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Sub & Assignment

Question : What are the potential energy saving measure that can be implemented in Bangladesh for household refrigerators? Discuss the environmental impact of your suggested design in extend.

Solution : Refrigerator may be defined as the device which fulfill the purpose of refrigerator, consume less power more efficiently and not harmful and eco-system. One of the most important applications of refrigeration is the preservation of perishable food and agricultural products through storing them at low temperatures. The demand and supply of refrigeration systems are growing rapidly. The refrigerants used in refrigeration systems nearly a century ago such as air, carbon dioxide, ammonia were more or less eco-friendly. But the quest of scientists and engineers for refrigerants

with better thermo-physical and chemical properties led to the development of chlorofluorocarbons (CFCs) and hydro chlorofluorocarbons (HCFCs). Both of them are harmful and directly adding to global warming. When both CFCs and HCFCs release in the environment, it affect the ozone layer. It releases two oxygen molecules out of three molecules from ozone atom. At present more than fifty refrigerator brands are available in Bangladesh. Most of them are Chinese brands and very much cheaper than others. In these refrigerators very poor and low quality refrigerants are used. These are neither renewable nor retrofit able and harmful, not environment friendly and cause many diseases.

It is high time to find out the refrigerant which is consumer, manufacturer, cost, noise friendly and not harmful to the environment at all. It is necessary to find out the refrigerant which has advantages in environmental compatibility,

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performance of the equipment, health and safety issues, materials compatibility (corrosion, swelling etc), maintenance / servicing, extent cost, future costs, availability of suitably, trained technicians, throughput of process, including cycle time, availability (number of suppliers of equipment and refrigerant), ease of installation (availability of power, water, compressed air, nitrogen, steam etc). So it is essential to find out alternative refrigerants. The refrigerants that are currently available need to consider their efficiency, direct and indirect environmental impact, and safety. There is no perfect refrigerant comparing the ODP, GWP and energy efficiency of today's commercial refrigerants and potential future refrigerants. The potential energy saving measure that can be implemented in Bangladesh for household refrigerators can be :

Application of energy efficient compressors, air handling units (AHUs), condensers and evaporators of high effectiveness are the some of the measures towards energy conservation in refrigeration systems. Cooling of compressor shell with the defrost drips is an energy saving measure can be implemented in Bangladesh for household refrigerators because -

- Defrost drips from the refrigerator is applied on the compressor's shell to cool the compressor.
- Enhanced heat removal from compressor's internal mechanism.
- Reduced friction leads to winding temperature and hence reduced current consumption.
- Energy saving up to 10.2% and hence reduced energy cost.

In this research, an experimental case study was carried out to explore the effects of drip

cooling on energy consumption in a indirect cool refrigerator.

The conclusions drawn from the study are appended below for given operating conditions.

Upon employing drip cooling system for the given conditions the heat removal rate from the compressor shell is increased and due to which the average shell temperature of the compressor falls by 4.2°C , a 6.5% reduction in shell temperature.

The reduced shell temperature results in enhanced heat transfer from the lubricating oil and hence the reduced winding temperature which results in reduction of current consumption from 1.075A to 0.85A , reduction of 21%. Reduced power consumption results in improvement of COP by 10.3% for the given operating conditions.

Also found from the research case study that the energy saving due to drip cooling system is up to 9.7% for the given refrigerator

at stated conditions.

Environmental Impact :

Defrost drips from the refrigerator is applied on the compressor's shell to cool the compressor. Enhanced heat removal from compressor's internal mechanism. Reduced friction leads to winding temperature and hence reduced current consumption. Energy saving up to 10-2% and hence reduced energy cost.

The refrigerants used in refrigeration systems nearly a century ago such as air, carbon dioxide, ammonia were more or less eco-friendly. But the quest of scientists and engineers for refrigerants with better thermophysical and chemical properties led to the development of Chlorofluorocarbons (CFCs) and hydro Chlorofluorocarbons (HCFCs). Both of them are harmful and directly adding to global warming. When both CFCs and HCFCs release in the environment, it affect the ozone layer. It release two oxygen molecules out

of three molecules from ozone atom. When we used the Defrost drips from the refrigerator is applied on the compressor's shell to cool the compressor then the production of such chemical one reduced.

Disadvantage :-

→ Through the drip function, you can automatically defrost only the refrigerator, which means for defrosting freezer compartment need to pull the cord. This is not very convenient, since it is almost half a day to exclude the use of the unit, storing food outside the cold. The output can be a device with two compressors - one is turned off, the second works, serving the refrigerator. It is also useful to get acquainted with the option. Frost free - when the frost system is installed in the freezer and the drip system in the refrigerator.

→ In the process of thawing increases the humidity in the apartment. This is especially annoying in apartments with poor heating - dampness occurs, leading to a fungus. In summer, in the hot kitchen, excess evaporation does not add comfort either. Exit - installation of air conditioning, which will dry the air and accelerate the process of volatilization of moisture.

→ Drip system eliminates the operation of the freezer during defrosting. With the function no frost, this problem does not arise.

→ To carry out you have to spend almost half a day. Periodic pouring of condensate on the walls does not exempt you from washing the unit. Thawing + washing + airing + drying will take a long time to complete. Therefore, the owners of such devices specifically plan this event, choosing the day in advance.

→ After a thorough cleaning, when the refrigerator is off for several hours, a failure in the settings may occur. So you need to carefully monitor the temperature - sometimes it rises by 3-5 degrees.

Reference :

- <https://www.sciencedirect.com/science/article/pii/S2214157X173008813>.
- <https://www.researchgate.net/publication/2938274772> Eco-Friendly Status of Domestic Refrigerators Available in Bangladesh.

Question : What are the economically feasible measures that can be implemented in Bangladesh for internal combustion engines to reduce the emission as well as ecological impact?

Solution : The internal combustion engines are those engines in which the combustion of the fuel takes place inside the engine cylinder. The distinctive feature of the I.C engine is that combustion and conversion of heat energy into mechanical work occurs inside a cylinder. These engines are noted for their high overall efficiency and low operating cost, lightweight and compactness and constant readiness for starting. Exhaust emission from internal combustible mixture and the composition of the product.

Emission from vehicles especially automobiles contribute significantly two-third of air pollution in the urban area.

a) Major pollutants emitted from gasoline fueled vehicles :

- i. CO : Carbon monoxide is colorless and odourless gas, slightly denser than air that is very harmful for environment.
- ii. HC : Hydrocarbon Compounds consisting of carbon and hydrogen and include a variety of other volatile organic compounds (VOCs)
- iii. NO : Nitrogen oxides (NO) include nitric oxide (NO_2) , nitrous oxide (N_2O) , nitrogen dioxide (NO_2) , dinitrogen trioxide (N_3O) and nitrogen pentoxide (N_2O_5).
- iv. Pb : Lead is also emitted from the vehicles which is very harmful for human health.

b) Pollutants from diesel-fueled vehicles

- i. Nitrogen oxides , include nitric oxide , nitrogen dioxide , dinitrogen trioxide and nitrogen pentoxide .

The problem of traffic congestion and uncontrolled vehicle emissions make life miserable and causing threat to health and economic loss as well. Public transport service and air quality situation of Dhaka City is continuously deteriorating every year and imposing huge cost on the society. Though there is little information on human health, there is clear evidence that the air quality in Dhaka is harmful for the city dwellers and it is causing not only discomfort but also several diseases including allergy and asthma.

Such a problem needs immediate attention from the policy makers. As vehicle emissions is a major contributor to air pollution, it is possible to improve air quality by reducing the vehicle stock through improving the public transport system service. Government should strengthen vehicle emission standards.

(VES), regulations, enforcement and measures to reduce fuel demand and improve traffic conditions. Improved public transport facilities of the city could solve the transport and congestion problems, as well as improve the air quality.

Use EPA's Green Vehicle Guide to learn about vehicles that are more efficient and less polluting, including :

- Electric vehicles;
- Plug-in hybrid electric vehicles;
- Hydrogen fuel cell vehicles; and
- Cleaner burning gasoline vehicles.

Automobiles have contributed to the destruction of our environment in the form of carbon dioxide since their creation. Emitting carbon dioxide into the environment increases the global-mean surface warming, and about 20 percent of all

CO_2 emissions originate from road traffic. However, internal combustion engine and electric vehicle technology is constantly advancing, with changes to fuel economy and emissions year by year.

From just 2005 to 2017, the average fuel economy of all vehicles in the United States has increased by 5 mpg³. This increase in fuel economy is especially helped by the addition of many electric vehicle models.

Electric vehicles (EV) and plug in hybrid vehicles (PHEV) have tripled in quantity from 2012 to 2017. Fully electric vehicles produce no tailpipe emissions; however, it must be noted that electric vehicles still contribute to the destruction of the environment through the carbon footprint generated by their production and disposal.

Internal combustion engines make up most of the vehicles on the road today because of their old, reliable technology. The technology has had countless hours of research to lower production costs and efficiency. It is important to note that among internal combustion engines, diesel fuel combustion engines produce less emissions than gasoline, and both are accounted for in all the studies used in this comparison. Biofuel combustion engines are also considered, but they make up very little of the automotive population, so they have a small effect on the data.

Electric battery vehicles are a relatively new form of transportation. On the market as of 2017, there were only under twenty new electric vehicle models being produced. This number can be compared to five years earlier, when there was only one third the

amount of electric vehicles being produced.

Overall, both electric battery vehicles and internal combustion engine vehicles contribute to harming the environment. However, they contribute in different ways. Overall, electric battery vehicles contribute less to harming the environment than internal combustion vehicles. The future of all vehicles is to create more energy sustainable technology that is less harmful to the earth, and the best way to encourage this is to increase the number of electric vehicles on the road. Research must be done to improve that cost efficiency and lessen the environmental burden of the production of lithium ion batteries.

Question : What are the potential energy saving measures that can be implemented in Bangladesh for household air conditioners? Discuss the environmental impact of your suggested design in extend.

Solution :

Energy saving measure that can be implemented in Bangladesh for the Air conditioners

Electricity demand for room air conditioners (ACs) has been growing significantly in Bangladesh in response to rapid economic development and mounting impacts of Climate change. We use the bottom-up model approach to predict the penetration rate of room ACs in the residential building sector of Bangladesh at the provincial level, with the consideration of the urban-rural heterogeneity. In addition, we assess co-benefits

associated with enhanced energy efficiency improvement of AC systems and the adoption of low-global-warming-potential (low-GWP) refrigerants in AC systems. The annual electricity saving from switching to more efficient ACs using low-GWP refrigerants is estimated at almost 1000 TWh in 2050 when taking account of the full technical energy efficiency potential. This is equivalent to approximately 4% of the expected total energy consumption in the Bangladesh building sector in 2050 or the avoidance of 284 new coal-fired power plants of 500 MW each. The cumulative CO₂-eq mitigation associated with both the electricity saving and the substitution of high-GWP refrigerants makes up 2.6% of total business-as-usual CO₂-eq.

emissions in Bangladesh over the period 2020 to 2050. The transition toward the uptake of low-GWP refrigerants is as vital as the energy efficiency improvement of new room ACs, which can help and accelerate the ultimate goal of building a low-carbon society in Bangladesh.

Efficiency and prospects of solar powered air conditioning systems in Bangladesh alongside portrays a comparative analysis of this system with the conventional AC units presently at use. We know that the air conditioning system nowadays is turning out to be a much popular approach to attain low temperature and less humid air. But as desirable as it may seem, it is very

costly and also consumes a lot from the power grid that has far reaching effects on the environment as well as the overall energy consumption. Solar powered air conditioning systems provide cool and low humid air by harnessing the renewable energy and the dehydrating power of desiccants causing the whole system to be environment friendly as well as cost efficient. The comparative analysis will show the advantages and drawbacks of both systems and thus contrast the preferable choice according to the economic. If we consider the solar thermal technologies then the measure of the relative humidity, average solar insolation, and the average temperature throughout the year are some eminent criteria. According to the Bangladesh

Meteorological Department two cities with highest monthly normal humidity in Bangladesh. It is seen that from the months May to September the relative humidity ranged from 75-86% in Rajshahi and 76-83% in Dhaka reaching the yearly maximum and directing the seasons mid of summer and rainy season. On the contrary, from the months November to February the relative humidity ranged from about 78-71% in Rajshahi and 73-64% in Dhaka being moderately less than the previous magnitude and directing the winter season. The highest monthly normal humidity of Rajshahi was 88% and that of Dhaka was 83% approximately. According to the above study we can come to some decisions.

Such as, the temperature of Bangladesh is more than the human comfort level and so

is the relative humidity, and the data analysis shows that Rajshahi and Dhaka has the most temperature among the other cities. Moreover the solar radiation is also significant in these areas and thus it can be efficiently utilized in solar powered air conditioning systems. We also identified several efficient solar plate collectors and a cost analysis of multiple disicccants facilitated the selection of the efficient, one among them based on Bangladesh's perspective. Although we observed numerous advantages of using solar air conditioning systems but this system has some drawbacks as well. The solar air conditioning system mainly works based on the amount of solar heat collected by the solar collectors. In moderate temperature its efficiency will be

low and thus in seasons except summer we would not be able to use it efficiently. Another point that can be taken into consideration is that the rate of renewables are generally discontinuous and this could cause variance in the performance in the air conditioning system. If the limitations can be taken care of by research based study for increasing the efficiency of the collectors, then the potential of solar air conditioning system is enormous.

Environmental Impact of my suggested plan :

We analyzed and came to the conclusion that the climate of Bangladesh is prone to reasonably high temperatures

that can be solved by air conditioning systems for increased human comfort and productivity. Then a comparative analysis was operated by taking in mind the parameters namely - cost analysis of conventional and solar air conditioners having different types of collectors, efficiency of conventional air conditioners and annual COP of solar air conditioners having different types of desiccants.

After our comparative study we can come to a conclusion that though the objective of both types of air conditioning systems are the same, but they do differ in certain criterion such as power saving capacity, environment friendliness. Our study

further directs us to the fact that the cost difference of the two types of systems is not that much, the solar system's cost being a bit low than conventional systems. Adopting solar air conditioning systems would be cost friendly, energy saving and environment friendly. We should exploit our opportunities and natural blessings in the field of solar power and imply it on solar powered systems to attain a green and sustainable future. Moreover being dependent on the renewable resources would effect on less CO_2 emission. So, implying renewable energies especially solar energy in air

Conditioning systems could be a beginning for Bangladesh in a path of sustainability.

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