CSP Water Heater

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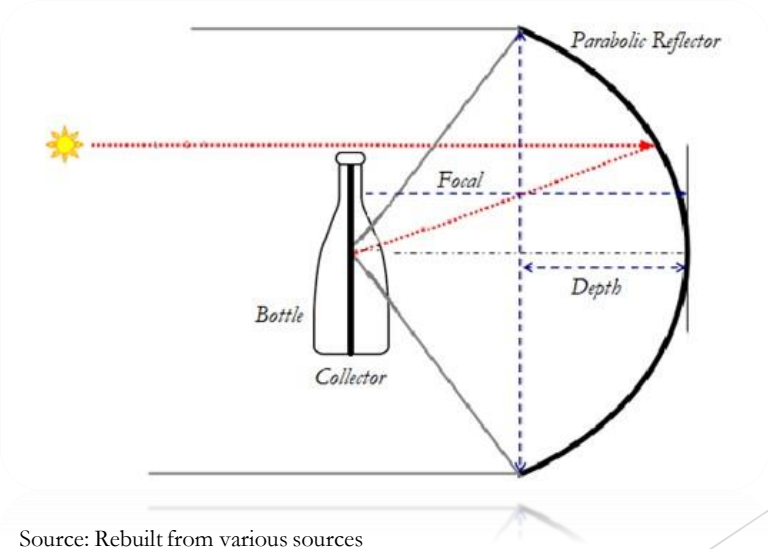
Abstract

- Aim: Introduce the concept of a cheap, DIY design for a solar water heater
- Application: For rural areas, low-capita income, with cold whether
- Requirements: Reused satellite dish, foil/wrapping paper, bottle, PVC/metal pipe

Principle

- Parabolic dish acts as concentrator
- Bottle is heated from the inside – 100% of energy directly transferred to surrounding water from receiver
- Heat losses only from water to surface of bottle, limited by covering bottle with wrapping paper



Source: Rebuilt from various sources

Design

- CSP is an established technology so why is this different? Our set-up recycles/uses cheap products
  - Concentrator - Recycled satellite TV dish which acts as an efficient parabolic concentrator
  - Water storage - Fully transparent plastic or glass bottle
  - Receiver - PVC pipe, best coated with non-reflective paint

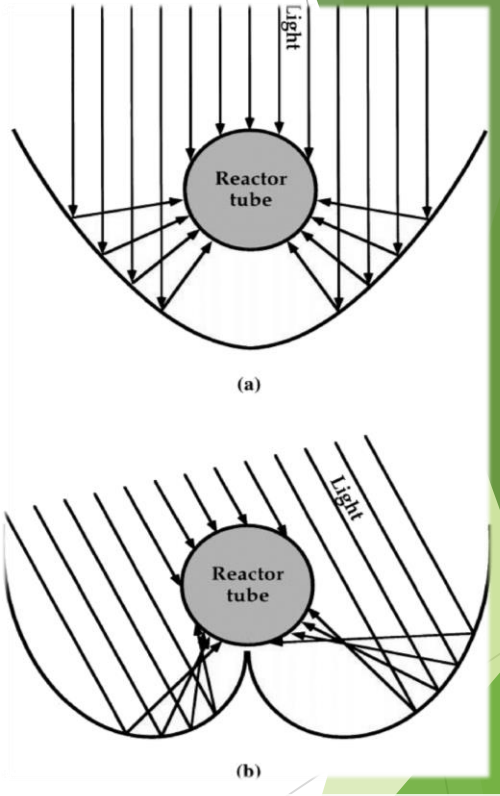
Video: https://www.youtube.com/watch?v=eoZ5gvtdADc

Testing and Results

- This CSP setup was capable of heating a 5L bottle (PET plastic) to 70C in (ambient 25C) in ~2 hours
  - Or ~0.4KWh of energy saved
- Results achieved under constant sunshine with no cloud cover (over 'winter'; Nov – Jan)
- **System is much cheaper than current Solar Thermals and far more efficient at heating applications vs. direct electricity from PVs**
- Quite durable if used with care (4 months with minimal deterioration). The aluminum foil/wrapping paper comes with some inherent protection and has reduced heat wear due to its high reflectivity
- **Practical concerns:**
  - Device requires sun-tracking adjustments every ~45mins to align the focal point to receiver
  - Dish must be cleaned occasionally
  - Care must be taken to avoid aligning focal point in direction of person or flammable objects (e.g. youtube.com) . Sunglasses are highly recommended

Other Design Considerations

- Other configurations include;
  - Linear Fresnel Reflectors (LFR)
  - Parabolic Trough Collectors (PTC)/ Compound Parabolic Concentrators (CPCs)
- For e.g. tracking is often a problem with CSP devices, therefore a CPC configuration would largely mitigate this
  - Do not require actuation to track the sun – high acceptance angles



(a) Parabolic trough collector (b) a compound parabolic collector

Source: Solar photocatalysis for water disinfection

Industrial Uses

- Industrial scale heating applications e.g. supportive heating fo (e.g. food processing, sterilizing, drying, preheating of boiler feed, etc)
- Water disinfection and even desalination
- High power application can be used to drive steam turbines for electricity generation

Fig: Baotou, Mongolia, heating to shopping centers

Source: https://www.solarthermalworld.org

Fig: Morocco's 160MW Noor I plant

Source: http://www.horizon-ste.eu/about-ste/

Fig: 100MW Kathu CSP in South Africa

Source: https://www.ee.co.za/article/kathu-plant

Aim

- Find interested partners willing to explore the merits and feasibility of both small and large scale CSP application locally
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Thank you!