

Performance, environment, and cost-benefit analysis of a split air conditioning unit using HC-290 and HCFC-22

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Abstract

A widely used hydrochlorofluorocarbon (HCFC) refrigerant HCFC-22 in the split air conditioner (AC) is being phased out in all countries under the Montreal Protocol. Propane (HC-290) is a favorable substitute for HCFC-22. The performance, environment impact and cost-benefit analysis of a split AC unit operated with HCFC-22 and HC-290 has been carried out experimentally under different test conditions prescribed by IS 1391. The results showed that the variation in system performance was more significant for HCFC-22 than for that of HC-290 while varying the refrigerant charge. The experienced optimum charges that represent the maximum coefficient of performance (COP) was varied with the working environment and it was realized that, generally the optimum charge for HC-290 was 50% lesser than that of HCFC-22. The COP of the AC unit with HC-290 was observed to be 5% more than that of HCFC-22. However, the system capacity diminished by 7.8%. The operation of a split AC unit with HC-290 produced up to 15.9% lesser CO₂ emission than that of HCFC-22 under all the test conditions. The use of HC-290 in an existing HCFC-22 split AC system can save up to 12.22% of the life time total cost. Finally, it was inferred that the replacement of HCFC-22 with HC-290 in the split AC unit showed dominance in all aspects such as performance, emission, and life time total cost.

KEYWORDS

COP, global warming potential, HC-290, HCFC-22, total equivalent warming impact

1 | INTRODUCTION

Hydrochlorofluorocarbon (HCFC) refrigerant HCFC-22 has been widely used as a refrigerant in heat pump and air conditioning (AC) applications. The use of HCFCs is restricted due to environmental protocols.¹⁻² The Montreal protocol agendas have been

progressive to phase out the manufacturing and practicing of HCFCs by 2020 and 2030 by the developed and developing countries (India), respectively.³⁻⁴ In India, about 6.7 million AC units were sold in 2018 and it is expected to reach 124 million by 2030. Approximately 145 GW of electricity is needed for its operation. Also, most of the split ACs in India use HCFC-22 (about 70%), and this results in more