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Air Conditioning System Powered by Solar Energy

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ABSTRACT
Solar-powered air conditioning systems are often extremely cost-effective when used in residential and commercial buildings. Today, energy is the greatest issue confronting humanity. Energy consumption is increasing due to the growing global population and the developing nations' economies. Solar energy is therefore the main alternative energy source that can meet the energy demand. For warm and humid regions, sustained comfort within the air conditioner is extremely important. Due to the intensive usage of the air conditioning system, the energy demand in mid-summer increases. In order to overcome this shortfall in CO2 emissions which contributes to global warming, the country faced an enormous problem in the electricity scarcity, while the vapor compression air conditioning system disturbs the stratospheric layer of ozone because of the use of chlorofluorocarbons (CFCs) in coolants. Solar energy air cooling may be utilized with absorption chillier with solution of lithium bromide and water. The solar-powered air conditioning system helps to reduce the usage of fossil fuel. Liquid Dry Air Conditioning (LDAC) is one of the most efficient and environmentally friendly air conditioning technologies. LDAC may be powered by minimal energy, such as solar electricity. The usage of Si solar cells with structured glass packing covers improved conversion efficiency by 6% at normal angle of incidence.

Keywords
Air Conditioning System, CFC, Fossil Fuels, Photovoltaic, Solar Energy**.**

1. INTRODUCTION
Energy from the sun is progressively being compensated for as a sort of ecologically friendly power. Solar energy systems are classified into two types: thermal systems, which convert solar energy into heat energy, and photovoltaic systems, which convert solar energy into electricity. Thermal systems are more common than photovoltaic systems. Massive numbers of solar radiation arriving on photovoltaic panels, but at the other side, is not transformed into electrical energy but is either deflected or converted into thermal energy. The outcome of utilizing this strategy is a reduction in the grade of electricity generated as a
consequence of rising in the temperature range of solar cells. Throughout the last decade, a considerable deal of energy has been invested by the scholarly community to enhance the fuel efficiency of dwellings in two primary directions: limiting the external supply of energy and employing renewable sources of energy. Sunlight-based energy sources are gaining popularity in each of these areas because they increase energy independence and efficiency while having practically no negative impact on the environment[1].
On a regular basis, the earth's surface produces a solar dose that is similar to 5 lakh billion barrels of oil, and that is thousand times greater than any known reserve of oil. Solar energy is reliant on the area of the collectors, is a selective form
of energy, which is only available for a part of a day, and is therefore costly. Many studies are being conducted out in places where solar energy is readily available, such as India and the
United States of America. Solar energy is plentiful during the summer months, when there is no demand for heating but a need
for cooling is there. Renewable power is considered to be the most important source of energy in the case of intermittent and non-depleting natural resources. From 2002 to 2030, the reference scenario is projected to increase global primary energy consumption by almost 61 percent, with an estimated annual growth rate of 1.6 percent each year between 2002 and 2030. A total of 17 billion tonnes of oil equivalent will be added to production, especially in comparison to Eleven billion tonnes during 2002. The expected speed of growth has stayed steady, but it is presently greater than there has been in over preceding three decades, expanding by 3 percent per year on average [2].
Fossil fuels, on the other hand, would have a tendency to dominate global energy use. Over the period 2002-2030, this paper is responsible for about 84 percent of the increase in worldwide primary demand. As a result, from 82 percent in 2002 to 85 percent in 2030, the proportion of total demand will only slightly increase from 2002 to 2030. Renewable energy sources will maintain their current proportion of the energy mix, which is about 16 percent, while nuclear power will drop from 6 percent to 4 percent.
As a result, the negative effect on the environment caused by the combustion of fossil fuels in limited supply would prompt many nations to investigate ecologically friendly alternatives to meet increasing energy demand. In this instance, the quality of life is improving as a result of the use of indigenous energy capital. The depletion of fossil fuels has sparked a worldwide interest in solar energy as a means of generating electricity. In regardless of the reality that solar energy is among the cleanest energy sources, this only serves and meets a tiny fraction of the global energy market. Nevertheless, owing to the reality that energy from the sun is believed to become one of the costliest alternative sources of energy, photovoltaic power contributes for less than 2 percent of the nation's population electricity supply.
Approximately 40% of Europe's energy budget is used by business and residential buildings, according to the International Energy Agency. Higher living and working standards, adverse outdoor conditions in urban environments, and lower prices for air-conditioning units have all contributed to a significant increase in the demand for air conditioning in buildings, even in areas where there was previously little demand for such equipment. In the past 20 years, the number of air conditioning systems with cooling

capacities more than 12 kW that have been installed in Europe has risen by a factor of five. Since 1980, the total amount of air-conditioned floor area has increased from 30 million m2 to more than 150 million m2 in 2000. Using room air conditioners used 6 TJ of energy per year in 1990, 40 TJ per year in 1996, and is expected to reach 160 TJ per year in 2010[3].

Demand for air conditioning has increased dramatically in recent years, resulting in a substantial rise in the demand for primary energy. Electric utilities have their highest demand during the summer months, and they are often forced to deal with brownouts as a result of being unable to keep up with the demand. The resultant CO2 emissions in the EU are projected to rise by a factor of 20 between 1990 and 2010, according to the European Commission. Solar cooling, when used in conjunction with appropriate technologies, may assist to ease the issue. It is particularly advantageous to utilize solar thermal technologies that can compete with heat-driven cooling systems during the summer months, since peak cooling demand in the summer is linked with high sun radiation. A special focus is on metropolitan regions, where poor outside circumstances, caused by increased outdoor pollution and the urban heat island effect, promote the usage of mechanical air-conditioning, which has a direct influence on peak electrical energy consumption.

Summer air conditioning represents a developing sector in the world of buildings services, with applications in both commercial and residential structures. The main reasons for the rising energy demand for summer air conditioning are increased thermal loads, rising living standards, and increased occupant comfort demands, as well as architectural characteristics and trends in buildings, such as an increasing ratio of transparent to opaque surfaces in the building envelope, and even the increasingly popular glass building. This rise in demand has a number of negative effects, including:

- Because the majority of air conditioning systems are powered by electricity, a rise in demand will result in an increase in both energy consumption and the emissions of greenhouse gases that come from this.
- Additionally, electrically driven vapor compression chiller technology makes use of CFC and HCFC refrigerants, both of which are environmentally harmful.

As a result, the development of alternative technologies that allow air conditioning to be operated using energy sources other than electricity is not only desirable, but also essential. Aside from providing a solution to the aforementioned problems, the use of solar energy in air-conditioning systems offers a number of benefits, which include the following:

- The maximum cooling load occurs at the same time as the maximum amount of available radiation.
- Work fluids such as water and salt solutions, among other things, are used by the equipment and are totally safe.
- With the advancement of technology, solar heating systems may be effectively used even when there is no need for heating energy.

The following technologies are now available on the market for solar thermal energy-based cooling production: absorption machines, solid and liquid desiccant, and solid adsorption, among others. Cold generation via absorption cycles has long been regarded to be one of the most desired applications for solar thermal energy. However, this has recently been challenged. The development of solar energy systems for air conditioning applications has been the subject of many studies and experiments, especially in the United States and Japan throughout the 1980s. Despite the fact that significant progress had been made in the creation of components and systems, the operations were eventually suspended, mostly due to economic concerns. Recently, many new operations in this area have begun, and both research and demonstration projects are being carried out in a number of nations, as well as in international co-operative initiatives such as the International Energy Agency's solar heating and cooling programme (IEA)[4].

1.1 The Corresponding Work

The current challenge facing human society is electricity, and experts believe that harnessing the abundant solar energy resources available to us will elucidate the issue. Energy consumption is predicted to double or treble by 2050 in the following year. Excessive oil usage as well as CO2 pollution are key causes of concern for the planet, because they emit greenhouse gases and deterioration of the atmosphere. Due to the obvious vapor - compression refrigeration ventilation system, chlorofluorocarbon as well as chlorofluorocarbons have an influence on ozone layer depletion. The LDAC system is an effective and environmentally safe way to provide comfort inside the house while also reducing greenhouse gas emissions[5].

AlMadinah system's architecture and enactment to calm the interior atmosphere through solar air conditioning were tested by Khaled S. Al Qdah because the temperature in the summer is approximately 42 degrees Celsius and the system's coefficient of performance (COP) varies from 2.16 to 4.22, with the result being better than traditional. He made a parallel among solar as well as traditional air conditioning units developed by Atlas JiunnHaoKhor and said that the continuing energy deficit is due to the increased usage of electricity in the world. Also discussed is the utilization of solar energy on the Limkokwing University campus to power an air conditioning facility on campus, the conservation of energy for green marketing, and the technique utilized to quantify electricity savings by calculating the cost payback. Carbon dioxide emissions will be reduced as a result of this energy saving effort. The final product shows the energy consumption differences between an air conditioner and a solar air conditioner; financial savings and environmental friendliness are reflected in the results of the study.

India obtains and over 5,000 trillion Kilowatt of solar radiation per year, should be more than sufficient to fulfill the country's total annual energy requirement. Countless solar photovoltaic alternatives include commodities and systems including such solar lighting, solar housing systems, sun street lamps, solar pumping, rooftop solar bundles, solar photovoltaic roofing systems, and other similar products and systems. The use of solar energy will help to alleviate the strain on fossil fuels. This technology, which can be used to manage electrical equipment in both rural and urban settings, is becoming more popular. To provide "air conditioning," the industrial building makes use of excess electricity, which ranges from 59 percent to 22 percent of the total power used for lights, 6 percent for ventilation fans, and ultimately 21 percent for the other services[6].

1.2 The Working Methodologies

Connecting the battery storage to the PV device can be accomplished through a variety of methods. The following measurements provide a summary of the techniques used in the research paper.

1.2.1 Collecting Meteorological Information

Specific humidity, relative humidity, angle of tilt, solar radiation values at daily and yearly locations, and the number of working hours are all examples of the types of data that may be collected. Because the office room, which measures four by four by four meters in volume, is being used as a

cooling space in this job, it is necessary to first determine the cooling load for this area before sizing the air conditioner.

1.2.2 Making a Calculation of the Cooling Load

There seem to be two traits that are necessary. First, establish what sort of cooling is required in order to evaluate cooling load, and then determine how much cooling is required. In this experiment, the space that would be cooled is the office room, where employees would spend eight hours a day at their jobs. When any location is selected in the experiment, the Hourly Analysis Program (HAP) assesses the cooling load for that particular spot. First and foremost, the area must be defined in terms of the temperature of the interior and external construction, relative humidity, the number and sort of insulating materials applied, and the layout of the building structure. In this scenario, because the mean average temperatures are 22 degrees Centigrade, the convenience or interior temperatures is 22 degrees Centigrade, and the humidity levels is 50 percent, total architectural temperature equals 40 degrees Centigrade. The result of the software would be ultimately visible once a month for each month. The greatest cooling load was discovered to be about 4 kW in the month of August, with the lowest cooling load discovered to be approximately 2.5 kW in the month of January[7].

1.2.3 System for Regulating the Temperature of the Air

On the foundation of the air conditioners computation, the unit with both the following parameters is chosen: input power 220 V, capacity 4 kW, in order to provide the required Officer power supply. If you want to choose and configure the requirements of the PV solar powered device, you can choose and configure them based on the "air conditioning" unit capability that you choose based on the temperature conditions of the experiment location and data that you obtain. A photovoltaic system is a collection of modules that are intended to generate electrical power that may be used for a number of applications. It is the sun's energy that we get in two primary forms: heat and visible light. A solar power system may be divided into two main categories: solar thermal systems, which convert heat into electricity, and solar photovoltaic systems, which convert sunlight directly into useable direct current energy. It is possible to utilize one or more inverters, which are voltage converters that convert direct current to alternating current. PV cells, which are usually made of silicon, are comprised of layers of semi conductive materials. As light reflects off the cell's surface, it generates an electrical field that travels through the layers of the cell. The greater the amount of energy produced, the greater the amount of sunlight created. It is possible to construct cell groups in panels or modules that may be put on top of a building[8].

In order to determine the number of PV modules to be placed, the peak sun hour must be determined. Until then, the amount of energy generated by the PV modules must be estimated in accordance with the solar irradiation of the surrounding area. An inverter charger is used to regulate the voltage and current flowing from the solar panel to the battery. The battery is the most important component of PV-SA systems since it provides energy backup. When it is cloudy or at night, it may also be used to store PV-generated power as a kind of energy storage. In order to connect this device to an alternating current load, an inverter is needed to convert the direct current (DC) energy generated by the PV cell into alternating current (AC). The AC load is a kind of load, and this component is easily accessible at a lower cost than other parts[9].

The charging operator's role is to regulate the current coming from the PV modules in order to prevent overflowing of the battery packs. When the cells are entirely charged so it is essential to limit or reduce the quality of current going through into the device, a potential transformer is used to detect the current that flows through the device. The PV module absorbs solar energy and turns it into electrical power to be used by the system. The electric power is then controlled, either by supplying it immediately to the workload or by the recharging controllers recharging the cells, depending on the setup. Because the electrical energy from the PV module is in direct current (DC), the inverter would convert it to alternating current (AC) because the compressor requires alternating current to function. A fixed voltage is provided by the DC power supplied by the solar panel array and battery. Although the stated voltage may not be equal to the voltage required by the load, it must be converted to alternating current (AC)[10].

2. DISCUSSION

Because of the contamination of the environment caused by the use of traditional refrigerants, as well as the ozone depletion and global warming concerns, the use of conventional refrigerants is discouraged. Following the implementation of environmental regulations, the use of all of these refrigerants for residential use has been prohibited. As a result, they must transition to a different alternative technology, such as vapor absorption or non-hazardous refrigerants. When compared to other vapor absorption devices, ours consumes less energy and is completely safe to the environment. Heating and cooling equipment are extensively employed in a variety of sectors and in household applications, among other things.

On the other hand, a significant amount of low-grade thermal energy is lost in many sectors, which may be recovered and utilized for cogeneration, thus reducing energy loss. Absorption cycles are among the heat-driven devices that may make use of low-grade heat from a variety of sources. Additionally, these absorption cycles are more environmentally beneficial since they reduce the emission of chlorofluorocarbons (CFCs) and carbon dioxide. Electricity is only required in extremely small amounts, if at all. Because of the high heat and mass transfer coefficients of the absorbent for the same chilling capacity, the physical dimensions of an absorption refrigeration system are very small. Despite the fact that a number of studies have been conducted using a variety of absorption cycles.

Using solar energy to generate power in sunny nations such as Algeria is a cost-effective method to address the country's energy shortage, particularly in remote regions where it may be difficult and costly to connect to the traditional electrical grid. Furthermore, Algeria is a nation with a significant solar potential; the yearly sunlight is always higher than 2104 kJ/m2 of catchment area, making it a highly energy-dense country. As the inclination to use this clean and plentiful solar energy in everyday life has become a priority rather than an option, it is important to note that Because of this, it is feasible to utilize solar energy in the area of air conditioning of different kinds in order to decrease the use of fossil power.

Air conditioning systems are one of the industrial and residential sectors that use significant amounts of energy throughout the globe. These systems account for about 17% of total world power usage. Therefore, efforts are being

concentrated on the search for clean and continuous alternative energy sources for the production of electricity, as well as on the reduction of use of mechanical elements that consume significant amounts of electricity, as well as on the development of environmentally friendly refrigerants.

In addition, because of the high cost of air conditioning (cooling and heating) by electric power, as well as the scarcity of this energy in remote and off-grid locations, much attention has been focused on the utilization of solar thermal energy in the areas of air conditioning of various types and sizes. According to the literature, one of the most significant contemporary solar technologies that has a large significance in the area of air conditioning is the solar-driven ejector air conditioning system, which is distinguished by its ease of design and execution. Because many valuable scientific researchers have touched on this positive technology in the field of conditioning of various types and formulas in recent years, solar-driven ejector air conditioning systems that use low or medium temperature heat rejection or a free energy source (solar) have become an interesting subject of study.

It was discovered that researchers had undertaken a study with the goal of studying a novel solar-powered cooling system that included an ejector, among other things. An additional important scientific effort was carried out by experts who investigated the optimum design of a solar energy cooling system for a variety of various operating conditions. When it comes to the use of the ejector in the areas of refrigeration, researchers have completed a very important scientific study in which they have summarized all of the applications of the ejector in the refrigeration sector.

3. CONCLUSION

It has been said that electricity is the most significant issue confronting human civilization today. Humanity will rescue the world from greenhouse gas emissions and ensure that the environment remains clean and green for future generations by harnessing solar energy. The use of electrical equipment such as air conditioners, ventilators, and other similar devices for the sake of convenience, while using fossil fuels that emit CO2 such as coal, petrol, and natural gas. There are many locations where renewable energy may be utilized, and the government also offers solar energy consumers with a strong strategy. Solar energy also has a long life span, with project expenses often being repaid within 4-5 years after installation.

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