CASE STUDY

VACUUM TUBE OR FLAT PLATE

VS

SDC
Solar District Cooling

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1.0 Introduction:

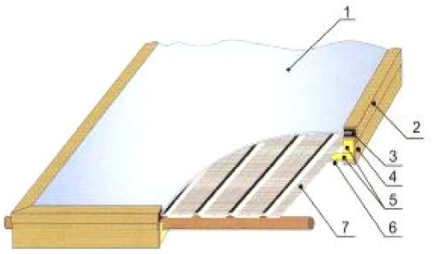
a. Project: Bungalow House
b. Location: Malacca
c. Background: Mr. Sean is an environmental activist. He wishes to incorporate a solar water heater for his new bungalow for hot bath, pre-heat for boiling, cleaning and laundry purpose without using electricity and less detergent. He has a wife and two children staying with him. Now, the task lies in selecting the most suitable solar water heater system.
d. Equipment: SDC Heat Pipe Evacuated Tube Solar Water Heater
Model: SDC 120SP-6TF
Feature: SPF certified patented "Thermal-Compression Sealing Technology" prevents heat loss and protect from corrosion. Aluminum Nitride Coating ensures more than *92% high solar absorption*. Performance tested accordance to EN 12975.

2.0 System Analysis and Comparison:

The following comparisons were made between the high efficiency heat pipe evacuated tube solar collector and the conventional flat plate solar collector:

Description	Heat Pipe Evacuated Solar Collector	Flat Plate Solar Collector
Storage Tank		
Capacity	120 liters	180 liters
Inner Tank Material	High quality 2.0mm stainless steel plate c/w quartz enamel coating (Withstand Hard water)	1.5mm Type YUS 190 steel plate
Cover & Side Cover Material of Tank	Colour Steel Plate, 0.5mm thick & Polypropylene UV Protected	Aluminum Stucco & Polypropylene UV Protected
Side Cover Material of Tank	Polypropylene UV protected	Polyethylene UV Protected
Working Pressure	4 bar	4 bar
Solar Collector		
Type	Heat Pipe Vacuum Glass Tube (Eliminate Heat Conduction & impurity clogging, able to heat up to 98°C)	Plate & Tube
Absorber Plate Material	Copper- Aluminum sun strip, 0.47 mm thickness (Increase collector surface and angle)	Aluminum / Copper
Absorber Area	1 m^2	2 m^2
Surface Coating	Aluminum nitride Al-N-O selective coating	Matt Black Polyester
Reflector	Aluminum Stucco (Enhance the solar absorption)	Not Applicable
Quantity of Tubes	6 pcs ϕ100mm x 2m heat pipe vacuum tube c/w double coating (2 way heat absorption)	9 pcs ϕ1/4" copper riser tube
Electric Back-up Heater	1.5 kW	3 kW
Gross Weight with Water	190 kg	274 kg
Overall Dimension (LxWxH)	2265 x 1200 x 500mm	2430 x 1490 x 510mm
Capacity Range	4 person	4 person
Water Filter Price	Not a necessity	RM 1,200.00
Solar Heater Price	RM4,100.00	RM4,200.00

3.0 Performance Analysis (Flat Plate Panels)



1.Tempered glass 2.Strip 3.Rubber seal 4.Frame
5.Glass woll insulation 6.Back sheet 7.Absorber

Efficiency

A flat plate solar collector basically is an insulated box with fine copper tubes, black color coated absorber plate and a tempered glass on the surface facing the sun. The absorber plate will absorb the sun radiation and convert the energy into heat, which will be carried away by the passing water in the copper tubes. As the temperature of the box increases to a certain degree that the temperature difference between the ambient and the flat plate collector is considerably big (above 10°C temp diff), the heat collected in the insulated box tends to dissipate out back to the atmosphere. This makes flat plate collectors are actually operating in lower efficiency. They may have high absorption coefficient, but they also have high emission of energy back to the atmosphere.

Total Cost of Ownership

A flat plat solar collector requires additional water filtration system to work as a system. As the copper tube inside the flat plate solar collectors is very small in diameter (1/4”), a good quality of incoming water is necessity to avoid any impurities to be deposited inside the copper tubes and eventually clog the water flow into the solar collector. Once the water flow inside the copper tubes is partially blocked, there will be a great deterioration in the solar collector’s performance and eventually malfunction once it is completely choked. Therefore, an unavoidable hassle of constant maintenance on the water filtration system is required, to ensure that the flat plate solar collector is working. Lastly, 10 years warranty of solar panels may end with 5 years operation due to owner’s fault of unable to provide the require water quality that meet the flat panel requirement.

Operation Expenses

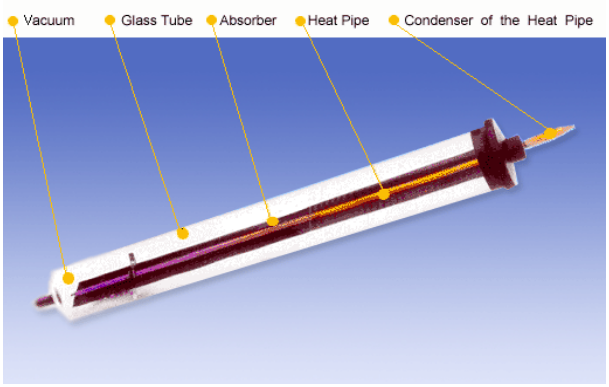
Should the copper tube inside the flat plate solar collector being clogged, the owner would require to replace the whole solar collector, as to repair it would seem unpractical and uneconomical. And should the tempered glass cracks or breaks due to some hard object e.g. spanner, screwdrivers, the flat plate solar collector is considered malfunction because whatever heat collected will dissipate back to the atmosphere. The downtime for replacement or repair would mean higher electricity bill on backup heater operation.

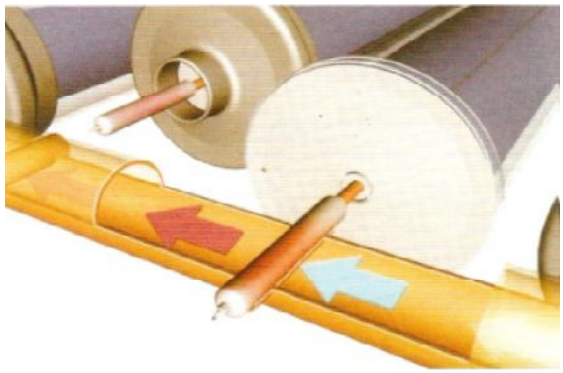
4.0 Performance Analysis (Heat Pipe Evacuated Tube Solar Collectors)

Reliable & Durable

With a 2.5mm borosilicate glass wall thickness, the evacuated tube solar collector is very durable and not easy to break as compared to other types of vacuum tubes. It was tested accordance to EN 12975.

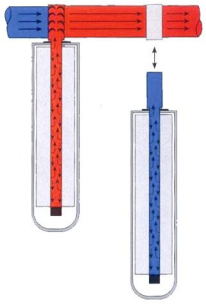
Latest Technology Creating High Efficiency





The heat pipe vacuum tube collects heat from the sun at high efficiency and absorbs up to 92% of the incoming radiation. The aluminum nitride selective coating on the absorber plate ensures the exceptionally high solar absorption and low thermal emission. As the glass tube is evacuated, the sun radiation energy collected will not dissipate back to the atmosphere as heat conduction and convection cannot travel through vacuum. The energy collected will be brought away by the flowing water and stored in the storage tank. The stagnation temperature can reach up to 190°C. With improve efficiency and high temperature storage; switching on the electric backup heater during rainy season can be avoided.

Fast Start-up



The heat pipe had originally been developed for the thermal control in space satellites. Inside the pipe, the heat is conducted with high efficiency to its upper end. From there it is released to the hot water circulation of the thermosyhon process. The pipe is charged with a small amount of water and carefully evacuated before sealing resulting in fast heat transfer start-up.

Easy Installation, Lower Operating Cost and Maintenance Free

Hot water flow passing the condensers for heat transfer, and does not flow through the collector itself. The plug-in structure guarantees an easy installation and convenience of hot swap-able without shutting the system down. There will be hot water generated even during the replacement of the evacuated tube. Should one of the evacuated tubes is broke, replacement of single tube is available, and thus replacement cost is very low. Plus, without the narrow tubes for water to pass by, there is no need for a good water filtration system, eliminating the hassle for filter maintenance work.