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Comparative Study and Design of Solar Water Heater

[1]K.Sainath,[2]Y.krishna, [3]Mohd Salahuddin,[4] Mohammed Siddique Ahmed, [5]Md Ismail, [6]Syed Rahman, [7]Mohammed Noman, [8]Mohd Khaleel Ullah, [9]Faraz Ur Rehman Azhar, [10] Mohd Moizuddin,[11]Mohd Riyaz Uddin.

[1,2,3,4,5,6,7,8,9,10] Mechanical Engineering Department , Sreyas Institute of Engineering & Technology, Nagole, Hyderabad-50068

[11] Mechanical Engineering Department, T.k.R Polytechnic college ,rathnapuri, sangareddy medak district, India

[1]sainthkasuba@gmail.com, [3]sala7dana@gmail.com, [4] Siddique786Asim@gmail.com, [11]zain0xxxx@gmail.com

Abstract:*A solar water heater design is made from the plastic bottles of thumps up & plastic pipe(p.v.c) run up by the centre of each solar heater in a row of bottles, these bottles act as glazing & hold reflectors made from the black paint. Solar water heaters are made of two basic parts: a solar collector that gathers radiant energy and a storage tank for the hot water inside. These systems are used to heat water for swimming pools, as well as for domestic cooking and cleaning needs. A system in which the sun's heat is gathered by a solar collector and used to increase the temperature of a heat-transfer fluid , which flows through the pipes in the collector; the heat contained in this fluid then is conveyed and transferred to the water to be heated. Solar water heaters use the solar energy from the sun to generate heat (not electricity) which can then be used to heat water for showering, space heating, industrial processes or even solar cooling. However, the research shows that the electric water spends about the 25% of its home energy costs on heating water. If we make a water heater without the collector then we can save a lot of money solar water heater do not polluted if one investing on SWH avoids carbon dioxide nitrogen oxide and sulphur dioxide and the other air pollution wastes and the utility generates power on your bum fuel to heat your household water when SWH replaces the an electric water heater. This electric displaced over 20 years replaced more than 50 tones avoided c02 emissions alone co2 traps heat in the upper most atmosphere thus, contributing to the 'Green House Effect.*

Keywords : SWH, plastic pipe, heat-transfer fluid

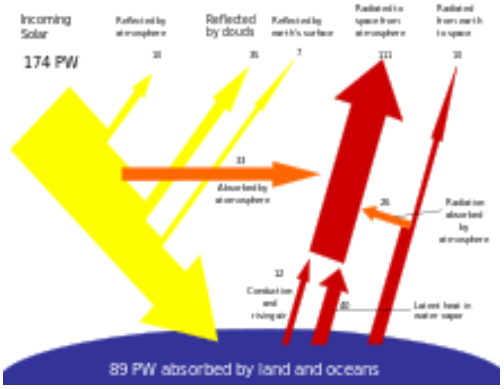
How Solar Energy Works:-

Solar energy, solar energy is the primary energy source for our planet as it is responsible for providing energy for plant growth (photosynthesis) and providing the warmth that makes our planet habitable. radiant light and heat from the sun, is harnessed using a range of ever-evolving technologies such as solar heating, solar photovoltaic's, solar thermal electricity, solar architecture and artificial photosynthesis, Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that, naturally circulating the air In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than costs of the incentives for early deployment should be considered otherwise. These advantages are global. Hence the additional learning investments; they must be wisely spent and need to be widely shared".

Theory:-

Energy from the Sun

Main articles: Insulation and Solar radiation



About half the incoming solar energy reaches the Earth's surface.

The Earth receives 174 pet watts (PW) of incoming solar radiation (insolation) at the upper atmosphere. Approximately 30% is reflected back to space while the rest is absorbed by clouds, oceans and land masses. The spectrum of solar light at the Earth's surface is mostly spread across the visible and near-infrared ranges with a small part in the near-ultraviolet.

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Earth's land surface, oceans and atmosphere absorb solar radiation, and this raises their temperature. Warm air containing evaporated water from the oceans rises, causing atmospheric circulation or convection. When the air reaches a high altitude, where the temperature is low, water vapor condenses into clouds, which rain onto the Earth's surface, completing the water cycle. The latent heat of water condensation amplifies convection, producing atmospheric phenomena such as wind, cyclones and anti-cyclones. Sunlight absorbed by the oceans and land masses keeps the surface at an average temperature of 14 °C. By photosynthesis green plants convert solar energy into chemical energy, which produces food, wood and the biomass from which fossil fuels are derived.

Yearly Solar fluxes & Human Energy Consumption	
Solar	3,850,000 EJ
Wind	2,250 EJ
Biomass potential	100–300 EJ
Primary energy use (2010)	539 EJ
Electricity (2010)	66.5 EJ

The total solar energy absorbed by Earth's atmosphere, oceans and land masses is approximately 3,850,000 exa joules (EJ) per year. In 2002, this was more energy in one hour than the world used in one year. Photosynthesis captures approximately 3,000 EJ per year in biomass. The technical potential available from biomass is from 100–300 EJ/year. The amount of solar energy reaching the surface of the planet is so vast that in one year it is about twice as much as will ever be obtained from all of the Earth's non-renewable resources of coal, oil, natural gas, and mined uranium combined.

Solar energy can be harnessed at different levels around the world, mostly depending on distance from the equator

Introduction to wind power :-

Wind energy is a source of renewable power which comes from air current flowing across the earth's surface. Wind turbines harvest this kinetic energy and convert it into usable power which can provide electricity for home, farm, school or business applications on small (residential), medium (community), or large (utility) scales.

Wind energy is one of the fastest growing sources of new electricity generation in the world today. These growth trends can be linked to the multi-dimensional benefits associated with wind energy.

- **Green Power:** The electricity produced from wind power is said to be "clean" because its generation produces no pollution or greenhouse gases. As both health and environmental concerns are on the rise, clean energy sources are a growing demand.
- **Sustainable:** Wind is a renewable energy resource, it is inexhaustible and requires no "fuel" besides the wind that blows across the earth. This infinite energy supply is a security that many users view as a stable investment in our energy economy as well as in our children's' future.

Affordable: Wind power is a cost-competitive source of electricity, largely due to technological advancements, as well as economies of scale as more of these machines are manufactured and put online around the world.

Economic Development: As well as being affordable, wind power is a locally-produced source of electricity that enables communities to keep energy dollars in their economy. Job creation (manufacturing, service, construction, and operation) and tax base increase are other economic development benefits for communities utilizing wind energy.

In regard to the establishment conditions for tidal generator, the tidal head, i.e. level difference between high and low tides, shall be considered. Those sites with lucrative tidal head exist in the river mouths or some specific bay areas. Generally speaking, more than 5 meter tidal head is a minimum requirement for tidal power generator. Then, a dam will be established to form a tidal lagoon to store sea water, which is similar to a reservoir, and used to separate this water body from rivers, lakes or sea near the coastal area. Another intriguing feature of a tidal power plant is the use of bidirectional turbine generator distinct from traditional one direction turbine. The bidirectional turbine can generate

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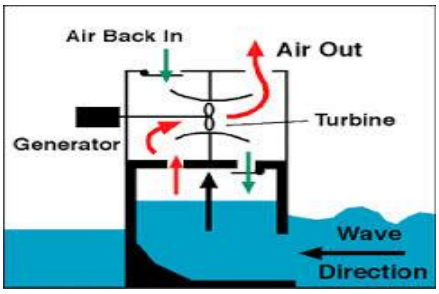
electricity from the flood/ebb and avoid the waste of tidal power. At present the diameter of some tidal turbines can reach as large as 10 meters which is proportional to various tidal power plant scales.



Hydrogen Basics - Introduction

The hydrogen atom is composed of one proton and one electron, making it the lightest element in the universe. It is also the most abundant element in the universe, making up more than 90% of all known matter. The abundance of hydrogen on earth, minimal environmental consequences of its use and the need to replace fossil fuels, makes it the ideal fuel of the future.

This is the hydrogen economy, a vision of a clean and locally produced energy future. This is also a vision of Florida's leaders in their quest for hydrogen in Florida.

Introduction to BIO GAS

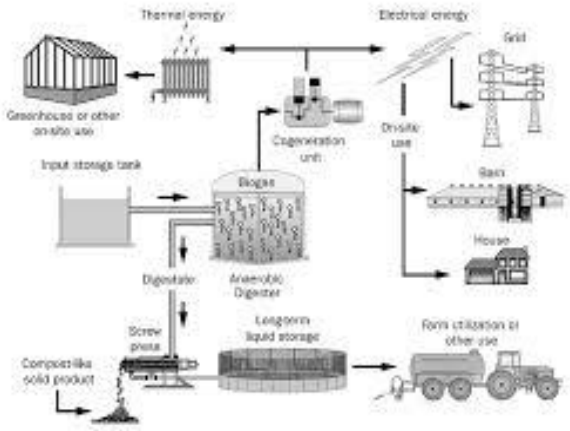
Biogas consists of about 2/3 methane (CH4), 1/3 carbon dioxide (CO2) a little hydrogen sulphide(H2S) & a little hydrogen(H2). It is created by the decomposition of manure & other forms of organic waste from industry or house holds in aerobic (that is oxygen free) tanks where it is heated. In the reactor a biological decomposition takes place where the bacteria are producing biogas. The biomass stays in the reactor for about 2-3 weeks. Biogas can be used for production of heat & electricity. Biogas is created naturally by the decomposition of organic matter, one example in the natural world is from moors where marsh gas is created. It is possible to use about 65% of the energy available in the bio gas.

30% for electricity,

35% for heat. This process has a loss of about 35%

20% for the heating of the biomass

15% engine loss in principle any kind of organic material can be transformed for biogas. But if the bio gas plant is supposed to be profitable with the current energy prices there should be used, manure (slurry) from the agriculture, sludge from cleaning of waste water, plants and waste from the food industry. Manure is the main ingredient waste is an additive that increases the production. pure waste material produces too much gas and thereby foam which destroys the gas(it has to be separated first) there are two kinds of different biogas plants in Denmark: common plants and farm plants, common plants receive manure from the industry and house holds. In Denmark the first common plant was inaugurated in 1984 and today there are 20 common plants. these plants produce can be sold to local chp units that generate electricity and heat. A farm plant uses only waste material from a single farm, but also uses manure as material.



The Research Challenges :-

Hydrogen is not an energy source. It is an energy carrier like electricity. On earth, hydrogen is found combined with other elements. For example, in water hydrogen is combined with oxygen. In fossil fuels and many organic compounds, it is combined with carbon as in petroleum, natural gas, coal or biomass. This is the technological challenge facing researchers: to separate hydrogen from other naturally occurring compounds in an efficient and economic process.

The production of hydrogen requires utilizing one of the primary energy sources – solar-based, fossil fuels or nuclear. Once hydrogen is produced, it can be reacted with oxygen in a manner similar to gasoline combustion in an engine or used in a fuel cell to generate electric power. The electricity produced by a fuel cell can then be used to power electrical devices such as computers or an electric car. An important benefit is that, using hydrogen does not produce carbon monoxide or carbon dioxide. This makes it attractive because no greenhouse gases are produced.

Since the 1970s, NASA has used fuel cells to power the space shuttle's electrical systems and to provide water for astronauts to drink.

Another challenge to a hydrogen vision is its storage after it is produced. Storing enough hydrogen energy in comparable weights, volumes and vehicle range to gasoline is a significant technological challenge hindering its wide-scale adoption. In order to store hydrogen in a more compact space, it must be stored either as a high-pressure gas, a liquid, or combined with other compounds in a solid form. Each of these storage methods has its limitations and none meets automotive manufacturers

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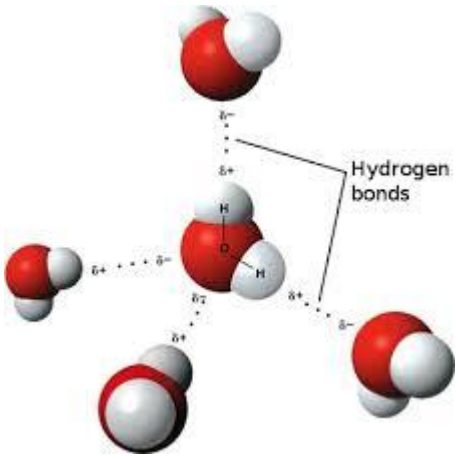
requirements as of yet. As a result, extensive research is being conducted on a variety of storage options. The U.S. Department of Energy has declared storage as the most critical technological challenge to the wide-scale adoption of a hydrogen economy.

The production and storage of hydrogen are major research efforts with activities in progress at the Florida Solar Energy Center, other universities, industry and government laboratories around the world. Explore this site to find out more about these issues and some of the solutions being developed.



Capacity Calculations

Volume of Pipes

→ π/4 d² x l
→ π/4 (1.27)² x 110
→ 1390.344 cm³
→ For 7 Pipes →1390.344 x 7
→ 9732.408 cm³

Volume of connecting Pipes-

→ π/4 d² x l → π(1.27)² x 30
→380.00 cm³
→ For 6 Pipes →2280.18 cm³
Total volume → 9732.408 cm³ + 2280.18 cm³
→12012.59 cm³
Convert cm³ → It (1 cm³ = 0.001 lt)
→12012.59 x 0.001
→12.012 lt

Estimation of Costing

→ Cost of wood = 350 (With finished into required Shape & drills)
→ Cost of PVC Pipes = 100
→ Cost of black cover,
→ Black paint, brush for painting and connecting Pipes = 400
→ Cost of nails = 20
→ Labour & water bottles = (80+50) 130 Rs.
→ Total cost = 1000

ESTIMATION OF WEIGHT

Wooden frame

Density of wood is 0.657 - 0.882 gm/cm³
→ Volume of Parts 1 & 3
= l x b x h
=122 x8x8
=2928 cm³
There are two parts 1 & 3
So 2x2928 = 5856 cm³
= l x b x h
=90 x 3 x 8
=2160 cm³
Total volume of parts 2 & 4
=2 x 2160
=4320 cm³
→Volume of holes
Diameter of hole = 16mm = 1.6 cm
Volume π/4 d² = 41.6² x 3 = 6.03 cm³
No. of holes = then, 14 x 60.3 = 84.4460 cm³
Total volume = 5856 + 4320 – 84.44
= 10091.553 cm³
→ Weight = Volume x Density
=1.91.55 x 0.8
=8073.248 gr
=8.07 kgs.

PVC Pipes

→ Volume π/4 (1.47² - 1.27²) x 110
=47.34 cm³
For 7 pipes = 331.39 cm³
→ Connecting pipes
= π/4 (1.67² - 1.27²) x 30
= 27 cm³
For 6 pipes = 166.25 cm³
→ Total Volume = 331.39 + 166.25 = 497.6 cm³
Weight = 497.6 x 1.4 (Density)=696.64 gr = 0.69kg
→ Weight of black cover -0.25 – 0.5 kg
Total weight = 8.07 + 0.69 + 0.5 = 9.26
Approx = 10 kg.

Result & disscusion:-

The water is heated at the temperature of 38ºC at the temperature (obtain in the water) is 52ºC

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