Hydrogen Sulfide Control in a Municipal Sewer Collection System

Odor and Corrosion Control in Pump Stations Using Microcat ® - ANL BioBlend – QM Study #107

Multi-Year Evaluation Program

Evaluation of sewer bioaugmentation with **MicroCat– ANL** BioBlend for hydrogen sulfide (H2S) control in this sewer system was undertaken in two cycles over a two year period. Year One results were excellent, and additional Year Two full-scale product applications confirmed both the Year One results and the cost savings for switching from nitrate chemical addition methods to natural, biological methods of H2S control. In Year Three, the switch was made to **MicroCat– ANL** BioBlend despite physical changes in the sewer system and mechanical difficulties with the H2S monitoring system.

Problem – Year One

Hydrogen sulfide generated in sewer systems can cause safety and maintenance problems including toxicity to humans, odors and corrosion. Several methods are used to control hydrogen sulfide in collection systems. While many have proven to be at least partially effective, they can be quite costly and require constant attention in order to exert sufficient control to keep the costs to a minimum without sacrificing performance.

In these lift stations the hydrogen sulfide levels were such that under certain conditions the installed chemical control technique in use could not keep up with the chemical demanded and hazardous sulfide hazard levels in the air could not be avoided from time to time. Chemical dosing could be increased, but the response was slow and the costs were deemed to be excessive. Therefore, a better, less expensive and more environmentally sound control method was sought .
The objective of this program is to determine the effectiveness of applying Microcat-ANL microbial sulfide controller for keeping the hydrogen sulfide levels below 10 ppm in the air at a full-scale pump station. If the application proved effective, then a further objective was to determine how much could be saved using the **MicroCat** product in comparison to the chemical product in use.

Application Procedure

Based on the sewer system layout, length of sewer lines from Pump Station 1 and Pump Station 2 to Pump Station 3 , daily average flow rate and hydraulic retention times, a dosing scheme was designed to inoculate Pump Stations 1 & 2, which lead to Pump Station 3.

Pump Station 1:

Start-up dosing during 5 days:	0.177 L/day
Maintenance dosing following the start-up period:	0.089 L/day

Pump Station 2:

Start-up dosing during 5 days:	3.79 L/day
Maintenance dosing following the start-up period:	1.89 L/day

Dosing started on the 16th of April and occurred 2 times a day by using programmable peristaltic dosing pumps. The only required additional equipment at both application points was a 20 L product container and a dosing pump. **MicroCat– ANL** is stable and non-hazardous, so no special storage conditions or safety precautions needed to be taken.

On the 15th of May **MicroCat– ANL** dosing was switched off the see if the treatment had any kind of prolonged effect after product application stopped. On the 22nd of May it was switched on again.

Results and Conclusions

The first graph below displays H_2S levels measured at Pump Station 3 from the 1st of April to the 31st of October. The graph displays the hourly average H_2S concentration. The second graph shows the H2S development at Pump Station 3 during the period of interrupted dosing of the **MicroCat– ANL**. H_2S levels stay below the 10 ppm limit during most of the evaluation period. During the period of interrupted dosing, 15 to 22 May, H_2S levels increased slowly until the 5th of June when the ANL treatment was fully reactivated, and H_2S levels started to come down again.

From the middle of July significantly warmer weather started which lasted up to the middle of September and this pushed H_2S levels up. However, for most of this period H_2S levels stayed below 10 ppm. On several instances H_2S levels rose over 10 ppm but stayed close to the 10 ppm target and reverted to the target quickly without increasing the dosing of the **MicroCat** product.

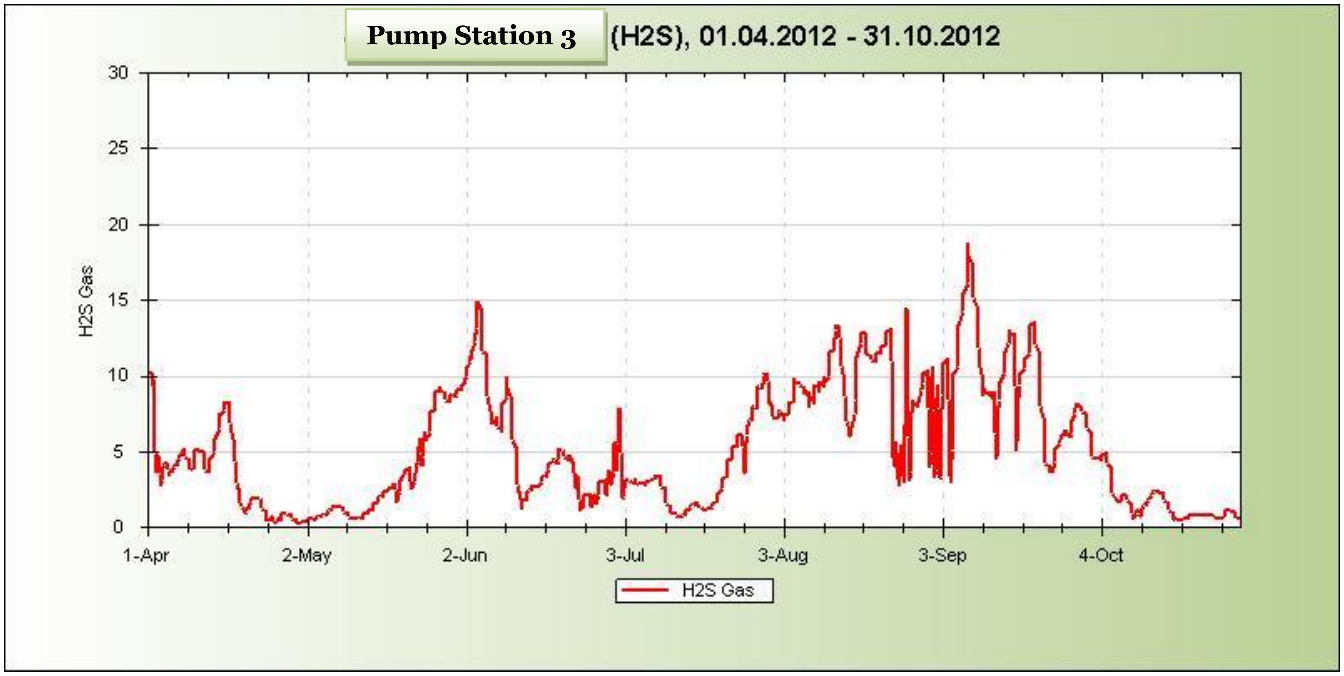
The second graph focuses on the period during which the application of **MicroCat– ANL** was purposely turned off (May 15 to May 22) and the response when it was restarted on May 23.

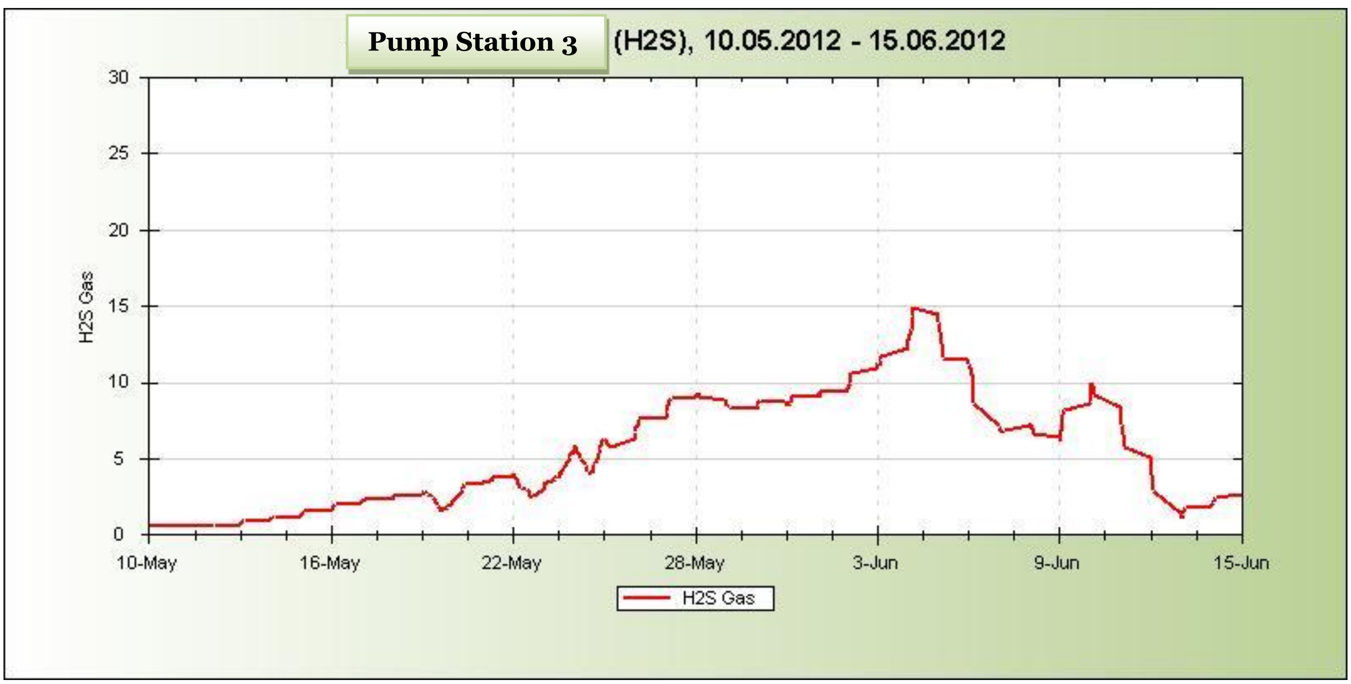
The **MicroCat– ANL** application program demonstrated that biological H_2S control is a viable method of controlling the emission of sewage gas and can keep H_2S levels within acceptable safety and corrosion limits.

As the application volume of the product is on a constant set amount and not controlled by H_2S loggers, the annual product consumption can be easily calculated beforehand, thus eliminating the possibility of exceeding the allocated budget for the H_2S control. **MicroCat– ANL** is non-hazardous, so storage conditions can be relatively simple and there is no risk to workers on site.

The **MicroCat– ANL** consumption during the trial period was a total of 382 L including the 5 day start-up. Due to the interruption of dosing in May an additional 19.8 L of **MicroCat– ANL** was used to start up again. A full year of dosing **MicroCat– ANL** treatment would consume 722 L, not including the start-up dose. Thus, an annual **MicroCat– ANL** cost about 50% less than the chemical program currently in use.

QM Environmental International B.V. – Henricuskade 123a – 2497 NB – The Hague – The Netherlands
Phone (+31) 157 370 486 - Fax (+31) 847 466 328 - E-mail: info@qmes.nl – Internet: www.qmes.eu





Additional Benefits

Based on applications of **MicroCat– ANL** at other locations there are additional benefits at the downstream wastewater treatment plant when **MicroCat– ANL** is used in the collection system. Reduced dissolved oxygen (DO) requirement, improved solids settling, reduced odor from primary clarifiers and sludge dewatering have been documented. These improvements in performance lead to additional operating cost savings.

Problem - Year Two

The objective of this follow-on program was similar to that in Year One, namely to determine whether H2S control to a 10 ppm standard using **MicroCat– ANL** could be achieved at a downstream wastewater treatment plant (WWTP), and, if so, how much could be saved by switching from nitrate chemical sulfide control to natural, biological sulfide control. In this case H2S levels were monitored at the inlet headworks to the municipal wastewater treatment plan (with a population equivalent of about 14,600) where H2S in the air often exceeded the target level of 10 ppm or less. Two upstream pumping stations discharging into the WWTP were treated:

Pump Station 1 – Operating Volume 1320 gallons (5 m3)
Flow rate: 0.4 gallons/second (1.5 liters/second)

Pump Station 2 – Operating Volume 9240 gallons (35 m3)
Flow rate: 52.8 gallons/second (200 liters/second)

Application Program

The application program ran from March 25 to May 27. H_2S levels were monitored using 3 different monitors at 3 different points near the sewer line discharge into the headworks of the WWTP.

Results

The overall results are shown in Table 1. Note that Monitors A and C had previously exhibited inconsistent operation and errors in measurement. Therefore, the customer decided to use the data from Monitor B for determining the results of this evaluation.

Table 1 – Summary of H2S levels (after stabilizing period) from March 25th to May 27th

H2S levels	Monitor A	Monitor B	Monitor C
Average	0.74 ppm	1.75 ppm	2.86 ppm
Min	0 ppm	0 ppm	0 ppm
Max	18 ppm	30 ppm	31.1 ppm
95 percentile	4 ppm	4.4 ppm	12.8 ppm

The customer concluded that the evaluation proved that "**MicroCat– ANL** Bio Blend can achieve the target H_2S level of 10 ppm or less 95% of the time based on the data from Monitor B".

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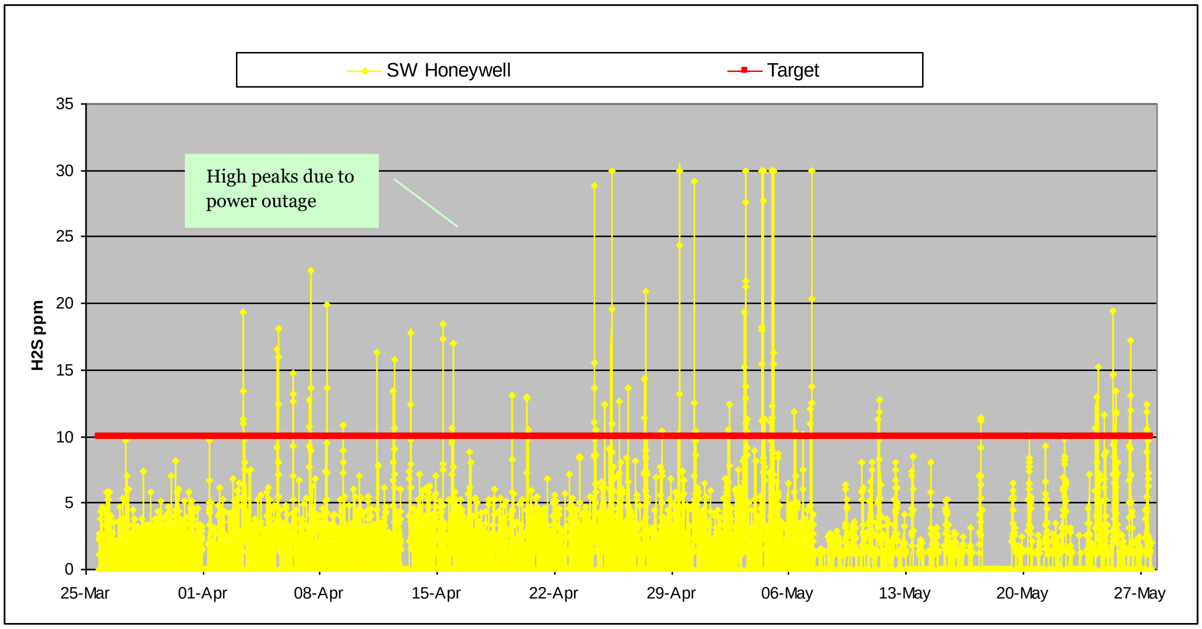

Figure 1: H_2S levels at WWTP inlet screens for full evaluation period

Cost Savings

The application rate of **MicroCat– ANL** BioBlend needed for effective, on-going bioaugmentation treatment of Pump Stations 1 and 2 was determined to be 1.3 gallons per day (5 liters per day) April through October and 0.8 gallons per day (3 liters per day) November through March for each pump station. This equated to a savings of about $2000 per annum in product cost compared to chemical dosing excluding delivery and service/maintenance costs. This was a bit misleading since the **MicroCat– ANL** product price included delivery, maintenance and dosing equipment, so the overall savings was much higher. In addition to chemical costs, the customer was paying approximately $9,000.00 per annum in service fees plus a chemical delivery charge of $17,000 per annum. Thus, per Table 2 the actual overall savings rose to $28,000.00 per year or about 41% less per year than the total cost of chemical addition (Table 2).

Table 2 –Nitrates vs. MICROCAT - ANL Cost Comparison

	Nitrates	MicroCat-ANL	Saving
Pumping Station 1 daily dosing cost	€ 5,62	€ 58,40	
Pumping Station 2 daily dosing cost	€80,86	€1.252,25	
Daily dosing cost total	€86,48	€ 1.311,78	
Yearly dosing cost total	**€ 31.622**	**€ 30.089**	
Dosing cost saving per year		€ 1.533,03	5%
Yearly service	€ 6,738,58	n/a	
Delivery of product	€ 12.702,-	n/a	
Total cost per year	**€ 51.064**	**€ 30.089**	**41%**

Work continues at the site to determine potential additional benefits of sewer line bioaugmentation for H_2S control in the WWTP. To date both improved and reduced WWTP performance have been observed, but neither can be definitively correlated with the sewer bioaugmentation.

Implementation- Year Three

The final section of sewer line (gravity sewer) was replaced from where the 2 force main sewers coming from the two main pumping stations joined and which ended at the central treatment plant. The new line is a 600 mm and Poly pipes PVC whereas the old line was a concrete pipe. The line was replaced without notifying the product supplier nor those responsible for the H_2S control.

During the replacement the sewage was diverted towards the treatment plant via a temporary line. During and after the installation of the new pipe H_2S levels in the inlet screening building started to rise. Also, the turbidity of the final effluent of the treatment plant increased and more aeration power was required. This indicated the rise of sulfide concentration in the influent.

Due to the removal of the old sewer line the already established ANL biofilm was removed and the product supplier initiated a new start up program (double dose) in order to reestablish the biofilm in the new section. Although the turbidity of the final effluent of the treatment plant quickly improved and aeration power was reduced again, there was no effect on the H_2S in the screening building. Target H_2S levels in this building should remain below 10 ppm for 95% of the time. At times H_2S levels spiked well over 30 ppm. As the months passed there was no improvement in H_2S levels and triple dosing was implemented. A meeting was called to discuss the progress toward achieving hydrogen sulfide treatment goals.

Simultaneously, the company responsible for maintaining the air filters in the screening building performed maintenance on the filters and noticed that the ventilation of the building was very poor due to blockages in the filter system. As soon as these blockages where removed, the H_2S levels in the screening building dropped significantly and where below the 10 ppm again in accord with prior results.

It was concluded that the increase of H_2S was not due to **MicroCat– ANL** performance but due to the fact the filter system of the screening building was blocked and allowed H_2S levels to build up due to improper ventilation. As soon as the ventilation system was repaired and the blockages removed the H_2S levels dropped to the levels achieved before of the sewer line replacement.

The main treatment plant operator also reported:
“Just thought I would let you all know that the site is over the worst of problems. The odor plant is now extracting and H_2S is much improved. The dissolved oxygen (DO) is reaching set points so blowers are more relaxed. Final (effluent) is very good, mixed liquor is back to normal and thickening well.”