Hot Sun Industries, Inc.

Burnaby BC
www.h2otsun.com
604 298 7095
ken@h2otsun.com

Kamloops BC
h2otsun@gmail.com
250 554 0589

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The following is a computer simulation study done for the City of Richmond, BC in an attempt to compare the boxed and glazed solar collector option to traditional swimming pool collectors also known as unglazed collectors.

The Minoru Aquatic Center 30m pool was simulated using Enerpool Pro 3, a solar pool heating software program endorsed and distributed by NRCan. Some of the inputs were assumed but kept constant between the unglazed simulation vs glazed and every attempt was made to favor the boxed and glazed option. Typical collector efficiency curves for each collector style were used. We used some data collected on a site visit we did in April, 1993. The portion of free stream wind normal to collector surface on the unglazed collectors was estimated at 25% of free stream wind. This is an important factor. 25% was the realistic number determined by high level monitoring of three unglazed panel systems on pools in Western Canada in 1995 funded by NRCan with the sole purpose of verifying this simulation software. This is all documented at www.h2otsun.com/enerpool.html Our web site demonstrates how we have used this simulation and verified its results ourselves all over North America since 2003 on many hundreds of real pools.

For comparison we used 30) 50 square foot (4.64sq m) solar collectors unglazed vs boxed and glazed.. The collector space assumed was the 45 degree slope south facing roof but note that if flat roof space is available , this can be even better in some cases for the unglazed collector option.

The unglazed system would cost $31500 installed and the boxed and glazed system would cost $150,000-$235,000 based on all comparable projects we have documented. . Unglazed systems are always direct whereas boxed and glazed collectors often transfer their energy to the pool via a heat exchanger. If glycol and a heat exchanger were used

there is not only a heat exchanger effectiveness that needs to be factored in but also the required higher operating temperature means the collector efficiency is reduced. Ignoring this tradeoff (in favor of boxed and glazed)

Unglazed	$31500 300GJ(annually)	$105/ GJ
Glazed	$150,000-@235,000 384GJ	$390-$612/GJ

If we assume a 22% loss due to the heat exchanger required in the boxed and glazed system, the outputs per sq ft are equal ! The output per dollar invested is 4-6 times better with unglazed collectors.

It is notable that the unglazed panel system if done with appropriate collector types, namely flexible Powerstrip collectors would carry a warranty longer than the simple payback period. Even the labor portion of the contract would carry a 10 year warranty under the typical contract arrangement we are used to delivering.

Whether or not the system would operate 12 months of the year or 8 depends a little on the mechanical considerations. Usually unglazed systems can be set up to operate at low pressure meaning the water is not present outside the heated space when freezes could occur. Due to a lack of freeze tolerance , boxed and glazed systems must be set up with glycol and a heat exchanger. If operated without a heat exchanger the thermal shock potential can wreak havoc with components. We've seen collector glazings explode when pool water was run through stagnating solar panels. There are additional technical difficulties associated with the high temperature breakdown of glycols.

The conclusion is that boxed and glazed collectors are not a solution to improving solar performance on indoor pools operating year round. Following are the summaries of the computer simulations. We'd be happy to go over the simulation program with your engineers, so these numbers can be further verified. See www.h2otsun.com/enerpool.html to download the program and learn how to use it.

UNGLAZED SYSTEM:

Enerpool v. 3.0.0 - Swimming Pool Simulation
Simulation File: C:\Users\Ken\Documents\Enerpool\minoruunglazed.epl
Run on: Sat Dec 04 10:52:45 2010

POOL CONFIGURATION:
- Solar Collector
- No Heat Exchanger
- Auxiliary Heater
- Weather file: C:\Users\Ken\Documents\Enerpool\Climate\VANC.TMY
- No Alternate Input File

POOL CHARACTERISTICS:
Pool Volume: 600 m3
Pool Area : 450 m2
Evaporation Model: RSPEC
Wind Correction Factor (Pool): 0.5

SOLAR SYSTEM CHARACTERISTICS:
Collector Type: Unglazed
Total Collector Area: 139.2 m2

SIMULATION SUMMARY UNGLAZED

	Passive	Active	Auxiliary	Total	Residual	Average
Mon	Gains	Gains	Heating	Losses	Gains	T Pool
	(GJ)	(GJ)	(GJ)	(GJ)	(GJ)	(C)
+---+---------+---------+---------+---------+---------+---------+
Jan	0.00	1.82	162.88	124.38	40.32	25.88
Feb	0.00	9.46	105.56	115.02	0.00	26.00
Mar	0.00	16.14	111.19	127.33	-0.00	26.00
Apr	0.00	30.95	92.40	123.35	0.00	26.00
May	0.00	38.37	89.09	127.46	-0.00	26.00
Jun	0.00	44.16	79.13	123.29	-0.00	26.00
Jul	0.00	53.50	74.38	127.87	0.00	26.01
Aug	0.00	48.52	79.28	127.80	-0.00	26.01
Sep	0.00	34.67	88.67	123.34	-0.00	26.00
Oct	0.00	17.18	110.00	127.18	0.00	25.99
Nov	0.00	3.28	119.84	123.12	0.00	26.00
Dec	0.00	1.87	121.31	123.18	0.00	26.00
+---+---------+---------+---------+---------+---------+---------+
|Tot| 0.00 | 299.92 | 1233.72 | 1493.32 | 40.32 | 25.99 |
+---+---------+---------+---------+---------+---------+---------+

SOLAR SUMMARY UNGLAZED

	Available	Collected	Piping	Pump	Active
Mon	Energy	Energy	Losses	Gains	Gains
	(GJ)	(GJ)	(GJ)	(GJ)	(GJ)
+---+---------+---------+---------+---------+---------+
|Jan| 20.00 | 1.80 | 0.00 | 0.03 | 1.82 |
|Feb| 34.79 | 9.39 | 0.01 | 0.08 | 9.46 |

Mar	55.56	16.02	0.02	0.13	16.14
Apr	77.63	30.75	0.02	0.22	30.95
May	87.38	38.12	0.03	0.28	38.37
Jun	87.06	43.87	0.03	0.32	44.16
Jul	96.57	53.17	0.03	0.36	53.50
Aug	87.59	48.23	0.02	0.31	48.52
Sep	68.80	34.44	0.02	0.25	34.67
Oct	47.86	17.04	0.02	0.15	17.18
Nov	21.73	3.23	0.01	0.05	3.28
Dec	17.71	1.84	0.00	0.03	1.87
+---+---------+---------+---------+---------+---------+
|Tot| 702.68 | 297.91 | 0.21 | 2.22 | 299.92 |
+---+---------+---------+---------+---------+--

THE BOXED AND GLAZED COLLECTOR EXAMPLE

Enerpool v. 3.0.0 - Swimming Pool Simulation
Simulation File: C:\Users\Ken\Documents\Enerpool\minoruglazed.epl
Run on: Sat Dec 04 10:52:07 2010

POOL CONFIGURATION:
- Solar Collector
- No Heat Exchanger
- Auxiliary Heater
- Weather file: C:\Users\Ken\Documents\Enerpool\Climate\VANC.TMY
- No Alternate Input File

POOL CHARACTERISTICS:
Pool Volume: 600 m3
Pool Area : 450 m2
Evaporation Model: RSPEC
Wind Correction Factor (Pool): 0.5

SOLAR SYSTEM CHARACTERISTICS:
Collector Type: Boxed and Glazed
Total Collector Area: 139.2 m2

SIMULATION SUMMARY BOXED AND GLAZED

	Passive	Active	Auxiliary	Total	Residual	Average
Mon	Gains	Gains	Heating	Losses	Gains	T Pool
	(GJ)	(GJ)	(GJ)	(GJ)	(GJ)	(C)
+---+---------+---------+---------+---------+---------+---------+
|Jan| 0.00 | 6.99 | 153.76 | 120.43 | 40.32 | 25.85 |

Feb	0.00	15.84	96.34	112.18	0.00	25.99
Mar	0.00	27.32	96.66	123.98	0.00	25.99
Apr	0.00	42.05	78.23	120.28	0.00	26.00
May	0.00	49.11	74.83	123.94	-0.00	25.99
Jun	0.00	50.73	69.22	119.94	-0.00	25.99
Jul	0.00	58.79	65.22	124.01	-0.00	25.99
Aug	0.00	53.18	70.85	124.04	0.00	25.99
Sep	0.00	39.89	80.17	120.06	-0.00	25.99
Oct	0.00	24.68	99.10	123.78	0.00	25.98
Nov	0.00	8.61	111.42	120.02	0.00	25.99
Dec	0.00	6.53	113.66	120.18	0.00	25.99
+---+---------+---------+---------+---------+---------+---------+
|Tot| 0.00 | 383.71 | 1109.46 | 1452.84 | 40.32 | 25.98 |
+---+---------+---------+---------+---------+---------+---------+

SOLAR SUMMARY BOXED AND GLAZED

	Available	Collected	Piping	Pump	Active
Mon	Energy	Energy	Losses	Gains	Gains
	(GJ)	(GJ)	(GJ)	(GJ)	(GJ)
+---+---------+---------+---------+---------+---------+
Jan	20.00	6.91	0.01	0.09	6.99
Feb	34.79	15.72	0.02	0.14	15.84
Mar	55.56	27.10	0.03	0.25	27.32
Apr	77.63	41.77	0.04	0.32	42.05
May	87.38	48.76	0.04	0.39	49.11
Jun	87.06	50.35	0.04	0.41	50.73
Jul	96.57	58.36	0.04	0.47	58.79
Aug	87.59	52.79	0.04	0.43	53.18
Sep	68.80	39.60	0.03	0.32	39.89
Oct	47.86	24.47	0.03	0.24	24.68
Nov	21.73	8.51	0.01	0.11	8.61
Dec	17.71	6.46	0.01	0.08	6.53
+---+---------+---------+---------+---------+---------+
|Tot| 702.68 | 380.81 | 0.36 | 3.26 | 383.71 |
+---+---------+---------+---------+---------+---------+

FURTHER DISCUSSION POINTS:

Note that we have estimated the numbers solely in order to prove that boxed and glazed collectors are not a solution to swimming pool heating. This is a common misconception and a mistake that is being repeated all over Canada as municipalities rush to satisfy budget and government incentive deadlines. This hurts our industry. This industry (solar pool heating) has been around a long time. It is nothing new. It has not been done on

commercial pools successfully and by successfully I mean reliably with good economics where the projects can be showcased and used to further markets. It has been done wrong over and over again with results like a 64 year return on investment that makes no-one look good, especially the solar industry. Unglazed plastic solar panels are pool heating solar panels. In fact a note of interest worth mentioning is that even when heating cold water to hot in a water preheating application, we have demonstrated under an NRCan funded IRAP grant in 1995 that unglazed collectors in that application do much better that the current status quo, boxed and glazed collectors. We did not commercialize that at the time (see www.h2otsun.com/PG3.html) We left the less attractive domestic and commercial water preheating markets to those dedicated to pursuing loftier "solar energy" goals. In doing so we left the door open for these "technologies of the future" to be transferred incorrectly to the viable applications of today. We're now pushing back because we feel the time is right for advancement of solar pool heating into municipal pools markets in Canada. It should be noted that the viability of evacuated tubes on pools is even worse.

Hot Sun's technology focus does not end here. It doesn't even begin. We have developed world class unglazed solar pool heating technology. Flexibility is key to cold weather survival and general durability. Competing flexible collectors are made of epdm synthetic rubber. This material is unsuitable for use with chlorinated swimming pool water. We will show you documented proof. The solar pool heating solution you need is home grown right here in Vancouver.

FINAL CONCLUSIONS:

In this case and in all cases we have experienced , boxed and glazed collector systems are so far less cost effective than the appropriate unglazed equivalent "swimming pool solar collectors" that they should not be part of the discussion.

Ken Wright,
BASc Mechanical Engineering UBC 1984
President, Hot Sun Industries Poway CA 858 627 9007
President Hot Sun Industries Ltd., Burnaby BC 604 298 7095
ken@h2otsun.com

Hot Sun is a Canadian company. Our main distribution and contracting arm operates out of Poway California (near San Diego) but our manufacturing and sales are mostly done in BC. Our unique technology, the Powerstrip solar collector was designed and built in BC specifically for this climate.