

Influence of Polyvinylether Lubricants on the Performance of R513a, R1234yf and R134a Refrigerants in Automotive Air Conditioning Systems

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ABSTRACT –This study investigates the performance of automotive air conditioning systems equipped with electric compressors using three different refrigerants: R513a, R1234yf and R134a, focusing on the role of polyvinyl ether (PVE) lubricants. The primary objective is to assess how varying refrigerant charges and compressor speeds affect key performance metrics such as cooling capacity, mass flow rate, compressor work, and overall energy efficiency. A custom-designed test rig was used to evaluate these parameters, with R513a and R1234yf being analyzed as an eco-friendly alternative to R134a. The results indicate that R513a shows the best performance, achieving the highest Coefficient of Performance (COP) at around 220g of refrigerant charge, with efficiency remaining stable at higher charge levels. Following this, R1234yf demonstrates lowest performance with a peak COP beyond 240g, with fluctuations at lower charge levels. R134a, while effective, reaches its optimal performance at 220g but exhibits a slight decrease in efficiency beyond this point. Overall, precise refrigerant charging is crucial for maximizing system efficiency, with R513a offering the best energy efficiency, followed by R134a and R1234yf. The research highlights the potential of R513a and R1234yf, particularly when paired with the PVE lubricant, to serve as a viable alternative to R134a, contributing to improved energy efficiency and reduced environmental impact while still meeting performance standards.