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Extraction of Water from Atmospheric Air Using Solar Power

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Abstract: *Water is one of the most essential natural resources required for human survival. However, the availability of clean drinking water is decreasing in many regions due to population growth, climate change, and water scarcity. The project "Extraction of Water from Atmospheric Air Using Solar Power" aims to develop an eco-friendly and energy-efficient system to obtain water from the moisture present in the atmosphere by utilizing solar energy.*

The proposed system works by extracting moisture from atmospheric air through a suitable water-condensation process. Solar energy is used as the primary power source to operate the required components, such as a fan, cooling system, and other electrical devices, depending on the design. When the moist air comes into contact with a sufficiently cold surface, the water vapour condenses into liquid water. The collected water can then be filtered and treated to improve its quality for suitable uses.

The main objective of this project is to reduce dependence on conventional water sources and provide an alternative water supply, especially in water-scarce and remote areas. The system also aims to reduce dependence on grid electricity by utilizing renewable solar energy, thereby minimizing environmental impact. It may be useful in rural areas, emergency situations, and disaster-affected regions where access to water is limited.

In conclusion, this project explores the possibility of producing water from atmospheric moisture using solar power. Its performance depends on factors such as humidity, air temperature, solar radiation, and system efficiency. With proper design and further development, the system has the potential to support sustainable water management and provide an alternative source of water.

Keywords: Atmospheric Water Extraction, Solar Energy, Drinking Water, Water Condensation, Moisture Extraction, Renewable Energy, Water Purification, Solar-Powered System, Sustainable Water Supply, Water Scarcity.

I. INTRODUCTION

Water is one of the most essential natural resources required for human survival. Access to clean drinking water is important for maintaining good health and preventing waterborne diseases. However, many regions face drinking water shortages due to drought, climate change, and limited freshwater resources. Therefore, alternative methods of obtaining drinking water are becoming increasingly important.

Extraction of Water from Atmospheric Air Using Solar Power is a sustainable technique that collects moisture from the atmosphere and converts it into liquid water. The process uses condensation, in which moist air comes into contact with a surface cooled below its dew point, causing water vapour to condense into liquid droplets.

In this project, solar energy is used to operate the required components, such as a fan and cooling system, depending on the design. Solar panels convert sunlight into electrical energy, reducing dependence on conventional electricity and promoting the use of renewable energy. The collected water undergoes suitable filtration and disinfection, followed by water quality testing, to ensure it is safe for drinking. The efficiency of the system depends on atmospheric humidity,

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temperature, solar radiation, and the performance of its components.

II. LITERATURE SURVEY

The extraction of water from atmospheric air has been studied by many researchers as an alternative method of obtaining freshwater. Various techniques, such as condensation, refrigeration, thermoelectric cooling, and moisture absorption, have been developed to collect water vapour present in the atmosphere. These methods demonstrate that atmospheric moisture can be converted into liquid water under suitable environmental conditions.

Previous studies on atmospheric water generation have shown that condensation is an effective method of collecting water from humid air. When atmospheric air is cooled below its dew point, the water vapour condenses into liquid water droplets. The amount of water collected depends on atmospheric humidity, air temperature, cooling capacity, and the efficiency of the system.

Researchers have also explored the use of solar energy in atmospheric water extraction systems. Solar photovoltaic panels can generate electricity to operate fans, cooling devices, and other necessary components. The use of solar energy helps reduce dependence on conventional electricity and supports environmentally friendly water production. However, the performance of these systems may vary depending on sunlight availability and weather conditions.

III. PROJECT OBJECTIVES

The main objective of this project is to develop an eco-friendly and cost-effective system for producing drinking water, particularly in rural areas, remote locations, and water-scarce regions. The system's performance depends on atmospheric humidity, temperature, solar radiation, and the efficiency of its components.

The specific objectives are:

- To extract water from atmospheric air by utilizing the moisture present in the atmosphere.
- To use solar energy as a renewable power source for operating the water extraction system.
- To convert atmospheric water vapour into liquid water through a suitable condensation process.
- To collect and purify the extracted water for drinking purposes.
- To reduce dependence on conventional drinking water sources and grid electricity.
- To develop an eco-friendly and cost-effective system for producing drinking water.
- To evaluate the performance of the system under different atmospheric conditions, such as humidity and temperature.

IV. SCOPE OF THE PROJECT

The scope of the project “Extraction of Water from Atmospheric Air Using Solar Power” is to develop a system that extracts moisture from atmospheric air and converts it into liquid water for drinking purposes. The system uses solar energy to operate the required components, providing an alternative approach to producing drinking water.

The project focuses on utilizing renewable solar energy to reduce dependence on conventional electricity. By using a suitable condensation process, the system collects water vapour present in the atmosphere. The collected water is then subjected to appropriate filtration, disinfection, and quality testing to ensure that it meets drinking-water standards.

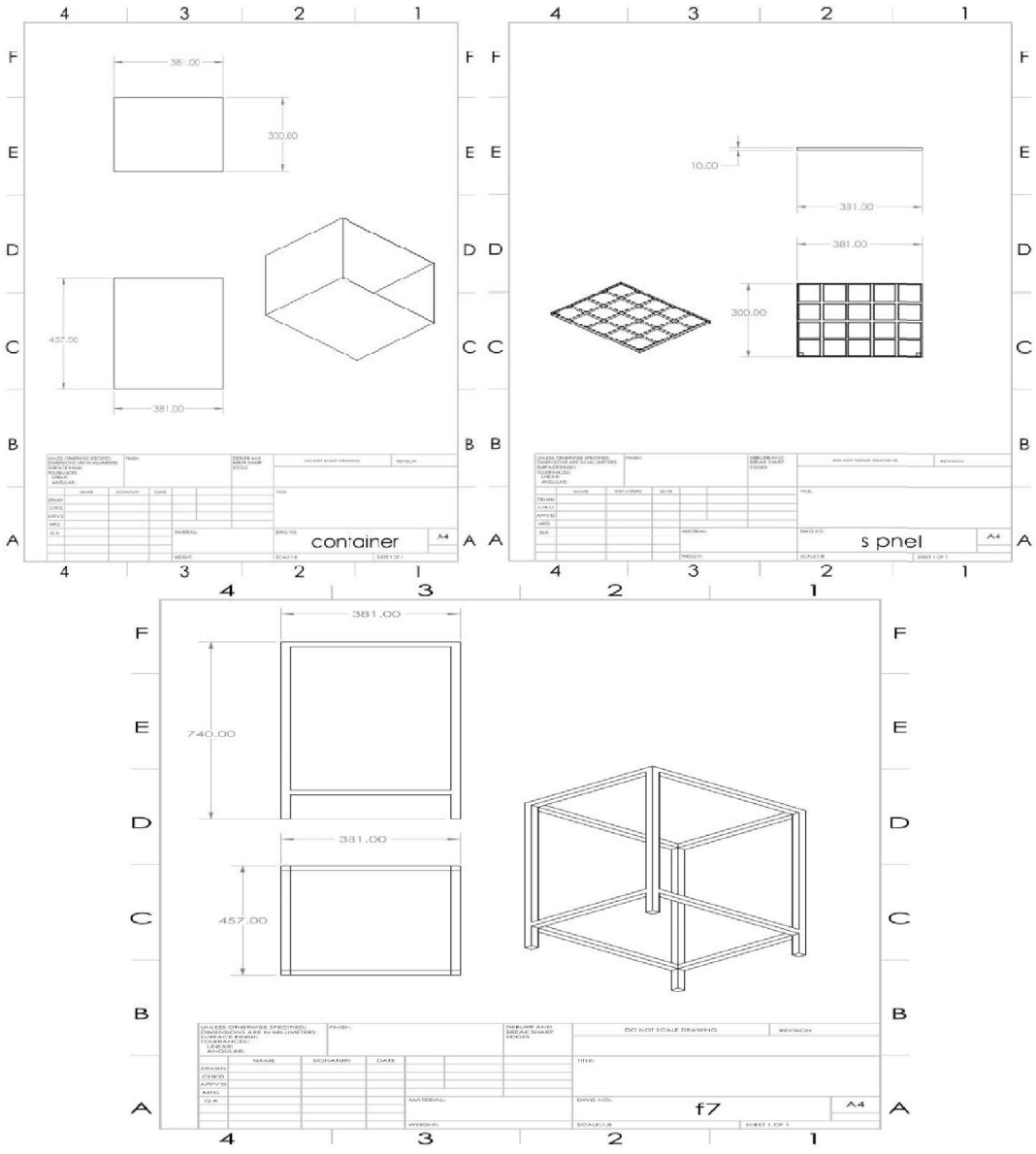
This system has potential applications in rural areas, remote locations, and regions experiencing drinking water shortages. It may also be useful during emergency and disaster situations when regular drinking water supplies are disrupted. Its effectiveness depends on environmental conditions, particularly atmospheric humidity, temperature, and the availability of sunlight.

The project can be further developed by improving the efficiency of the cooling system, reducing energy consumption, increasing water production, and incorporating suitable water storage and purification arrangements. With further development, the system may be adapted for household use and small-scale drinking water production, depending on its performance, cost, and environmental conditions.

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V. METHODOLOGY AND DESIGN

The system uses solar panels to convert sunlight into electrical energy, which is supplied to the required components. A fan draws atmospheric air into the system, where the moisture present in the air is exposed to a cooling process. When the air temperature falls below its dew point, the water vapour condenses into liquid droplets. The condensed water is collected in a storage tank and passed through suitable filtration and disinfection processes to remove impurities and harmful microorganisms. Finally, the purified water is tested to ensure that it is safe for drinking. The system's performance is evaluated based on the quantity of water collected, atmospheric humidity, temperature, and solar energy availability.



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VI. RESULTS AND DISCUSSIONS

(For atmospheric temperature 25°C and relative humidity 35%)

Saturation Pressure of water vapour (P□) at 25°C is obtained from steam table as 0.03167 bar. Thus, Partial pressure of water, P_v

$$P_w = \frac{RH}{100} \times P_s$$

$$= \frac{35}{100} \times 0.03167$$

$$= 0.0110845 \text{ bar}$$

Humidity Ratio

$$= 0.622 \times \frac{P_w}{P_a - P_w}$$

$$= 0.622 \times \frac{0.0110845}{1.01325 - 0.0110845}$$

$$= 0.006879661$$

Therefore, amount of water (in litres) present in 1 m³ of atmospheric air:

$$= Humidity\ Ratio \times 1000$$

$$= 0.006879661 \times 1000$$

$$= 6.879661\ litres$$

VII. FINAL DESIGN SUMMARY

The design of the project, Extraction of Water from Atmospheric Air Using Solar Energy, consists of three major components: the container, solar panel and supporting frame. The complete structure is designed using 3D modelling to ensure proper arrangement, stability and easy fabrication.

Container: The container is designed to collect and store the extracted water. It has a rectangular shape with a base dimension of 381 mm × 457 mm and side dimensions of 381 mm × 300 mm. The design provides sufficient space for water collection and storage.

Solar Panel (S Panel): The solar panel arrangement has dimensions of 381 mm × 300 mm and a thickness of 10 mm. It consists of multiple small rectangular sections arranged in rows and columns. It is used to capture solar energy and supply the required electrical power to operate the system.

Supporting Frame (F7): The supporting frame is designed to provide support and stability to the complete assembly. It has an overall height of 740 mm, width of 381 mm and depth of 457 mm. The frame is designed with vertical and horizontal members to hold the components securely.

Overall Design: The complete structure is compact and rectangular, with proper space for arranging the container, solar panel and other required components. The design helps in easy fabrication, assembly and maintenance while providing a stable arrangement for the atmospheric water extraction system.

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VIII. CONCLUSION

The project "Extraction of Water from Atmospheric Air Using Solar Energy" focuses on extracting water from atmospheric air by utilizing renewable solar energy. The system is designed to collect moisture present in the air and convert it into liquid water through a condensation process. The collected water is intended to be used for drinking purposes after ensuring proper purification and quality testing.

The project provides an alternative approach to water collection, especially in areas facing water scarcity. By using solar energy, the system aims to reduce dependence on conventional electricity and promote the use of renewable energy sources. The designed structure consists of a container, solar panel and supporting frame, which provide proper arrangement and stability to the system.

Overall, this project demonstrates the potential of atmospheric water extraction as a sustainable method of obtaining water. With further improvements in efficiency, water production and purification, the system can be useful in remote areas, emergency situations and places where access to clean drinking water is limited.

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