EP-DT
Gas Detector

PERFORMANCE EVALUATION OF ADSORBENTS FOR R134- ADSORPTION

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ADSORPTION TECHNIQUE & ADSORBENTS

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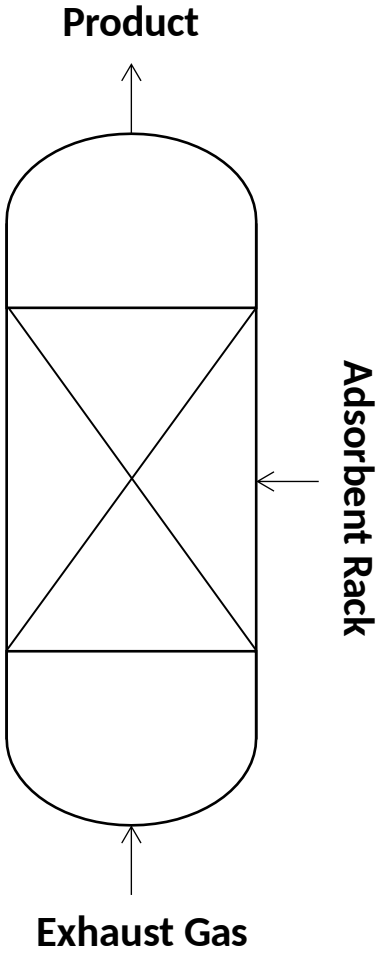
Surface phenomenon where molecules adhere to adsorbent, enabling selective capture and separation from gas mixture for recovery or purification. **Why Adsorption?**

- **High Purity and Selectivity**
- **No Phase Separation Issues**
- **Regeneration and Reusability**
- **Safety Advantages**
- **Compact and Modular Design**



An **adsorbent** is a solid material that **captures and holds** molecules from a gas or liquid onto its surface e.g. MOFs, COFs, Zeolites, Membranes and Porous polymers

Candidates are Zeolites like **13X** and MOFs like **Aluminium Fumarate, ZIF4** and **DUT67,** due to their higher selectivity towards R134a

SETUP & TESTING

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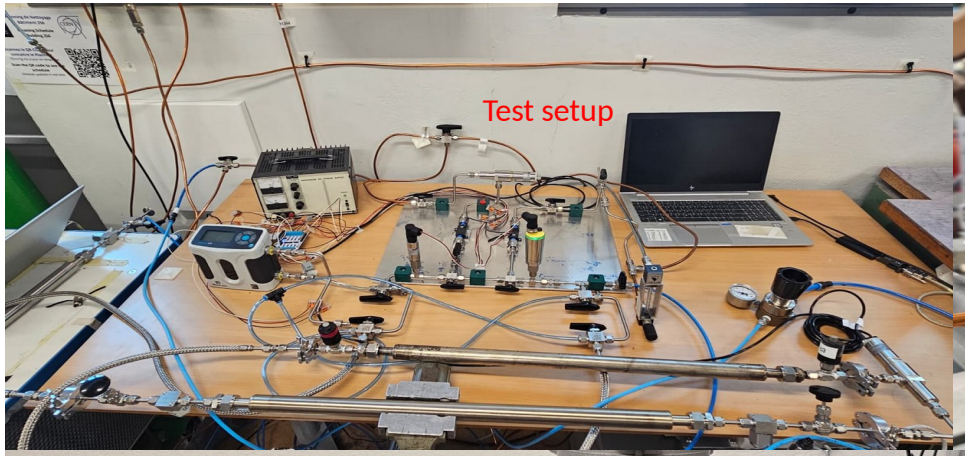
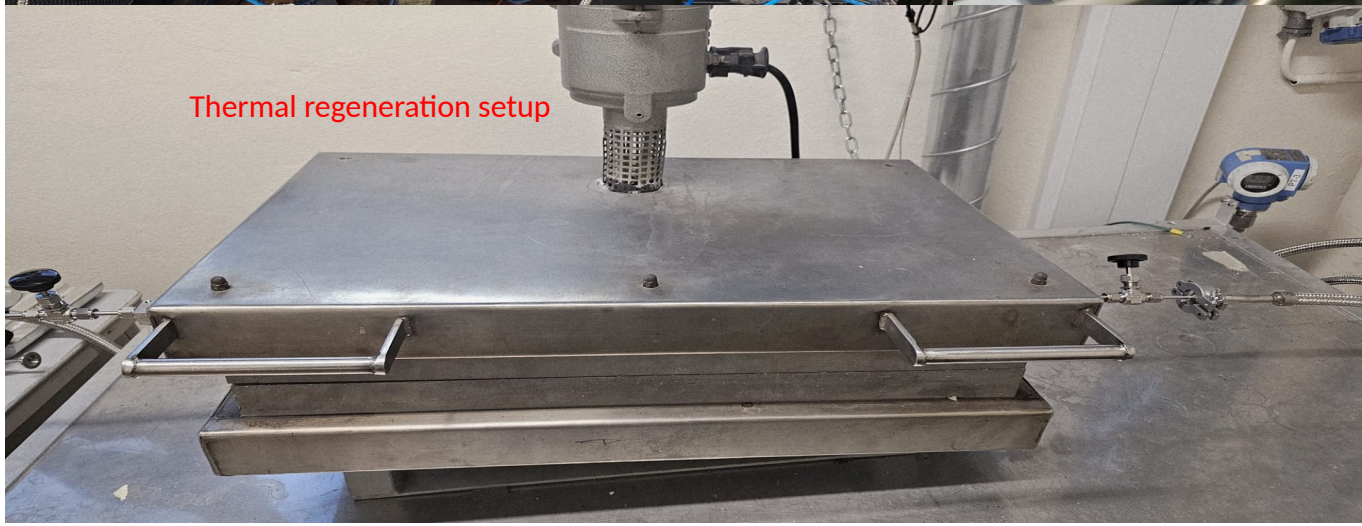
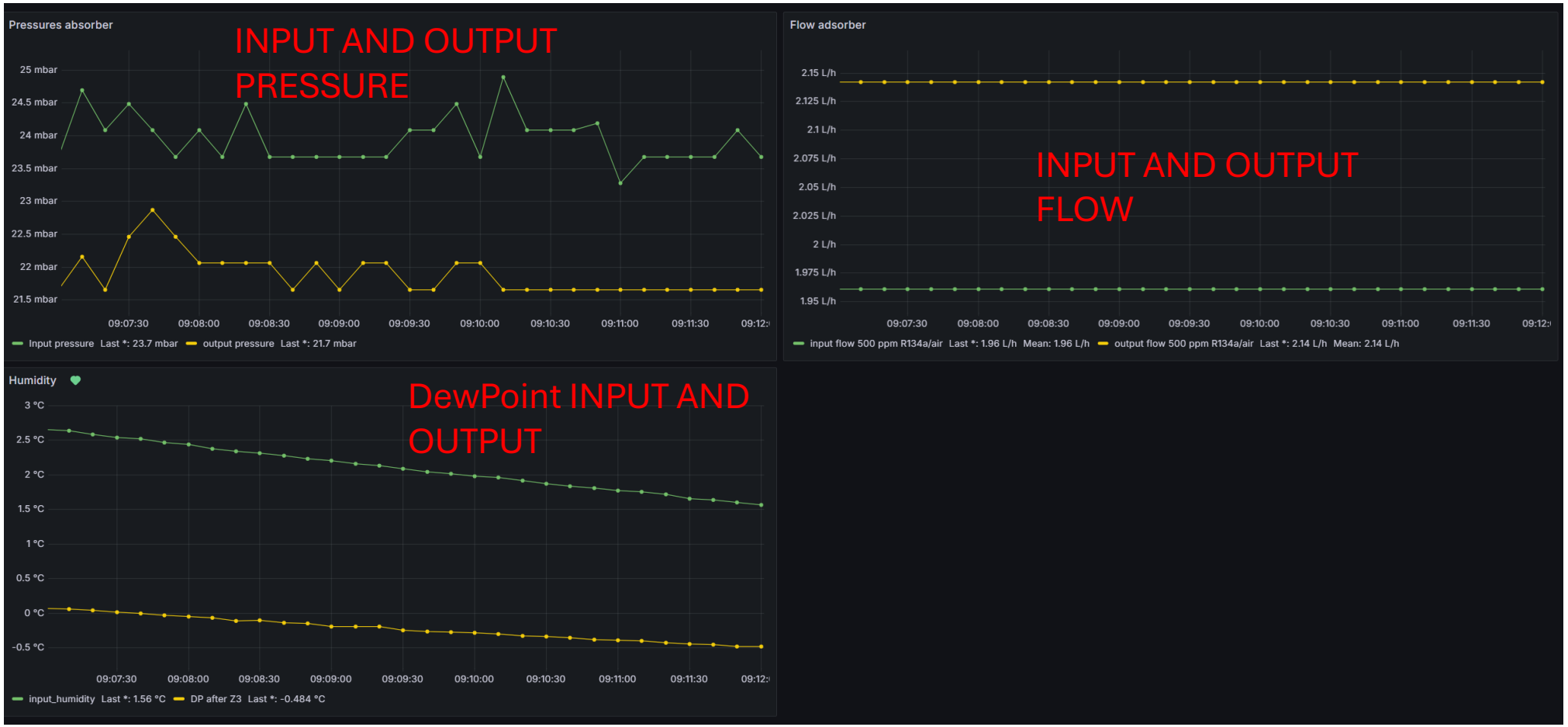
Testing:

- Choose test conditions (Material, gas composition, and type of regeneration (using thermal or vacuum, depends on the material and condition))
- Continuously run gas mixture through cartridge
- Using GC, reads the output of gas mixture from cartridge
- Allow us to plot break through curve using GC data
- Breakthrough curves gives adsorption capacity of material under specific conditions





GRAFANA MONITORING



Thanks to this Grafana panel we can monitor the status of the test online

Thanks a lot Mattia V!

RESULTS COMPARISON – Thermal vs Vacuum

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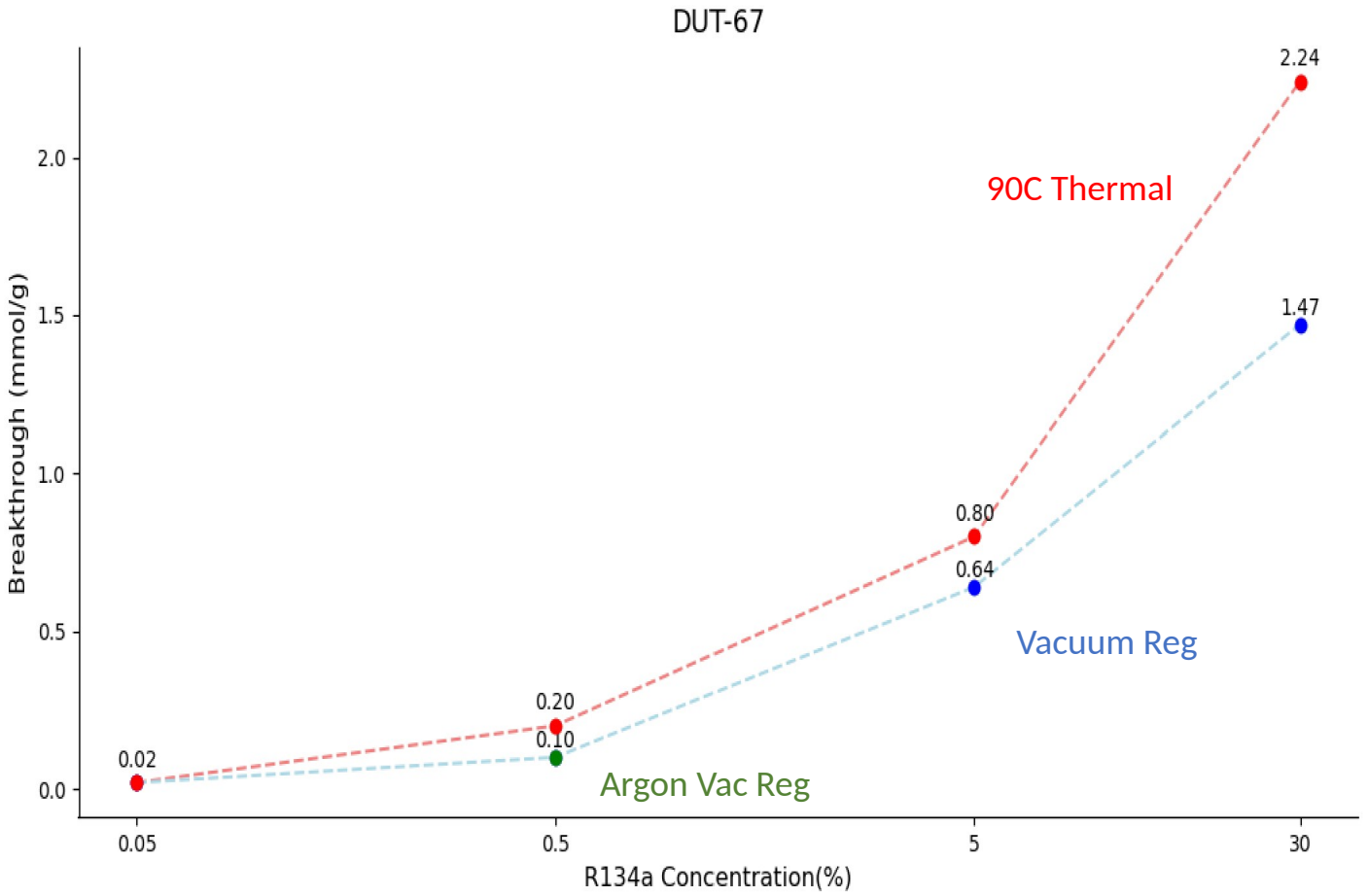

- Thermal regeneration is performed by flushing with Argon at 90°C using a pump (TSA)
- Vacuum regeneration done by cycling pressure in a vacuum to remove adsorbed species from the adsorbent, ~ **-940 mbar** (VSA)
- Argon vac regeneration is process uses a combination of vacuum (to lower pressure, through pump, ~ **-940 mbar**) and flushing Argon ~**10-15L/h**) to remove adsorbate from adsorbent. (Closer to VPSA)

RESULTS COMPARISON – CERN Lab vs Journal data

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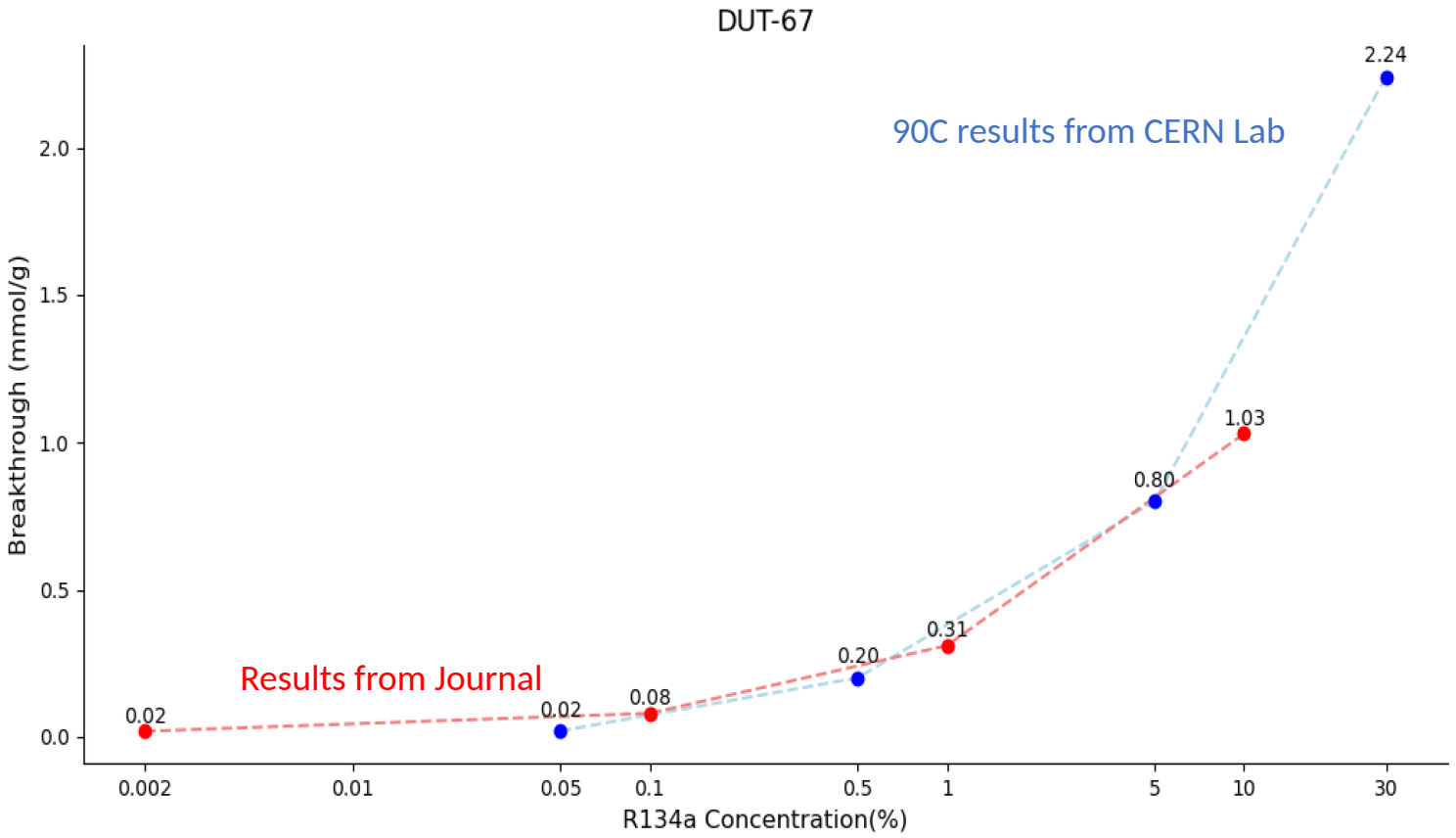

- The results are obtained using thermal regeneration with Argon purging at 90C for ~ **8 hrs heating and 8 hrs cooling time**(TSA)
- From the journal all tests done in fixed column with different flow of gas mixture and regeneration done at 110C with Helium purge

  for 10% , flow were 10mL/min

  for 1% , flow were 20 mL/min

  for 0.1% , flow were 10 mL/min

  for 0.002% , flow were 50mL/min
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FUTURE

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- Planning to lower the concentration to **100PPM**
- ZIF4 (MOF) is ready to test for same coditions
- Working on simulations for finding out diffusion, structural selection, and adsorption capacity for easier experiment executions using **MC (Monte Carlo)**, and MD (Molecular Dynamics) simulations using LAMMPS