Protein Matrix

Product Overview

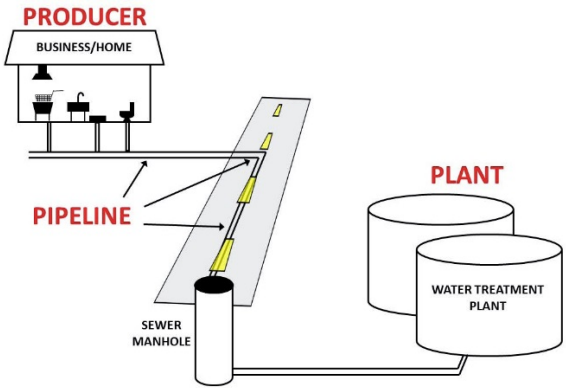
CONTENTS

Executive Summary 2
Overview 3
The “3P” Model of Comprehensive FOG Treatment 4
FOG Producers (Food Service Establishments) 4
FOG Pipeline (Collection Systems) 6
Hydrogen Sulfide Prevention 7
FOG Treatment (Water Treatment Facilities) 8
The Safer Choice 10
Conclusion 10

EXECUTIVE SUMMARY

Protein Matrix disrupts the intermolecular forces of fat, oil, and grease (FOG) molecules, preventing the formation of large, solid balls of grease in grease traps, pipes, lift stations, and wastewater treatment plants (WWTP). The result of the PM-FOG reaction is a flowable byproduct that does not re-solidify, is compatible with collection systems, and is easily digested by WWTP microorganisms.

Protein Matrix has developed a line of products for each of what we call the "3 P's": point sources such as food service establishments (Producers); collection systems, pipes, and lift stations (Pipeline); and water treatment facilities (Plants).



The practical benefits of Protein Matrix for each of these 3 P's include:

- Odor control
- Elimination of FOG-related maintenance
- Microbiological balance and efficiency
- Increased plant efficiency
- Reduced hydrogen sulfide
- Cleaner effluent

In addition, Protein Matrix is the safe choice: biodegradable, plant-based, non-toxic, non-volatile, non-flammable, non-combustible, and non-carcinogenic. Unlike bacterial or enzyme-based products, Protein Matrix will not allow FOG to re-solidify downstream in hard-to-reach places – in fact, it has never caused adverse effects downstream. Protein Matrix is certified under NSF/ANSI 60 as safe to use in wastewater and potable water systems.

It is a testament to the product's efficacy, safety and overall benefits that all Protein Matrix demonstrations have resulted in adoption of the technology. Protein Matrix is committed to working with leading wastewater engineering companies, food service establishments, and chemical suppliers to expand use of PM throughout the global marketplace.

A video detailing the above and more is available for viewing at:

https://vimeo.com/136250500 (password is PM4FOG)

OVERVIEW

Protein Matrix is a patent-pending technology that reacts with fat, oil and grease (FOG) on a molecular level, converting FOG into a benign liquid byproduct that is compatible with collection systems, wastewater treatment plant (WWTP) infrastructure and microbiological treatment processes. This plant-based material is a safe and green product - biodegradable, nonflammable, non-carcinogenic, nontoxic, and NSF/ANSI 60 certified. Use of Protein Matrix can prevent:

- repeated maintenance events
- clogs and sanitary sewer overflows
- major adjustments to plant processes
- foul odors
- overpopulation of *nocarida* / *M-parvicella*
- effluent compliance limit violations

Protein Matrix products disrupt the intermolecular forces of FOG molecules and permanently impede the re-formation of grease balls or mats, preventing the resolidifcation and reagglomeration of FOG that can result from the use of bacterial or enzyme-based products. A flow chart illustrating this reaction (and the corresponding advantages for WWTP owners and operators) is seen in Figure 1 below.

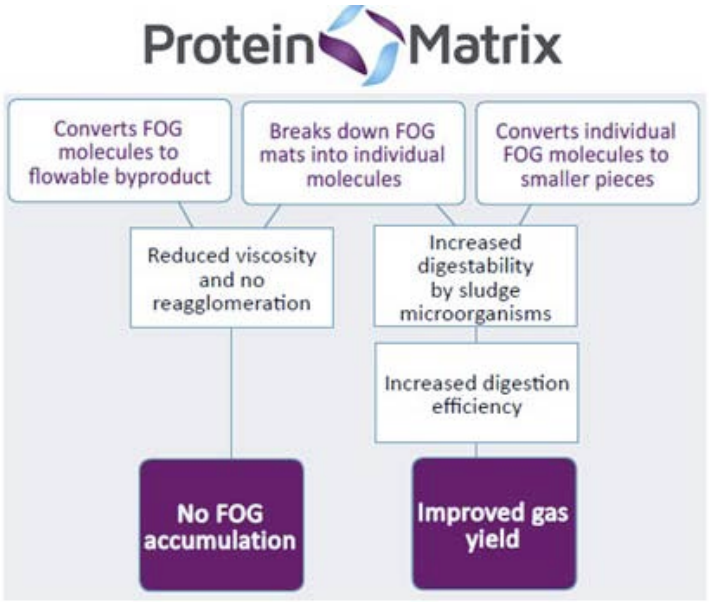


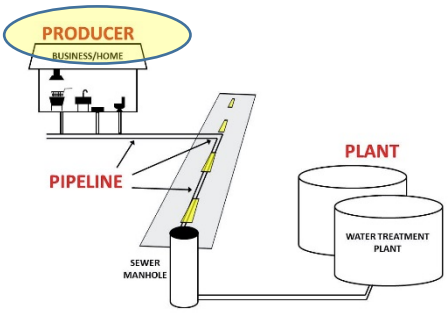
Figure 1. Flow chart illustrating the effects of the reaction of Protein Matrix and FOG molecules

The following pages will summarize Protein Matrix's ability to solve FOG problems at each of what we call the three "P's" of wastewater management:

- Producers (point sources such as food service establishments)
- Pipeline (pipes and lift stations)
- Plant (water treatment facilities)

THE "3P" MODEL OF COMPREHENSIVE FOG TREATMENT

FOG PRODUCERS (FOOD SERVICE ESTABLISHMENTS)



Just as important as the end-point in the process (the treatment Plant) are the two preceding Producer and Pipeline components. Variants of the product are in use throughout each of the '3P' view of the treatment process. A franchisee of one of the world's largest fast food brands was experiencing significant FOG buildup and, in turn, regulatory violations, due to the release of accumulated FOG from grease interceptors (Figure 2A). The owners had installed a second 1,500-gallon interceptor at the restaurant in the hopes that the additional capacity would alleviate non-compliance. Despite cleanouts of both interceptors every three weeks, FOG buildup was still extensive and non-compliance still an issue.

Protein Matrix was applied to these interceptors continuously for twelve weeks. Upon examining the interceptors at the end of this period, no buildup was seen (see Figure 2B). While prior to treatment, four cleaning events would have been needed over three months, it is evident from the photos that Protein Matrix usage resulted in interceptors as clean as when treatment was initiated. In addition, the use of Protein Matrix has led to a marked increase in the restaurant's compliance with effluent quality limits. Based on this success, the franchisee has installed Protein Matrix systems at all of their franchise locations.

One month of buildup	Three Months of Protein Matrix
	Video[1]

Figure 2. While one month of FOG accumulation from the restaurant resulted in solid grease buildup (left), three months of Protein Matrix IGR treatment led to clean interceptors containing only flowable liquid (right).

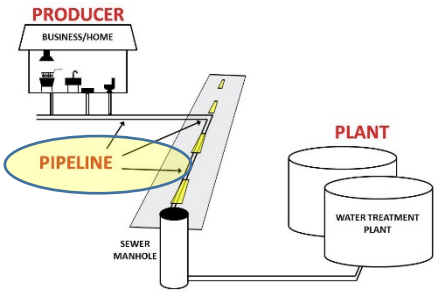
The company has worked with operators (such as professional cleaners of industrial kitchens) who have assisted in the 'upstream' approach, allowing Protein Matrix to effectively "pre-treat" Plant influent by treating the effluent at the FOG source. The company has developed an above-the-

[1] **https://www.youtube.com/watch?v=0IVIgoyUzs4**

counter variant of the Protein Matrix technology. Its maximum effectiveness is evident in Figure 8 below, where filthy commercial range hood ventilation grates look brand-new again after treatment with Protein Matrix.

Figure 8. Protein Matrix used to clean grease-covered ventilation panels

FOG PIPELINE (COLLECTION SYSTEMS)



Protein Matrix has been proven effective in one of the most environmentally-sensitive areas in the United States – the Lake Tahoe Basin. The WWTP in question required quarterly maintenance of its lift stations due to FOG accumulation. This labor not only required confined space permits, but was known as one of the most dangerous and unpleasant tasks performed by operations staff. In addition, the sulfur odors emanating from the lift station often led to complaints from the neighboring tourist community.

To solve these problems, Protein Matrix initiated a corrective course of action in June 2014 in which Protein Matrix was applied to wet wells and lift stations. For two weeks prior to the start of the project, FOG was allowed to accumulate in these locations (see "Before" in Figure 3). After four months of application, that FOG buildup was no longer present (see also Figure 3). Notice in the lower photographs that grease has been removed from the corners of the wells – those "hard-to-reach" places that are of particular difficulty during the clean out process. The wet well did not require cleaning for over a year, until pump failure went undetected for several weeks, during which time grease again accumulated in the wet well. Upon restoration of treatment, the grease problem again was eliminated. The plant operator states that not only does Protein Matrix eliminate FOG buildup without any detriment to plant efficiency, but also that the product can significantly reduce water treatment costs.

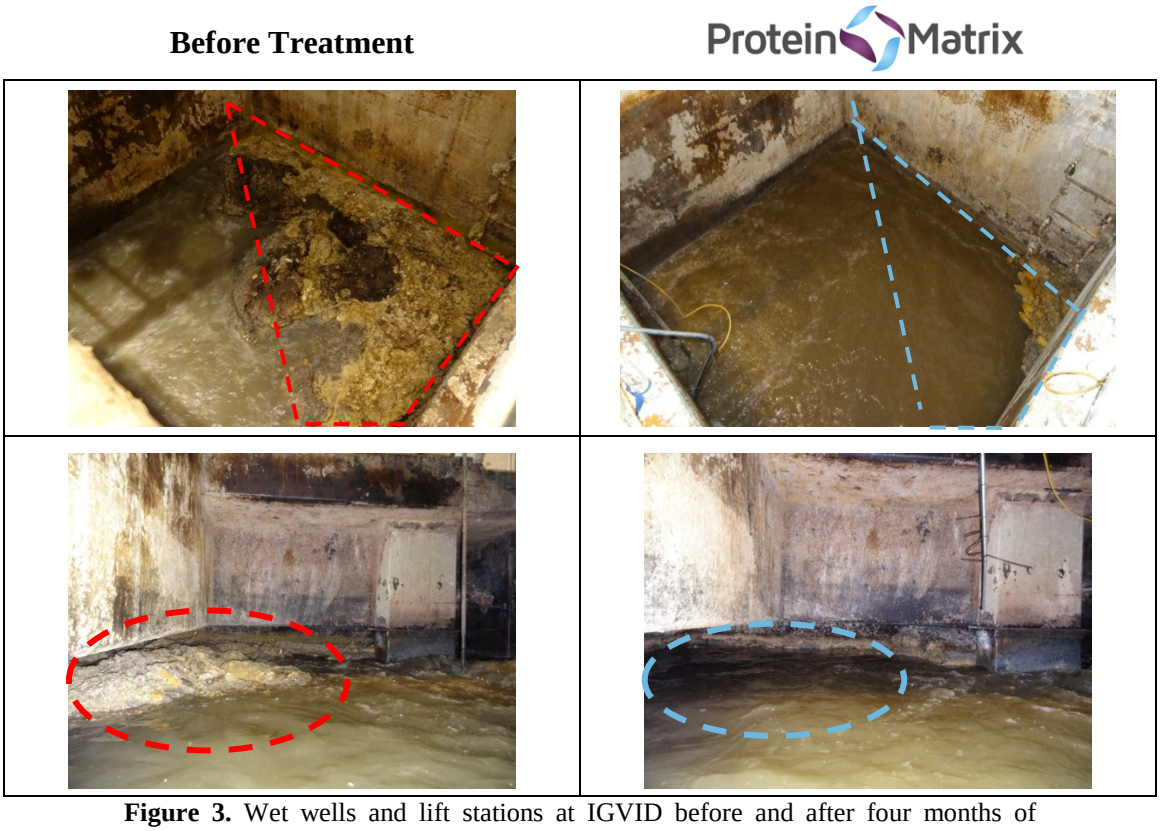


Figure 3. Wet wells and lift stations at IGVID before and after four months of treatment with Protein Matrix IGR, demonstrating substantially reduced accumulation of FOG.

On the heels of this success, Aqua America, a $4 billion company responsible for operations at over 250 WWTP across nine U.S. states, invited Protein Matrix to collaborate on a study of Protein Matrix's ability to maintain grease-impacted pipes and lift stations without manual cleaning actions. Prior to Protein Matrix application, FOG buildup at the facilities in question was so severe that certain wells and pipes were completely blocked and required pump-outs on a weekly basis. However, upon addition of Protein Matrix to wet wells and lift stations, the solid grease buildup completely disappeared (and with it, the blockages) and did not return throughout the term of the study (see Figure 4). Since the conclusion of these studies, Aqua America has installed Protein Matrix systems at a number of their most problematic FOG hot spots nationwide. In each case, areas that previously required cleanouts on a weekly or bimonthly basis have remained clean throughout months and years of treatment. In addition, Aqua America also observed no adverse impact whatsoever on the processes and treatment effectiveness of their downstream facilities.

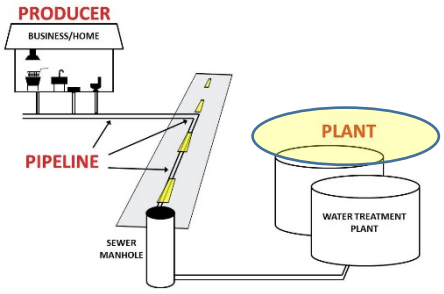
One week of buildup	Two Months of Protein Matrix

Figure 4. Figure 4A shows one week of solid grease accumulation, while 4B is the same lift station after two months of Protein Matrix treatment.

HYDROGEN SULFIDE PREVENTION

Protein Matrix has also been shown to reduce hydrogen sulfide production due to FOG accumulation. Hydrogen sulfide, which can be produced by bacteria that thrive on FOG mats, is not only extremely dangerous (even limited exposure can be deadly), but can also cause significant structural damage to pipes and lift stations. Protein Matrix was applied to a lift station with a history of FOG accumulation and high concentrations of hydrogen sulfide. Throughout treatment, not only did the lift station remain free of FOG, hydrogen sulfide was not detected, potentially saving the municipality in question thousands of dollars in repair costs and eliminating the risk of tragedy during a cleaning or repair event.

FOG TREATMENT (WATER TREATMENT FACILITIES)



Protein Matrix was used to treat 100% of the influent of a 14.1 MGD WWTP[2] in order to study its comprehensive effects on treatment plant and collection system operations. To this end, Protein Matrix was applied at several different locations: the plant headworks and two lift stations, each of which had significant historical levels of FOG accumulation.

Protein Matrix treatment of all influent resulted in a significant decrease in FOG within the facility and surrounding collection system. Throughout the demonstration, thick FOG mats, normally present within three days of a thorough and lengthy cleaning process, simply did not form. The primary clarifiers were classified as "the best they've ever looked" by the plant operators. The reduction in grease had immediate effects on plant O&M, as the maintenance staff reported that during the treatment period, the time spent dealing with FOG within the plant was reduced by an estimated 50%.

In addition to the observed reduction in grease, plant staff also noted elimination of a "grease odor" that had been present the summer before. Also notable was that FOG did not resolidify downstream of the lift stations, which were several miles away from the plant. The plant operations staff anticipate that Protein Matrix will lead to a reduction in equipment wear/tear, including (among others) a decrease in the pump repair budget.

All normal plant process data was monitored throughout the study, and no harmful side effects were observed by any plant operators. Moreover, no effluent violations were noted. Select plant process data is graphed in Figures 5-7 below. Importantly, the rate of BOD and TSS removal remained consistent, as seen in the figures (the biochemical oxygen demand (BOD) and total suspended solids (TSS) readings from both before (unshaded) and during the pilot (shaded in purple). As with all of the above endeavors, the facility in question has implemented Protein Matrix as part of the permanent treatment process.

[2] A copy of the report from this application – produced in conjunction with the plant operators – is included as Appendix A

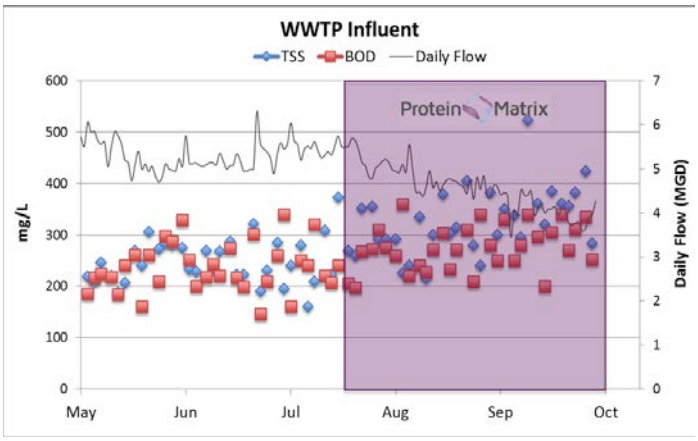


Figure 5. Influent TSS and BOD before (unshaded) and during (shaded) pilot study. The increase in influent BOD and TSS concentration is a result of the decrease in flow (black line).

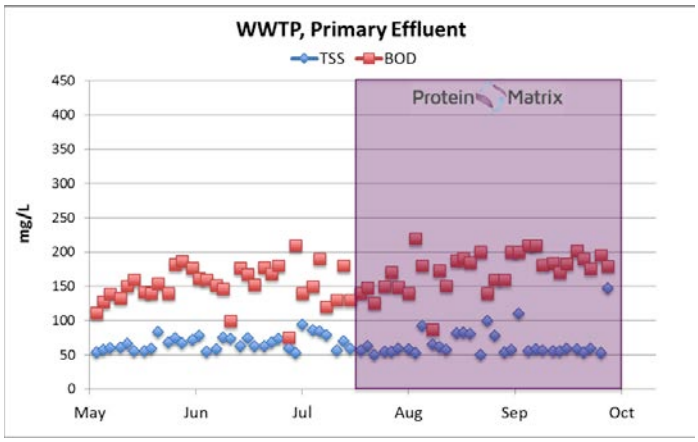


Figure 6. Primary effluent TSS and BOD before (unshaded) and during (shaded) pilot study. BOD and TSS removal ratios remained the same throughout.

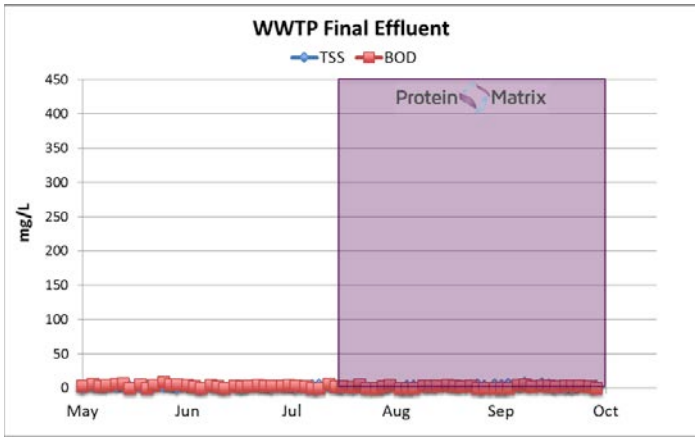


Figure 7. Final effluent TSS and BOD before (unshaded) and during (shaded) pilot study. During the pilot, final effluent BOD and TSS remained under 5 mg/L.

THE SAFER CHOICE

Protein Matrix has been designed to maximize effectiveness without the hazards of competitive FOG treatment chemicals.

Traditional degreasers contain carcinogenic solvents and/or dangerously corrosive compounds that come with very serious health concerns, including immediate skin and lung burns and long-term irritation of the nervous and gastrointestinal systems. In contrast, Protein Matrix products are:

- water-based
- biodegradable
- non-toxic
- non-flammable
- non-carcinogenic
- derived from plant materials
- free of solvents, glycols, and alcohols
- green

Protein Matrix has been independently tested by third-party labs and proven nontoxic toward fresh and saltwater organisms. It is safer than other FOG removal products and does not burn skin on contact, as the natural amino acids, peptides, and proteins that help to mitigate the effects of high pH. This, on top of its ability to help eliminate deadly hydrogen sulfide buildup, make Protein Matrix not only the effective and efficient choice, but also the safest choice in FOG management.

CONCLUSION

In short, Protein Matrix provides a safe and effective solution for FOG management from producer to pipeline to plant. It is unlike any other product heretofore seen, a fact with which we have both been challenged by skeptical operators, and equally lauded after showing the product's unique capabilities. We have no doubt that this technology can solve any grease problem and provide the aforementioned odor control and efficiency benefits, all without harming treatment processes. We look forward to working with you to find the appropriate method for both demonstration of the product and planning for potential broad implementation.