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TROJAN technologies®

APPLICATION NOTE

INDUSTRY-SPECIFIC APPLICATIONS FOR UV TECHNOLOGY

APPLICATION: Liquid Sugar

Aquafine® Ultraviolet Treatment Systems for Liquid Sugar

In today's increasingly regulated beverage market, beverage plants are striving to meet more stringent quality standards. Concentrated sugar syrups have a high osmotic pressure. Generally, in concentrations above 66°Brix (1°Bx is 1 gram of sucrose in 100 grams of solution), the osmotic pressure of the solution is so high, it prevents microorganisms from growing and reproducing. But they can still survive in spore form and may grow once the syrup is diluted – then they start to multiply. Liquid sugar applications utilizing UV are typically between 60°Bx and 67°Bx.

Microbial growth can cause food discoloration, adverse flavors, undesired odors, and reduced product shelf-life. Controlling bacterial growth is, therefore, an important issue. The threat of microbial contamination is further increased as manufacturers respond to consumer demand for reductions in chemical additives and preservatives. As a result, food and beverage manufacturers are looking for alternative techniques to protect their products from microbial contamination while maintaining product quality and shelf-life without chemical additives preservatives.

For products that can tolerate the temperature, heat pasteurization may be an option. However, rising energy costs and the space constraint in many food processing plants have led to the successful adoption of ultraviolet (UV) technology as a solution. UV inactivates all known food spoilage organisms. It is a low-maintenance technology, but ensures high levels of microbial inactivation.

Syrups – solutions of sugars like sucrose, fructose, and glucose – are key ingredients in thousands of food and beverage products, adding sweetness to soft drinks, fruit juices, confectionery, and even tomato ketchup.

Soft-drink manufacturers use various types of sugars and non-sugar sweeteners to create liquid sugar for soft drinks. Granulated sugar is the most popular option for most of the world and parts of Europe, while caloric sweeteners, such as high fructose corn syrup (HFCS), are used heavily in North America and other parts of Europe to create liquid sugar syrup. However, for non-caloric drinks, such as Coke Zero, ingredients such as Aspartame or sugar alcohols such as Erythritol is used to make the liquid sugar syrup to manufacture non-caloric drinks.

Typically, a medium to large size bottling plant will have liquid sugar flow rates in the range of 20,000-30,000 L/Hr, while small plants will have flow rates in the range of 10,000 L/Hr. Liquid sugar syrup ultraviolet transmittance (UVT) typically ranges between 20%-65%, while typical dosage required for liquid sugar treatment is 50 mJ/cm². This dosage ensures the inactivation of thermally resistant Alicyclobacillus acidoterrestris spores and common yeasts and molds in liquid sugar that lead to early spoilage.

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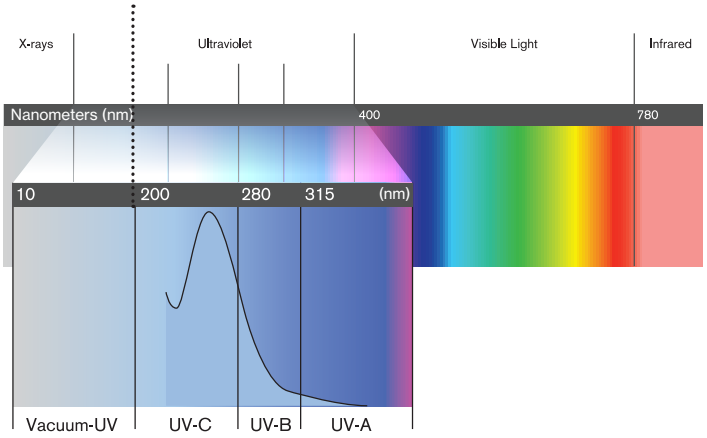
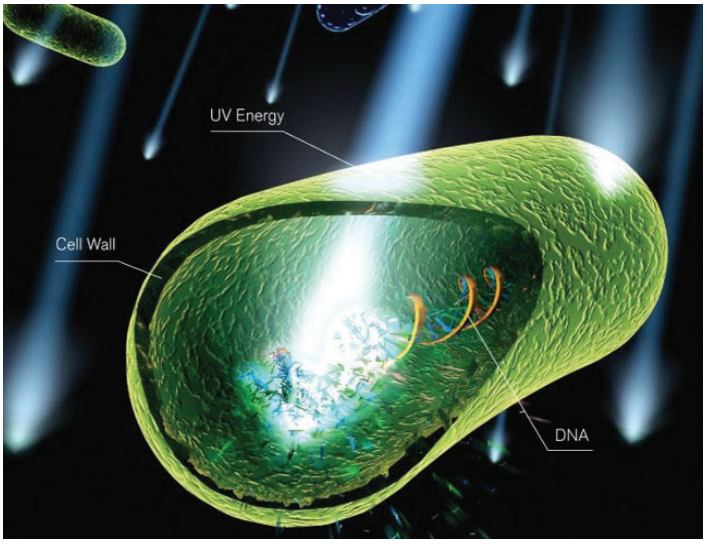
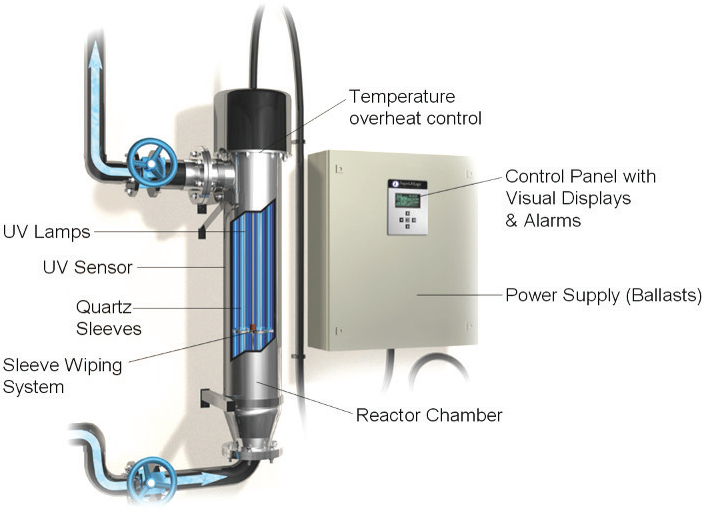
LIQUID SUGAR







How UV Works for Liquid Sugar

UV is the part of the electromagnetic spectrum between visible light and x-rays. The specific portion of the UV spectrum between 200-400nm (known as UVC) has a strong microbial inactivation effect, with peak effectiveness at 265nm.

At these wavelengths, UV inactivates microorganisms by penetrating their cell membranes and damaging the DNA, making them unable to reproduce. UV is able to inactivate a wide range of microorganisms, including thermophilic spores that are tolerant to pasteurization. UV treatment is a proven technology, having been first applied to sugar solutions in the 1980s. Our UV systems have been successfully installed on liquid sugar applications by leading brands including AB InBev, Refresco, Coca-Cola, and Pepsi.

A typical UV system consists of one or several UV lamps housed in protective quartz sleeves and mounted within a cylindrical stainless-steel chamber. The liquid to be treated enters at one end and passes along the entire length of the chamber before exiting at the other end. Many liquids can be effectively treated using UV, including viscous sugar syrups, raw municipal water, filtered process water, and beverages.

Aquafine UV systems are optimized to treat liquids which have a low UV transmittance (i.e. low depth of UV penetration in a fluid) by forcing the liquid to be exposed closer to the lamps for a longer time period to receive higher doses of UV energy. Our systems are designed to treat liquid sugar with UV in dark fluids with high osmotic pressure, glucose, and sucrose. The two natural sugars that are used most often are fructose and sucrose. Fructose is produced from fruits and corn and is generally less e×pensive than sucrose, while sucrose is made from cane sugar and contains both glucose and fructose. UV works well on fructose and sucrose applications.

Benefits of UV

- Increases product quality and shelf life
- Reduces food discoloration
- Helps maintain flavor
- Cost-effective vs. pasteurization

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LIQUID SUGAR

Aquafine Liquid Sugar Treatment Solution

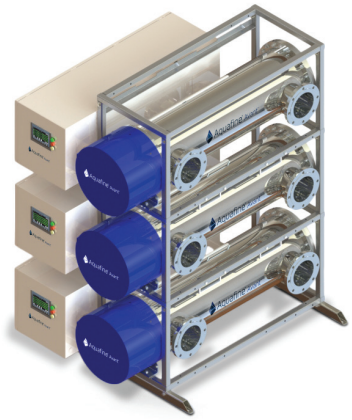
We offer UV solutions to meet all your needs for liquid sugar. Our product offering includes OptiVenn® and Avant series.

OptiVenn: A robust and versatile UV solution that offers the following features and benefits:

- 2–12 lamps: supports a wide flow rate range 9–220 gpm (2–50 m³/h) @ 50% UVT
- Flexible: can be installed in different positions to adapt to existing pipes and layout constraints
- 254nm wavelength: OptiVenn can provide treatment capabilities for liquid sugar solutions that have UVT as low as 20%

Avant: The latest, more intelligent and efficient addition that offers the following features and benefits:

- No. of lamps: 20–44 supporting flow rate ranges 345–728 gpm (78–165 m³/hr) @ 50% UVT
- Flexible: can be installed in different positions to adapt to existing pipes and layout constraints
- Intelligent: Display Lamp Status and UV Dose on 7" touchscreen. Enhanced lamp and driver diagnostic capabilities
- 254nm wavelength: Avant can provide Liquid Sugar treatment for solutions that have UVT as low as 20%



Conclusion

A method of controlling microbial contamination gaining increasing popularity is ultraviolet (UV) treatment. UV inactivates all known food spoilage organisms. It is a low maintenance, technology, and ensures high levels of microbial inactivation.

For food and beverage plants seeking to improve the quality of their final product, UV is an economic and effective option. UV systems are easy to install and retrofit and cause minimal disruption to the plant.

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

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OPTIVENN SERIES | LIQUID SUGAR

MODEL:	02CDS	03CDS	02CDM	02DDM	04CDM	04DDM	04CDL	04DDL	06DDL	08DDL	08EDL	08FDL	10GDL	12HDL
Maximum Flow Rate														
Flow Rate (gpm)*	9 gpm - 220 gpm													
Flow Rate (m^3/hr)*	2 m^3/hr - 50 m^3/hr													
Minimum Cooling Flow Rate gpm (m^3/hr) @25°C	0.2 (0.04)						0.4 (0.08)		0.5 (0.11)				0.7 (0.15)	0.8 (0.18)
Number of UV Lamps	2	3	2	2	4	4	4	4	6	8	8	8	10	12
For Application Specific Sizing, please contact Trojan Technologies														
Operating Conditions														
Fluid operating temperature °F (°C)	34° - 131° (1° - 55°)													
UV Transmittance Range	20% - 50% UVT													
Maximum Operating Pressure PSI (BAR)	150 (10)													
Hot Water Sanitization °F (°C)	194° (90°)													
Electrical Requirements														
Electrical Supply	110-240V, 50/60Hz, L-L or L-N, 2W+GND													
Operating power (kVA)**	0.2	0.2	0.2	0.2	0.3	0.3	0.7	0.7	1.0	1.2	1.2	1.2	1.5	1.8
Chamber														
Material of Construction	316L Stainless Steel													
Lamp Length - in (cm)	15 (38)		30 (76)				60 (152)							
Chamber Diameter - in (cm)	6 (15)			8 (20)	6 (15)	8 (20)	6 (15)	8 (20)			10 (25)	12 (30)	14 (36)	16 (41)
I/O Sanitary Tri-clamp size - in (cm)	2 (5)			3 (8)		4 (10)		6 (15)			8 (20)			10 (25)
Surface Finish	Ra15													
Elastomers	EPDM (EC1935/2004, FDA)													
Monitoring and Controls														
Standard	Base Package: Lamp status indicator, System hours of operation, Lamp out alert (LOA) and Remote start/stop (HOA)													
Optional	UV Monitoring Package: UV intensity reading with NIST certified sensor													
Control Panel														
Standard														
Material of Construction	304 Stainless Steel													
Rating	UL Type 1 (IP51) Forced Air & Vent												UL Type 12 (IP54) Forced Air & Vent	
Dimensions H×W×D - in (cm)	16 × 16 × 7 (41 × 41 × 18)								16 × 20 × 9 (41 × 51 × 23)				22 × 23 × 9 (56 × 59 × 23)	
Shape	Flat Top												Sloped Top	
Installation Location	Indoor Only													
Operating Temp Ambeint °F (°C)	34° - 104° (1° - 40°)													
Optional														
Rating	UL Type 4X (IP56) Forced Air and Vent/Shroud								UL Type 12 (IP54) Forced Air and Vent UL Type 4X (IP56) Forced Air & Vent/Shroud UL Type 4X (IP66) with AC				UL Type 4X (IP56) Forced Air & Vent/Shroud UL Type 4X (IP66) with AC	
Size H×W×D - in (cm) ***	18 × 19 × 8 (46 × 49 × 21)								22 × 23 × 9 (56 × 59 × 23) 24.5 × 23 × 9 (62 × 59 × 23)				23 × 24.5 × 9 (59 × 56 × 23) 24.5 × 23 × 9 (62 × 59 × 23)	
Shape	Sloped Top													
Installation Location	Indoor Only													
Operating Temp Ambient °F (°C)	34° - 104° (1° - 40°)													
Certifications	   													

* Dose Level: 50 mJ/cm² after 9,000 hours of operation @ 50% UVT
** Standard Control Panel
*** Please consult drawings for exact specifications

AVANT SERIES | LIQUID SUGAR

MODEL:	Avant 20		Avant 36		Avant 44	
Maximum Flow Rate						
Flow Rate (gpm)*	345 gpm - 728 gpm					
Flow Rate (m^3/hr)*	78 m^3/hr - 165 m^3/hr					
Minimum Cooling Flow Rate gpm (m^3/hr) @25°C	1.5 (0.36)		2.4 (0.54)		2.9 (0.66)	
Number of UV Lamps	20		36		44	
For Application Specific Sizing, please contact Trojan Technologies						
Operating Conditions						
Fluid operating temperature °F (°C)	34° - 131° (1° - 55°)					
UV Transmittance Range	20% - 50% UVT					
Maximum Operating Pressure PSI (BAR)	150 (10)					
Hot Water Sanitization °F (°C)	194° (90°)					
Electrical Requirements						
Electrical Supply	System Power (kVA)	System Current (A)	System Power (kVA)	System Current (A)	System Power (kVA)	System Current (A)
208Vac, 3PH, 50/60Hz 3W + GND	3.9	12	6.8	19	8.3	24
220-240Vac, 1PH, 50/60Hz, 2W + GND	3.9	18	6.9	31	8.3	38
240Vac, 3PH, 50/60HZ, 3W + GND	4	11	6.9	17	8.3	21
380/220Vac, 3PH, 50Hz, 4W + GND	3.9	7	6.9	11	8.3	13
400/230Vac, 3PH, 50Hz, 4W + GND	3.9	6	6.9	11	8.3	13
415/240Vac, 3PH, 50Hz, 4W + GND	4	6	6.9	10	8.3	12
440Vac, 3PH, 50/60Hz, DELTA	4	7	6.9	12	8.3	15
480/277Vac, 3PH, 60Hz, 4W + GND	4.3	6	7.2	9	8.7	12
Chamber						
Material of Construction	316L Stainless Steel					
Chamber Length - in (mm)[1]	79 (200.6)					
Chamber Diameter - in (cm)	12 (30.5)		14 (35.6)		16 (40.6)	
I/O Sanitary Tri-clamp size - in (cm)	4 (10)		6 (15)		6 (15)	
Surface Finish	Ra15					
Elastomers	EPDM (EC1935/2004, FDA)					
Monitoring and Controls						
Standard	Base Package: Lamp status indicator, System hours of operation, Lamp out alert (LOA) and Remote start/stop (HOA)					
Optional	UV Monitoring Package: UV intensity reading with NIST certified sensor, theoretical dose display					
Control Panel - Modular (Standard)						
Material of Construction	Painted Carbon Steel					
Rating	UL Type 1 (IP51) with Forced Air and Vent					
Dimensions H×W×D - in (cm)	23 × 66 × 23 (59 × 168 × 59)					
Installation Location	Indoor Only					
Operating Temp Ambeint °F (°C)	34° - 104° (1° - 40°)					
Control Panel - Stand Alone (Optional)						
Standard						
Material of Construction	Painted Carbon Steel					
Rating	UL Type 12 (IP 54) with Forced Air and Vent					
Installation Location	Indoor Only					
Operating Temp Ambeint °F (°C)	34° - 104° (1° - 40°)					
Optional						
Material of Construction	304 Stainless Steel					
Rating	UL Type 4X (IP56) Forced Air and Vent, With Shroud					
Dimensions H×W×D - in (cm)	65 × 35 × 19 (166 × 90 × 50)					
Conduit Length	Standard: 9 feet Optional: 15 feet					
Installation Location	Indoor Only					
Operating Temp Ambient °F (°C)	34° - 104° (1° - 40°)					
Certifications						

NOTES: Dimensions are for informational purposes only and not to be used for design. Refer to system layout drawings.
1. Overall Length with End Cap Installed
* Dose Level: 50 mJ/cm² after 9,000 hours of operation @ 50% UVT