ABSTRACT

In the present work an exergical thermodynamic model is used to analyze and optimize an air conditioning packaged unit working with vapor compression refrigeration cycle.

The model deals with each component of the system, i.e. reciprocating compressor, air cooled condenser, short tube expansion device, evaporator, and suction, discharge, and liquid lines. The modeling depends on a recent development in the entropy generation minimization (EGM) utilized by famous institutes like energy optimizer such as ASHRAE, NIST, AHRI, Carrier and TRANE companies.

The experimental work was carried out using 3 T.R. packaged unit working with R-22, recently manufacturered by Carrier Company. The apparatus covers many research requirements such as type of condenser, evaporator, configuration and number of circuits and the work cover additional component such as scroll compressor and thermal expansion valve with an external equalizer.

The apparatus was installed and connected with a test room by a supply and return ducts. The modifications that are required to make the packaged unit as laboratory apparatus were prepared including measuring devices for pressure, temperature, and power consumption. Most of the tests were carried out on June-July /2011 in machines and Equipment department –B building.

The results show that the compressor is the first component in exergy dissipative due to friction losses in bearings, suction and discharge valves and the transformation of power. The exergy efficiency for the compressor was varying between (60-68) %. The scroll compressor was found to be better than the reciprocating compressor at an environment temperature of 35 ℃ due to its low total losses which is 10% less than the reciprocating

compressor. The heat losses percentages were 3% for scroll and 2% for the reciprocating. The condenser exergy losses were found to be the second after the compressor with an exergy efficiency of (71-83) %. The results were seen to be near the optimum for refrigerant side and far away for air sides which highlight that more research can be done in this area to improve exergy level. The expansion devices were found to be the third after the condenser with an exergy efficiency varying between (89-93)%. The fourth rank was for the evaporator with an exergy efficiency of (92-96) %.

The thermodynamic model has shown to be reliable in dealing with a change in the environmental temperatures and such system components and size.