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EFFECT OF AC COMPRESSOR MODIFICATION ON FUEL CONSUMPTION IN CAR

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Abstract. The cooling system is a refrigeration technology that is growing, especially regarding the cooling medium (refrigerant), new vehicles nowadays mostly use air conditioning to condition the air in the vehicle's cabin, but for now, there are still many aspects that have not been given much attention, especially the compressor. Compressor systems in vehicles still rely on the engine as a direct drive resulting in increasingly wasteful fuel consumption and reducing the performance of the vehicle. This study analyzes the results of modifying a conventional compressor into an electric compressor by utilizing a split AC compressor whose supply voltage is obtained from a DC to AC inverter on vehicle fuel consumption and the required electrical energy. Inverter modification is highly recommended in the application of car air conditioners, split AC compressors, and others. The results of this research show that AC compressors using split compressors affect fuel consumption.

Keywords: air conditioning, split ac, refrigeration, compressor,

1. INTRODUCTION

Comfort while driving, especially in a car is very necessary, so various ways are done to ensure a comfortable driving experience. An effective way at this time is to condition the air by installing an air conditioner [1]. An Air Conditioner (AC) is a tool used to regulate or condition air quality which includes air circulation, humidity adjustment, cleanliness regulation, and air purification. Air Conditioner has become a relatively important requirement for vehicle users, both for drivers of public transport cars and private cars [2]. The compressor which is the main component has an important role in circulating and compressing the refrigerant flow in the air conditioning system. Changes in engine speed will affect the work of the compressor, which affects the performance of the air conditioning system in vehicles [3]. Air conditioning in the room helps regulate air cooling in the room, this conditioning aims to provide comfort, to reduce fatigue [4]. The higher the temperature from outside and from the room, the higher the cooling capacity of the inverter AC and will cause the compressor motor rotation to change [5]. Refrigerants containing CFCs (Chloro Fluoro Carbon) and HCFCs (Hydro Chloro Fluoro Carbon) harm the environment which can reduce the ozone layer which can cause global warming. Based on the reason above, a regulation was made that prohibited the use of a compound containing CFCs and HCFCs. As an alternative, environmentally friendly refrigerant R-134a (without CFCs) is used [6]. Refrigerant coming out of the compressor will be in the form of high-pressure gas and high temperature. Refrigerant from the compressor will be pumped into the condenser

[7]. The condenser in the AC cooling system is cooled by an extra fan or additional fan so that the refrigerant that passes through the condenser changes from gas to liquid [8]. The refrigerant that passes through the expansion valve hole experiences a decrease in temperature and pressure. After the refrigerant passes through the expansion valve, it will enter the evaporator [9]. Air conditioning machine commonly called Air Conditioning (AC) Split is one of the air conditioning machines that work with a vapor compression cycle. The vapor compression cycle is one of the cycles used for mechanical refrigeration systems, where the refrigerant vapor will be compressed by the compressor as the main component in addition to other components such as the condenser, expansion valve, and evaporator [10]. Poor system performance can be caused by compressor performance that is not optimal, as one of the main components of the cooling system. As a result, the amount of refrigerant flowing through the system and through the evaporator and condenser also decreases [11].

From the description above, it can be seen that the use of an air conditioner is very necessary for thermal comfort in a vehicle environment. Since the fuel consumption coefficient is very influential on the vehicle, the addition of a load such as an air conditioner will burden the engine which will make fuel consumption even more wasteful. The efficiency of fuel consumption can be described by the specific fuel, which is a characteristic of fuel consumption in grams per power unit per hour of the engine [12]. Fuel consumption (mf) is directly proportional to engine speed (rpm) and Specific fuel consumption (Sfc) is inversely proportional to engine speed, meaning that fuel consumption is more efficient when the engine speed is higher, especially at low and medium rpm [13]. This research uses a split compressor which is rarely used in cars. Optimal fuel efficiency to maintain high-efficiency levels and low levels, is an important goal for power in the engine and fuel efficiency depending on the characteristics of the vehicle [14],[15]. Therefore, it is necessary to test and analyze the car AC compressor to the split AC compressor for fuel consumption.

2. METHODS

The method applied in this study uses experiments that aim to analyze the modification of a car AC compressor to a split AC compressor on fuel consumption. The framework of thought can be seen in the following figure:

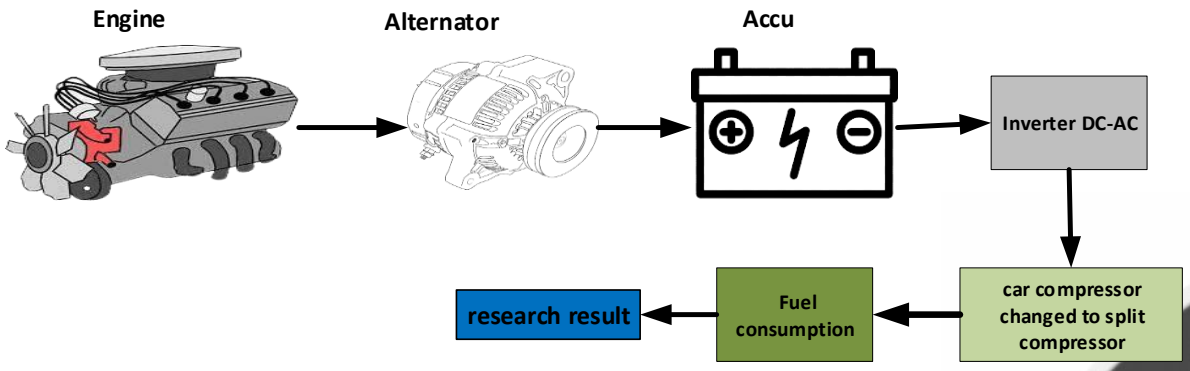

Figure 1. Research framework

The compressor is the main cooling system for cars that utilizes the drive on the engine. In this study, the compressor that should be driven by the engine will be driven by an electric compressor on the split. The difference between a car compressor and a split AC compressor is in the piston player inside to compress the freon, namely the engine is rotated on the car compressor, and the electric motor is driven on the split AC compressor. By changing the compressor which should be driven by the engine to be driven by an electric compressor on the split, it is expected that fuel consumption will be more efficient.

3. RESULTS AND DISCUSSION

The cooling system in this study has been modified by using a split compressor for fuel efficiency in vehicles. The refrigerant used for this study was R134a in 1 can of 390 grams. This test was carried out for 2 tests with different RPM variations. From these RPM variations, data will be generated regarding the effect of using a split AC compressor on fuel efficiency. Figures and tables can be seen as follows:

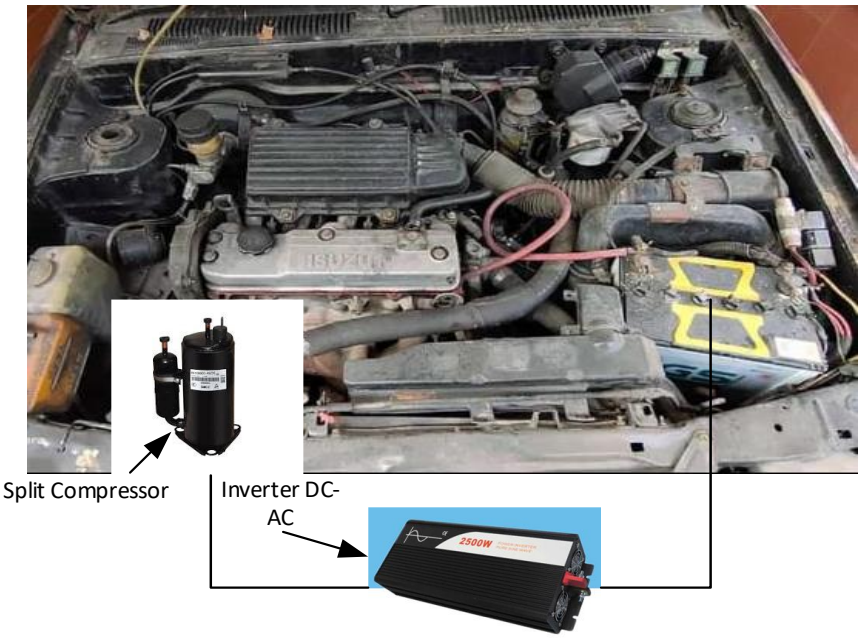

Figure 2. Modified split AC compressor

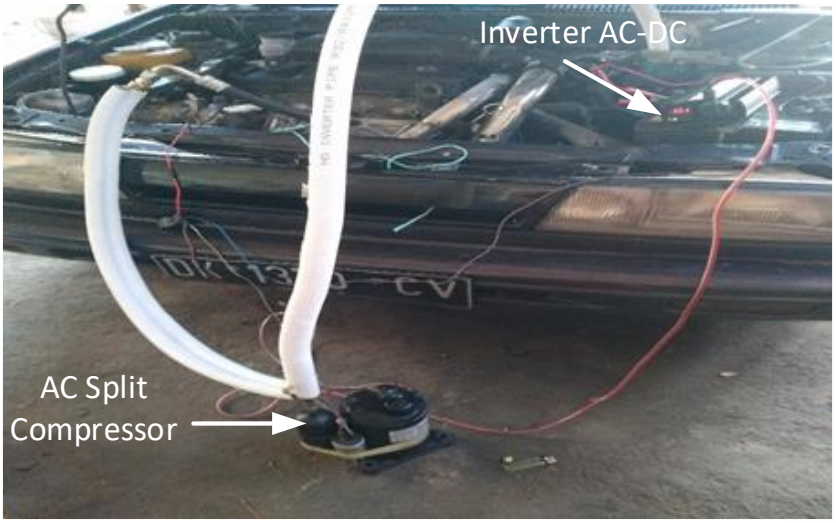

Figure 3. Split AC Testing in Vehicles

Figures 2 and 3 show the process of testing compressor modifications to car compressors and electric motors driven to split AC compressors. In the tests carried out, a table will be shown showing the fuel coefficient in the car by modifying the compressor using electricity on the split.

Table 1. Fuel Consumption (830 RPM)

Fuel Consumption (830 RPM)		
Minutes	Standard Compressor CC/Minutes	Split Compressor CC/Minutes
1	2,19	1,59
2	2,27	1,92
3	2,38	2,11
4	2,43	2,21
5	2,48	2,34
6	2,78	2,41
7	2,82	2,48
8	2,91	2,67
9	3,05	2,87
10	3,02	2,91
11	3,39	3,23
Average	2,70	2,43

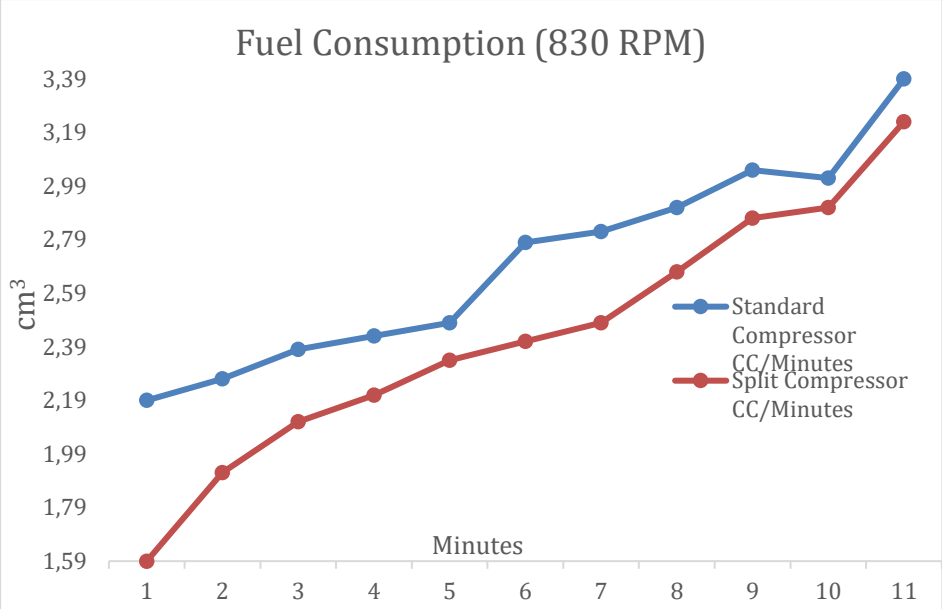

Figure 3. Fuel Consumption graph (830 RPM)

Table 2. Fuel Consumption (871 RPM)

Fuel Consumption (871 RPM)		
Minutes	Standard Compressor CC/Minutes	Split Compressor CC/Minutes
1	2,41	2,11
2	2,89	2,21
3	2,97	2,26
4	3,19	2,34
5	3,48	2,52
6	3,52	2,63
7	3,71	2,71

8	3,81	2,89
9	3,92	2,91
10	4,02	3,21
11	4,11	3,31
Average	3,46	2,65

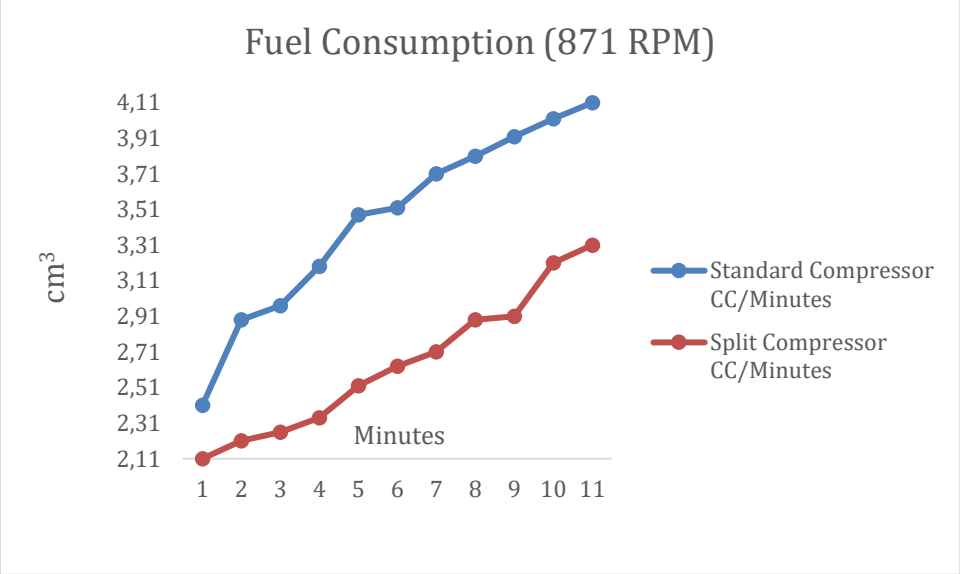

Figure 4. Fuel consumption graph (871 RPM)

Figures 3 and 4 show graphs of fuel consumption using a speed of 830 RPM, the results obtained using a split compressor fuel consumption is more efficient with an average value of 2.43 cc/minute while the average value using a standard compressor is 2.70 cc/minutes. The graph of fuel consumption in Figure 4 uses a speed of 871 RPM, the results obtained using an average split are 2.65 while with a standard compressor, the value obtains an average value of 3.46. The difference between these two data is that the standard AC compressor uses a larger rotation from the vehicle engine than the split-type compressor, the use of rotation on the standard vehicle compressor results in greater fuel consumption so the use of split AC in the vehicle is more efficient.

4. CONCLUSION

The results obtained from this study show that the AC compressor using a split compressor affects fuel consumption. This is attributed to the fact that the split AC compressor does not require engine power to move it. Based on the data obtained, the split compressor demonstrates an average fuel consumption that is lower than the AC compressor.

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