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Flat Plate Collectors v. Evacuated Tubes – A Brief Overview

The 1st Rule of Solar – Use the Right Collector for the Job

There is no single collector that can be labeled 'the most efficient,' as the efficiency of collectors depends on what they are hooked up to. For seasonal swimming pool heating, an unglazed collector (e.g., Sunearth Oasis or polymer collectors) will beat out a flat plate collector at a fraction of the cost. An unglazed collector can pull off this feat because it is heating a pool at 80 ˚F when it is right about 80 ˚F outside. Under those conditions, the collector is running at ambient temperature and has no heat loss, therefore it does not need to be insulated.

When we start moving up in temperature it becomes more important to insulate the collector against losses. Whereas collectors on seasonal pools operate within 10-20 ˚F of ambient, domestic hot water (DHW) collectors are designed to run through the colder winters and at higher temperatures in a wide range of 25-125 ˚F above ambient, depending on location and season. The last application of thermal is in high-end process heat such as steam production or powering absorption chillers in the range of 150 ˚F above ambient. Efficiency plots of the various collector styles against collector inlet fluid temperature above ambient are shown in the figure below. As discussed above, unglazed pool collectors dominate in low temperature applications 0-25 ˚F, flat plates hold sway in the mid range of 25-125 ˚F, and evacuated tubes come into their own at the upper end at 125+ ˚F. This is the reason why no particular collector has dominated the entire thermal market, each collector has its own place.

As you move from unglazed to glazed and on to evacuated tubes you move up and up in price. Evacuated tubes could be used to heat swimming pools, but it would not make economical sense to do so given that an unglazed collector is 1/10th the cost and 30% more efficient. The same holds true, to a lesser degree, for using evacuated tubes to heat domestic hot water.

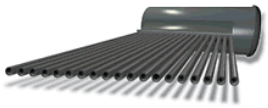


Photo courtesy Fafco

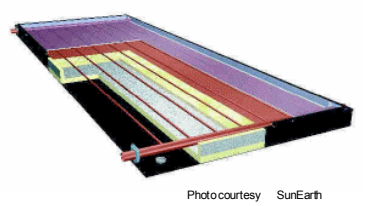


Photo courtesy SunEarth

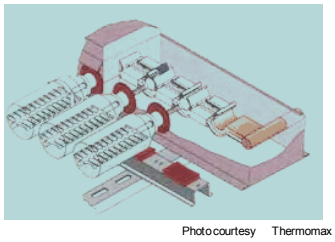
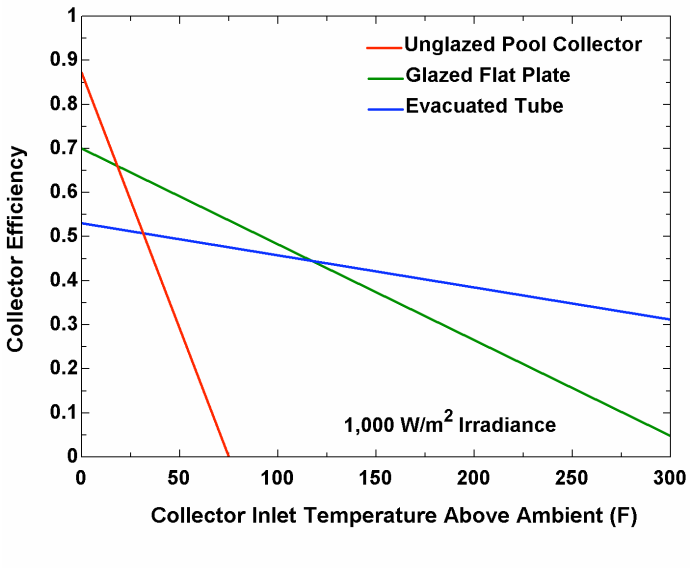


Photo courtesy Thermomax



What About Low-Sun Conditions?

The performance charts above are only part of the efficiency equation. The other factor is the amount of sunshine (i.e., irradiance) on the collector. The lower the amount of sun, the greater the advantage of glazed over unglazed and evacuated tube over glazed. However, this is a double edged sword as doubling the efficiency at low sun doesn't mean much if there wasn't much sun to begin with. Actual collector output is the input times efficiency (Input x Efficiency), therefore if the input is nothing to start with but your efficiency is high, you still don't get much out.

SRCC OG-300, the Final Word

Arguments could be made all day long about flat plates versus evacuated tubes and the benefits under various operating conditions. Flat plate collectors outperform evacuated tubes by 8,000 BTU's on sunny summer days, but evacuated tubes outperform flat plate collectors by 4,000 BTU's on cold cloudy winter days – on mildly cloudy cool days they break even. The only relevant, apples-to-apples comparison is to look at the SRCC OG-300 system ratings that compare collectors when they are connected to actual systems in actual climates. Sunearth has a system comprised of 2 EC-24 collectors (49.3 sq. ft. of black chrome flat plates) connected to an 80-gallon tank that is almost identical to a Thermomax Mazdon 30 (49.3 sq. ft of evacuated tubes), which is connected to the same type of 80-gallon tank. If you look, for example, at the SRCC OG-300 annual performance ratings for Seattle, Washington, which are modeled with real 20-year average weather data, you will find the following:

Company	Product Model	Technology	Surface Area (ft^2)	kWh/Year Savings
Thermomax	Mazdon 30	Evacuated Tube	49.3	1,800
SunEarth	TE64C-80-1 (EC-24 x 2)	Black Chrome	49.3	**2,200**
SunEarth	TE40C-80-1 (EC-40 x 1)	Black Chrome	40.8	2,000
SunEarth	TE40P-80-1 (EP-40 x 1)	Selective Paint	40.8	1,900

As you can see, the SunEarth system, which is identical in collector area, beats out the leading evacuated tube by 22% on annual savings. The SunEarth system even beats the evacuated tube by 6% with a single 4' x 10' painted absorber collector at a fraction of the evacuated system's cost. The reason the numbers fall this way is that overall performance depends more on your efficiency when the sun is out and the system is cranking away as opposed to when you can't see your own shadow in the middle of winter.