REFA BRIEF

Renewable Energy Farmers of America

Solar Panels & Chemical Safety

Solar panels are primarily composed of glass (around 77-80%), aluminum (10-14%), silicon (3-5%), and polymers, with only trace amounts of metals such as cadmium, copper, tellurium, and lead in very small quantities. The most common types of solar panels are crystalline silicon (c-Si) and cadmium telluride (CdTe) panels. Both types are considered safe for the environment.

Solar panels contain minimal amounts of metals that are safely sealed within glass and other non-toxic materials. Multiple scientific studies and EPA testing confirm that intact solar panels do not leach toxic chemicals into soil or water under normal conditions.

What Are Solar Panels Made Of?

Solar panels are primarily composed of common, non-toxic materials:

- **Glass (75-80%)**: Standard tempered glass that protects the internal components
- **Aluminum (8-14%)**: Used for frames and electrical contacts
- **Silicon (3-5%)**: The semiconductor material that converts sunlight to electricity
- **Polymers and other materials**: Various plastics and encapsulants that seal the panels

The Two Main Types

Crystalline Silicon Panels (95% of market):

- Made mostly of inert materials like glass and aluminum
- Contain less than 0.1% lead, which is encapsulated within non-porous glass
- Lead content is about 1/750th of what's in a car battery

Cadmium Telluride Panels (CdTe):

- The semiconductor layer is only 3% the thickness of human hair
- Sealed between two sheets of heat-strengthened glass bonded under high pressure
- CdTe compound is 99% less toxic than elemental cadmium and has a very high melting point

Scientific Testing Results

EPA Testing Standards: Solar panels are regularly tested using the EPA's Toxicity Characteristic Leaching Procedure (TCLP), which subjects materials to conditions far more extreme than real-world exposure. The test involves:

- Crushing panels into small pieces
- Exposing them to acidic solutions
- Agitating for extended periods

Research Findings:

- Even under these extreme laboratory conditions, solar panels consistently pass EPA safety tests
- Multiple studies show minimal release of toxic substances, even when panels are deliberately damaged
- The encapsulation design prevents chemical leaching under normal environmental conditions

Important Note on Studies: Some research has found chemical leaching when solar panels are deliberately crushed and subjected to extreme acidic conditions in laboratory settings. However, these studies specifically note that such extreme conditions don't represent normal operational or environmental scenarios.

Real-World Safety

Normal Operation:

- Intact panels show no evidence of chemical leaching during their 25+ year lifespan
- The encapsulation design specifically prevents water penetration and chemical release
- Panels are designed to withstand extreme weather including hail, high winds, and temperature fluctuations

Fire Safety: Solar panel fires are extremely rare (less than 0.01% of installations), but when they occur:

- First responders are trained in proper safety protocols
- Standard firefighting equipment and procedures effectively manage any risks
- Most solar-related fires result from electrical issues, not the panels themselves

End-of-Life Management

Waste Characterization: When solar panels reach end-of-life, some may be classified as hazardous waste depending on TCLP testing results. However:

- This classification is based on potential future leaching in landfills, not operational safety
- Proper recycling programs are being developed to recover valuable materials
- The EPA is developing new rules to improve solar panel recycling

What This Means for Farmers and Ranchers

Solar panels installed on your property:

- Do not pose chemical leaching risks to soil, crops, or livestock under normal conditions
- Are designed with multiple safety layers to prevent chemical release
- Meet strict safety standards before reaching the market
- Can operate safely for 25+ years when properly installed and maintained