Cadmium Sulfide vs. Silicon

Electronic photocontrols are available today with a choice of two kinds of light sensors: Cadmium Sulfide (CdS) Photocells and Silicon (Si) Phototransistors. Some photocontrol manufacturers promote one or the other; actually there are advantages and disadvantages to each. As a manufacturer of electronic photocontrols with both kinds of light sensors, DTL understands the issues.

So, how does a utility decide? Here are a few ways to think about this decision:

How do light sensors work?

A CdS cell is a large area photo resistor, made by depositing doped cadmium sulfide on a ceramic substrate. The CdS cell resistance changes in proportion to the amount of visible light; this allows more or less voltage/current to appear at the input of an electronic switching circuit. They can be uncoated, plastic cased, plastic dipped, or glass-to-metal hermetically sealed.

A silicon sensor is a small area silicon junction in a clear epoxy package. Silicon photosensors are available in several forms, including phototransistors, photodiodes and photodarlingtons. When a silicon sensor is exposed to light, particularly red or infrared light, current flows.

For both kinds of sensors, DTL's electronic circuit senses these changes and provides a DC voltage to the coil of a power relay. The relay then switches the lighting load that the photocontrol is operating.

What are the performance differences between CdS and Si sensors?

1. Is it dark yet? CdS photocells have excellent correlation with human eye spectral response. In other words, cadmium sulfide sees a color spectrum of light very similar to that seen by most people's eyes. Thus CdS cells can measure the useful light that is illuminating the roadway and being seen by people.

Silicon sensors, on the other hand, have peak sensitivity to infrared and red light; they are almost insensitive to blue and green. Thus silicon sensor controls have their turn ON and OFF radically affected by a cloud cover and atmospheric pollution. In comparison with comparable CdS controls, the switch points of silicon sensor controls appear to wander from day-to-day. The only way to make silicon sensors more consistent is to use infrared absorbing filters. More on this later.

2. What about drift? Failures in low cost, non-electronic CdS photocontrols have created the impression that CdS is bad. This is incorrect. Electronic controls, properly designed around quality CdS cells, have very low drift. This is a fundamental principle of DTL's D Series CdS controls such as our widely-used D120-1.5.

The design of almost all low-cost controls (including AC relay and thermal utility controls) causes CdS cells to be overpowered or thermally abused. As a result, many of these controls tend to change switch points with time (cell drift) and have high failure rates.

Silicon is more resistant to very high temperatures and contamination. Therefore silicon should be considered in areas with extreme environmental conditions. This is why DTL offers our DP Series silicon sensor controls such as our DP120-1.5, our most frequently-ordered silicon sensor control.

What's in use in the field?

1. Quality electromechanical photocontrols with CdS cells came into common use in the 1960s. They were relatively expensive (e.g. $20.00-$25.00). Some of those installed 25 years ago are still in use, still meet original OFF/ON specifications, and have saved many maintenance calls.

2. Use of silicon sensors has grown with the use of electronic photocontrols. However, it's not only the cell but the rest of the electronic circuit that makes the difference. With electronic controls, you get better surge protection, stronger mechanical parts, electronic components, stringent QA, etc.

3. Silicon sensor controls are usually the best choice for 1000 watt or 400 watt floodlights.

What's new?

For years it has been known that, if a glass infrared blocking optical filter is placed inside the control in front of a silicon sensor it will eliminate sensitivity to infrared. The result is a filtered silicon photocontrol that has the advantages of both CdS and silicon with none of the disadvantages.

However, glass filters are expensive. That said, recent advantages in polymer technology have made filtered silicon economically viable. Polymer filters add very little to initial cost, and in some very hot parts of the world, will pay back by eliminating switch point drift. Long and short term stability are very good. Typical model would be DE124-1.5.

Any other considerations?

1. If your specification says silicon sensor, you can be sure of getting electronic controls. All controls using silicon sensors use electronics to control the output relay.
2. Because of the day-to-day wandering of unfiltered silicon sensors, they are not recommended for applications requiring precise or consistent daily turn ON and turn OFF performance. If you want to use silicon, you should consider filtered silicon.
3. Disposal of CdS may be a real or perceived issue for your utility. Although there are only tiny amounts of CdS in electronic controls, if disposal is a current or coming issue, silicon sensors should be considered.
4. All DTL controls, except for the D Series CdS controls, are RoHS compliant. This means DTL restricts the use of mercury, lead, hexavalent chromium, cadmium and a range of flame retardants notably polybrominated biphenyls and polybrominated diphenyl ethers in the manufacturing of its products. This makes the disposal of DTL controls more environmentally friendly.

DTL would be happy to recommend the right sensor and photocontrol for your specific applications.