Dew Heat Pump
for
Heating Water

Case Study

Content

1. EXISTING SYSTEM INTRODUCTION

Technical Specifications:

Heat Pump Based Hot Water System :

Sr. No	Item	Specifications
1	**Heat Pump System**	
1.1	System Capacity. **Only Heat Pumps.**	The heat pumps are back up to Solar System of 15,000 LPD. They should generate 15,000 LPD in 12-13 Hours. (see section 1.6 in the same table)
1.2	Heat Pump - Hot water generator (completely automated with all protections) generating Hot Water from and at approx.10 deg C Ambient to 60°C	Capable of producing hot water up to 55-60°C
1.3	Hot Water circulation Pump between Storage Tank and *heat exchanger. Pumps must be with SS/ bronze impeller and CI Body, stainless shaft coupled to 3 phase squirrel cage induction motor, TEFC with class F insulation, 1450 RPM, 415 Volt 50 Hz along with foundation bolts vibration isolator, base plate with mechanical seal all complete to handle hot water at 70 deg.C. Duty condition shall be selected by vendor to match the Heat Exchanger heat transfer rate and flow rate.(EACH SET WILL HV 2 NOS PUMP 1 W+1STD BY) (1 Working + 1 Stand-by).	Suitable flow rate /Suitable Head. *If required as per manufacturers requirement or Design after approval of COEP.*
1.4	**No. of systems	(4500 Liters Tank +3000 Liters Tank) X 2 Systems connected to Heat Pumps. Heat Pumps should be capable of delivering 7500 Liters in 12-13 Hours (30 Dec. C, Delta T) with a capacity of 8200 Kcal / hr,
1.5	Water Hardness handling capacity	~ upto 250 - 300 ppm

1.6	Estimated life	Minimum 20 years [with warranty period assured on bond paper]
2 Electricals for total Heat Pump system		
2.1	Electrical Panel	For Heat pumps and all water pumps
	Cabling for Heat pumps	As per site requirement
	Cabling for All pumps	As per site requirement
	Earthing	Cu wire
	Panel Specs: Apart from standard specs additional instruments shall be - Universal Timer to set different Timings to start & Stop the Heat Pumps.	
3 Piping and Accessories for Heat Pump system		
3.1	Pipes and fittings- for entire Hot water systems	GI / MS Piping to integrate with existing Solar Hot Water Tanks with necessary insulation provision.
3.2	BF / Ball valves for Heat pump	Suitable size
3.3	BF / Ball valves for all Water pumps	Suitable size
3.4	Strainers for all Water pumps	Suitable size
3.5	NRVs for all Water pumps	Suitable size
	detail shall be submitted , finalized and get approved from the client	
4. Erection and Commissioning		
4.1	**Insulation specification** (piping)	
	Material	Rockwool
	Thickness	25 mm
5. Energy Monitoring		
5.1	Water Flow Meter, to be installed on Cold Water Inlet Line.	Suitable size For measuring actual water heated

2. MULTI-UTILITY ENERGY EFFICIENT HEATGENERATORS

Simple things and technology often work best and so it is here. Using the proven principles of refrigeration and air conditioning, cooling and or heating effects can be simultaneously delivered if required. In addition to the cold utility generated from the evaporator side heat from the condenser can also be delivered as a hot utility. Condenser heat is approximately the sum of the energy supplied to the compressor and the heat gained from the cold utility in the evaporator. Heat exchanges are enabled using patented Tube-Tube Heat Exchanger Technology which is patented. Heat Generator technology has been used in air conditioning globally for more than 50 years and our technology is also well proven. The MWE Multi Utility Heat Generator is at the leading edge in terms of energy efficiency and durability in all weather conditions. The system uses a high performance system configuration and components along with the Vented-Double Wall TT_HE Technology to enable direct integrating with the potable water streams or process fluid streams to enable high COP and reduced CO_2 emissions.

2.1 Some of the basic features of the MWE DEW_HP are as under:-

- **High Reliability**: field-proven patented vented-double-wall Tube to Tube Heat Exchangers TT_HE is used to assure contamination free hot and cold water delivery
- **Energy Efficient**: can heat tap water from 27 to 57 to 60^{o}C with a heating Coefficient of Performance (COP_h), typically in the range of 3 to 4; while simultaneously cooling air from 25 to 18^{o}C; overall energy saving would be over 66 to 75% when compared with electric water heating and conventional air conditioning
- **Low Internal Volume**: fast start-up; hot and cold water generation in a few minutes
- **Durable**: no worries about contamination of water and water tank pressurization
- **Non Water Contamination: Most heat Generator water heaters use a single wall heat exchanger for exchanging heat between the refrigerant and water being heated. This poses the danger of the water getting contaminated by the refrigerant which is not desirable.**
- **Intelligent Application engineering:-** There will be no wastage of water and waiting time to get hot or cold water at the taps as the MWE DEW_HPs and the unique water tank and piping configuration ensures cold or hot will flow almost immediately from the tap.
- **Surplus cooling** effect can be delivered as Air Conditioning FCUs,
- **Integrated Intelligent Information System:-**
    - The system will be so custom designed that it will be integrated with Scada (**supervisory control and data acquisition system**)
    - Our intelligent Scada system will **monitor the energy consumption, flow, pressure and usage of hot and chilled water.**

- System is engineered to monitor and operate the heat pumps depending upon the demand to conserve energy.
- Data of usage and consumption will be available in digital format.
- A complete alert mechanism is activated in case of abnormal variations.
- Our IIIS is web enabled, performance is monitored by our technical team and alert mechanism as per customer's choice can be provided.

Air to Water Multi-Utility Generator		
Particulars	**Premium Model** **Single Pass 30°C ΔT without recirculation**	**Esteem Model** **5°C ΔT Recirculation**
Heat Exchanger Type	Tube_Tube Heat Exchangers (TTHE)	Tube-in-Tube Type
Scaling	Can be cleaned online using Chemical Descaling Fluids while keeping the chiller/refrigeration system online	Esp. in Double vented wall type Water side may be cleaned using chemical descaling technique. Generally difficult to descale uniformly. Cleaning of scales is laborious and time consuming leading to higher down time
Cost	Moderate cost	Costly. High cost if Heat Exchanger is with several joints
Size	Compact size resulting in small inventory of refrigerant and water	Requires large surface area for high heat duties. Large size with high inventory of refrigerant and water
Design	Simple but Versatile design wherein multiple circuits can be integrated in single heat exchangers.	Complex design
Rated Water Temperature Rise per Pass through the Heat Pump	Water temperature rises by 30°C to 40°C in single pass. Water enters at 25°C and outlet at 55°C within seconds.	Water temperature rises by 5°C to 8°C and water is recirculated till the temperature of 55°C is attained. In most of cases it takes 15 minutes to heat up the water.
Additional Pump power	Not required in case pressurized inlet water.	Internal Reticulating Water flow m3/h capacity is high. Hence heavy duty Generator required
Reliability	Excellent. Concern of accidental mixing of the fluids exchanging heat is put to rest with this versatile and reliable heat exchanger.	Low :-More chances of water and refrigerant mixing due to tube leakage. High cost in proportion to heat transfer area
CO-efficient of Performance	Ambient Temp -10°C to 15°C :- 2.5 to 3 Ambient Temp 5°C and above :- 3 to 4.8 considering pumping power	COP of 3 and lower after considering internal recirculation pump.
Modular	Prechiller or complete water based evaporator can be retrofitted to generate Cold water and Chilled Water of at different temperatures. Hot water of different temperatures can also be produced. Cold Air if required can be circulated through indoor DX unit	Not modular

Retrofitting Existing Aircon	Existing Air con Can be converted into Heat Generator. thereby generating hot and cold utility	Not Possible
ROI / Payback	Due to Multiutility functions paybacks are between 12 to 18 months	Payback are longer considering the overall power consumption
Programming Controller	Available	Available in case of European and US Makes.
Response time	Fast :- Start hot water recovery within few minutes	Moderate. Longer response time due to vented double wall
Super Heat Recovery	Super heat is recovered and additional hot water is generated and thereby improving COP and Heating and Cooling efficiency	Not Supported in this Model

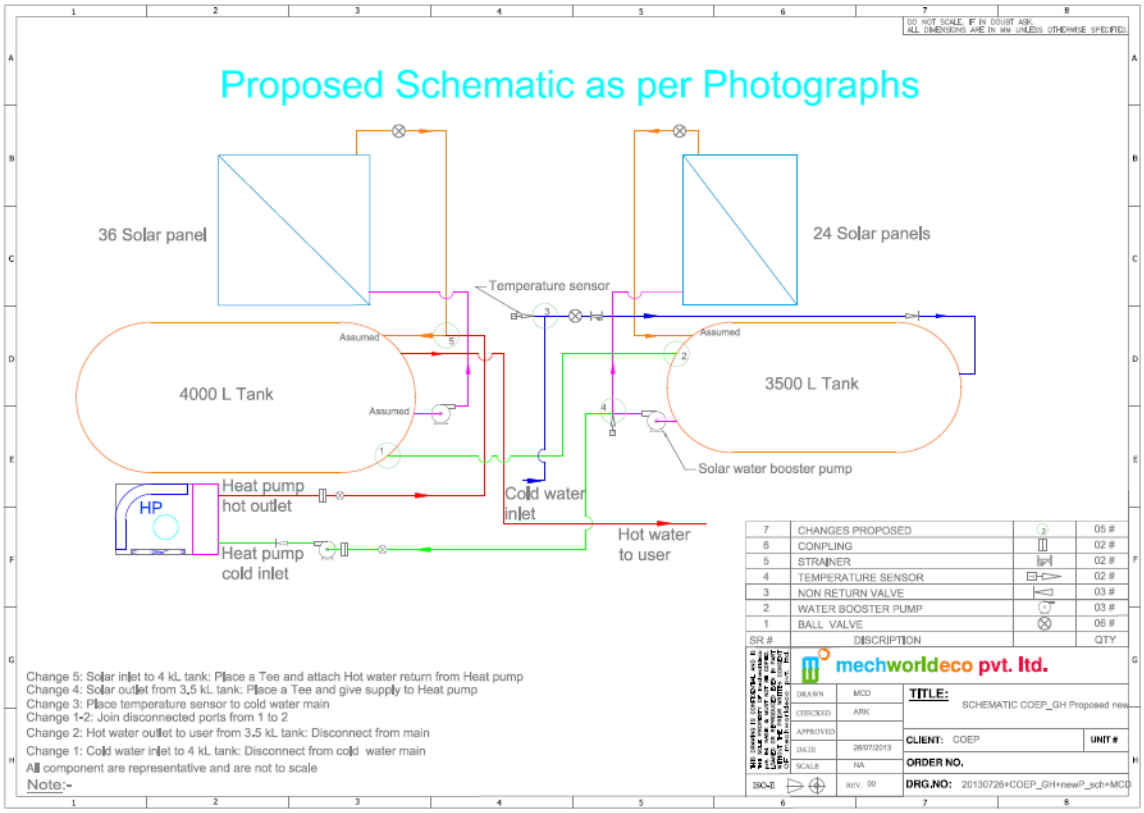
Particulars	Heat Exchangers with ΔT of 5°C to 10°C	Tube tube heat exchangers (tthe) with 20°C to 40°C
Instant Hot / chilled water	Not possible	Streams of Hot water available within seconds
Recirculation of Pump	Mandatory	Not required
Pumps Required in non pressurized system	Primary and Secondary pump required of higher capacity due to higher flow rate of water	Only Primary Pump required to put the hot water in tank.
Pumps required in pressurized system	Secondary pump required	No pump Required
Storage Tank	Mandatorily required to recirculate the water to achieve desired temperature	Optional
Feed Water for Boiler at70°C	Not Possible	Possible in single pass taking water at 20 °C and delivering upto 70 °C
Power saving	Overall COP is less if all pumping power consumption is considered.	Overall COP is high even is pumping cost is considered.

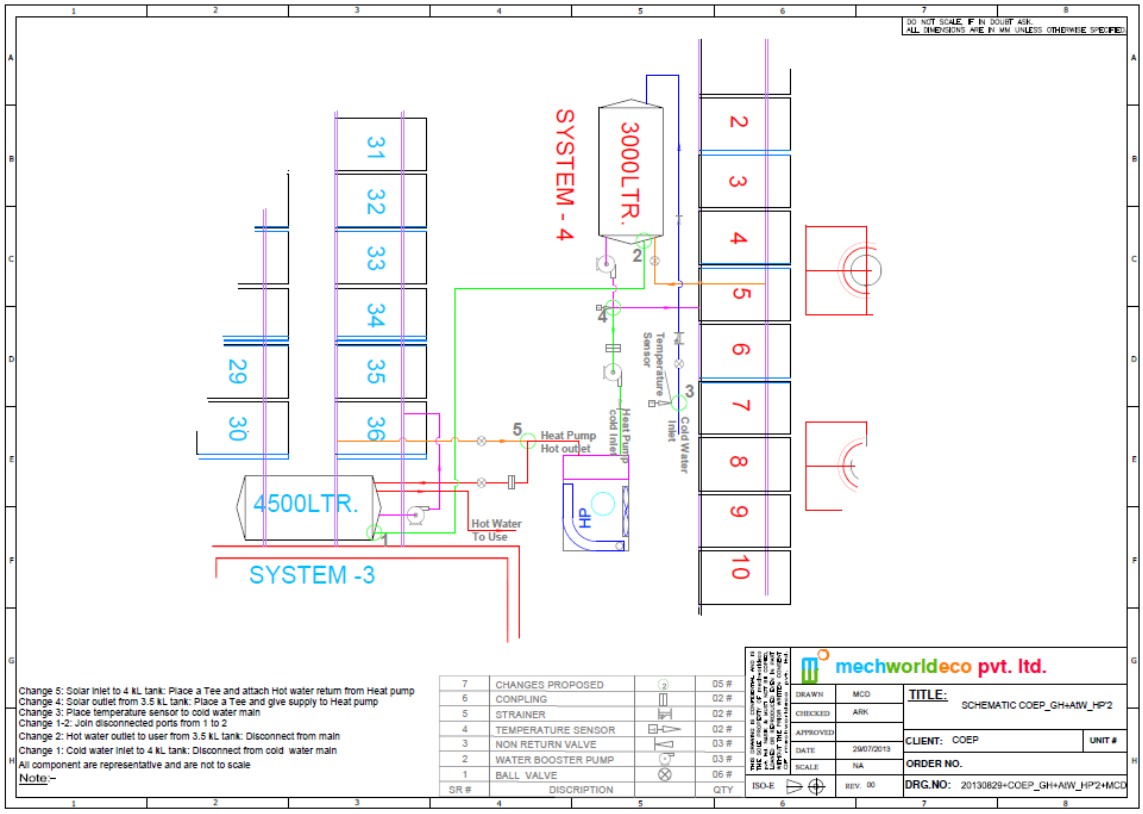
3. PERFORMANCE SITE TEST READINGS :

		Reading U1			Reading U2	
Date		27-9-13			27-9-13	
Time	Hrs	1030	1100		900	1000
Water flow	$W_{flow\ in}$ l/m	15	15		15	15
Condenser Inlet water temp	$t_{cond.i}$ in ^{0}C	28.4	30		28.6	28.9
Condenser outlet water temp	$t_{cond.o}$ in ^{0}C	57	58.5		59.2	60
Heat load	Q_{cond} in kW	29.89	29.78		31.98	32.50
Inlet air temp	t_{evpi} in ^{0}C	26.4	27.4		25.8	25.9
Outlet air temp.	t_{evpo} in ^{0}C	20.7	21.2		20.5	20.6
Evaporator pressure	P_{evp} in psig	90	90		92	92
Saturation temperature		11.91	11.91		12.56	12.56
Condenser pressure	P_{cond} in psig	308	312		298	301
Saturation temperature		55.4	55.8		54.5	54.7
Voltage R	V	376	378		383	385
Y	V	376	379		382	383
B	V	380	380		387	390
Average		377.33	379.00		384.00	386.00
Current R	A	13.2	14		11.8	11.9
Y	A	12.9	13.1		11.7	11.8
B	A	10.6	11		11.3	11.6
Average	A	12.23	12.70		11.60	11.77
Heat pump power	P_{comp}.in kW	6.35	6.62		6.13	6.25
COP		4.71	4.50		5.22	5.20

SITE READINGS HEAT PUMP NO 1										
Date	Time	Inlet temp	Outlet temp	Flow meter reading	Energy reading	Hot water	Power	Δt	heat load	COP
	h	C	C	litre	kWh	litre	kW	C	kW	
7/10/2013	930	28.6	52	56700	193					
8/10/2013	915	29.2	52.2	60100	214	3400	21	23	90.93	4.33
9/10/2013	920	27.9	53.8	63400	235	3300	21	25.9	99.38	4.73
10/10/2013	910	27.6	52	66700	257	3300	22	24.4	93.63	4.26
11/10/2013	940	29.5	54.3	70300	279	3600	22	24.8	103.81	4.72
12/10/2013	925	28.7	53.1	73900	303	3600	24	24.4	102.14	4.26
SITE READINGS PUMP NO 2										
7/10/2013	930	28.2	52.5	65900	221					
8/10/2013	915	28.1	52.2	68700	242	2800	21	24.1	78.47	3.74
9/10/2013	920	31.9	55	73800	264	5100	22	23.1	136.99	6.23
10/10/2013	910	28.6	52.5	78200	287	4400	23	23.9	122.28	5.32
11/10/2013	940	30.5	54.3	82400	311	4200	24	23.8	116.23	4.84
12/10/2013	925	28.7	52.1	86300	336	3900	25	23.4	106.12	4.24

4. INSTALLATION SCHEMATIC :


Proposed Schematic as per Photographs
36 Solar panel
24 Solar panels
Temperature sensor
Assumed
Assumed
Assumed
4000 L Tank
3500 L Tank
HP
Heat pump hot outlet
Heat pump cold inlet
Cold water inlet
Hot water to user
Solar water booster pump
7 CHANGES PROPOSED 05 #
6 CONPLING 02 #
5 STRAINER 02 #
4 TEMPERATURE SENSOR 02 #
3 NON RETURN VALVE 03 #
2 WATER BOOSTER PUMP 03 #
1 BALL VALVE 06 #
SR # DISCRIPTION QTY
Change 5: Solar inlet to 4 kL tank: Place a Tee and attach Hot water return from Heat pump
Change 4: Solar outlet from 3,5 kL tank: Place a Tee and give supply to Heat pump
Change 3: Place temperature sensor to cold water main
Change 1-2: Join disconnected ports from 1 to 2
Change 2: Hot water outlet to user from 3.5 kL tank: Disconnect from main
Change 1: Cold water inlet to 4 kL tank: Disconnect from cold water main
All component are representative and are not to scale
Note:-
mechworldeco pvt. ltd.
DRAWN MCD
CHECKED ARK
APPROVED
DATE 26/07/2013
SCALE NA
ISO-E REV. 00
TITLE: SCHEMATIC COEP_GH Proposed new
CLIENT: COEP
UNIT #
ORDER NO.
DRG.NO: 20130726+COEP_GH+newP_sch+MCD


DO NOT SCALE, IF IN DOUBT ASK.
ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED
SYSTEM - 4
3000LTR.
4500LTR.
SYSTEM -3
Heat Pump
Hot outlet
Heat Pump
cold inlet
Temperature
Sensor
Cold Water
Inlet
Hot Water
To Use
HP
Change 5: Solar inlet to 4 kL tank: Place a Tee and attach Hot water return from Heat pump
Change 4: Solar outlet from 3.5 kL tank: Place a Tee and give supply to Heat pump
Change 3: Place temperature sensor to cold water main
Change 1-2: Join disconnected ports from 1 to 2
Change 2: Hot water outlet to user from 3.5 kL tank: Disconnect from main
Change 1: Cold water inlet to 4 kL tank: Disconnect from cold water main
All component are representative and are not to scale
Note:-
7 CHANGES PROPOSED 05 #
6 CONPLING 02 #
5 STRAINER 02 #
4 TEMPERATURE SENSOR 02 #
3 NON RETURN VALVE 03 #
2 WATER BOOSTER PUMP 03 #
1 BALL VALVE 06 #
SR # DISCRIPTION QTY
mechworldeco pvt. ltd.
DRAWN MCD
CHECKED ARK
APPROVED
DATE 29/07/2013
SCALE NA
ISO-E
REV. 00
TITLE: SCHEMATIC COEP_GH+AIW_HP'2
CLIENT: COEP
UNIT #
ORDER NO.
DRG.NO: 20130829+COEP_GH+AIW_HP'2+MCD

5. RETURN ON INVESTMENT :

INPUT	Quantity of hot water required in litre	15000
	Inlet Water temp.	30
	Out let water temp. Required	60
	COP	4.5

Saving with Alternative Fuels

Efficiency (in %)			70	75	35	35	35	70	35
Parameter	Heat Pump	Electric Geyser	Diesel	LPG	Coal	Charcoal	Wood	Natural Gas	Town Gas
Calorific value (kcal/kg)			10700	11600	5015	7069	3749	6675.50	2321.46
Heat Required in kcal.	450000	450000	450000	450000	450000	450000	450000	450000	450000
HEATING REQUIREMENT kWh	116.28	523.26							
Heat delivered per kg			5243.00	8700.00	1755.25	2474.15	1312.15	4672.85	812.51
Total fuel required in kg			85.83	51.72	256.37	181.88	342.95	96.30	553.84
Cost/unit	6.00	6.00	58.00	78.00	4.00	12.00	4.00	28.00	3.87
Total cost PER day	697.67	3139.53	4978.07	4034.48	1025.49	2182.57	1371.79	2696.43	2143.36
Saving per day		2441.86	4280.39	3336.81	327.82	1484.89	674.12	1998.75	1445.68
Saving per day		6,10,465	10,70,098	8,34,202	81,955	3,71,223	1,68,530	4,99,688	3,61,420