TROJAN UV

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CASE **STUDIES**

Central Texas, USA – Using UV for Primary Drinking Water Treatment

Location:
Central Texas, USA

System:
TrojanUVFlex®200

Plant Capacity:
25 MGD with future expansion to 35 MGD

Technology:
UV Water Treatment

Water Source:
Surface Water

Treatment Targets:
Microorganism Prevention

BACKGROUND

A city in Central Texas with a population of 85,000 as well as several nearby industries, receives drinking water that is extracted from the local river and treated at the nearby water treatment plant.

In the United States, all water plants which draw from surface water sources carry out primary treatment in accordance with the USEPA Surface Water Treatment Rule (SWTR), achieving 3-log (99.9%) removal/inactivation credits for *Giardia lamblia* and 4-log (99.99%) removal/inactivation credits for viruses, (e.g. adenovirus).

The application of chlorine and chlorine-based chemicals to achieve SWTR targets has historically been favored due to chlorine's effectiveness against viruses. However, by-products of chlorine treatment regulated through the USEPA Disinfection Byproduct Rule (DBPR), including trihalomethanes (THM), and haloacetic acids (HAA), are often a concern and in addition, the price of chlorine-based products nearly doubled from 2017 to late-2022. While bulk chlorine prices have slowly begun to stabilize since the end of the pandemic, chemical handling concerns, tightening regulations, and higher transportation costs are compelling many water providers to investigate alternative treatment methods which do not require chemicals.

	Required UV Dose (mJ/cm²)	
Treatment Credits (Log)	**Cryptosporidium**	**Virus**
1.0	2.5	58
2.0	5.8	100
3.0	12	143
4.0	22	186

Table 1 – UV dose requirements for indicated targeted microorganisms. (Source: USEPA, 2006)

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UV FOR PRIMARY DRINKING WATER TREATMENT

Since the early 2000s, in response to the release of the Long Term 2 (LT2) Enhanced Surface Water Treatment Rule, UV technology has been applied more frequently in surface water treatment facilities as an added secondary treatment barrier for microorganisms which are resistant to treatment with chlorine, such as *Cryptosporidium parvum*. However, chemical treatment methods are still required at these sites to achieve the primary treatment mandated by the SWTR.

The application of UV as an exclusive primary treatment method has historically been limited to sites with lower flow capacities such as those which extract from groundwater aquifers.

One of the challenges UV technology faces when achieving SWTR treatment standards is that the prescribed USEPA UV dose targets for virus (adenovirus) credits (**Table 1**) are much higher when compared to those needed to achieve equivalent credits for *Cryptosporidium*. Higher dose targets drive the cost of UV equipment needed to achieve them higher. However, recent advances in UV lamp technology and UV chamber engineering are helping to reduce lamp count, chamber size, and cost, to make UV more economically-suited to achieve the high dose target needed for 4-log virus credit (186 mJ/cm²) stipulated by the SWTR.

THE TROJAN SOLUTION

Trojan Technologies designed a solution that would allow the water treatment plant to meet SWTR primary treatment requirements using only UV technology, allowing the site to significantly reduce its dependence on chlorine (which would be limited to being a residual [secondary] treatment method for finished water distribution to end-users).

The site uses the TrojanUVFlex®200 that employs a high-powered 1,000 Watt Solo Lamp®. These high-powered and high-efficiency lamps require smaller and less expensive steel UV chambers to contain them. Additionally, the lamps are installed perpendicular to the flow of water allowing the chamber to be engineered with individual lamp sections (**Figure 1**) which can be independently operated. If the treatment conditions at the plant become more favorable either due to a decrease in demand or improvement in water quality, then these lamp sections can be turned off (**Figure 2**) without resulting in "dark zones" or regions of diminished treatment. By turning off lamp sections, fewer lamps are used, resulting in less power required by the system and lower operating expenses.

The TrojanUVFlex 200 designed for the 25 million gallon per day (MGD) water treatment plant achieves the full 4-log adenovirus credit UV dose of 186 mJ/cm² with three (3) UV chambers each with 120 Solo Lamps. The lamps were arranged in five independent sections of 24 lamps. To also allow for a planned expansion of the facility from 25 MGD to a future expected capacity of 35 MGD, an additional unpopulated section was added to each of the UV chambers. This forward-thinking design ensures that the future expansion plan at the site can be cost-effectively completed without additional UV treatment trains. Once populated with lamps, the final 144 lamp TrojanUVFlex 200 will be able to achieve the required dose of 186 mJ/cm² at a full capacity of 35 MGD.

By incorporating UV technology and reducing the amount of chlorine at the plant, they were able to reduce the amount of THMs and HAAs generated, from levels that were near the regulated limits of the DBPR to much lower and much less concerning concentrations. UV also ensures that the plant's planned expansion and increase in water intake can be managed without increasing byproduct risk

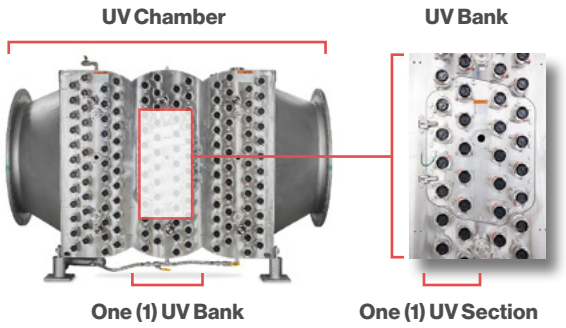

Figure 1 – TrojanUVFlex 200 UV chamber. This chamber shows a total of 3 UV lamp banks and 6 UV lamp sections with 144 lamps in total. The inset shows a close-up of a single lamp bank with the lamp section more clearly defined.

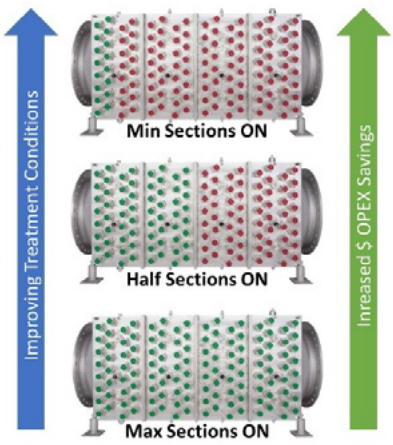

Figure 2 – Lamp sections can be turned off when treatment conditions such as flow rate and UV transmittance (UVT) improve, requiring less UV intensity and lamps to deliver a target UV dose. This reduces lamp replacement frequency and power demand and lowers cost of ownership.

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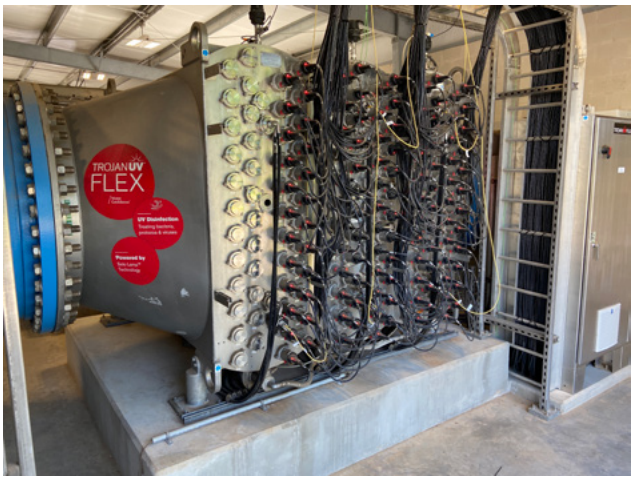
The entire facility which included the three UV chambers plus an additional redundant UV chamber required only just over 700 square feet (~65 square meters) of space including all control panels and maintenance space requirements.

Design Summary		
Design	Current	Planned Expansion
Design Flow	25 MGD	35 MGD
Treatment	4-log (99.99%) Inactivation of Virus	
Target UV Dose	186 mJ/cm² USEPA Validated Dose	
TrojanUV System	TrojanUVFlex®	
Model	200	
Chamber Configuration	3 Duty Trains + 1 Redundant Train	
Chamber Design	5 Sections	6 Sections



CONCLUSIONS

The TrojanUVFlex® is engineered to manage challenging water treatment applications including those with high-capacity demands, poor quality water, or high UV dose requirements, such as those demanded by the SWTR. With these advances, UV technology is now capable of helping drinking water providers reduce dependency on chlorine treatment in favor of alternative technologies that do not generate regulated disinfection by-products, and are also compact and economic to implement.

To learn more about the brands and affiliates of Trojan Technologies, please visit www.trojantechnologies.com

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