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Development and Preparation of Energy Strategy for 3 Door Refrigerator

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ABSTRACT

Among all home appliances, refrigerators consume the most energy in the world accounting for around 30% of the total energy consumption. The annual production of refrigerators in 2015 was about 150 million units with a rapid growth trend, and around 1.5 billion units are in use worldwide (CLASP website). The energy consumed by refrigerators is rapidly growing, especially in developing APEC economies, which has a great impact on APEC energy intensity reduction goals if no active assistance with efficient promotion of refrigerators is provided. Currently 3 door refrigerator are not coverd under india energy efficiency norms. To make these refrigerator redy fir energy efficiency need to have 30% improvement in system COP.Key energy improvement components are evaporator , compressor and fan motor.Other energy efficiency components are insulation thickness, vacuum insulation panel, these components need higher investment. To accomplish energy demands 3 door needs major efficiency improvement.Devlope and prepare energy strategy for 3 door models of refrigerator. As currently there is no regulationsavailable for 3 door refrigerator category, as india government alredy pushing to bring this product category inside energy norms. Once we develope this strategy for energy this is going to be leverage by refrigerator manufactures.

Keywords: APEC,CLASP,Energy efficiency,COP

INTRODUCTION

Many APEC economies including the USA; Japan; China; Korea; Australia; New Zealand; and Chinese Taipei have succeeded in boosting the overall energy efficiency (EE) of refrigerators through technology developments and EE management systems, as well as appropriate subsidies[1]. However, some developing economies such as the ASEAN economies and Central and South America regions are still pending trials. They not only need to build integral EE management systems, but also need to strengthen their refrigerator industry technical capacities to achieve overall market efficiency improvements. The APEC region is expected to accelerate the refrigerator efficiency promotion through sharing successful experience regarding the enhancements of refrigerator efficiency technology and EE management systems to developing economies[2].

This project aims to build the capacity to implement high efficient refrigerator / freezer technologies and policies in developing APEC economies, meeting APEC energy intensity reduction goals, and the directives of the 2014 Ministerial Meeting to "enhance cooperation among member economies, get a deeper understanding of their R&D needs, build information platforms, develop Asia-Pacific intellectual networks, share R&D results, and strengthen practical project cooperation [3]".

According to data, the refrigerator / freezer accounts for 9 to 25% of the U.Shousehold energy consumption. The refrigerator is amongst the most widely used appliances in the world and it is safe to assume every household in the developed countries has at least one average size refrigerator if not 2 or more, as well as most houses in the developing countries with at least one refrigerator [4]. This is over and above commercial refrigerators used around the globe, in supermarkets, food outlets, restaurants, cafes, hospitals, hotels, laboratories, trucks, ships, planes, even morgues and many other places. Therefore, any improvement in eco sustainability of a refrigerator, however marginal will result in a significant impact on the environment through sheer volume and presence around the globe [5].

This project aims to improve the eco sustainability of the domestic refrigerator by focusing on reducing the energy usage of the appliance. The energy used to power refrigerators is mainly supplied through burning of fossil fuels with an ever increasing production cost [6]. Therefore, any reduction in energy consumption will result in reduced CO_2 emissions as well as reduced power bills for the end user of the refrigerator.

VAPOUR COMPRESSION SYSTEM

A vapor compression refrigeration system is an improved type of air refrigerationsystem in which a suitable working substance, termed as refrigerant is used. It condensed and evaporates at temperatures and pressures close to the atmospheric conditions [7]. Therefrigerants usually used for this purpose are ammonia, carbon dioxide and Sulphurdioxide. Compression refrigeration cycles take advantage of the fact that highly compressed fluids at a certain temperature tend to get colder when they are allowed to expand. If the pressure change is high enough, then the compressed gas will be hotter than our source of cooling (outside air, for instance) and the expanded gas will be cooler than our desired cold temperature. In this case, fluid is used to cool a low temperature environment and reject the heat to a high temperature environment. Vapor compression refrigeration cycles have two advantages. First, a large amount of thermal energy is required to change a liquid to a vapor, and therefore a lot of heat can be removed from the air-conditioned space. Second, the isothermal nature of the vaporization allows extraction of heat without raising the temperature of the working fluid to the temperature of whatever is being cooled. This means that the heat transfer rate remains high, because the closer the working fluid temperature approaches that of the surroundings, the lower the rate of heat transfer.

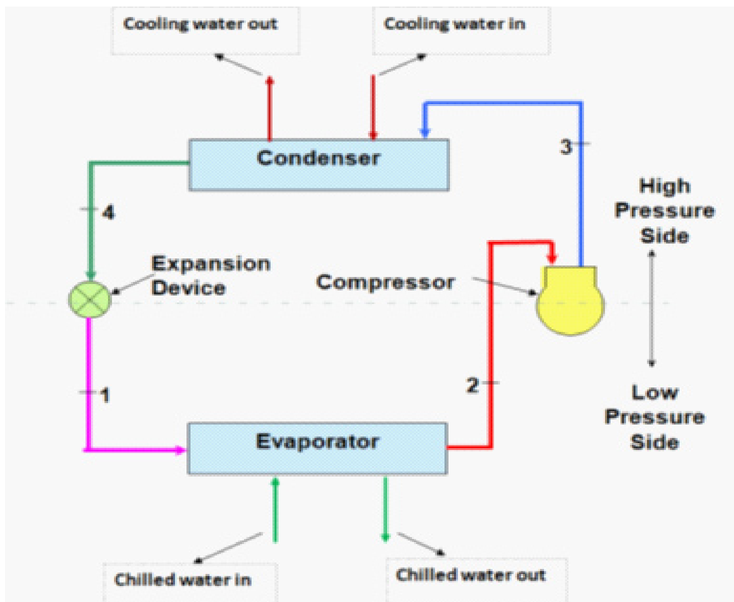

Figure1. Vapor Compression System.

Dry saturated vapor coming from evaporator is compressed in compressor so pressure is increases superheated vapor is passed through condenser where vapor is condensed by flowing the cooling water in condenser. Dry saturated liquid is passed through expansion valve where expansion takes place so pressure is decrease by expansion after expansion liquid is passed in evaporator where it absorb the heat of storage space and evaporate so cooling process in storage space is achieved, thus cycle is complete. Vapor compression refrigeration system is used in domestic refrigeration, food processing and cold storage, industrial refrigeration system, transport refrigeration and electronic cooling. So improvement of performance of system is too important for higher refrigerating effect or reduced power consumption for same refrigerating effect. Many efforts have to be done to improve the performance of VC refrigeration system

STAR RATING CALCULATIONS

Most major appliances have an energy efficiency star rating sticker on them. Thisis a good way of comparing energy efficiency between brands. Basically, more stars meansgreater efficiency and this could be a factor in determining the overall value of yourpurchase. What may seem like a bargain could look less attractive once you compare therunning costs with more expensive models. Choosing an appliance in the size that suits our needs. That way we can save on unnecessary energy costs. The star labels also give you anenergy consumption figure, shown as kilowatt hours (kWh) per year. One kilowatt hour(kWh) equals 1000 watts over an hour. For example, a 1000-watt appliance used for onehour will use one kWh. But a 100-watt light globe, will take 10 hours to use one KWh."[21]We can calculate the hourly running costs of any electrical item. Simply multiply the KWoutput of the appliance, with the hours of use, with the rate per KW.Running cost = KW x hrs x rate

Star Rating for Domestic Refrigerator

Refrigerators are one of the highest consumers of electricity in houses. However, they have become significantly efficient in the past few years, and are is improving. A typical refrigerator has a lifespan of 15-20 years. The cost of running it over that time period is several times the initial purchase price. So buy the most efficient model available; investing a little more in a refrigerator with higher efficiency offers solid payback. Smaller models will obviously use less energy than larger models. Generally, larger the refrigerator, the greater the energy consumption. But one large refrigerator will use less energy than two smaller ones with the same total volume. Models with top- or bottom-mounted freezers average 12% less energy use than side-by-side designs. Features like through-the-door ice, chilled water, or automatic ice-makers increase the energy consumption, purchase price and also greatly increase energy use and are far more likely to need service and repair. Avoid these costly, troublesome options. Be willing to pay a bit more initially for rower operating costs. A five-star refrigerator that costs more initially, but costs less per year to operate due to better construction and insulation, will pay for itself in less than four years compared to a two-star refrigerator. Recycle rider or second refrigerators could costsignificantly more per year in electricity so it should not keep the rid, inefficient refrigerator running in the occasional refreshments.

According to TERI (The Energy and Resources Institute) Guidelines for BEE labelled equipment/ applications. The star rating parameters Knf (Constant Multiplier (KWh /Liter/Year)) &Cnf (Constant Fixed Allowance (kWh/Year)) shall be obtained from Error! Reference source notfound.depending on the year of manufacturing/import/assembling. The following

Equation shall be used to determine the Star

Rating Bands for a particular model:

Star Rating Band (SRB) nf = Knf * Vadj_tot_nf + Cnf

Where,

Knf = Constant Multiplier (KWh/Liter/Year)

Vadj_tot_nf = Total Adjusted Storage Volume for No Frost (Liter)

Cnf = Constant Fixed Allowance (KWh/Year).

CONCLUSION

The ethnographic research material presented above the following conclusions are made and targets set. It was established that refrigerators are globally significant energy consumers mainly due to high quantity of refrigerators and the long running time of each domestic refrigerator. Looking at LCA data it was shown that the usage cycle of a refrigerator uses more energy in one year than the entire life cycle of the appliance. Hence, looking at improving efficiency of the domestic refrigerator in it usage phase is a viable eco sustainability improvement project. Linking the power consumption and other refrigerator end-of-life concerns back to CO_2 emissions provides a common scale for assessing the environmental impact of different options in the project as well as the environmental evaluation of the final product.

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