TECHNICAL DATA SHEET

Description:

Polywater® Solar Panel Wash™ (SPW) effectively cleans PV panels and maximizes power generation. Its special formulation removes a wide range of contaminants such as air pollution residue, pollen, bird droppings, dust, and volcanic ash. It is designed with a rinsing aid to eliminate the need for deionized (DI) or reverse osmosis (RO) water. The SPW™ solution rinses clean without spotting.

Polywater® SPW™ works without damaging specialty polymer coatings and without oxidation or abrasion to metallic rails and mounting brackets. Its use has been approved by many global solar panel and cleaning equipment manufacturers.

Polywater® SPW™ is safe for users and the environment. It quickly biodegrades, so it will not affect surrounding plant life or water-table/aquifers. SPW™ contains no solvents and is non-corrosive.

Reduces Water Use:

Polywater® SPW™ is more effective than water alone. As a result, soils are removed more efficiently and *less water is used*. Field experience proves this:

Polywater® SPW™ was tested at a winery in India where the existing cleaning procedure used 5 liters of water alone per panel. Using a 25:1 water-to-SPW™ mix, only 3 liters were required to clean 10 panels. *Water use was reduced by a factor of 15*.

In a Mexican trial, approximately 1.7 liters of SPW™ solution was used per panel. Water use was also reduced in this field trial.

Polywater® Solar Panel Wash™ has a spot-free rinse, eliminating the need for deionized water. Elimination of deionized water yields more water savings, since it takes more than a gallon of water to create one gallon of DI or RO water.

Efficient cleaning saves water and is more environmentally appropriate. It is an effective cleaning method that also saves labor time.

Product Features:

- Effectively removes all types of contaminants
- Cleans efficiently, conserves water
- Works without deionized water
- Quick sheeting action—dries without spots
- Biodegradable—does not harm the environment
- Does not contain solvents or corrosive soaps
- Compatible with anti-reflective films, metal rails, and mastics

Approvals:

Polywater® Solar Panel Wash™ is approved for use on most types of solar panels by the following manufacturers:*

- Canadian Solar
- Solar World
- JASolar Technology Co.
- Sixvan Intelligent Systems Technology Co.
- Noark-Electric Co.

** Approval letters available upon request.*

Compatibility:

Polywater® SPW™ Solar Panel Cleaner is compatible with PV panels and is approved by multiple panel manufacturers. It is compatible with:

- Specialty Films
- Aluminum Rails
- Cables and Wiring
- Mastics and Sealants

Test Method: Panels were placed against a south-facing wall at a 45° angle, at American Polywater's factory in Stillwater, MN.

A sprinkler sprayed the panels with ground water for 15 minutes at 3:00 each morning. Water conductivity was measured at 95 µS, approximately 67 ppm water hardness. The panels were exposed to Polywater® Solar Panel Wash SPW™ using the following process over a two-week period:

1) Monday: Between 8:00 and 10:00 a.m. each panel was rinsed with a 25:1 solution of the Solar Panel Wash SPW™ in water. The panel was then scrubbed with a very soft brush, then rinsed again with the 25:1 SPW™ solution and allowed to dry without any further water rinse.
2) Tuesday–Friday: Between 8:00 and 10:00 a.m. each day, both panels were rinsed with the 25:1 SPW™ solution and allowed to dry.
3) The panels were not cleaned over the weekends, but the sprinkler continued to spray the panels with groundwater for 15 minutes at 3:00 each morning.

Conclusion: Modules were re-flashed after they were returned to SolarWorld. No degradation of the antireflective coatings or other irregularities to the panels were detected after application of American Polywater Corporation's Solar Panel Wash (SPW™).

Environmental Impact:

Polywater® SPW™ Solar Panel Wash is readily biodegradable per OECD Guidelines. Materials must be 60% biodegraded within 10 days to meet these OECD Guidelines. The resulting products of biodegradation are carbon dioxide and water. Because Polywater® Solar Panel Wash SPW™ is so biodegradable, it does not accumulate in the environment. Polywater® Solar Panel Wash SPW™ is the environmentally safe solution to cleaning solar panels.

Physical Properties:

SPW™ is a clear, odorless, non-caustic liquid cleaner that contains no solvents. It is freeze-thaw stable and safe to use.

Property	Result
Initial Boiling Point	~100°C
Specific Gravity	1.0
pH	Neutral
Solvent/Volatile Content	None
Phosphate Content	None
Ammonia Content	None
Flashpoint (ASTM D93)	None

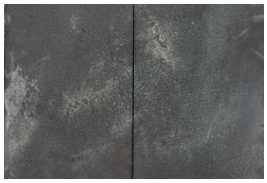
Cleaning Effectiveness:

SPW™ Cleaner removes a broad range of ash, dust, oils, and organic matter, rinsing the contamination clean from PV surfaces and aluminum rails.

Bentonite, oils, and salts were coated on glass panels to test cleaning efficacy. A 25:1 solution of the Solar Panel Wash SPW™ in water was used to clean the surface. Cleaning solution effectiveness was compared to a water control.

Panels are coated and dried for 24 hours to set. Contaminated surface is lightly and evenly sprayed with either SPW™ cleaning solution or DI water control. Wetted surface is lightly passed with soft cleaning brush, then rinsed with tap water. Result is noted.

Contamination	SPW Solution	Control
Bentonite and Mineral Oil	Excellent (4)	Poor (1)
Salt Solution and Bentonite	Good (3)	Fair (2)
Bentonite and WD-40®	Excellent (4)	Fair (2)



Before cleaning

Control *SPW*

SPW™ diluted 25:1 emulsified oils and lifts dusts. It simplifies and speeds the cleaning with less scrubbing and faster dry times.

Usage Directions:

General Maintenance Note:

Inspect the entire solar array system prior to cleaning to detect loose or broken wires and panels, or improperly functioning apparatus. Make necessary repairs before cleaning. Schedule quarterly cleaning and maintenance to keep system operating at theoretical maximum output.

Solar Panel Wash SPW™ Usage Recommendation:

Recommended dilution ratio is 1 part Solar Panel Wash SPW™ to 25 parts water (25-1). For heavily soiled areas, use either a higher SPW™ cleaner concentration or more rinsing. The cat #SPW-35HS hose adapter package has a selector switch atop the sprayer to toggle between the 25-1 and water-only ratios.

Always schedule panel cleaning early in the morning or at night when it is cool. This will minimize thermal stress on photovoltaic cells and protective glass that could damage the panels.

1) Use 25-1 Solar Panel Wash™ solution to rinse panels. Rinsing removes loose sand and debris from the panels and protects them from scratching when brushes are used in Step 2 below. In locales known for hard water, deionized water can be used to dilute the SPW™. It is okay to rinse with local water only. **Wet only the number of panels that can be brushed and rinsed before the SPW™ solution dries.** Large arrays may need to be cleaned section by section. Use heavier amounts of SPW™ on areas with bird droppings or other organic matter.
2) Scrub panels with a very soft brush (Hog's Hair or similar). Rinse the brush bristles frequently when cleaning heavily soiled arrays to reduce scratching. The use of brushes also helps agitate the SPW™; dirt tends to "carry" or be lifted from the panels better. Water alone—even deionized water—will not lift or carry dirt adequately. SPW™ is far more effective at removing residue and cleaning panels.
3) Allow the contamination and SPW™ solution to shed from the panel surface. Repeat Steps 1 and 2 if hard-to-remove contamination remains.
4) Rinse the panels with a 25-1 SPW™ solution and let dry; otherwise, rinse with deionized water or local water supply.
5) If desired, buff dry, clean panels with blue microfiber cloths followed by white microfiber cloths for a fine finish.

End Uses:

- Utility-Owned Solar Farms
- Industrial Arrays
- Commercial Arrays
- Residential Ground and Rooftop-Mounted Panels

Washing Panels Increases Performance:

Regular cleaning maximizes PV system performance and longevity. A 2011 World Academy of Science, Engineering and Technology study concluded that "accumulated dust on the surface of photovoltaic solar panels can reduce the system's efficiency by up to 50%."[1]

In an EPRI study, industry stakeholders estimate "panel washing can improve efficiencies by as much as 10-15%."[2]

Cleaning maximizes return on investment. It is especially effective on flat, low-tilt panels. Google cleaned solar panels on their campus for the first time after 15 months of operation, and energy output doubled. A second cleaning, 8 months later, resulted in a 36% increase in output.[3]

Even small areas of contamination can have a significant impact on panel performance. Solar cells connected in series are only as good as the lowest performing cell. Cleaning is also a good practice to avoid hot spots.

[1] Sulaiman S, et al, "Effects of Dust on the Performance of PV Panels." *World Academy of Science, Engineering and Technology. International Journal of Mechanical Aerospace, Industrial, Mechatronic and Manufacturing Engineering* Vol: 5, No 10, 2011. Web. 23 January 2017.

[2] "Addressing Solar PV Operations & Maintenance Challenges: A Survey of Current Knowledge and Practices." *EPRI*, Palo Alto, CA. 2010. 1008434.

[3] Lam, Winnie. "Should you spring clean your solar panels?" Google Official Blog, 31 July 2009. Web 23 January 2017.

Model Specification:

The statement below may be inserted into a customer specification to help maintain engineering standards and ensure work integrity.

The solar panel cleaning solution shall not contain solvents or other volatile components. It shall be non-toxic with a neutral pH for safe handling. It shall be biodegradable based on OECD standards.

The solar panel cleaning solution shall remove a wide range of contaminants including dust, ash, clay, pollen, industrial grime, and bird excrement. The cleaning solution shall rinse with a thin, water-shedding film to minimize spotting.

The solar panel cleaning solution shall be compatible with all panel components. It shall be approved and tested by solar panel manufacturers.

Order Information:

Cat #	Package Description
SPW-35LF	1-qt bottle with flip-top cap (.95 liters)
SPW-35HS	1-qt bottle with hose sprayer attachment (.95 liters)
SPW-128	1-gal pail (3.8 liters)
SPW-640	5-gal pail (18.9 liters)

LIT-SPWTECHSPEC/REV002.

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