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## A Study on the New Type of Hot Water Solar Tank with Energy Saving

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**ABSTRACT**: India receives an adequate amount of sunlight. Solar-powered water heaters will still be obtainable in the northern highlands. The first generation conventional storage water heater and the second generation improved storage water heater designs, on the other hand, are not viable options. When hot water is used, the tank refills itself with cold water, causing the water temperature inside the tank to drop. This will result in an additional heating cycle for the heater, as well as increased energy consumption. Concerning the disadvantage of the second generation storage water heater, we designed the third generation storage water heater, the smart solar water heating tank with a movable "partition disc" inside the tank, to improve and effectively resolve the problem of mixing hot and cold water, allowing the hot water to be effectively implemented. As a result, hot water usage is twice as strong as in the first generation conventional design and approximately twice more efficient than in the second generation improved design.

**KEYWORDS**: Carbon decrease, renewable power, and a tank for water heating.

#### I. INTRODUCTION

Solar energy is the most eco friendly, purest, and limitless renewable energy source. India is a country with a lot of sunshine. Even in the northern high latitudes, the solar heater can be used. However, conventional solar water heaters do not save energy because the water heating tanks are not designed optimally. Because the tank's hollow design cannot separate hot water from refilling cold water, the temperature inside the tank drops. It causes the heating element to go through an extra heating cycle, trying to increase energy consumption.

To address this issue, we created a smart water heating tank that completely separates cold and hot water, allowing the hot water within the tank to be fully utilised. It is a latest and patent design, and the tank model is already completed. If this new category of solar water heater is commodified, it will be much cheaper and use less energy than a Heat Pump water heater.

#### **II. OVERVIEW OF THE INDUSTRY**

Industrial development is dependent on an adequate supply of energy. We urgently require a clean, ecologically friendly, and limitless source of energy. Solar energy is the most efficient option for this. The sun's solar energy is approximately 3.845 x 1026 J per second. The Earth receives 1.743 x 1017 J of energy per second. That equates to approximately 6.1 million tonnes of coal combustors heat produced, which would be 16,700 times the global demand.

Solar radiation conversion and application are based just on density of solar energy. Solar water heating systems, solar green - house systems, solar cold rooms, and other applications The primary purpose of low temperature applications (100 °C) is for heating systems and other warming purposes; medium temperature applications (100 °C 200 °C) are for industrial heating and air conditioning; and high temperature applications (> 200 °C) are for smelting and poison putrefaction purposes. India is situated in the Hemisphere, across the Cancer Tropic in a subtropical area with a median salary insolation of approximately 11,746 kJ / m2 per day.

Solar water heating systems use solar collectors (flat plate or vacuum tube) to convert radiation from the sun to thermal energy. They had first appeared on the market in 1891. In 2001, the total area with solar collector designs exceeded seventy million square metres.

Gas heaters, power heating elements, heat pump heaters, and solar water heaters are the most common types of water heaters. The heat pump and solar water heaters are the most eco-friendly and energy-efficient of these four heaters. Their energy efficiency is nearly identical, depending on the weather and location. In overall, we get about half a year's worth of sunshine per year—about 210 days (that's about 4 hours of sunshine a day). As a result, using solar water heaters is much more energy efficient and cost effective. In contrast, when there are fewer than 180 days of sunshine, a



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heat pump water heating system is a better option than solar water heating. However, when the cost of each system is considered, the heat pump system is the most expensive. A standard residence heat pump system would cost approximately 40 to fifty thousand NTD, whereas a solar heating system would cost approximately thirty thousand NTD. As a result, solar water heaters are significantly more energy efficient and cost effective. When there are fewer than 180 days of sunshine, a heat pump water heating system is preferable to solar water heating. When the costs of each system are added together, the heat pump system is the most expensive. A standard home heat pump system would cost between 40 and 50 thousand NTD, whereas a solar heating system would cost around thirty thousand NTD. The solar water heater is the most environmentally friendly heating method. Natural cycle and forced cycle solar heating systems are the most common types of solar heating systems (see Fig. 1, Fig. 2).

Solar water heater with natural circulation

Inside the solar collector, the water temperature goes up and density decreases as it absorbs heat from the sun and travels to the storage tank. The cold water inside then collects at the bottom and flows towards the solar collector, which uses a natural circulation cycle to heat the water. Natural circulation systems are commonly used in homes.



Figure Fig 1: shows a solar water heater's natural circulation system.

#### III. SOLAR WATER HEATER WITH FORCED CIRCULATION

By using a collector circuit pump, the temperature is controlled forces water inside the storage tank to circulate through solar collector and return solar radiation heat to the heat storage. This is most commonly found in large-scale solar heaters.

According to Khalifa's research, solar water heating systems with forced circulation outperform those with circulating water by 35-80%. However, before purchasing a solar water system, the additional costs for the circulation pump, the method of operation and maintenance (such as leakage), and other issues need to be considered.



Figure 2: Forced Cycle Solar Water Heater



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#### **IV. PREVIOUS PRODUCT OVERVIEW**

#### Solar water heating tank of the first generation

Why is a solar heater not necessarily the most energy-efficient method to heat water? It is because the solar heater must use electric energy to heat on cloudy and rainy days. Furthermore, when hot water is being used, cold water is replenished into the storage tank at the same time, lowering the temperature of the stored hot water. When the temperature is not hot enough, electric heating is required. Figure 3 depicts an analysis chart of a conventional heater storage tank.

#### V. FIGURE 2 DEPICTS A SCHEMATIC OF A CUSTOMARY FIRST-GENERATION SOLAR WATER HEATER STORAGE TANK.

Inlet pipe and outlet pipe are situated on both sides of the conventional storage water tank. When hot water is used, hot water flows from the outlet pipe, while cold water is replenished via the inlet pipe. (there is some water that is poured in by pressurised motor). The resupplied water will mix with hot water, causing the water temperature to drop. To keep the temperature within the predetermined range, a power heater is managed to install alongside to keep the water heated at the suitable temperature. Although, due to the tank's large capacity (usually at 400L), The water heater used more electrical energy and take longer to heat up. Instead of saving energy, it wastes it for users.

#### VI. SOLAR WATER HEATING TANK OF THE SECOND GENERATION

According to the government's carbon reduction policies, some manufacturers have proposed solutions to the aforementioned storage tank issues, such as temperature drop, additional energy consumption, and time. The solution they proposed is to install a partition disc inside the tank that divides the tank into two sections (hot water on the left and the buffer zone on the right) that are linked by a tube. This equipment results in buffering time for cold flowing water into to the buffer state and out to the hot water zone, as well as slower mixing of hot and cold water.

#### VII. FIGURE 2 DEPICTS A SCHEMATIC OF A SECOND GENERATION SOLAR WATER HEATING TANK.

#### Figure 2 depicts a schematic of a second generation solar water heating tank.

Although the aforementioned design can help with water temperature reduction, cold water can still enter and mix with hot water via the connecting tube. It can only slow down the mixing of hot and cold water. As a result, our research team came up with the "smart solar water heating tank." This design allows the hot and cold water to be completely separated without mixing. As illustrated in

#### VIII. SMART SOLAR WATER HEATING TANK ANALYSIS DIAGRAM

The new partition disc design is movable and located on the far right hand side. When hot water flows out of the discharge line and cold water continues to flow in from the inlet port, the partition disc will slowly move to the left side due to water pressure to avoid water mixing. When the partition disc reaches the end of the left side, it immediately activates the motor pump, transferring cold water from the right hand side to the left and trying to push the partition disc back to the start for water heating the next day.

#### IX. DEPICTS A SOLAR WATER HEATING TANK MODEL

When the hot water runs out, the motor pump kicks on, pushing the partition disc back to the far right side. At this point, the heating tube would heat the entire tank of water. However, it is rarely used because the entire tank of hot water is always available.

Furthermore, the motor pump that stimulates to push the partition disc back to the far right side consumes only 0.0953kWh of electricity (take WALRUS water pump TP320P as a sample). It could almost be omitted when compared to the electricity consumption in heating 400 litres of cold water from 23 degrees to 60 degrees (electricity usage costs around 19.88 kWh).



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The partition disc is made of HIPS, which is large intensity and heat resistant and is the best material for a partition disc. To avoid leaking and slow down moving speed, the aperture between the partition disc and the tank must be lesser than 1mm during fabrication. Because of the aperture, the partition disc cannot completely separate hot and cold water; however, the quantity of permeating water is exceptionally tiny.

assumes that in the winter, hot and cold water are completely mixed and heated to 50 degrees. When quarter of the hot water (200L) is used up, the temperature of the new fully replenished cold water is 20 degrees, so the temperature is (50 + 20) / 2 = 35 degrees at this time. Most people find the water to be too cold at this temperature. As a result, the available hot water in a 400L traditional design storage tank is only half of the total content, which is roughly 200L. The excess moisture has already been mixed with cold water, resulting in a temperature that is not hot enough for hot baths.

The improved storage tank design (2nd generation) can slow down the speed of mixing hot and cold water, but it still needs to be heat up by electricity and waste energy. According to our calculations, the estimated amount of available hot water is much more than half of thestorage capacity, or around 250L. According to the experimental results (the data is deduced from a 2000ml imitating tank), we can conclude that the estimate of available hot water is correct. Because the smart solar water heating tank can completely separate hot and cold water, the available hot water is 400L. The following is the outcome based on the hot showers . The traditional storage tank has four hot showers, the improved one has five, and the smart one has eight. Thus, the efficiency of a smart storage tank is two times that of a traditional storage tank and 1.6 times that of an improved storage tank.

#### X. CONCLUSION

As previously stated, when compared to traditional and improved models, the capacity of accessible hot water in smart holding tanks for use is significantly greater. Our smart storage tank's efficiency is the best because of the design of the movable separation disc, which is the most important feature.

However, there is still a problem to be solved in smart solar heating tank, and that is "if we still have a demand for hot water that runs out, how can we solve this problem?" Solar heaters on the industry either heat the entire tank of water via a heating tube or heat a small tank. However, it will use more energy and have higher material costs. This is the goal for which we must strive.

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