather condition
- ✓ **Nanotechnology provides the solution to improve performance and energy efficiency**

Product



Benefits

- Coefficient of Performance (COP) enhancement achieved up to 47.2% with average of 25.3%
- Energy saving increased up to 19.5% by implementing novel lubricant
- **Save fuel Up to USD 480 / year.**
- **Reduction up to 916.5 kg in CO₂ emission**
- **Just invest USD 0.07 for nanoparticle**

Analysis of **fuel consumption** for and **product cost**:

Fuel consumption & Co ₂ release/ Vehicle	
Average KM per Year *	40,000 km
Average Fuel (8.9 L/100 km) *	3,560 L
Fuel Consumption w/ AAC (+20%)	4,272 L
Fuel Cost per Year (USD 0.69/L)	2,456.40 USD
19.5% Reduction in Fuel	1,977.40 USD
Annual return per Year	479.00 USD
Co ₂ emissions per year *	4700 kg
Reduction of CO ₂	916.5 kg
Cost analysis for nanolubricant	
Cost for Al ₂ O ₃ nanoparticle /0.1 kg	177.00 USD
Weight of Al ₂ O ₃ use per sample	0.042 g
Cost for Al ₂ O ₃ use per sample	0.07 USD

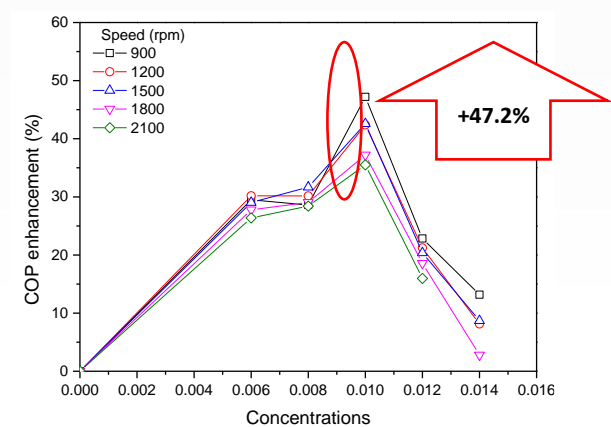
*Natural Resources Canada (NRCan)

Publications

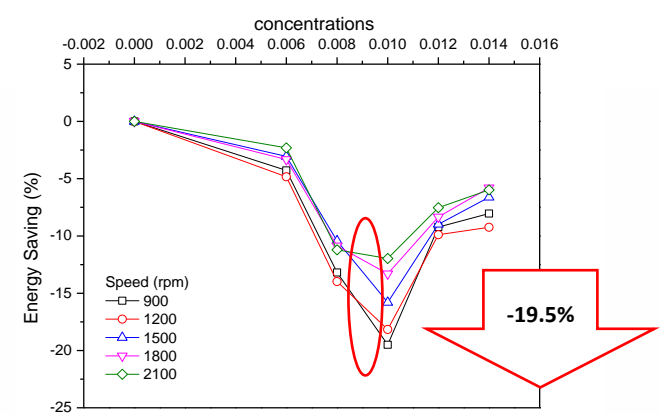
- [1] M.Z. Sharif, W.H. Azmi, **A.A.M. Redhwan**, R. Mamat. 2017. Performance analysis of SiO₂/PAG nanolubricant in automotive air conditioning system. *International Journal of Refrigeration*. 75: 204-216 **Q1 (IF = 2.241)**
- [2] M.Z. Sharif, W.H. Azmi, T.M. Yusof, Rizalman Mamat and **A.A.M Redhwan**. 2017. Potential of nanorefrigerant and nanolubricant on energy saving in refrigeration system - A review. *Renewable and Sustainable Energy Reviews*. 69:415-428 **Q1 (IF = 5.901)**
- [3] M.Z. Sharif, W.H. Azmi, **A.A.M. Redhwan**, R. Mamat. 2016. Investigation of Thermal Conductivity and Viscosity of Al₂O₃/PAG Nanolubricant for Application in Automotive Air Conditioning System. *International Journal of Refrigeration*. 70: 93-102 **Q1 (IF = 2.241)**
- [4] **A.A.M. Redhwan**, W.H. Azmi, M.Z. Sharif and R. Mamat. 2016. Development of nanorefrigerants for various types of refrigerant based: A comprehensive review on performance. *International Communication in Heat and Mass Transfer*. 76: 285-293 **Q1 (IF = 2.782)**
- [5] **A.A.M. Redhwan**, M.Z. Sharif, W.H. Azmi, R. Mamat and Z.A.A. Majid. 2017. Comparative study of thermo-physical properties of SiO₂ and Al₂O₃ nanoparticles dispersed in PAG lubricant. *Applied Thermal Engineering*. 116: 823-832 **Published Q1 (IF 3.043)**

Novelty

Enhanced the Coefficient of Performance (COP)



Increased Energy Saving



Marketability

- Collaboration with Air conditioning industries
- Target market in Automotive Air Conditioning

Industrial Partners



Achievements

- Croatia Inova Special award – Malaysia Technology Expo 2017 (MTE 2017)
- Gold Medal – Malaysia Technology Expo 2017 (MTE 2017)
- Best Invention in Fluid - Citrex 2016
- Top 5 –PIN 2016



Patent

Patent Pending
 PI 2011002027