

PAR Value Comparison Between SICCE LED and Radion
by John Tullock
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Photosynthetically Active Radiation, or PAR, as it's commonly called, is a term that's widely used in the aquarium hobby, and is often not well understood, especially when applied to LED lighting. When used correctly, PAR information can be very helpful in determining the best way to light a reef aquarium, and where best to place corals, clams, and other photosynthetic invertebrates. When misunderstood, it can lead to unnecessary and costly lighting purchases and have detrimental effects on your reef aquarium!^[1]

PAR is important because it is roughly the measurement of how much usable light energy is available to your corals and other reef tank inhabitants. PAR measurements, taken with an underwater PAR meter, allows determination of the exact amount of light the aquarium receives. Both too little and too much light can have negative consequences for photosynthetic organisms. Therefore, achieving the correct level of illumination throughout the aquarium is an important key to success.

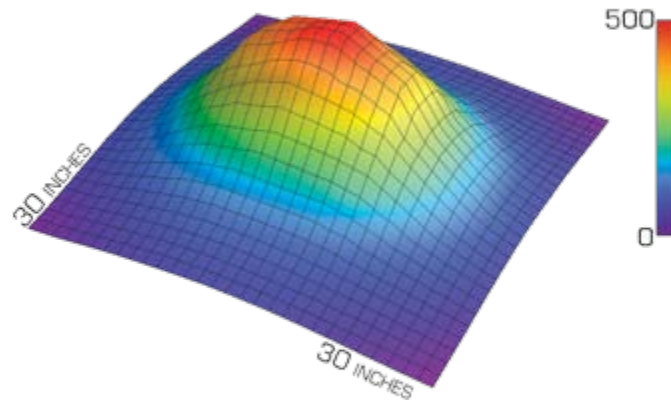
PAR values are most easily visualized by three dimensional graphs that show the light distribution over the entire area being illuminated. The graphs for many of the lighting systems on the market are in the shape of a pyramid, i.e., PAR values are highest in the center directly below the light source, even reaching levels that many consider dangerous for corals. The PAR value drops off dramatically as one moves away from the center. This is done in order to achieve desirable PAR values on the surrounding area, but often only a few inches away from the center. At the edges of the tank, the PAR drops to nearly zero.

What SICCE has done in order to solve this is to design a unit that produces a uniform “curtain” of illumination that achieves maximum PAR values over the entire tank area, not just in the center.

^[1] Captive Aquatrics.com

Comparison With Radion's Published Data

Here is the PAR Distribution graph for the Radion™, as published on the Ecotech web site. [LINK HERE]



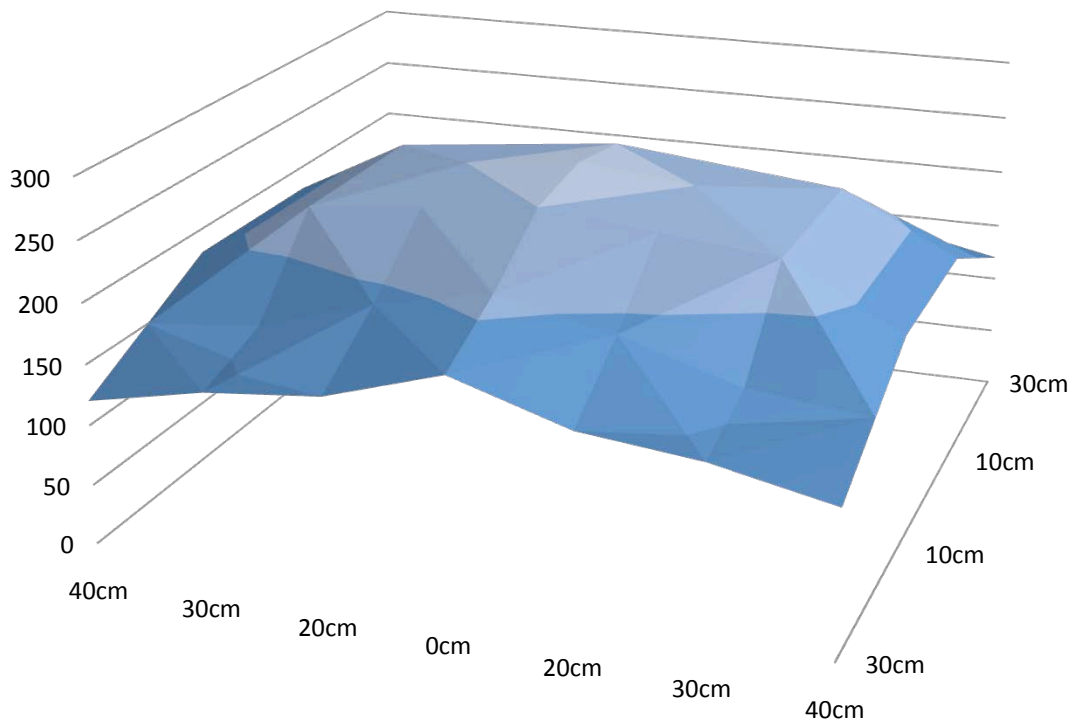
PAR Distribution

From this graph it can be seen that the Radion™ unit provides >400 PAR in the center, but the level drops dramatically as one moves away from the center. For most of the aquarium, the PAR values range from 80 to 159. At 15 inches (38 cm) from the center, the Radion™ unit PAR value is near zero. At the same point, the Sicce unit gives a reading >100. (see below)

The graphs on the following pages show PAR measurements for the AM366. From these it can easily be seen that the unit creates a more uniform distribution of light over the entire tank area, and

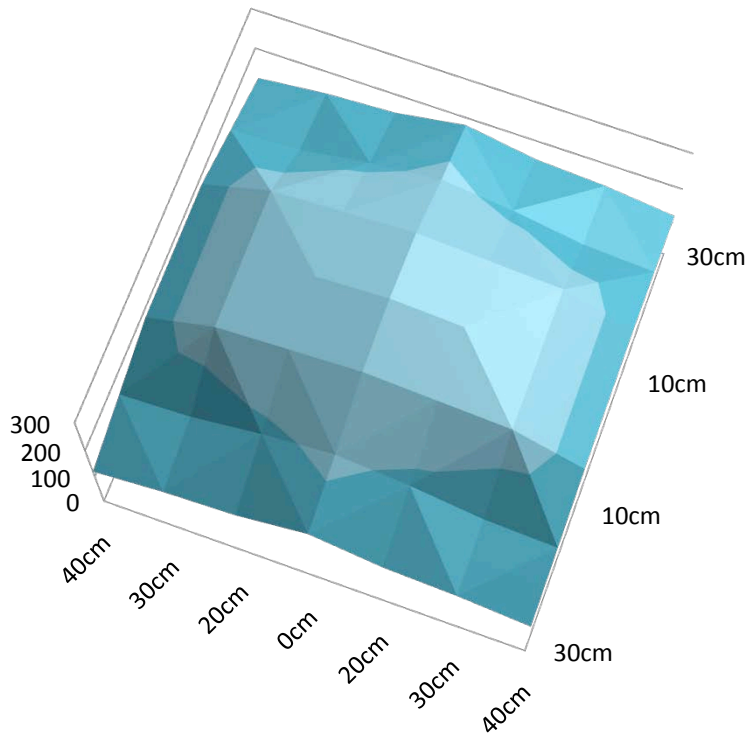
AM 366 PAR

■ 0-50 ■ 50-100 ■ 100-150



AM 366 PAR

■ 200-300 ■ 100-200 ■ 0-100



Evaluation of PAR Value Distribution for Sicce LED Lighting Systems

The coverage and homogeneity of light intensity over the entire tank is impressive. We are suggesting the AM366 model for a tank of maximum length of 60 cm (23.65 in.) but PAR values >100 were measured even at 40 cm (15.75 in.) from the center. Therefore, the unit could actually be used for larger tanks.

Our technology and design have resulted in LED lighting systems that use less energy to illuminate the largest possible aquarium size, with an even distribution of light over the entire tank area. Energy use is minimized by optimizing LED output. The number and arrangement of LEDs insures that homogeneous light will reach all corals in the tank.

Photosaturation, Photoinhibition and Coral Growth

Adequate light intensity is essential for proper growth and development of many photosynthetic marine organisms. However, *too much* light can have deleterious effects. Depending upon the physiology of a given organism, high light levels may result in *photosaturation* (the point at which the rate of photosynthesis ceases to increase with increasing light intensity) and *photoinhibition* (the point

at which increased light intensity actually lowers the rate of photosynthesis). Dana Riddle carried out measurements on several species of marine invertebrates, and the results were posted online in 2007

<http://www.advancedaquarist.com/2007/3/aafeature1>

A brief summary of Riddle's results reveals marked variation in photosaturation and photoinhibition points among different species of invertebrates. For example, in *Pocillopora meandrina*, photosaturation occurred at a PAR value of 275 $\mu\text{moles of photons/m}^2/\text{sec}$, and photoinhibition at 425. *Porites lutea*, on the other hand, has photosaturation and photoinhibition values of 400 and 750, respectively. Not surprisingly, the two coral species host different varieties of zooxanthellae. *P. lutea* is able to live in tide pools, where it experiences not only high light intensity but also thermal stress.

Given that the photosaturation point for many invertebrates popular with reef hobbyists lies in the range of 350-400 $\mu\text{moles of photons/m}^2/\text{sec}$, there may be some risk of damage to certain corals if placed directly below the Radion unit. For example, rice coral, *Montipora capitata*, which is typically found at depth of 30 meters, sometimes settles in shallow water areas where light intensities are much higher than its normal range. With a photosaturation point of about 135 $\mu\text{moles of photons/m}^2/\text{sec}$, this coral often appears bleached and stunted when it is found growing in a tide pool.

Conclusion

The Sicce LED unit provides an even curtain of light in the proper range of PAR values for the majority of photosynthetic reef invertebrates maintained in hobbyist aquariums. Radion's lighting unit provides overly-intense illumination directly underneath the lamp, and the intensity drops off rapidly as one moves away from the center.