

## Hydrogen Sulfide and Grease Control in Domestic Sewage Lift Station and Force Main by the Addition of Bio-Organic Catalysts (BOCs)

### ABSTRACT

The wastewater from a small section of a southwestern U.S. city was studied. Concerns of grease accumulation and the increasing cost of operation year after year of a current odor control chemistry gave rise to searching for a better solution. There was evidence that grease and slime layers within the pipes and lift station were increasing with the current chemical solution. The city substituted a novel Bio-organic Catalyst (BOC), manufactured by Neozyme International, Inc., for the current chemistry in one lift station and studied the results through subjective daily observations. The results indicated a complete control of odor and an elimination of slime and grease.

Key words: grease, sewer, odor, bio-organic catalyst, hydrogen sulfide, dissolved oxygen.

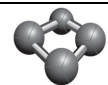
### DESCRIPTION

The production of odors, especially hydrogen sulfide, within the sewer system and sewer left stations in the D.S. has been an increasing concern to sewer system operators. Since restrictions on toxic substances took effect in the early 1970's and organic loads have increased, the sewer system is more biologically active. The odors are generally caused by a dominating collection of bacteria within the sewer water and within the slime and grease layer that attach to the inside of the sewer pipe. This bacteria utilizes the oxygen in sulfate compounds in the waste stream. The sulfates are reduced to sulfides which combine with water to form hydrogen sulfide gas and sulfuric acid. This gas is the rotten egg smell of sewers and the sulfuric acid corrodes metals and concrete.

For several years, the city utilized a chemical process using a liquid form of nitrate. The nitrate can be reduced by bacteria that will then dominate over the sulfate reducing bacteria and thus stop the sulfide and the subsequent hydrogen sulfide production. These nitrate reducing organisms are like their sulfate reducing cousins in that they attach to the walls of sewer pipes and form protective houses of slime. Grease from restaurants and homes also attach to pipes and these organisms find this grease a good food source. Grease can also accumulate to the point that flow through the pipe is restricted and can cause severe flooding and even equipment failure.

The lift station is a typical two well design using a wet well to capture sewage from a gravity sewage main line and a dry well that holds the lift pumps. A level control triggers the pumps on and off as the level in the wet well changes. The lift station wet well was constantly aerated using a blower and simple coarse bubble diffuser made from a PVC pipe with holes drilled in it. The force main from the lift station was approximately 3,800 feet long. Observations were made at a manhole at the end of the force main and at the wet well. Approximately 60 gallons per day (GPO) of calcium nitrate was being injected directly in to the wet well of the lift station. Average daily flow through the lift station is 720,000 gallons per day or 0.72 million gallons per day (MGO). This is equal to 83.3 parts per million (PPM) of calcium nitrate to daily sewage flow. This injection had been on-going for six years and had steadily increased between 5 and 8% per year to the 83.3 PPM.

The Bio-organic catalyst, called ECOSYSTEM PLUS™ (ESP), manufactured by Neozyme International, Inc of Aliso Viejo, CA was analyzed as an alternative to calcium nitrate. Tests with ESP was chosen after trials with an oxidant proved partially successful for odor control but did nothing for grease and slime control. During that trial, an operator suffered a minor chemical burn from the oxidant. Safety became an issue that had been overlooked prior to this event. ESP is a safe product to handle, non-toxic, noncorrosive and is biodegradable. Prior experience by Neozyme International had indicated successful



odor control in similar applications but grease control had not been closely monitored in the past. Based on this experience, an injection program was devised.

### MATERIALS AND METHOD

The ESP product works in a different manner than the calcium nitrate and the injection program had to allow for a conditioning period inside the sewer pipe while maintaining odor control. The mechanism of action of the ESP product required several weeks for proper conditioning. During this "conditioning period", the program required the continued use of the calcium nitrate and a higher than normal dose of ESP. The injection rate of the calcium nitrate was reduced over the conditioning period while the rate of ESP was also decreased. At the end of the conditioning period, the ESP dosage was at a maintenance level while the calcium nitrate was completely eliminated. The injection program also required a constant solution of ESP and water to be injected instead of ESP concentrate only. This required the use of a simple, inexpensive device called a dilution unit that represents a torturous path for water and ESP to travel and mix together. A fresh water source (garden hose) at the lift station was connected to the dilution unit. A simple chemical feed pump was set upon a 55 gallon drum of ESP. The discharge of this pump was also attached to the dilution unit. The discharge of the dilution unit was a 3/8" polyethylene tube directed through a small hole in the top of the wet well. A constant stream of water and ESP mixture entered the wet well at a rate of approximately 1.5 gallon per minute (1.5 GPM).

### Injection Program

Time Period	ESP PPM	ESP GPD	H2O:ESP	Calcium Nitrate PPM	Calcium Nitrate GPD
Week 1	5	3.6	600:ESP	8.3	60
Week 2	3	2.1	1028:1	58.3	42
Week 3	1.5	1.1	1960:1	29	21
Week 4	1	0.75	1620:1	8.3	6
Week 5-10	1	0.75	1620:1	0	0
Week 11-25	1	0.75	1047:1	0	0

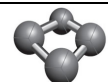
Week 5 - Beginning of maintenance dose

Week 11 - Sprayer installed, dilution ratio changed.

### RESULTS AND DISCUSSION

The injection program was initiated and followed without incident. No offensive odors occurred during the conditioning period and grease accumulation in the wet well was minimal. At the end of week 3, observers at the end of the force main noticed a change in the color of the slime build up in the pipe. The slime that had previously been dark brown to black in color with a gelatinous appearance changed to a light brown color and less slime was present. It was estimated that 70% of the slime layer was gone. At the end of week 5, collection system operators had concluded that the slime layer had been reduced to 90% of its original size and that the color was a light brown.

The color change of the slime layer is indicative of the change in dominant bacteria population. Light brown organisms are generally associated with aerobic bacteria that are generally aggressive food consumers. These organisms utilize dissolved oxygen in the waste stream and do not reduce sulfate or nitrate compounds readily. For this reason, they are the preferred organisms in this environment and tend to produce very little slime. Ideally, these bacteria, if given enough residence time in the sewer pipe, can actually begin the breakdown process of the sewage. As a result, if enough of the sewage system is treated, the sewer pipes could potentially become an extension of the treatment plant, reducing the load to the plant while the sewage is still in the pipes.



At the beginning of week 11, the collection system operators, convinced of the effectiveness of the ESP program, modified the discharge of the dilution unit to include a small sprinkler head. This spread the water and ESP solution over the entire surface of the wet well and even hit a small portion of the wet well walls. The water rate was reduced but the ESP remained constant. By the end of week 11, it was observed that the grease layer was completely eliminated from the surface and the walls of the wet well. Furthermore, observations made at the end of the force main showed a continued light brown color and minimal slime levels.

A cost comparison was performed by the operators using actual consumption rates after the conditioning period. Actual data was not made available to Neozyme for this study but the operators indicated a 15% cost reduction by using ESP and this did not include any cost savings for grease maintenance since replacing the calcium nitrate.

Although not part of the original experiment, dissolved oxygen (DO) readings were taken during week 15. These included the level of DO in the sewage entering the wet well from the gravity main line, the wet well and at the observation point at the end of the force main. These readings were taken using a field instrument, taking direct readings within the individual waste streams. At the same time, similar readings were taken at another location using calcium nitrate only.

#### **Dissolved Oxygen Levels**

	ESP Treated DO	Calcium Nitrate DO
Inlet	0.12	0.11
Wet Well	4.2	0.25
Down streams	2.8	0.1

#### **CONCLUSIONS**

The results demonstrate, the bio-organic catalyst (ESP) showed an excellent ability to control odor and grease in the city lift station and force main sewer pipe at a substantial cost savings over the current odor control treatment alone. Although the exact mechanism of action was not studied in this experiment, the BOC mechanism of action appears to include greatly increased dissolved oxygen levels and solubilizing properties.

These benefits compliment the physical hydraulics within the pipe to displace anaerobic organisms and their protective slime layer and grease, while promoting dramatic dissolved oxygen levels and aerobic bacteria populations that prevent production of sulfides and eventually hydrogen sulfide gas.

