King Fahd University of Petroleum and Minerals

Self-Cleaning Heat Exchanger System

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Team 91

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Introduction

Problem Statement

Persistent fouling in conventional heat exchangers reduces efficiency, increasing energy and maintenance costs. This project aims to develop a self-cleaning heat exchanger to minimize downtime, lower maintenance expenses, and optimize energy usage.

Constraints

Budget

- Limited budget: 4000 SR.
- Prioritization: Essential components within financial limits.

Time

- Completion in four months.
- Deadline for design, development, testing, and implementation.

Technical Knowledge

- Required expertise: Sensor programming and automation technologies.
- Effective design and implementation.

Reliability

- High reliability to withstand industrial conditions.
- Consistent performance over time.

Safety

- Safety prioritization: Throughout design, implementation, and operation.
- Mitigation of potential hazards.

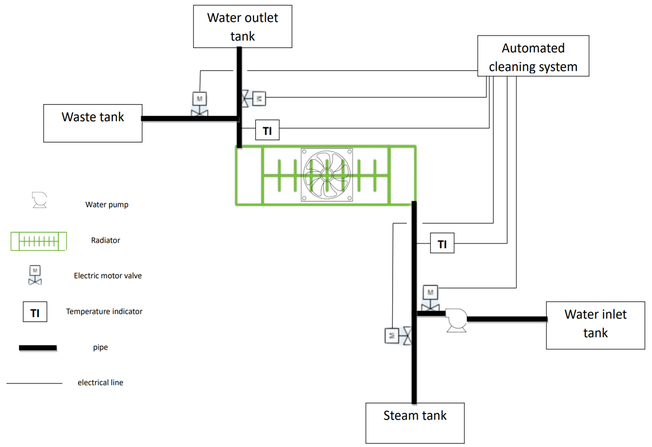
Target Specifications

- Response time less than 5 seconds
- Power consumption less than 3000 W
- Heat transfer efficiency > 70%
- Notification delay less 5 minutes

Project Impact

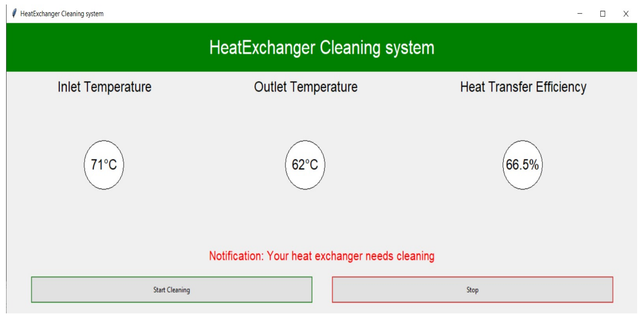
- Improved safety for workers by eliminating direct exposure to hazards.
- Economic benefits from decreased manual maintenance costs and downtime.
- Alignment with sustainability goals through monitoring environmental impacts.

Prototype Design



In this prototype, there are two water tanks, one pump, four valves, four servo motor, one car radiator, fan, compressed air vassal, and two Temperature sensors.

The program will take the reading from the sensors, calculate the heat transfer efficiency, and notify the user if the efficiency goes below 75%.



Testing / Validation

- On average, there is a 10% increase in heat transfer efficiency after cleaning
- Post-cleaning efficiency consistently exceeds the specified threshold of 70%

These findings underscore the efficacy and reliability of the self-cleaning system in enhancing heat exchange performance.

Efficiency before cleaning	Efficiency after cleaning
65.90%	76.30%
66.50%	77.20%

- Average notification delay: Less than 5 minutes
- Despite fluctuations, all notification delays fall within the acceptable timeframe of less than 5 minutes

Notification Number	Notification Delay (in sec)
1	69.4
2	115.4
3	83.6
4	54.2
5	127.8

Conclusion

- Our self-cleaning heat exchanger project marks a significant advancement in combating fouling challenges.
- Automation ensures constant monitoring and efficient removal of fouling deposits.
- Industrial heat exchange performance is boosted, promising greater efficiency.
- Ongoing research and collaboration with experts pave the way for continuous improvement.
- Together, we're shaping a cleaner, more efficient future for heat exchange technology.