TEAM F004

Open-Loop Seawater Cooling with Galvanic Corrosion Protection Using Sacrificial Anodes

Ashwaq Alahmed, Rama Alraish, Teahera Alsaydsaleh, Zainab Aldukhi, Rahaf Alfahad, Jawaris Almuhatrish
Coach: Dr. Zuhair Al-Yousef

CHE ISE 3 ME

Background

- Seawater cooling is efficient but highly corrosive
- Galvanic corrosion damages metals and reduces lifespan
- Study evaluates zinc protection for corrosion control

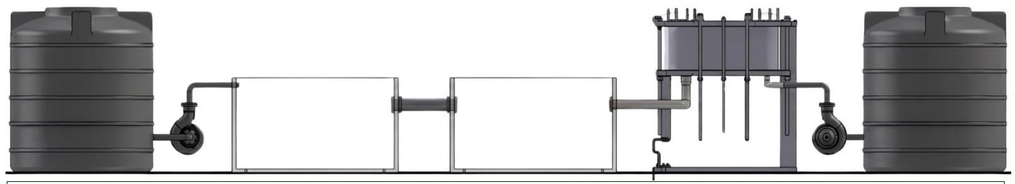
Problem Statement

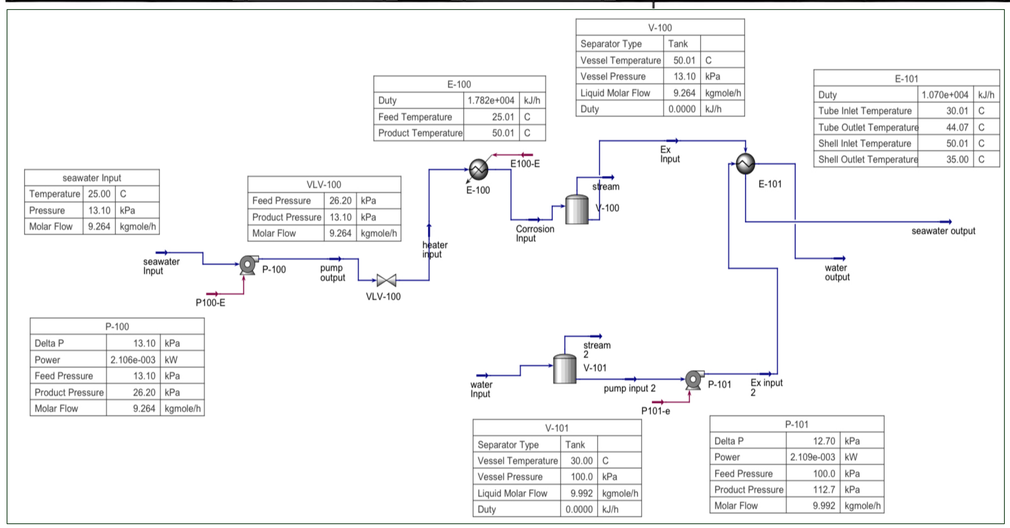
Galvanic corrosion in seawater cooling systems leads to material failure, downtime, and higher maintenance cost. This project investigates a practical and low-cost protection method

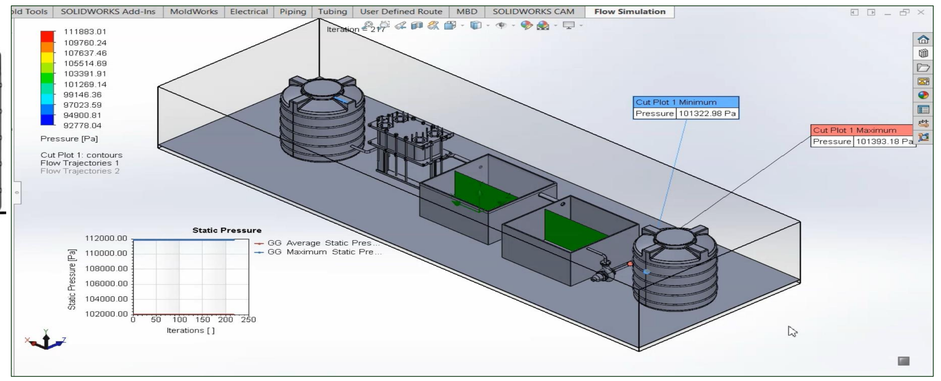
Technical Requirements

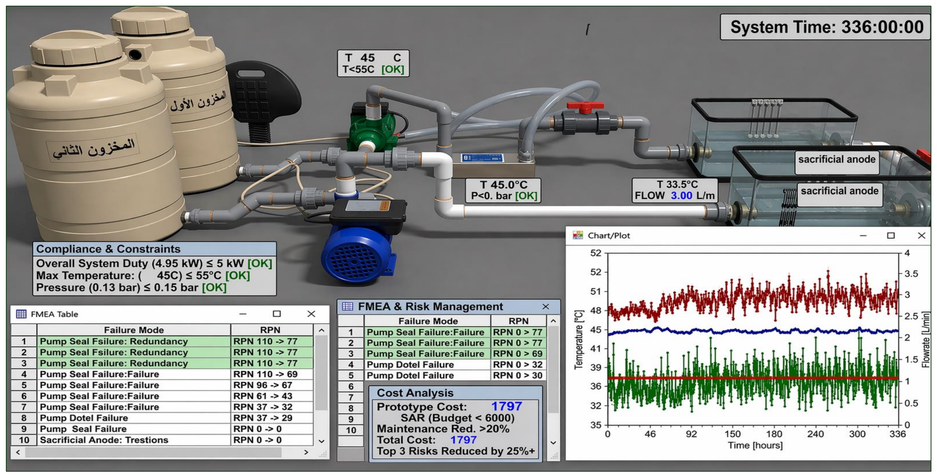
Constraints	Specifications
Pump pressure: ≤ 0.15 bar	TDS: 30000-40000 mg\L
Heat exchanger heat duty: ≤ 5 kW	Flow Rate: 0.5–3 L/min
Reynolds Number: ≤ 25,000	Corrosion Reduction: ≥ 30%
Heater temperature ≤ 55°C	Measurement Cycle: < 10 min
Cost: ≤ 6000 SAR	O&M Cost Reduction: ≥ 20%

Prototype / Simulations



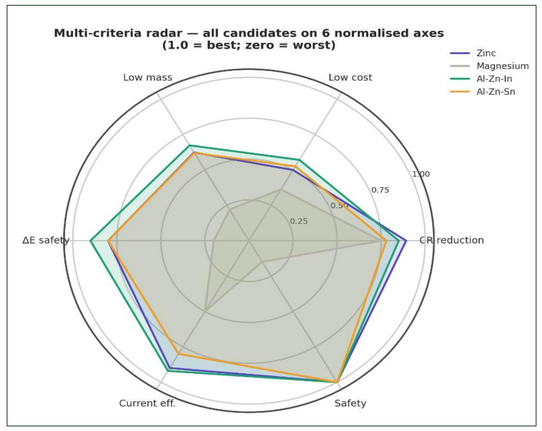




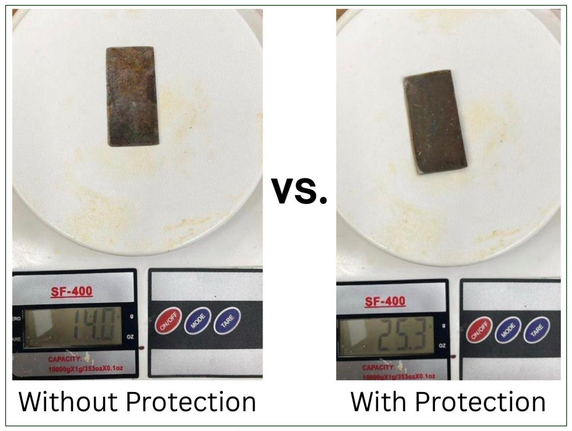


Testing / Validation

Anode Material Selection Analysis:



Carbon steel after corrosion:



Conclusions

- Successful design and operation of the system
- Zinc anodes reduced corrosion (~80–90%)
- Reliable long-term protection (~10–17 years)
- Lower maintenance and operating cost (~50–65%)
- Stable, safe, low-cost solution
- Practical and scalable corrosion protection