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 totally 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** ($\Delta T$) 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** temperatures.

• **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.