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AirDrop Irrigation model

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Abstract: In this paper we propose a new method in which air is condensed into water with the help of the low soil temperature and using the water obtained, to irrigate our crop fields instead of the conventional water pump and drip irrigation method. We use an instrument, consisting of a turbine to suck in air from the surroundings and send them through a copper piping. Copper wool is used to facilitate the movement of air inside the copper piping so that a turbulent flow of air is created which helps in efficient condensation due to the surrounding soil temperature. The condensed water inside the copper piping is allowed into the roots of the soil with the help of a semi permeable hose. Thus water is created from thin air. Favourable results have been obtained with sufficient amount of water being generated for crop growth.

Keywords: Airdrop irrigation, Condensation, Copper-wool, Copper piping, solar panels, semi-permeable pipe.

I. INTRODUCTION

It is estimated that nearly 1.22 million hectare of crop field in India die annually as a result of drought or dry climatic conditions. Though expensive methods have come up to facilitate irrigation of crop fields during dry climatic conditions, Indian farmers below poverty line could not afford such expensive irrigation systems. In order to solve the crisis of farmers we have devised a new irrigation system called airdrop irrigation. This doesn't require any costly raw materials as it gives farmers water just from thin air.

II. MECHANISMS INVOLVED

A. Turbulent flow of air

It is a flow in which the air undergoes irregular fluctuations, or mixing, in contrast to laminar flow, in which the air moves in smooth paths or layers. In turbulent flow the speed of the air at a point is continuously undergoing changes in both magnitude and direction. In turbulent flow, unsteady vortices appear on many scales and interact with each other due to boundary layer skin friction which gets increases. The structure and location of boundary layer separation often changes, sometimes resulting in a reduction of overall drag. Although laminar-turbulent transition is not governed by Reynolds number, and if the same transition occurs the size of the object gets gradually increased or the viscosity of the air is decreased, or if the density of the air is increased.

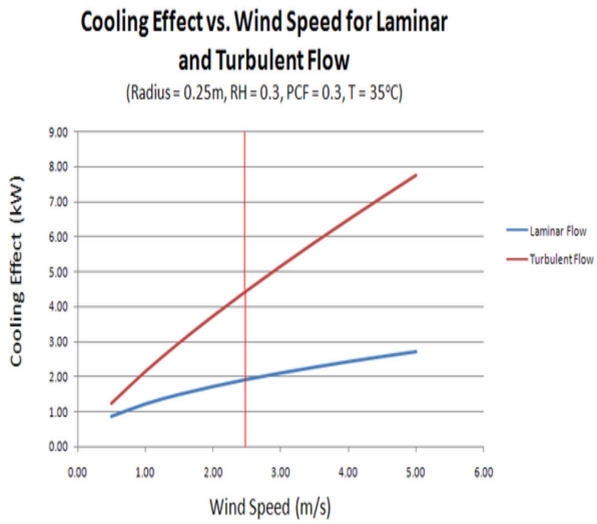

Fig1. Comparison of laminar flow vs. turbulant flow

The cooling effect of the turbulent flow is more than laminar flow of air as seen fom the graph. As the wind velocity is decreased because of the turbulant flow the cooling effect increases.

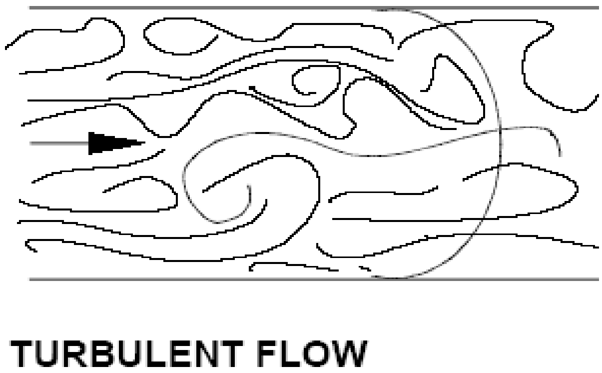

Fig 2. Flow visualisation of air inside copper piping

B. Copper wool

Copper wool are put inside the copper pipings to increase the condensation time as it slows down the passage of air inside the copper takes place on the walls of the piping but also on the surface of the copper wools, thus increasing the surface area of condensation. By increasing the surface area of condensation turbulance is created inside the copper piping.

Fig.3.Copperwool

C. Condensation

Condensation is the change of the physical state of matter from gasesous state to liquid state, and is the reverse of vaporization. It can also be defined as the change in the state of water vapor to liquid water when in contact with any surface. Psychrometry measures the rates of condensation from and evaporation into the air moisture at various atmospheric pressures and temperatures. Water is the product of vapor condensation.condensation is the process of such phase conversion. Condensation commonly occurs when a vapor is cooled and/or compressed to its saturation limit when the molecular density in the gaseous state reaches its maximal threshold. Vapor cooling and compressing equipment that collects condensed liquids is called a "condenser

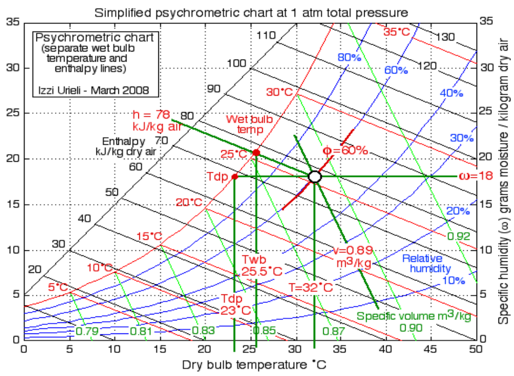

Fig.4. psychrometric chart

III. MATHEMATICAL RELATIONS

The **Psychometric Ratio** is the ratio of the heat transfer coefficient to the product of mass transfer coefficient and humid heat at a wetted surface. It may be evaluated with the following equation:

$$r = \frac{h_c}{k_y c_s}$$

where:

- r = Psychrometric ratio, dimensionless
- h_c = convective heat transfer coefficient, W m^{-2} K^{-1}
- k_y = convective mass transfer coefficient, kg m^{-2} s^{-1}
- c_s = humid heat, J kg^{-1} K^{-1}

The psychometric ratio is an important property in the area of psychometrics, which relates the absolute humidity and saturation humidity to the difference between the dry bulb temperature and the adiabatic saturation temperature. Mixtures of air and water vapour are the most common systems encountered in psychometric. The psychometric ratio of air-water vapour mixtures is approximately unity and implies that the difference between the adiabatic saturation temperature and wet bulb temperature of air-water vapour mixtures is small. This property of air-water vapour systems simplifies drying and cooling calculations often performed using psychometric relationships. With this formula the humidity of the surrounding air can be calculated. By knowing the humidity present in the air, a raw estimation can be made regarding the amount of water that can be collected inside the underground water tank. With the help of this a farmer can come to know how well he can irrigate his land and if the water is not sufficient enough he can find for alternative sources of water to irrigate or he can continue irrigating his land with the water produced by the air drop irrigation model

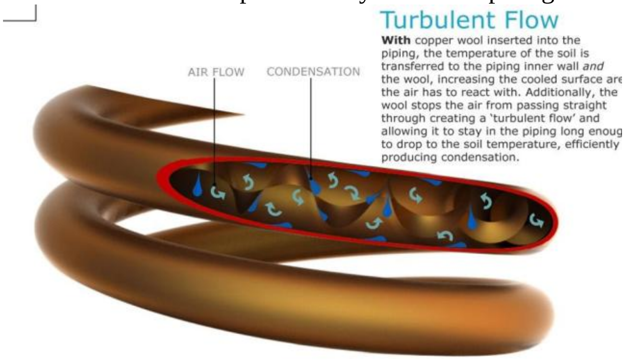

Fig.5 Copper wool inside piping

IV. WORKING

The solar panel fitted at the top of the model uses solar energy to power the device and allow the air to be sucked into the copper piping. Solar panel can be used only if the air velocity is less. The air flows underground into the copper piping where it reaches the copper wool. The copper piping is surrounded by the soil. Since the temperature of the soil is very low, Condensation of air takes place on the walls of the copper piping. Copper wool's present inside the piping increases the surface area of the condensation and also reduces the abrupt passage of air inside the piping. Thus condensation of air takes place effectively. The water thus produced is stored inside an underground tank. This water is allowed to pass through a semi permeable hose pipe. With small amount of pressure applied the water enters the soil of the crop field and thus helps in irrigation. A LCD display is also fitted to monitor the amount of water collected inside the underground tank. It can also calculate the humidity and wind speed and ultimately calculate the amount of water collected in the underground water tank

The figure shows the complete process of the airdrop irrigation model.The solar panel on the top of the model comes into play during low wind velocity. Photo-voltaic cells are used to maximise the surface are so that more amount of sunlight can be absorbed and inturn produce large amount of power required to run the device. In our prototype we can place a pump to transmit water to the crop field once the water in the underground storage tank is full. We can also transfer the water from the tank to a secondary storage and make the tank empty for the next cycle of the process to take place effectively

TABLE I.
WATER AMOUNT OBTAINED

S.no	Readings		
	Temp (°C)	Water obtained	Per kg of air
1	20	15	g/kg
2	25	20	g/kg
3	30	27.7	g/kg
4	35	32	g/kg
5	40	39	g/kg

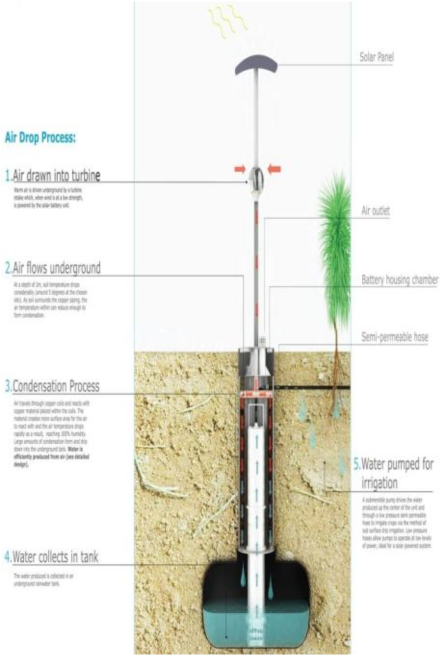

Fig 6. Complete proces

Fig.7. prototype

V. OBSERVATION

The air sucked in through the turbine which passed through the copper piping was initially restrained by the copper wool's. The air was subsequently subjected to the cool temperature and condensation started to take place on the copper wool's and also on the walls of the piping. The condensed water was stored in an underground tank. By taking different readings of the temperature at different days, we found water levels obtained to be changing. It was found that greater the temperature, greater is the amount of water obtained. Airdrop, can harvest 12.5 millilitres of water for every cubic meter of air in the driest deserts such as the Negev in Israel, which has an average relative air humidity of 64 per cent.

The following results were obtained after repeated calculation and observation.

VI. RECOMMENDATIONS

A. Conclusion

This paper cites the importance of the implementation of Airdrop irrigation model in drought driven areas. The Airdrop primarily focuses on the use of air surrounding the crop field to be used in irrigation process. In the absence of copper wool inside the copper piping, only a laminar flow of air is obtained which reduces our chances of condensation. By using copper wools inside the piping, condensation takes place not only on the sides of the piping but also on the copper wools and reduces the time taken for the air to pass inside the copper piping and thus raising the condensation time. Copper wools allows the turbulent flow of air as against the laminar flow of air during the absence of the copper wools. This results in efficient condensation of air and the water obtained can be stored in an underground tank and later released into the crop fields with the help of a semi-permeable hose fitted at the roots of the crop fields. The device is a low tech solution that powers itself and can be installed and maintained by the farmers themselves..

B. Future work

A very big solar panel can be used as a single source of power supply for a number of airdrop irrigation models than just one. Attempt can also be made to create a very large airdrop irrigation model that could adhere to the needs of a number of crop fields instead of the traditional small one. Further iterations of the design are expected to increase the yield.

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