Immersed Cooling of Electronics

(Program: Sustainable Energy Engineering)

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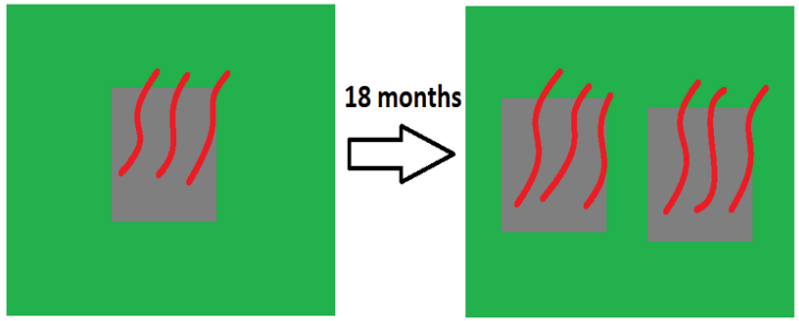
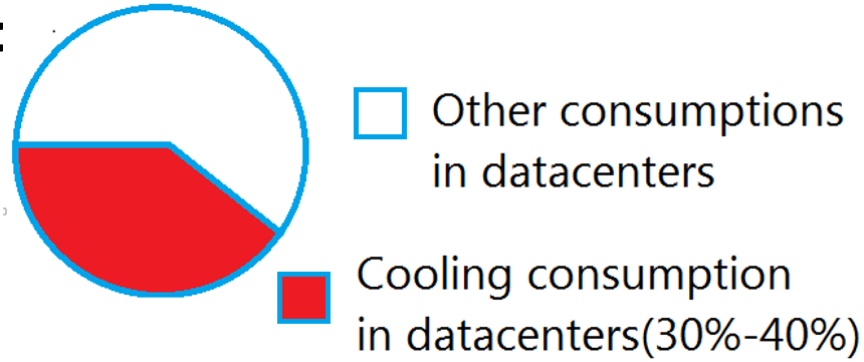
The challenges for cooling of electronics:

- Rapid **increase in power dissipation** in electronics along with Moore's law



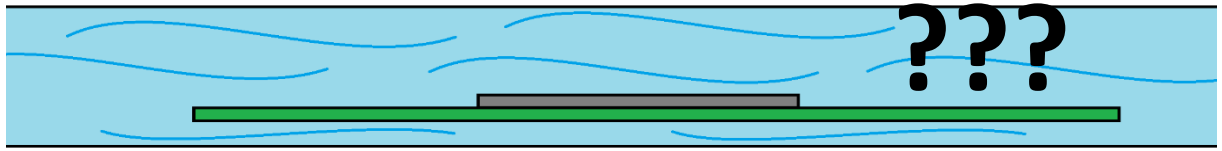
- Rapid **increase in energy consumption** of electronics:
  The energy consumption of cooling electronics contributes 30-40% of the total consumption in datacenters.



The Approaches to meeting those challenges:

natural air convection → forced air convection(e.g. fans) → liquid cooling (e.g. heat pipe)

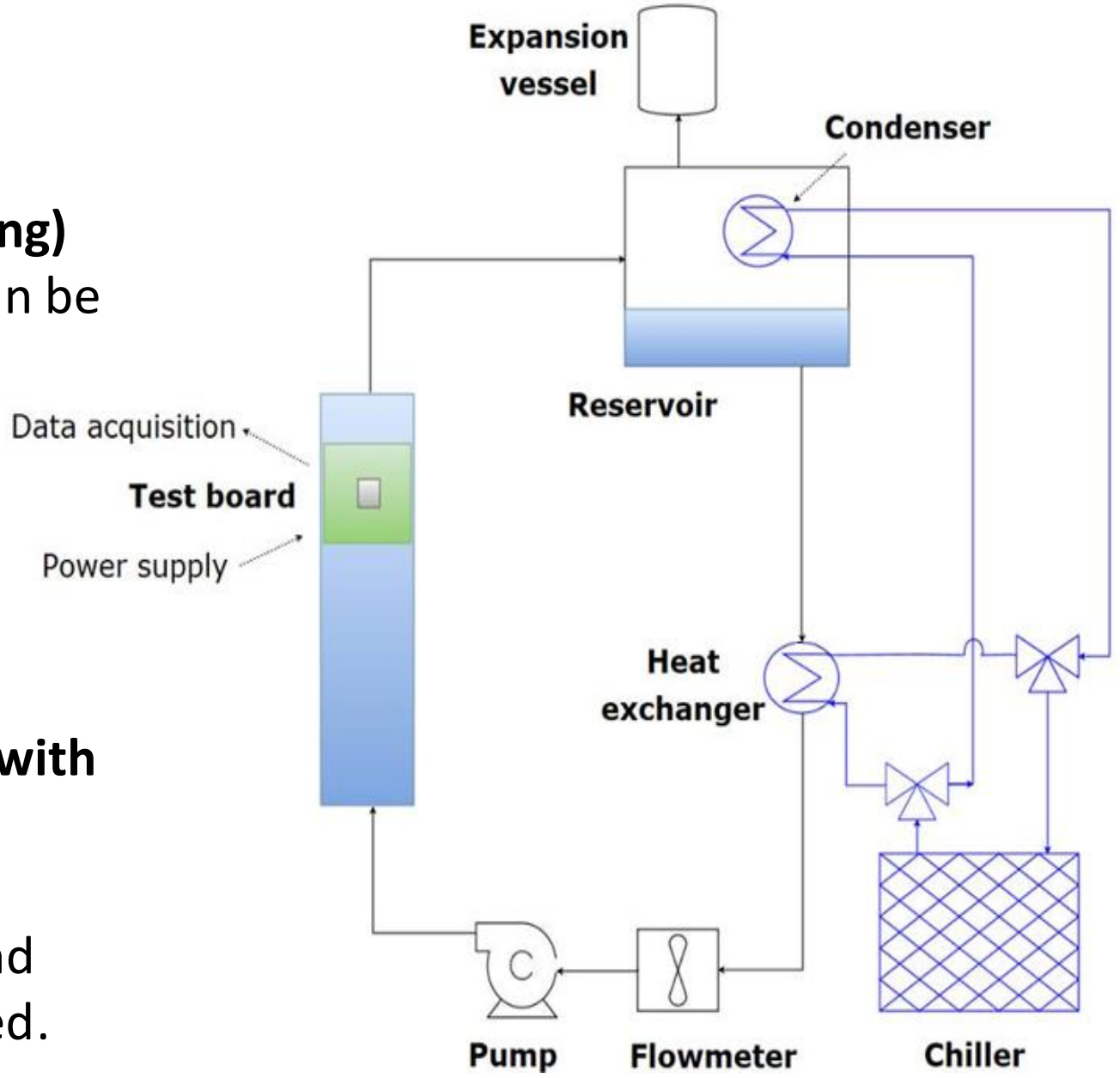
→ Is **immersed liquid cooling** practical**???**



(The green PCB board along with the grey component is totaly immersed in the dielectric liquid.)

The experiment and research:

- To **design** and **build** a system which can apply both **single-**and **two- phase (boiling) immersed liquid cooling**. (Our system can be seen on the right side.)
- To obtain a deeper understanding of the **characteristics** and **process** of both **single-** and **two- phase (boiling)** cooling.
- To **compare** the results of liquid cooling **with air cooling** with the same geometry.
- **Heat flux limits** for air cooling, single- and two-phase liquid cooling will be examined.

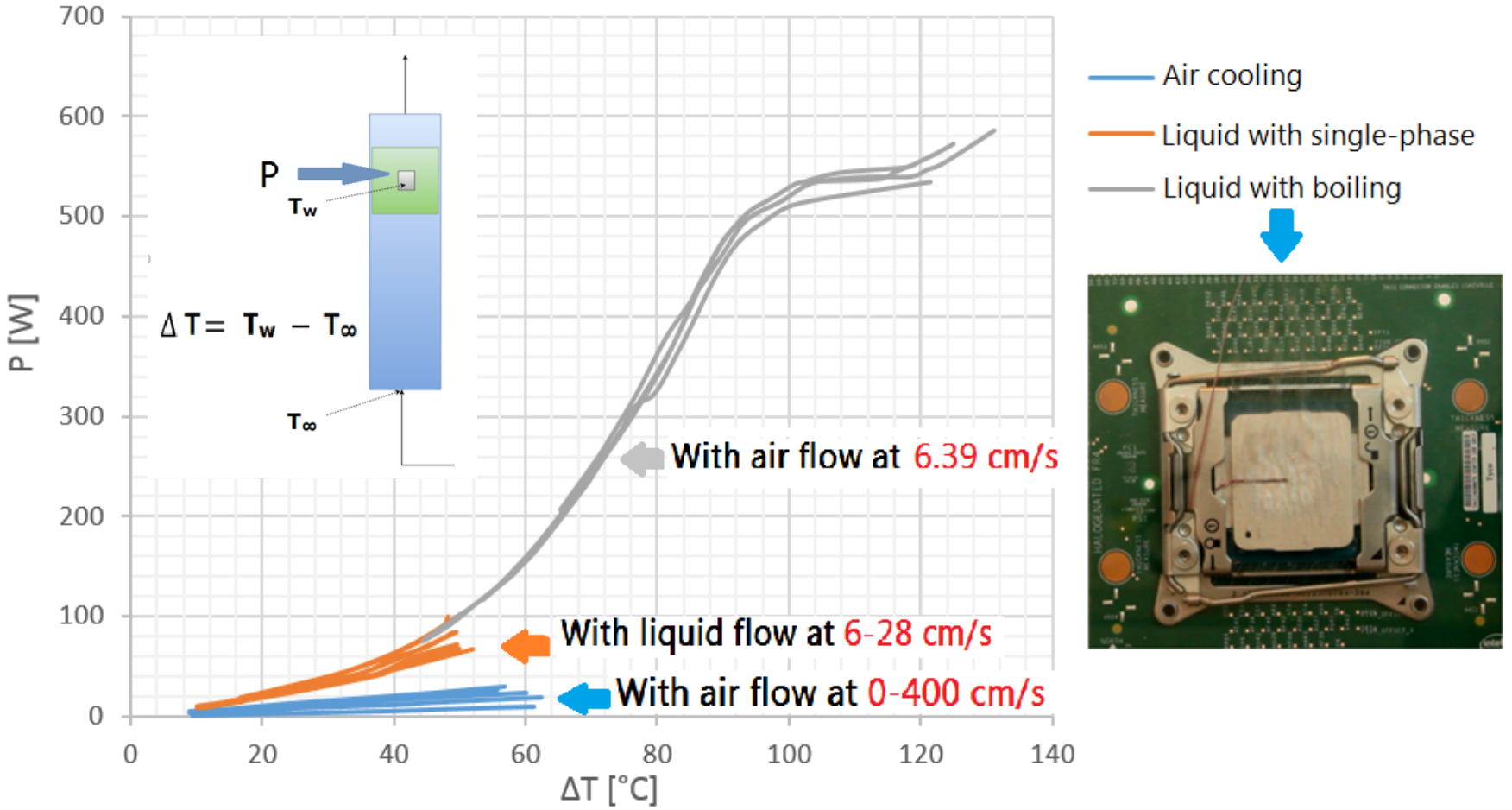


Results of experiment:

- When the ***temperature difference***(ΔT) is ***the same,*** the component can hold much ***more power input***(P) with liquid cooling than air cooling.

- When the flow of liquid is much ***slower*** than the flow of air, the component can still handle ***more power input*** at ***lower emperatures***.

- ***Two-phase*** (boiling) cooling can hugely ***increase the potential of cooling***.



Advantages of our immersed cooling system:

- Our immersed cooling system ***can be applied to an industrial scale***.
- The lower flow with liquid by ***a pump*** is likely to ***save much more electricity*** than forced air flow by ***many fans***.
- The ***thermal control*** of datacenters can be ***more steady and effective*** .
- The ***size of a datacenter*** can be hugely ***decreased***.
- There will be ***no noise*** at all without noisy fans.