FLAT PLATE COLLECTORS OR EVACUATED TUBES - CHOOSE WHAT IS APPROPRIATE

LIFE EXPENCY: The first flat plate collector was manufactured in 1909 by the Day & Night Company in California. Many flat plates installed in South Florida in the 1930’s to 1940’s were still operational in the 1990’s. Between 1977 and 1986 the Solar Thermal Industry was a thriving vital industry with many Fortune 500 Companies manufacturing flat collectors & evacuated tubes. A salient fact is that many flat plate collectors installed during that time period are operational today. When re roofing (re installing collectors that were over 20 years old) it is noticeable that the flat plate collector headers and piping on non vented drainback systems look like new copper. These flat plate collectors installed in non vented drainback systems look like they will easily last 50 to 100 years if all fasteners are stainless steel , and the flat plate collectors are all copper plates and risers, with anodized aluminum framewalls , and tempered plate glass (page 73). Well serviced and maintained pressurized glycol systems also have flat plate collectors that look like they will last from the 1977 to 1986 time period to 2020 before the copper absorbers will need to be replaced.

Evacuated tubes history of holding the vacuum was not positive. Not a single manufactured evacuated tube collector installed in the USA or Worldwide except Thermomax between 1977 to 1986 lasted 10 years. I believe many types of evacuated tubes manufactured since 2000 that use soda lime glass like Thermomax will probably last 20 years. System stagnation will shorten the life of evacuated tube collectors and the absorber plate in pressurized glycol antifreeze systems. However you can expect well made flat plate collectors to last at least 30 to 100 years and the absorber plates can be easily replaced. When Evacuated tubes lose their vacum they cannot be repaired.

Test results by Pacific Gas and Electric Co. (PG& E California) department of electrical research (report 005.41-08.1 and 005-82.5) using ASHRAE 93-77 testing methods for solar collectors in the 1980’s in San Ramon, California were revealing. The amount of solar energy that falls on a square foot of collector area is constant – concentrating collectors, evacuated tubes, or flat plate technology does not affect that. The only way to increase the BTU’s collected is to increase collector area. Sizing of collector area according to PG and E is based on annual contribution not on maximum performance. Sizing should be based not only on delivery under ideal conditions (March 21 to September 21) but on year round output. PG and E testing involved evacuated tubes and flat plates measuring the collector productivity, capturing heat with evaluation of ambient temperature, different plane of collector (s)and the orientation to the sun. Wind velocity and physical properties of the collectors determine thermal efficiency under the same ASHRAE test standards that are used today for the SRCC test results. Flat plate collectors performance was not affected much up to a 40 angle of incidence to the sun. Evacuated tubes were much more sensitive due to the reflectivity of the curved tubes holding the vacuum. Evacuated tubes probably have improved since the 1980’s but the SHAPE of the curved tubes has not been altered.

Simply put, flat plate collector’s glass is still a flat surface on a flat plate collector and the curved tubes for evacuated tubes haven’t changed. The basic physics of sunlight relative to the angle to incidence to the glass of curved tubes or flat plates is the same today. PG& E testing revealed that evacuated tubes need to be at an optimum angle to the sun much more than flat plate collectors to achieve their potential of producing higher temperatures (See page 211).

PG & E found the optimum annual contribution for domestic hot water was with flat plate collectors when providing hot water to 145° F - for low temperature domestic water and space heating.

PG & E stated that evacuated tubes advantage was when the use for a storage temperature required was more than 100° F over the ambient air temperature. Their optimum application is heating over 160°F for industrial processing for up to 200°F. These PG and E results were confirmed by German Research in 2005 (page 2A.) Once again, flat plates out performed evacuated tubes from October through March for simple water heating and space heating. Snow and frost retention contributed to the evacuated tubes poorer than expected winter performance in the German testing.

Studies like these can help the contractor choose the best collector for the desired daily design temperature. A contractor choosing flat plate collectors should be aware of SRCC collector ratings during the colder months at their location. If higher than 145°F temperatures are required in severe winter conditions or over 180°F in the summer the evacuated tubes SRCC collector ratings should be evaluated. Flat plate or evacuated tubes should be evaluated on how much energy at the design temperature is required per dollar spent across the desired application. CHOOSE WHAT IS APPROPRIATE! Keep in mind an honest appraisal to the purchaser of past experience in evaluating the life expectancy of the collectors. (100 years on flat plates) in unvented drainback systems – 50 years in well serviced and pressurized glycol and open loop direct systems to perhaps 20 years for evacuated tubes. Stagnation will shorten the life of evacuated tubes and the absorbers in pressurized antifreeze systems. Flat plate collectors will heat water faster to 145°F than evacuated tubes, however, remember evacuated tubes can eventually hit much higher temperatures than the flat plate collectors. The basic physics of sunlight relative to the angle of incidence to the glass of curved tubes or flat plates is the same today. Evacuated tubes performance will drop off with greater angles of incidence to the glass to the sun than flat plates. Rotating the tubes i.e. turning the absorber south on tubes facing east or west will not change the angle of incidence to the glass and it will lower the performance from April 21 to August 21. The angle of incidence alone determines how much insolation gets through the glass to be collected. Thanks to Paul Menyhartz for the PG& E research.