**Solar Water Heating System**

A solar thermal device captures and transfers the heat energy available in solar radiation which can be used for meeting the requirements of heat in different temperature ranges.

Three main temperature ranges used are -

| | |
|---|---|
| Low temperature | Hot water - 60°C to 80°C |
| Medium temperature | Drying - 80°C to 140°C |
| High temperature | Cooking & power generation - > 140°C |

**Configuration**

Solar water heating system (SWHS) is a device which supplies hot water at 60°C to 80°C using only solar thermal energy without any other fuel. It has three main components, namely,

1. Solar Collector
2. Insulated hot water storage tank and
3. Cold water tank with required insulated hot water pipelines and accessories.

In the case of smaller systems (100 – 2000 litres per day), the hot water reaches the user end, by natural (thermo – siphon) circulation for which the storage tank is located above the collectors. In higher capacity systems, a pump may be used for forced circulation of water.

**Working Principle**

In a typical solar water heater, water is heated by the solar thermal energy absorbed by the collectors. The hot water with lower density moves upwards and cold water with higher density moves down from the tank due to gravity head. A bank of collectors can be arranged in a series – parallel combination to get higher quantity of hot water. A typical 100 litres insulated tank with a 2 $m^2$ collector area, will supply water at a temperature of 60 - 80°C.

Based on the collector system, solar water heaters can be of two types.

**Flat Plate Collectors (FPC) based Solar Water Heaters**

The solar radiation is absorbed by Flat Plate Collectors which consist of an insulated outer metallic box covered on the top with glass sheet. Inside there are blackened metallic absorber (selectively coated) sheets with built in channels or riser tubes to carry water. The absorber absorbs the solar radiation and transfers the heat to the flowing water.

| Capacity (in LPD) for $60^0$C SWHS | Recommended Collector Area (in Sq.m) |
|---|---|
| 100 | 2 |
| 200 | 4 |
| 300 | 6 |
| 500 | 8 |
| 1000 | 16 |

**Evacuated Tube Collectors (ETC) based Solar Water Heaters**

Evacuated Tube Collector is made of double layer borosilicate glass tubes evacuated for providing insulation. The outer wall of the inner tube is coated with selective absorbing material. This helps absorption of solar radiation and transfers the heat to the water which flows through the inner tube.

| Capacity (LPD) | Tube size | | | Collector Area (Sq.m) |
|---|---|---|---|---|
| | Dia:47mm Length:1500mm | Dia:47mm Length:1800mm | Dia:58mm Length:1800mm | |
| 100 | 14nos | 12 | 10 | 1.5 |
| 125 | 18 | 15 | 13 | 1.93 |
| 150 | 21 | 18 | 15 | 2.25 |
| 200 | 28 | 23 | 19 | 3.0 |
| 250 | 34 | 28 | 23 | 3.75 |
| 300 | 40 | 33 | 27 | 4.5 |
| 400 | 52 | 43 | 35 | 6 |
| Above 500LPD | 12 Tubes per 100LPD | 10 Tubes per 100LPD | 8 Tubes per 100LPD | 1.3sq.m/100LPD |

**Selection of suitable Solar Water Heating Systems:**

1. Flat plate collector (FPC) based systems are of metallic type and have longer life as compared to Evacuated tube collector (ETC) based system as ETCs are made of glass which are of fragile in nature.
2. ETC based systems are 10 to 20% cheaper than FPC based system. They perform better in colder regions and avoid freezing problem during sub-zero temperature. FPC based systems also perform good with anti-freeze solution at sub zero temperature but their cost increases.
3. At places where water is hard and have larger chlorine content, FPC based system with heat exchanger must be installed as it will avoid scale deposition in copper tubes of solar collectors which can block the flow of water as well reduce its thermal performance. ETC based systems do not face such problem.
4. For a house with one bathroom and 3 to 4 members, 100 liter per day capacity system should be sufficient. For more numbers of bathrooms, the capacity will increase accordingly due to pipe losses & more number of family members. Generally the capacity is decided based

on hot water required in mornings for bathing. If the usage is in evening & at other times also, the capacity is decided accordingly.

5. A 100 lpd capacity may cost Rs. 20,000 to Rs.25,000 depending on type & location. The cost, however, does not increase linearly with increase in capacity, rather it comes down proportionately as we go for higher capacity system. The system cost does not include the cost of cold water tank, & its stand which is required if overhead tank is not installed in a house/ building. Cost of hot water insulated pipe line also, may be extra if number of bathrooms are more than one. Additional cost towards all these components may increase by 5 to 10%.
6. Avoid putting of electricity back up in storage tank of solar system. If you have electric geyser of say less then 10 lpd capacity or an instant geyser it would be better if you connect the outlet line of solar system with inlet of geyser & set thermostat at 40$^{o}$C. Your geyser will start only when you get water below 40$^{o}$C from solar system and will switch off when temperature goes above say 42$^{o}$C or so. This will save lot of electricity and heat water according to your requirement. However, if you have storage geyser of higher capacity, better to have a separate tap for solar system and use your electric geyser when you don't get hot water from solar water heater.

**Hot Water Storage Tank**

The tanks are generally made of stainless steel to avoid corrosion and are insulated to reduce heat losses. They are also fitted with electrical heater as a backup during monsoon days. The tanks may also be made of G.I.

**Cold Water Tank & Pipelines**

Cold water comes from the over head tank. Hot water from the system is transferred to various utility points through insulated pipelines. A heat exchanger may be provided when the water is hard.

**Usages**

Domestic: Bathing, Coffee / Tea preparation, Utensils Cleaning etc.

Industrial: Pre-heating of boiler feed water, cooking / dishwashing in industrial canteens. washing of milk canes in dairies, sterilisation of surgical instruments etc.

**Economics (Tentative)**

- A 100 lpd domestic solar water heating system (SWHS) can cater to a family of 4-5 persons and costs about Rs.20,000 to Rs.25,000
- It saves about 1500 units of electricity per annum equivalent to about Rs.5000/- per year.

MNRE LINKS

Announcement Solar Water Heating Systems - Revised Benchmark Costs / Subsidy with effect from 1st June 2013 - Click here for more details - Click here for more details

http://mnre.gov.in/file-manager/UserFiles/amendment_jnnsm_28052013.pdf

ETC Manufactures Solar Water Heating System (SWHS) (as on 29.04.2013)
FPC Manufactures Solar Water Heating System

**Incentives by Government of India (MNRE) under JNNSM Scheme**

**Subsidy released to beneficiaries installed in the year 2011-12**

| SL NO | Name of the Beneficiary | Subsidy amount utilized In Lakhs | MNRE Sanction No | Total Sanctioned amount by MNRE |
|---|---|---|---|---|
| 1 | Alliance Business School | Rs.160500/- | MNRE Sanctioned order No:5/23/2010-11-P&C dated:3.8.2011 and MNRE sanctioned order No:30/27/2011-12/ST dated:16.3.2012 | Rs.275 lakhs |
| 2 | Eversun Energy Pvt Ltd | Rs.17,01,00/- | | |
| 3 | Sainath Education Trust | Rs.792000/- | | |
| 4 | Mahatma Gandhi Memorial College Udupi | Rs.98230/- | | |
| 5 | Manasadhar Trust Shimoga | Rs.83197/- | | |
| 6 | Saketha Guest House Dharmasala | Rs 342975/- | | |
| 7 | Dhwanwantri School of Nursing | Rs 50829/- | | |
| 8 | JNNCE Shimoga | Rs 172615/- | | |
| 9 | Bangalore Study Circle | Rs 112500/- | | |
| 10 | Marian Infrastructure | Rs 180000/-/- | | |
| 11 | Mrs Sharavathy Vasudeva | Rs 43200/- | | |
| 12 | Kishore Menon and others | Rs 86400/- | | |
| 13 | Nimhans Hospital | Rs 802846/- | | |
| 14 | Manipal Global Education Services (P) Ltd | Rs 595036/- | | |

| | | | | |
|---|---|---|---|---|
| 15 | Shringar Engineering Pvt Ltd | Rs 45120/- | | |
| 16 | Rudset Institute Gandhinagar Dharwad | Rs 52800/- | | |
| 17 | Vasudev Nayak KN | Rs 22283/- | | |
| 18 | B.R.Chandrashekar | Rs.6000/- | | |
| 19 | Jayaram,Mysore | 14100/- | | |
| 20 | Ravishankar PN | 19500/- | | |