CONCEPT FOR RESTARTING THE WASTEWATER TREATMENT PLANT AFTER A BLACKOUT

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OBJECTIVE

- Development of a restart concept for Hamburg wastewater treatment plant after a blackout.
- Ensure smooth and efficient resumption of operations by understanding process engineering and energy requirements.

WHAT IS LOAD MANAGEMENT?

- Load management is a concept used to balance the supply and demand of electricity, ensuring that the power grid operates efficiently, reliably, and sustainably.
- It involves the controlled restoration of power to various plant systems to prevent overloading the electrical supply and ensuring a smooth and safe return to full operation.

Reference;Musabandesu, E., & Loge, F. (2021). Load shifting at wastewater treatment plants: A case study for participating as an energy demand resource. Journal of Cleaner Production, 282, 124454. https://doi.org/10.1016/j.jclepro.2020.124454

TASK

Analyze process flow diagrams (PFD) and to understand the plant's operation and load management system.

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Generate graphs to illustrate data.

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Analyze power consumption trends over time.

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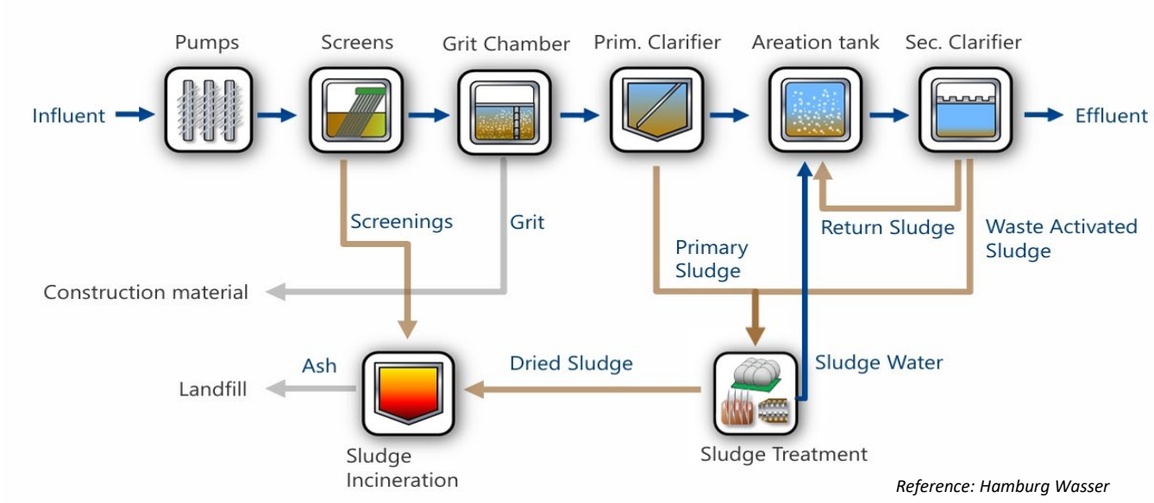
Calculate specific power for individual unit to assess energy efficiency during restart.

WASTEWATER TREATMENT

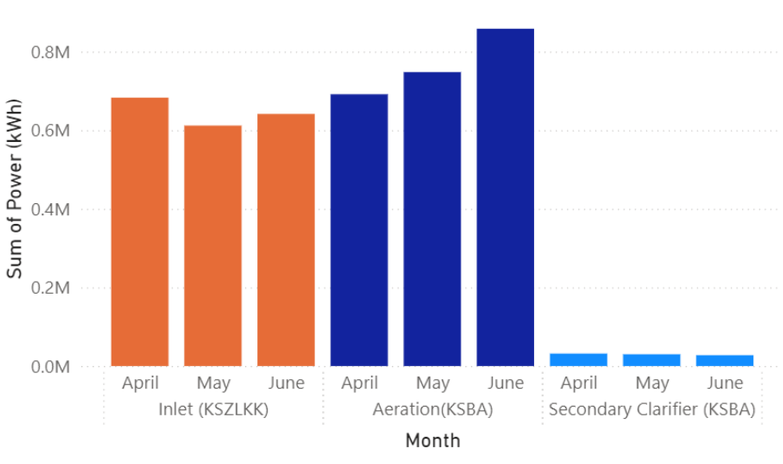


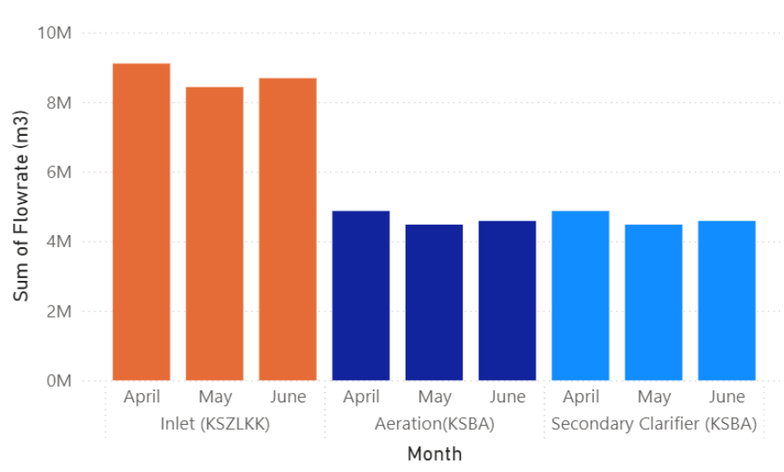
Reference: Hamburg Wasser

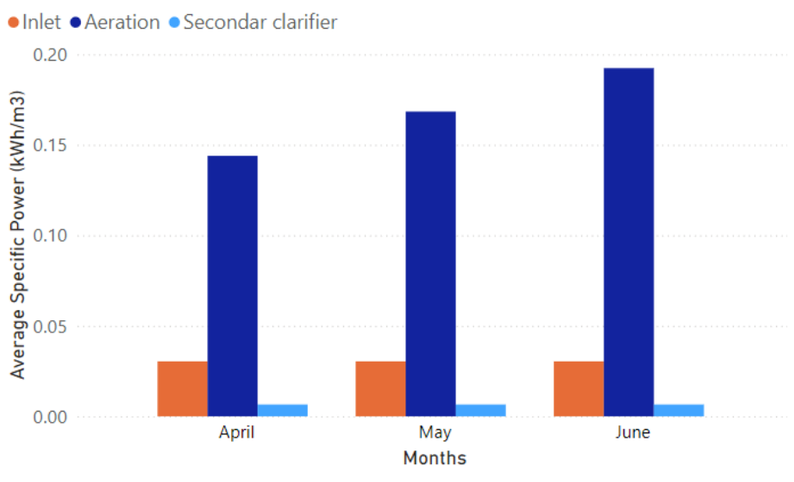
SOLUTION APPROACH

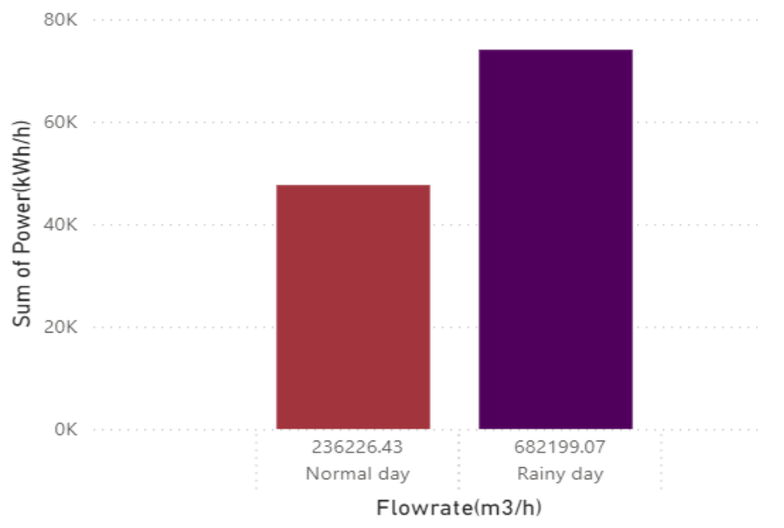
Understanding of P&ID	Flow and Energy Calculations	Data Analysis
Extracting the no of inlet pumps, screens, aeration tanks, primary and secondary clarifier tanks.	Based on the provided data, calculating the total flow and total energy per day.	Using MS Excel and Power BI for analysis.
Analyzing each unit operation and its function.	Determining the flow rate and energy consumed through each unit.	Developing and analyzing various plots to understand energy consumption.
Visiting the plant to gain a better understanding of the process.	Calculating the specific power for a given month and for each individual unit operation.	Analyzing data for power consumption of each cascade, aeration tank and secondary clarifier tank.

OUTCOMES









- The aeration blower operation in wastewater treatment consumes more energy than any other unit operation.
- The specific power consumption was determined to be 0.163 ± 0.023 kWh/m³ for the inlet pumping station, 0.167 ± 0.034 kWh/m³ for each individual tank in the aeration system, and 0.01 ± 0.0011 kWh/m³ for the secondary clarifier.
- The energy consumption for water treatment was higher on rainy days compared to normal days (Assumption: Inflow on a rainy day = Inflow WWTP > 0.3 Mil m³/day).
- From the analysis, it is preferable to operate a cascade of the inlet pumping station at high energy rather than running two cascades at a low energy level.