Long-Term Thermal Energy Storage by Combining Thermochemical Reactions and Chemical Separation

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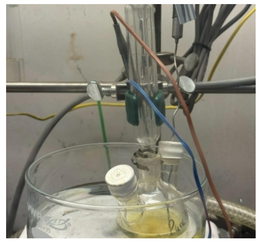
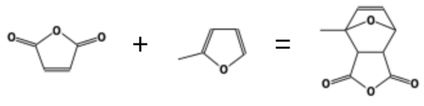
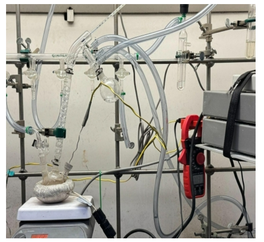
Can **reversible Diels–Alder reactions** be used to store and transport low-grade industrial waste heat efficiently in a **liquid-phase** thermochemical system?

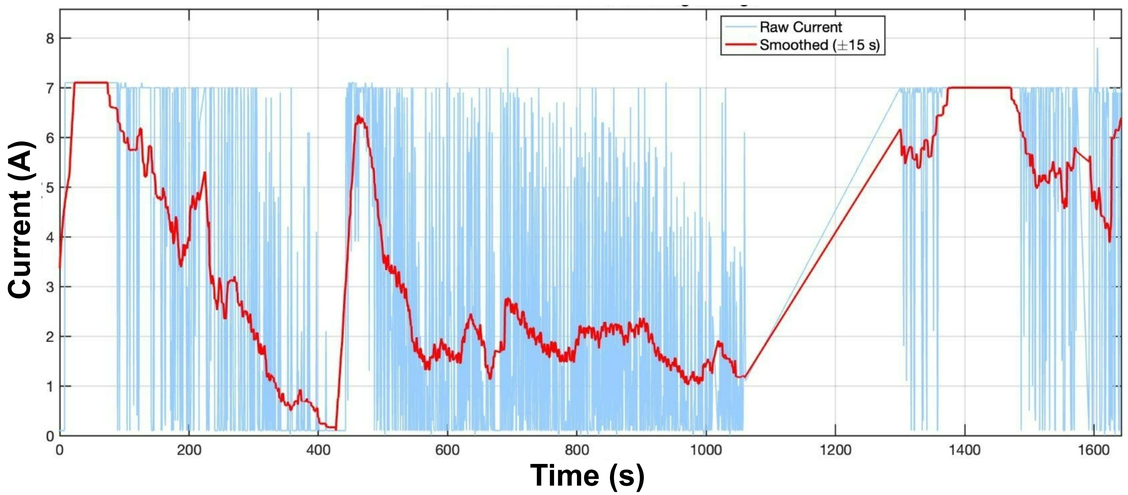


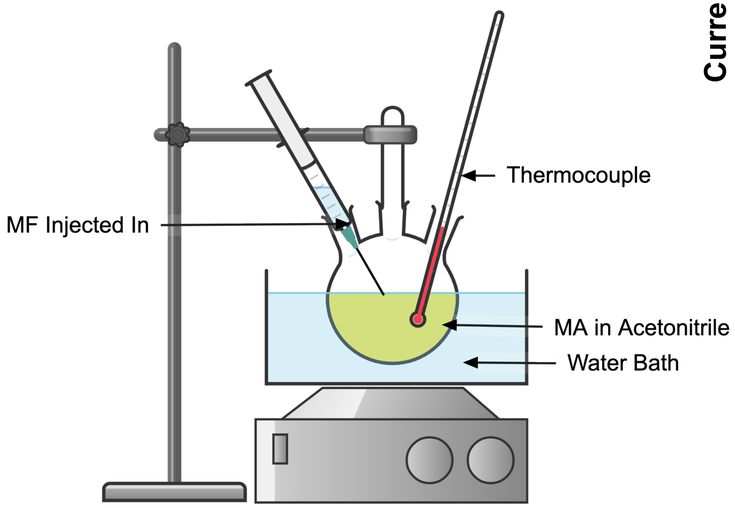


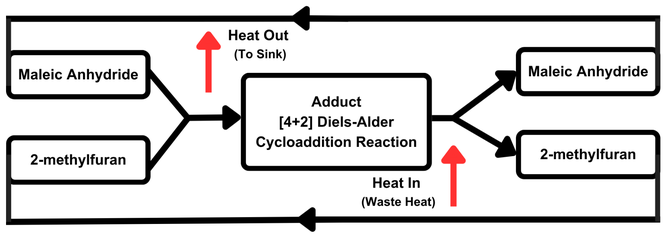
Reaction Enthalpy = –58.5 kJ/mol

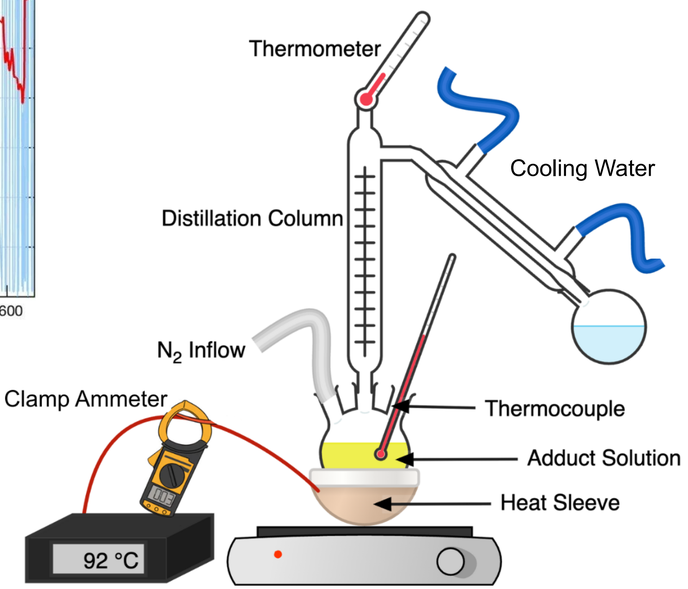
Maleic Anhydride + 2–Methylfuran ⟷ Adduct + Heat











FORWARD REACTION

Reactants combine to form new chemical bonds, **releasing heat** in the process. The **energy released** during the reaction is **measured** using a **water bath**. **Recombination** of the products back into the adduct is an efficient method for **recovering thermal energy.**

FUTURE WORK AND IMPACT

The reaction's **reversibility and stability** will be evaluated over **multiple thermal loops** to assess long-term performance. Scaled systems could **recover industrial heat**, support **district heating** and long term thermal **energy storage**, turning waste heat into a **reusable resource**.

REVERSE REACTION

Heating the adduct **breaks** chemical bonds, **absorbing heat** in the process. **2-Methylfuran distills** first, confirming decomposition and enabling **chemical recycling**. Electrical input is tracked with a **clamp ammeter** to calculate energy required for the breakdown.

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