New approaches for Recovering and Recycling EVA and sheet from c-Si EOL PV Modules from India

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Objective: To develop sustainable recycling strategies by adopting a circular economy approach for managing EOL solar PV waste, India.

Introduction:

Projection of emerging End-of-life PV waste modules volume by 2050,India.

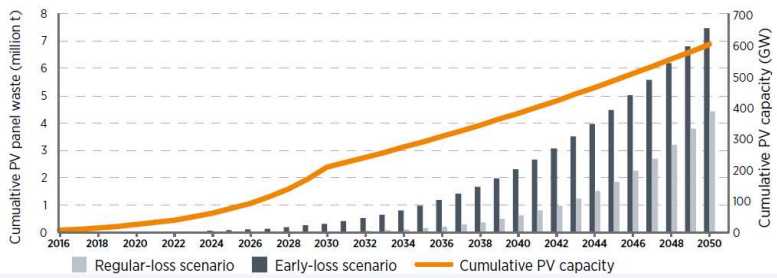
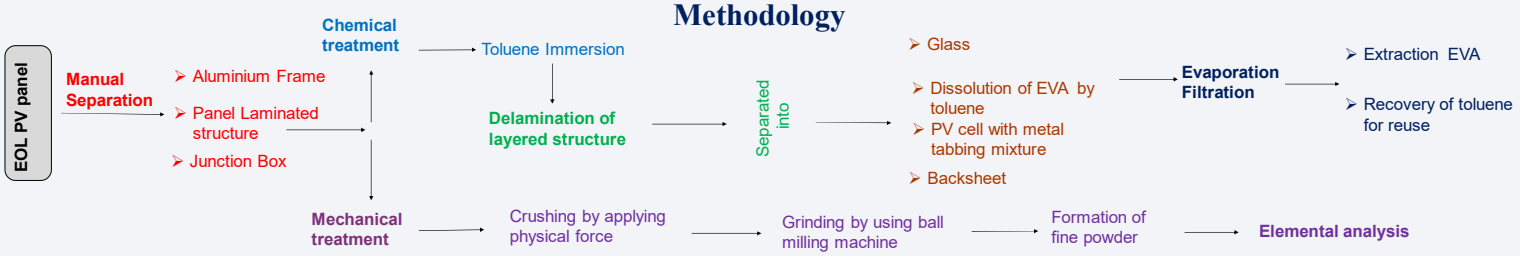


Figure 1: Illustrates the future problem, i.e. associated with the emerging EOL photovoltaic panel waste, in India [1].

- Recovery and reuse of valuable metals such as silver, aluminium, copper, and silicon from c-Si PV panels are of economic interest [2].
- Toxicity is also associated with this PV technology, as it contains lead, silicon, and copper that are harmful to the ecosystem and human health. Hence, it requires a proper waste management process such as recycling [2].
- The polymers such as EVA and back sheet associated with c-Si PV panel waste are also of concern since they release toxic gases when incinerated.
- First generation c-Si upcoming waste panels contain about 76% glass (panel surface), 10% polymer (encapsulant & backsheet foil), 8% aluminium (the frame), 5% Metallurgical silicon (solar cells), 1% copper interconnectors) and <0.1% silver (contact lines) and other metals (mostly tin & lead) [1].

Methodology



Experimental investigation:

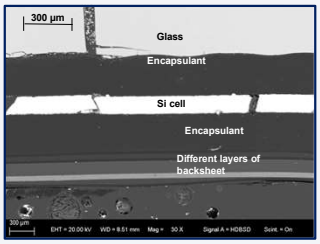


Figure 2: Electron microscopy cross section image of end-of-life c-Si solar panel showing composition and different layers present in solar cell. Chemical composition can be determined by EDX measurements.

Figure 3: Chemical treatment of EOL PV panel waste sample by the dissolution process in an organic solvent basically toluene.

Chemical recycling approach

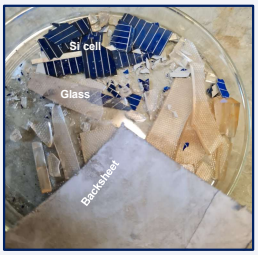


Figure 4: Laminated PV panel layered structure separated into different components after immersing into toluene.

Figure 5: Extraction of EVA from toluene by evaporation filtration and manually recovered fractions of PV cell for further elemental analysis.

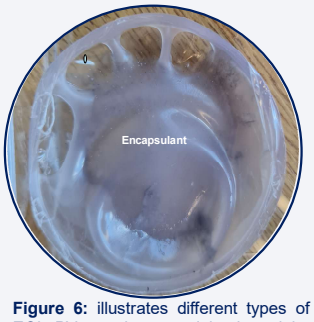


Figure 6: illustrates different types of EOL PV panel waste delaminated by using different kind encapsulated available at the time when they manufactured.

Discussion & Future work:

- In this research study, the recovery of Si cell, encapsulant and backsheet is carried out by an organic solvent (toluene) dissolution method followed by chemical treatment.
- However, the experimental investigation is done on EOL PV panels waste from India. Also,finding reveals that different types of encapsulant and backsheet were used during their manufacture process.
- Variety of Encapsulated used in these waste panel play a crucial role for developing appropriate recycling process.
- To develop and investigate the appropriate recycling process that can be eco-friendly & cost-effective, focusing on green chemicals and processing methods, and appropriate for the informal economy.
- Ongoing findings will be helpful for further data analysis and find applications of secondary raw material in the respected field.

Conclusion:

The purpose of this research study is to find an appropriate recycling methodology using a combination of chemical, thermal & mechanical recovery approaches that can provide a simple solution to informal solar PV recycling sector in developing countries.

References

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[2] Dias, P., et al., Comprehensive recycling of silicon photovoltaic modules incorporating organic solvent delamination-technical, environment and economic analyses. Resources, Conservation & Recycling 165 (2021) 105241.

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