

## Original Research Article

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## Development of Water Extraction Device from Air Using Condensation Principle

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Water scarcity is not a recent problem. Shortage of drinking water is constant, severe, and wide-spread in the worldwide. Worldwide, people are suffering from lack in adequate fresh drinking water. The amount of fresh water on the earth is only 2.53 percent of the total amount. We can solve this problem by extraction of water from atmospheric air using condensation principle. It is suitable techniques for remote villages in order to produce clean drinking water. In which a six feet depth pit is made and have one condensation chamber (Water Storage Tank) in it. A 4.5 W fan is used to suck the air from the atmosphere. This fan is operated by 12 V solar plates. In this, we can extract about 250 ml water. If we provide more depth and higher capacity fan than we can extract more amount of water.

### Introduction

Water scarcity is not a recent problem. The amount of fresh water on the earth is only 2.53 percent (35 million km<sup>3</sup>) of the total amount (1.384 billion km<sup>3</sup>). A large fraction of freshwater (24 million km<sup>3</sup>) is ice and permanent snow in the Antarctic and Arctic regions. The main source of water for human consumption (freshwater lakes and rivers) which about 0.26 percent of the total global fresh water reserves (90,000 km<sup>3</sup>). Atmospheric air contains about 14,000 km<sup>3</sup> of water in vapour form, and hence it can be used as a new and renewable water resource

(3). A Water Aid report in 2016 ranked India, among the worst countries in the world for the number of people without safe water.

Extraction of water from atmospheric air can be accomplished by two different methods. The first method is by cooling moist air to a temperature lower than the air dew point. The second one is by absorbing water vapour from moist air using a solid or liquid desiccant, with subsequent recovery of the extracted water by heating the desiccant and condensing the evaporated water(3). The study was an attempt to make a device that would be capable of converting atmospheric

moisture directly into usable and even drinking water. The device uses the principle of latent heat to convert water vapour molecules into water droplets. In many countries like India, there are places which are situated in temperate region; there are deserts, rain forest areas and even flooded areas where atmospheric humidity is eminent (4).

A device that relies on simple condensation promises to collect clean water from the atmosphere without an external power source, greenhouse gas emissions, or adverse environmental impacts. Device could potentially run forever, gifting generations of people with access to ‘liquid gold’ in areas of the world where a harsh climate or lack of infrastructure make access to clean drinking water a major problem.

### Materials and Methods

The study was carried out at College campus, School of Engineering, RK University, Rajkot Gujarat. The latitude and longitude of the location are  $22.3039^{\circ}$  N and  $70.8022^{\circ}$  E respectively. A 4.5 Watt fan was used to suck the air from the atmosphere and drive it to the condensation chamber through the PVC pipe. The fan has 3 blades and each blade placed at the angle of  $45^{\circ}$ . For continued operation of the fan, solar plate of 12 V and 0.9 Ampere

was used.

The clay water pot was used for the storage of extracted water. The level of extracted water into the storage tank was determined by water level indicator. The depth of pit for condensation was around 6 feet, so as to produce temperature difference. The air is sucked by fan and converted into the small fine droplets of water and that droplets are collected into the condensation chamber. The water can be lifted from the condensation chamber with the help of a hand pump. Below given sketch shows the design of device with their Dimensions.

### Results and Discussion

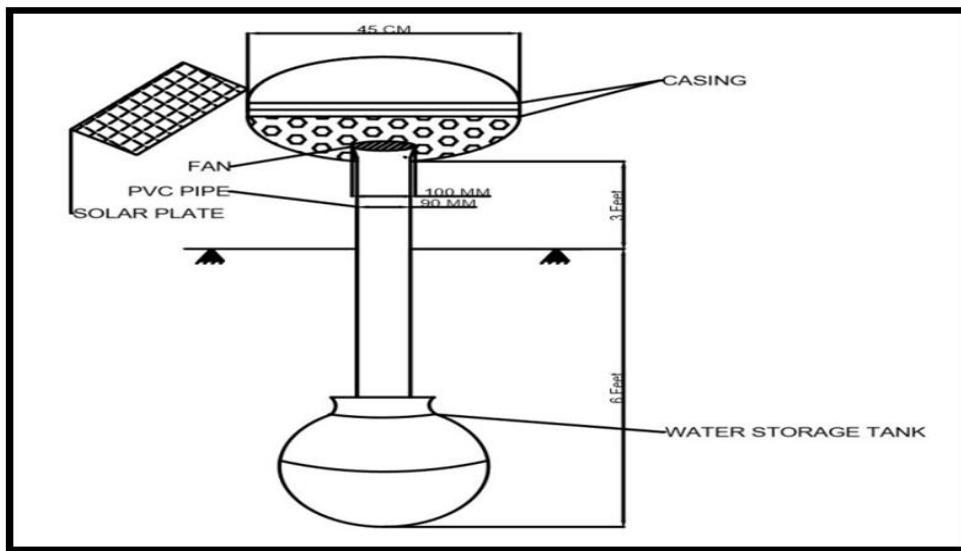
The experiment was carried out in September 2017. During this, temperature of air, temperature of soil, relative humidity and Wind Speed was measured twice in a day at morning and evening. As per the below given parameters the on an average water obtain is 250 ml per 24 hours. The measured parameters are in table 1.

Some problems were faced during the experiment. Digging was difficult because of Hard Rocks. The depth of pit was 6 feet, it is not sufficient to get more temperature difference (Fig. 1).

**Table.1**

Average Temperature of air (Morning) (°C)	26.73°C
Average Temperature of Soil (Morning) (°C)	21.9°C
Average Temperature of air (Evening) (°C)	28.38°C
Average Temperature of Soil (Evening) (°C)	25.23°C
Average Relative Humidity (Morning) (%)	43.32%
Average Relative Humidity (Evening) (%)	37.65%
Average Wind Speed (Morning) (m/s)	0.89 m/s
Average Wind Speed (Evening) (m/s)	0.52 m/s

**Fig.1** Diagram of device



The Temperature difference between soil and the atmosphere was about 3-4 degree and the relative humidity is also less. If we provide more depth and higher capacity fan than we can extract more amount of water. A proof-of-concept of the device was tested in 2014 with good results, 2.3 liters of pure water per day in a relatively humid climate. Proof-of-concept field tests in India extracted an average of 1.75 liters of water per day using a 9 Sq. Meter surface (1).

In conclusion for the extraction of water the soil formations and type of soil, depth of the pit, climate condition and size of fan are the major responsible factor to produce the more water. To get more amount of water the relative humidity should be more. The storage tank should be made up of metal for the ease of collection of extracted water instead of clay. The humidity of a region must remain above 50% for proper functioning of the device. So we expect that the water output may increase if the device is tested in coastal areas where the humidity is high (2).

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