Table 3: Average H_2S level comparison before and after using AI at PS 6, Monroe Township

Chemical feed at PS 6 was optimized using AI from January 2021. Table 3 and 4 provide a monthly comparison of amount of chemical fed with respect to resulting average H_2S concentrations. This annual comparison clearly indicates that with the help of AI, H_2S concentrations were maintained within the contractual targets without having to increase the chemical feed rates. Month over month the AI tool was able to provide better optimization, which was clearly indicated by the reduction in feed rates and also maintaining the H_2S levels below 10 ppm.

Case Study 2:

For the next case study, we have considered a pump station from a Southeast coastal region. This pump station has a monitoring location downstream at an air relief valve (ARV) with a control target of 50 ppm average throughout the year. This system is slightly manifolded with flow from one other lift station joining the force main, finally reaching the monitoring location.

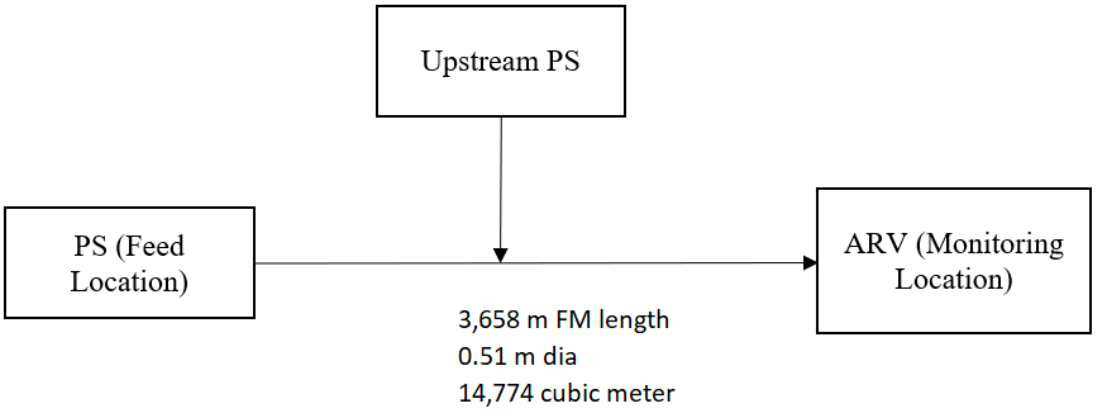

Figure 5: Case study 2 – Southeast PS FM Line Diagram

Calcium nitrate was being fed at just one pump station at a calculated feed rate in order to maintain the H_2S levels as per the customer's requirement. H_2S gas will be released at the monitoring location only when the ARVs open. This adds more variables for the AI to learn from when designing the dose curves.

System Treated:	Force Main
Diameter of Line:	0.51 meter (20 inches)
Length of Line:	3,657 meter (12,000 feet)
Daily Flow (approx.):	14,774 cubic meter (3.25 MGD)
Type of Wastewater:	Residential

Detention Time:	6.1 hours
Control Point	Air Release Valve (ARV)
AI Start Month	October, 2021

Table 4: Case study 2 - PS Flow parameters

The pump station in this case study is located in a residential area and Bioxide® (calcium nitrate) solution was fed using an advanced dosing controller in order to maintain H_2S concentrations. Based on the force main information and the safety requirements, calcium nitrate is dosed at both the locations for the removal and prevention of sulfides. The physical attributes of the site along with the historical data sets from both the monitoring and the feed locations are fed into the AI platform. This helps the tool in evaluating the necessary dose rate and the periodic dose values to improve site compliance. The AI tool also validates the calculated dose rate is within the suggested budget limit.

The overall performance evaluation was determined based on the feed rates and H_2S levels before and after the introduction of AI.

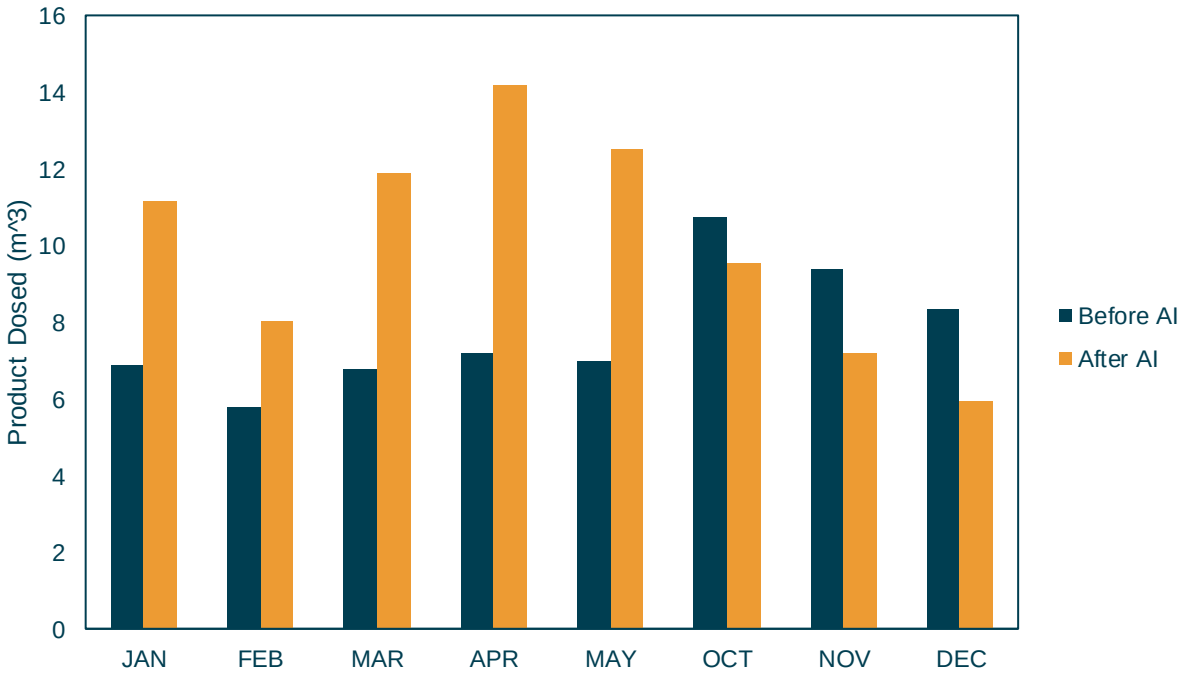

Figure 6: Case study 2 – Chemical Feed (volume) monthly comparison

Before AI (cubic meter)		After AI (cubic meter)	
January, 2021	6.86	January, 2022	11.15
February, 2021	5.81	February, 2022	8.05
March, 2021	6.79	March, 2022	11.88
April, 2021	7.21	April, 2022	14.18
May, 2021	6.96	May, 2022	12.51

October, 2020	10.77	October, 2021	9.54
November, 2020	9.38	November, 2021	7.18
December, 2020	8.34	December,2021	5.93

Table 5: Product Feed data comparison before and after using AI at a Southeast PS

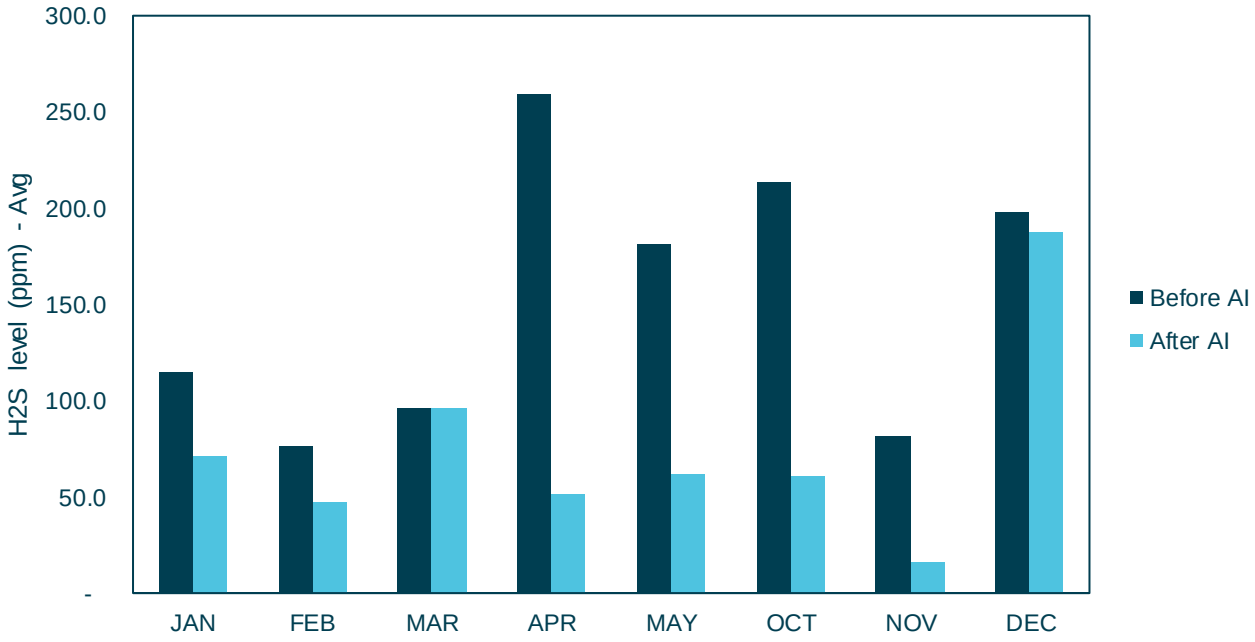

Figure 7: Case study 2 – H_2S Levels (ppm) monthly comparison

Before AI (ppm)		After AI (ppm)	
January, 2021	115	January, 2022	72
February, 2021	76	February, 2022	47
March, 2021	96	March, 2022	96
April, 2021	259	April, 2022	52
May, 2021	181	May, 2022	62
October, 2020	213	October, 2021	61
November, 2020	82	November, 2021	17
December, 2020	198	December,2021	188

Table 6: Product Feed data comparison before and after using AI at a Southeast PS

The pump station in the Southeast region was slightly complex to optimize manually due to the influence of a different stream coming from the north and the monitoring location being an ARV. Despite having these challenges, AI was able to show a reduction of H_2S concentrations by 51%. Especially during the beginning of summer (from April to May) with rising temperatures, the AI tool was able to bring the peaks down and maintain the average H_2S concentrations around 50 ppm. Before the introduction of AI, the average of peaks throughout the considered period were around 826 ppm. It was later reduced to 531 ppm which is almost a 35% reduction and is

continuing to trend down. This control was achieved with a slightly higher chemical dose rate in order to meet the underdefined goals. The chemical dose rates were reduced during the winter months (of October, November, and December) by 20% by reducing the H_2S loadings by 46%.

DISCUSSION

With the help of AI, a measured odor control product was dosed in order to maintain the H_2S concentrations around the provided targets. The AI technology was able to reduce the H_2S concentrations by 20% and 51% in both the case studies. Optimal odor control without over or underfeeding of chemical was achieved by using AI. Historic H_2S concentrations were tracked and used to predict the demand for the upcoming weeks, significantly reducing the workload of the user to continuously optimize dose rates.

CONCLUSION

Artificial intelligence is one of the uprising soft computing and communication technologies widely used in various industries for process monitoring and optimization. AI tools are effective for optimal modelling and data forecasting. Municipal utilities, which are highly driven by environmental and social factors, and subject to immutable infrastructure and budget constraints, will benefit from continuous optimization using AI in their liquid phase odor control programs. With the help of AI, we are able to achieve better optimization with very little effort and time. By providing accurate upper and lower limits we will be able to operate with higher productivity and confidence. The presented case studies indicate that the AI was able to optimize odor control dose rates more effectively and consistently than optimizing manually in a very short period of time.

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