Progress in Recycling of Retired Cadmium-Telluride Photovoltaic Modules

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Recycling Retired Photovoltaic Modules to Valuable Products, Where Are We Standing?

- Used PV Modules
- Processing Facility (Ion Exchange Separation)
- PV Module Fragments
- Tellurium Product
- Cadmium Metal
- Clean Glass

Energy Efficiency and Renewable Energy
CdTe Module Fragments (Crushed with Hammer Mill)

Components of the fragments
- Glass: 97%
- EVA flakes: 3%
- Cd: ~0.06%
- Te: ~0.075%
- Cu
Ion Exchange Separation Device

Influent solution:
Te-~1000 ppm
Cd-~900 ppm
Cu-~150 ppm
H$_2$SO$_4$: 0.5 M (pH: ~0.53)

US Patent Pending: Assigned Series Number- 60/686,911
Ion Exchange Separation with Two Columns in Series


Influent flowrate: 7.5 BV/hr.

Cd and Cu Removal: 99.95-99.99%
Cd and Cu in Effluent:<1ppm
Tellurium Products

Tellurium precipitates

Container
Elution of Ion Exchange Resin

Elution curve (Resin: Dowex 50, Eluted with 5.0 M H₂SO₄)
Cadmium Product

Cadmium metal plate deposited

Cathode electrode

Cadmium metal plate deposited
Clean Glass (Pass TCLP)
Our Achievements

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–Fthenakis, V.M. and Wang, W., Advances in the Recycling of Cadmium Telluride Photovoltaic Modules, submitted to *Progress in Photovoltaics*