

REDUCTION RATES ACCORDING TO REPORTED LAB RESULTS

Measured ozone response across water, air,
surfaces and biological targets

**REPORTED LABORATORY EVIDENCE + ACTUAL ENGINEERED
O3 SCIENCE SYSTEMS**

PRINT-READABLE REFERENCE PAMPHLET

LABORATORY EVIDENCE + ACTUAL ENGINEERED SYSTEM RESULTS

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How to read this booklet

The recovered source sheet mixes quantified reduction percentages, legacy words such as destroyed or killed, threshold values, qualitative susceptibility statements, seconds, minutes and CT values. This booklet preserves that wording in the result tables and in the exact-order appendix.

Every result stays attached to its stated target, dose, contact time and medium. A result is placed in the Water and aqueous section only when the recovered wording expressly identifies water, clean water, wastewater, sludge effluent, raw wastewater, distilled water or phosphate buffer. All other rows remain under Medium not stated.

The source states: 1-mg/l = 1-PPM. Unit spelling and obvious source typographical forms are retained in the exact-order appendix. The organized tables retain the complete result wording.

Important evidence distinction

The actual-results charts plot only rows with reported numerical endpoints. The controlled-dose charts are engineering illustrations. They explain how dose, ozone demand, contact time and usable residual can interact; they are not a universal organism-specific laboratory curve.

Reported laboratory evidence and actual engineered systems

This booklet contains two evidence streams: reported laboratory results for specific targets under stated conditions, and results from actual O3 Science systems engineered, applied and tested in agricultural, food-processing, storage and facility environments.

O3 Science reports facility sanitation testing up to 99.9999% reduction in produce, meat and fish packing, milk-storage tanks, storage facilities and processing facilities. O3 Science also reports that applicable FDA, USDA and health-department personnel were present during relevant facility testing. These company-reported project results are presented separately from the recovered Ozone Effects source sheet.

Every system is engineered for its conditions

A dose shown in a laboratory result or past project is an evidence point, not a universal recipe. The engineered dose, transfer, distribution, contact time, monitoring and operating controls can change with water quality, air quality, flow rate, pipe size, room volume, humidity, temperature, organic and microbial load, facility type, process conditions, surface materials and the required endpoint. When those variables change, the dosing recommendation and system engineering may also change.

Agricultural water and air are different treatment routes



Left: engineered ozonated irrigation water is treated before crop delivery and followed through the root zone. Right: controlled gaseous treatment occurs in a separate empty, isolated and monitored space. The airflow and root cutaway are educational overlays.

Ozonated water before crop delivery

O₃ Science reports that its agricultural laboratory and field testing has repeatedly achieved rapid pathogen reduction in treated water, including complete removal at the measured endpoint under applicable test conditions, using low engineered dissolved-ozone settings. The treatment is engineered into the water before crop delivery and verified through water, root-zone, plant and harvest measurements.

Controlled air treatment remains separate

Controlled gaseous ozone can also reduce microbial load rapidly, but direct ozone-gas exposure is a plant-safety boundary. Agricultural air treatment is isolated from exposed crops and uses its own concentration, distribution, monitoring, clearance and re-entry controls. Water-treatment settings are never transferred directly to air treatment.

Why the medium changes the reaction

In water, the useful reaction depends on transfer into solution, water chemistry, temperature, flow, mixing, oxidizable demand and the residual that remains after that demand is satisfied. In air, distribution, humidity, surface access, leakage, room geometry and verified clearance become separate design controls. A concentration reported in one medium cannot be copied into the other.

What these results apply to

The practical objective is not merely to generate ozone. It is to deliver a measured amount to the target, maintain useful contact under the actual load and verify that the selected biological or process endpoint was achieved.

O3 Science evidence remains O3 Science evidence

The laboratory data, field testing and engineered-system results identified as O3 Science evidence belong to the O3 Science technology and the conditions under which those results were produced. Recovered reference entries remain separately identified where their original record requires that distinction.

Results cannot be transferred to another machine by claim alone

O3 Science reports that ozone machines evaluated in its comparative testing did not reproduce the same reaction or verified performance under the tested comparison conditions. Another manufacturer or equipment supplier therefore cannot properly apply O3 Science percentages, reaction rates or project outcomes to its own machine without matched, documented testing. Doing so would misrepresent the origin and meaning of the evidence.

Why machine and test conditions matter

Performance depends on how ozone is generated, measured, transferred and controlled; the stability and quantity of delivered output; the water or air matrix; temperature and chemistry; organic and microbial load; mixing or distribution; contact time; monitoring; and the required endpoint. A fair comparison must hold those variables in view.

Independent studies support the science - not an equipment claim

University and peer-reviewed studies support ozone susceptibility, oxidation mechanisms and dose-contact relationships. Their results belong to their own generators and test conditions. They help explain why O3 Science results are scientifically consistent, but they do not authorize another ozone machine to claim O3 Science performance.

Copyright and evidence use

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Part 1 - Organized reported lab results

The original source rows are reorganized first by reported medium and then by target class. Wording is preserved; classification labels are editorial navigation only.



Actual engineered applications do not share one fixed setting. Irrigation, produce washing, dairy tanks, meat and fish processing, and cold storage each create different water, air, load, distribution and contact-time conditions.

Engineering follows the conditions

Laboratory results help establish the relationship among target, dose, medium, contact time and endpoint. The installed O3 Science system is then engineered around the conditions it must overcome and the result it must produce. Generation capacity, transfer, mixing or air distribution, contact, residual, monitoring and controls are sized and adjusted together.

Independent research supports the reaction pattern

University and peer-reviewed studies independently confirm rapid ozone effects on viruses, bacteria, biofilms and fungal spores. They also confirm the same engineering lesson seen in O3 Science work: the response changes with organism, matrix, temperature, pH, surface, organic load, ozone residual and contact time.

Those outside studies use their own generators and their own reported figures. They support the oxidation mechanism and susceptibility pattern, but they are not direct dose settings, performance limits or substitutes for O3 Science laboratory and engineered-system results.

O3 Science generation distinction

O3 Science uses the term strong-molecule ozone for the higher-output, controllable behavior of its proprietary generation method and distinguishes it from weaker UV-generated ozone. The meaningful comparison is the measured delivered dose, transfer, demand reduction, usable residual, reaction time and verified endpoint under matched conditions - not the generator label by itself.

Water and aqueous media

This section includes water, clean water, wastewater, sludge effluent, raw wastewater, distilled water and phosphate buffer exactly where the source states those media.

O3 Science agricultural water result

In O3 Science agricultural practice, the rapid reduction occurs within the engineered water-treatment chain. Correctly controlled ozonated water can reduce pathogen and biofilm pressure before irrigation or recirculating water reaches the crop, while downstream measurements verify the root-zone and plant response.

Bacteria and bacterial spores

Target	Reported result / dosage - source wording	Reported medium
Bacillus cereus	99% destruction after 1-min at 0.12 mg/l in water	Water
B. cereus (spores)	99% destruction after 1-min at 2.3 mg/l in water	Water
c. difficile	99.999% destruction at 0.6 mg/l for 2 minutes (in water)	Water
E-coli (in clean water)	99.99% destruction at 0.25 mg/l for +/- 30 seconds	Clean water
E-coli (in wastewater)	99.9% destruction at 2.2 mg/l for 19 minutes	Wastewater
Legionella pneumophila	99.99% destruction at 0.32 mg/l for 20 minutes in distilled water	Distilled water
Mycobacterium avium	99.9% with a CT value of 0.17 in water (scientifically reviewed document)	Water
Mycobacterium fortuitum	90% destruction at 0.25 mg/l for 1.6 minutes in water	Water
Salmonella typhimurium	99.99% destruction at 0.25 mg/l for 1.67 minutes in water	Water

Viruses and bacteriophages

Target	Reported result / dosage - source wording	Reported medium
Bacteriophage f2	99.99% destruction at 0.41 mg/l for 10-seconds in water	Water
Coxsackie Virus A9	95% destruction at 0.035 mg/l for 10-seconds in water	Water
Coxsackie Virus B5	99.99% destruction at 0.4 mg/l for 2.5-minutes in sludge effluent	Sludge effluent
Enteric virus	95% destruction at 4.1 mg/l for 29 minutes in raw wastewater	Raw wastewater
Hepatitis A virus	99.5% reduction at 0.25 mg/l for 2-seconds in a phosphate buffer	Phosphate buffer
Poliovirus type 1	99.5% destruction at 0.25 mg/l for 1.6 minutes in water	Water

Where the remaining target evidence appears

The recovered record also contains results for molds and fungi, yeast, an oomycete plant pathogen, protozoan cysts and a parasite. Because those entries do not state water or air, they are presented next under Medium not stated instead of being incorrectly shown as unsupported or reassigned to water.

Additional supported biological targets

These recovered results support the additional target classes. Their original wording does not identify the treated medium, so the booklet preserves that limitation rather than guessing. Several entries describe a target as ozone susceptible or very susceptible; those qualitative susceptibility statements are evidence, but they are not converted into invented percentages.



Educational microscopy-scale reference showing representative bacteria, virus-like particles, mold structures and yeast cells. The organisms are magnified for teaching and are not shown at literal visible scale.

Different structures create different reaction paths

Ozone can attack cell walls and membranes, proteins, enzymes, capsids, nucleic acids and the extracellular material that helps hold a biofilm together. The dominant pathway and the time needed to reach the endpoint differ by organism and by the material surrounding it.

That is why a susceptibility label is useful evidence but not a complete design. A free organism in low-demand water may react quickly, while the same target protected by organic material, an established biofilm or a difficult surface may require more delivered ozone, better contact or a longer controlled treatment.

Bacteria and bacterial spores

Target	Reported result / dosage - source wording
Bacillus Bacteria	Destroyed by 0.2 m/l within 30 seconds
Bacillus Anthracis (causes anthrax in sheep, cattle and pigs. Also a human pathogen)	Ozone susceptible
Bacillus subtilis	90% reduction at 0.10-PPM
Clavibacter michiganense	99.99% destruction at 1.1 mg/l for 5 minutes
Clostridium Bacteria	Ozone susceptible
Clostridium Botulinum Spores. Its toxin paralyses the central nerve system, being a poison multiplying in food and meals.	0.4 to 0.5 mg/l threshold value
Diphtheria Pathogen	Destroyed by 1.5 to 2 mg/l
Eberth Bacillus (Typhus abdominalis). Spreads typically by aqueous infection and causes typhoid.	Destroyed by 1.5 to 2 mg/l
Escherichia Coli Bacteria (from feces)	Destroyed by 0.2 mg/l
Klebs-Loffler Bacillus	Destroyed by 1.5 to 2 mg/l
Proteus Bacteria	Very susceptible
Pseudomonas Bacteria	Very susceptible
Salmonella Bacteria	Very susceptible
Staph epidermidis	90% reduction at 0.1-ppm for 1.7 min
Staphylococci	Destroyed by 1.5 to 2.0 mg/l
Streptococcus Bacteria	Destroyed by 0.2 mg/l within 30 seconds
Virbrio Cholera Bacteria	Very susceptible

Viruses and bacteriophages

Target	Reported result / dosage - source wording
Echo Virus 29: The virus most sensitive to ozone.	After a contact time of 1 minute at 1 mg/l of ozone, 99.999% killed.
Encephalomyocarditis Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l.
Enterovirus Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l.
GDVII Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l.
Herpes Virus	Destroyed to zero level in less than 30 seconds wit 0.1 to 0.8 mg/l.
Influenza Virus	0.4 to 0.5 mg/l threshold value
Poliomyelitis Virus	99.99% kill with 0.3 to 0.4 mg/l in 3-4 minutes
Rhabdovirus virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l
Stomatitis Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l
Vesicular Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l

Molds and fungi

Target	Reported result / dosage - source wording
Aspergillus Niger (Black Mount)	Destroyed by 1.5 to 2 mg/l
Botrytis cinerea	3.8 mg/l for 2 minutes
Cladosporium	90% reduction at 0.10-PPM for 12.1 minutes
Fusarium oxysporum f.sp. lycopersici	1.1 mg/l for 10 minutes
Fusarium oxysporum f.sp. melonogea	99.99 % destruction at 1.1 mg/l for 20 minutes
Luminescent Basidiomycetes (species having no melanin pigment).	Destroyed in 10 minutes at 100-PPM
Mucor piriformis	3.8 mg/l for 2 minutes
Penicillium Bacteria	Ozone susceptible
Verticillium dahliae	99.99 % destruction at 1.1 mg/l for 20 minutes

Yeasts

Target	Reported result / dosage - source wording
Candida Bacteria	Ozone susceptible

Oomycetes and plant pathogens

Target	Reported result / dosage - source wording
Phytophthora parasitica	3.8 mg/l for 2 minutes

Protozoan cysts

Target	Reported result / dosage - source wording
Endamoebic Cysts Bacteria	Ozone susceptible

Parasites

Target	Reported result / dosage - source wording
Schistosoma Bacteria	Very susceptible

Mildews - supplemental application evidence

Target	Reported result / dosage - source wording
Mold and mildew removal	Ozone Shock Systems 091021.odt identifies mold and mildew removal as an ozone shock-treatment application. This is presented as documented application evidence; the source keeps that statement separate from organism-specific laboratory dose and contact-time entries.

How to read the susceptibility pattern

The recovered evidence includes fast responses at low reported concentrations for several organisms and qualitative labels such as ozone susceptible and very susceptible for others. That pattern supports ozone sensitivity, but the engineered setting still depends on the target, medium, demand, transfer, distribution and required endpoint.

What changes between target classes

Viruses do not respond exactly like vegetative bacteria, bacterial spores do not respond exactly like active cells, and fungal spores can show a rapid first-stage reduction followed by a slower surviving fraction. Mildew, yeast, protozoan cyst and parasite results must likewise remain attached to their stated test conditions.

For O3 Science design work, the target class helps define the initial treatment window. Baseline testing, measured delivered ozone and follow-up sampling then determine whether the setting is adequate for the actual water, surface, air volume or process.

Ozone water at the surface



Educational microscope-scale demonstration: the visible biological load is enlarged so the reaction can be seen. As ozonated water moves across a food-contact surface, it reacts with organic demand, bacteria, virus particles, mold spores and early biofilm. The measured reduction belongs to the applicable lab or facility result, not to the artwork itself.



A trained sanitation worker applies ozonated water to stainless food-processing surfaces. The engineered setting depends on incoming water quality, surface load, spray coverage, flow, pressure, contact time, drainage and the required sanitation endpoint.

Ozone water inside the treatment system



A realistic pump, injection and contact arrangement demonstrates controlled ozone transfer into process water. Pipe size, flow rate, water chemistry, temperature, dissolved and organic load, transfer efficiency, residual and available contact time all affect the engineered dose.



Educational cutaway: ozone first satisfies oxidizable demand and attacks organisms and attached biofilm. As the load falls, more usable residual can remain available. The organisms are magnified for teaching and are not shown at literal scale.

Air and gaseous treatment

The recovered Ozone Effects source sheet does not expressly identify any individual row as an air or gaseous laboratory result. Those rows therefore are not moved into this section.

Agricultural air-treatment boundary

O3 Science reports rapid microbial reduction during controlled air treatment. Ozone gas can also injure exposed plant tissue, so agricultural air cycles are engineered as isolated treatments with crops absent or protected from exposure. Treatment duration alone is not a plant-safety control; distribution, concentration, monitoring, ozone decay or destruction and verified clearance remain part of the procedure.



Controlled off-hours air treatment requires distribution through the unoccupied room, around equipment and into the treatment volume. The visible blue airflow is an educational overlay showing distribution, not dense ozone fog.

O3 Science company-reported facility applications

Controlled air treatment is used as one stage within produce, meat and fish packing and related processing or storage sanitation plans. The company-reported facility result is up to 99.9999% reduction under the conditions of the applicable test.

A typical staged application may include ozone bubblers for fish or product ice baths, controlled treatment of process areas, and unoccupied overnight room shock treatment. Air shock treatment is performed only in unoccupied spaces with controlled distribution, monitoring and re-entry procedures.

Air-treatment demonstration and design variables



Educational microscope-scale demonstration: ozone moving through an unoccupied room reacts with airborne and surface bacteria, virus particles, mold spores and organic residue. The biological structures are magnified to demonstrate reduction and are not literal objects floating at visible scale.

Air-treatment variables change the engineered setting

Room volume, air quality, humidity, temperature, ventilation, leakage, equipment geometry, surface load, distribution pattern, ozone demand, contact time, monitoring and the required endpoint determine the engineered air-treatment setting and re-entry control.

Target-class separation

The current company-reported facility statement is an overall microbial reduction result. The supplied record set does not provide an organism-by-organism air breakdown for bacteria, viruses, molds, mildews, yeasts or other targets, so this booklet does not invent one.

Part 2 - Actual reported endpoint charts

These visuals use selected numerical endpoints from the recovered source sheet. Each point remains labeled by target and contact time; the underlying rows remain in Part 1 and the exact-order appendix.



Laboratory evidence connects the treated medium and exposure conditions to measured before-and-after results. The image represents sampling, controlled contact and culture comparison; the tables and charts preserve the reported dose, medium, time and endpoint.

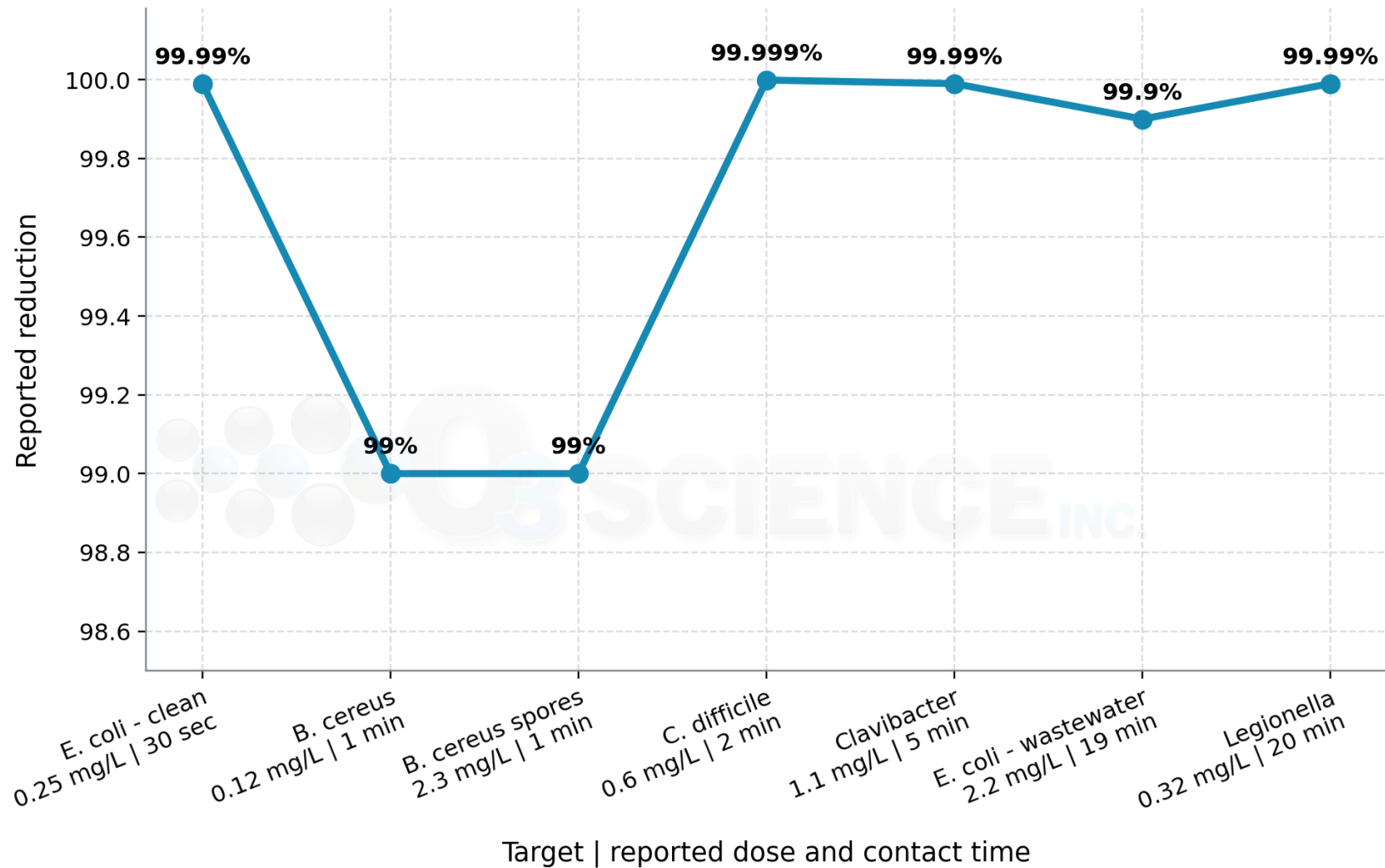
How outside studies back the interpretation

At the University of North Carolina, a bench-scale water study reported more than a 3-log reduction of Norwalk virus within 10 seconds at 0.37 mg/L ozone, pH 7 and 5 C, and more than 4-log reduction by 5 minutes. The same study observed residual ozone falling as sample demand was introduced and rising again after that demand was satisfied.

A Medical University of Warsaw study reported that ozonated water at 1.2-3.6 micrograms/mL reduced viable *Staphylococcus aureus* biofilm cells to background levels after 30 seconds, while *Pseudomonas aeruginosa* was more tolerant. A separate fungal-spore study reported a rapid first stage followed by a slower stage, with pH, temperature and real-water matrix changing the rate.

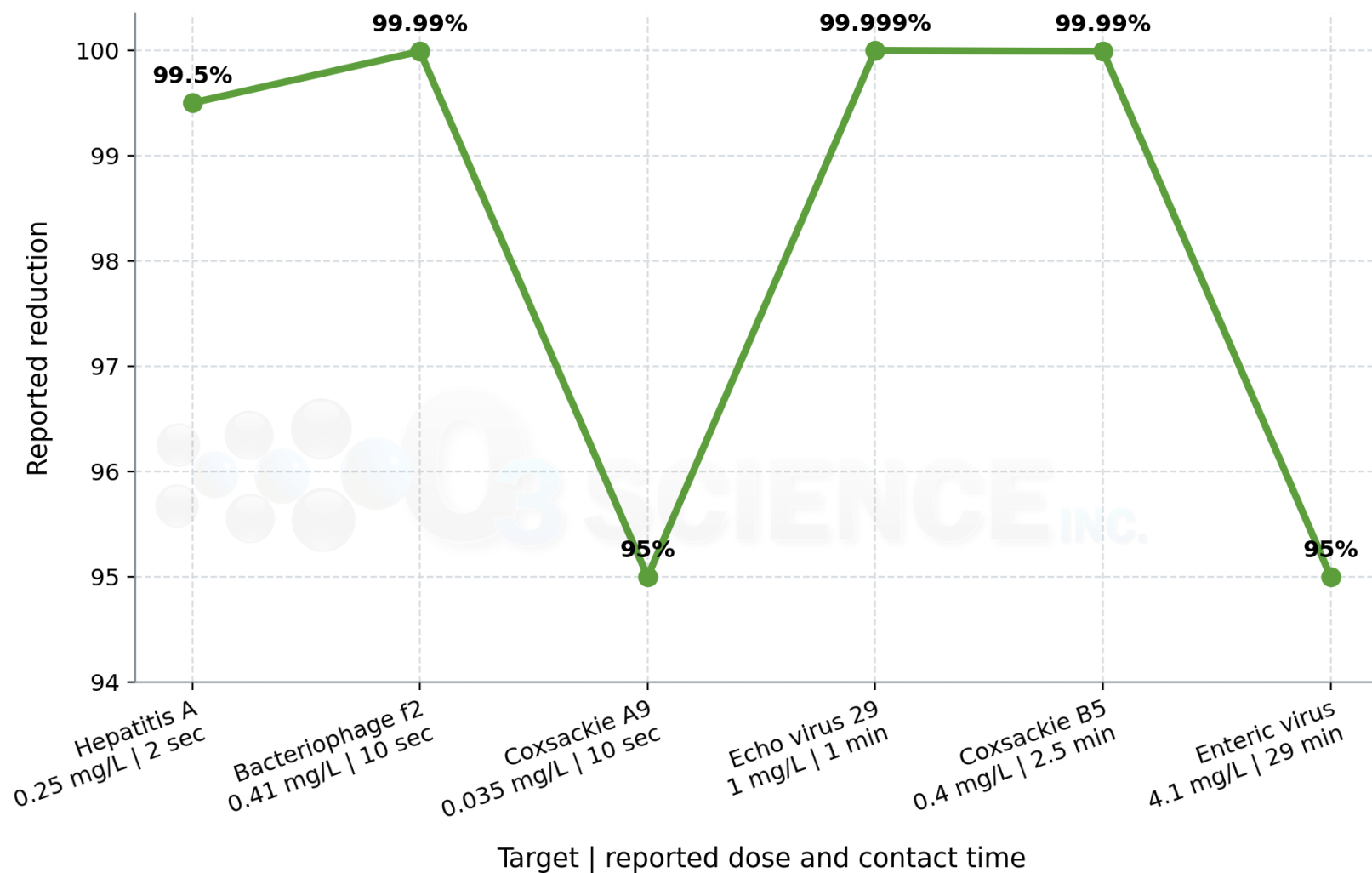
These are independent examples using different equipment and conditions. They support the response pattern; they do not replace O₃ Science figures or set the operating range of an O₃ Science system.

Bacteria - actual reported endpoints



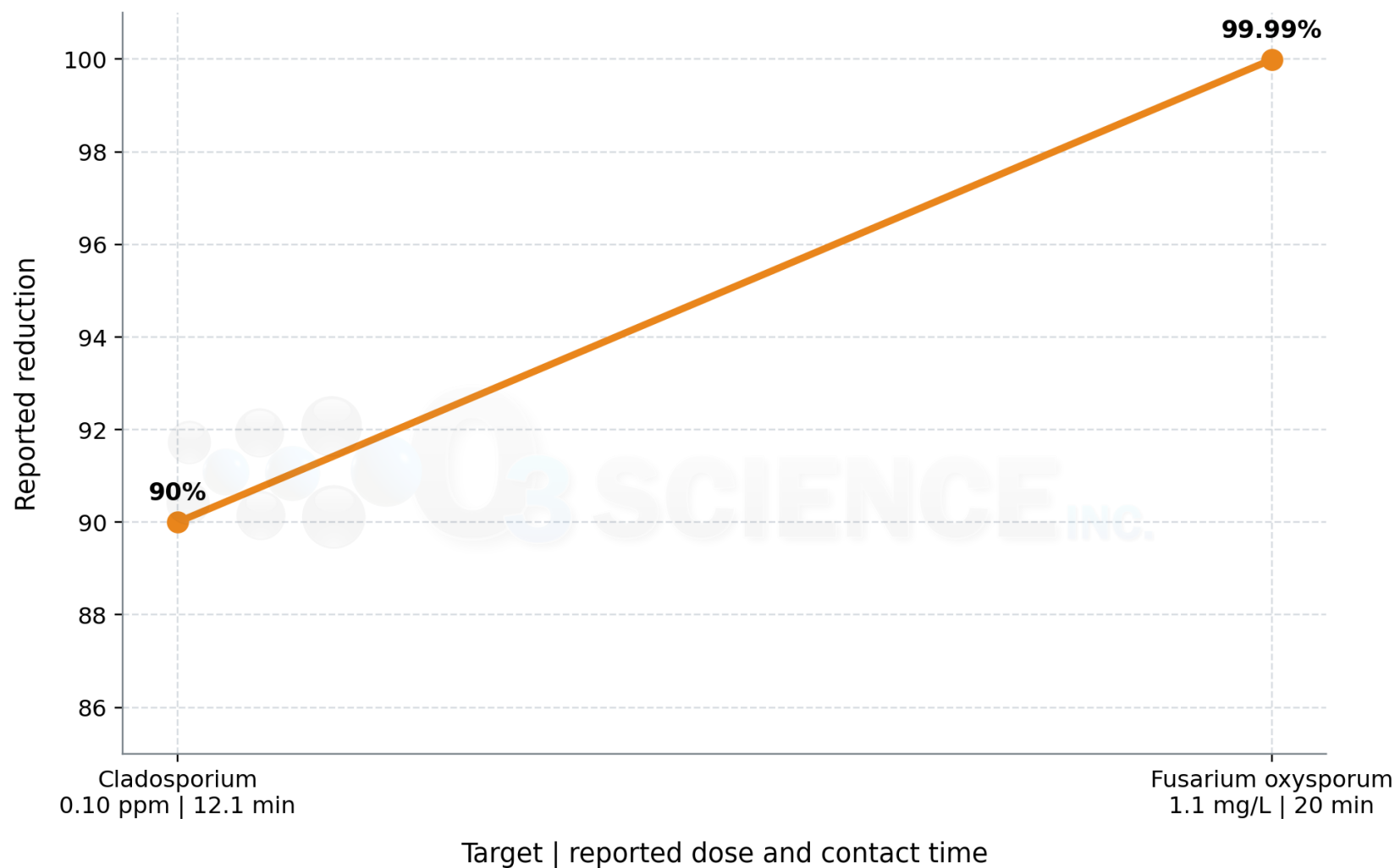
The vertical scale is intentionally narrow so the differences among high reported reductions remain visible. Consult the tables for the target-specific dose, medium and contact time.

Viruses - actual reported endpoints



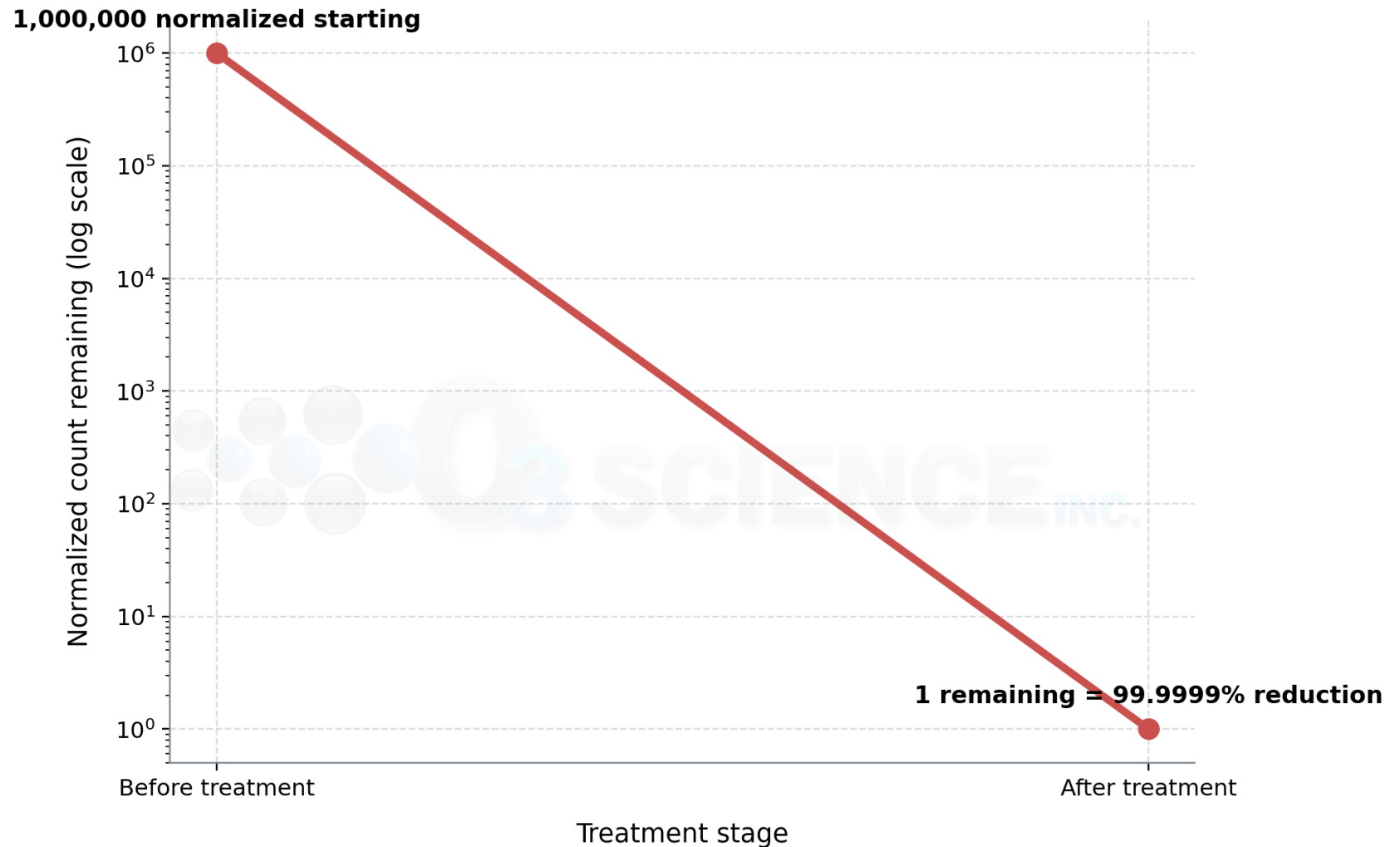
This comparison shows reported endpoints, not a single universal response curve. Media and doses differ by target and remain stated in the tables.

Molds and fungi - actual reported endpoints



The recovered numerical examples include different targets and contact times. They are shown as separate reported points and are not combined into a universal fungal treatment setting.

Facility sanitation - company-reported result



O3 Science reports up to 99.9999% reduction in relevant facility sanitation testing. The normalized before/after count is a visual expression of that percentage, not a replacement for the applicable test record.

Part 3 - Controlled-dose engineering visuals

With a controlled O3 Science strong-molecule ozone system, the delivered dose can be adjusted to pursue the selected result. Increasing the controlled dose can accelerate the reaction because the oxidizable load falls, ozone demand declines and more usable residual becomes available.

The correct setting still depends on the application: flow rate, pipe size, water chemistry, organic and microbial load, distribution, contact time, intended endpoint and monitoring. These visuals are adjustable engineering examples and do not replace site-specific testing.

O3 Science terminology

O3 Science uses strong-molecule ozone to describe its higher-output controlled system and distinguishes it from weaker UV ozone. In company application experience, the controlled system can produce a faster and more dramatic dose-response, while weak-molecule UV ozone is less adjustable for the same type of result.

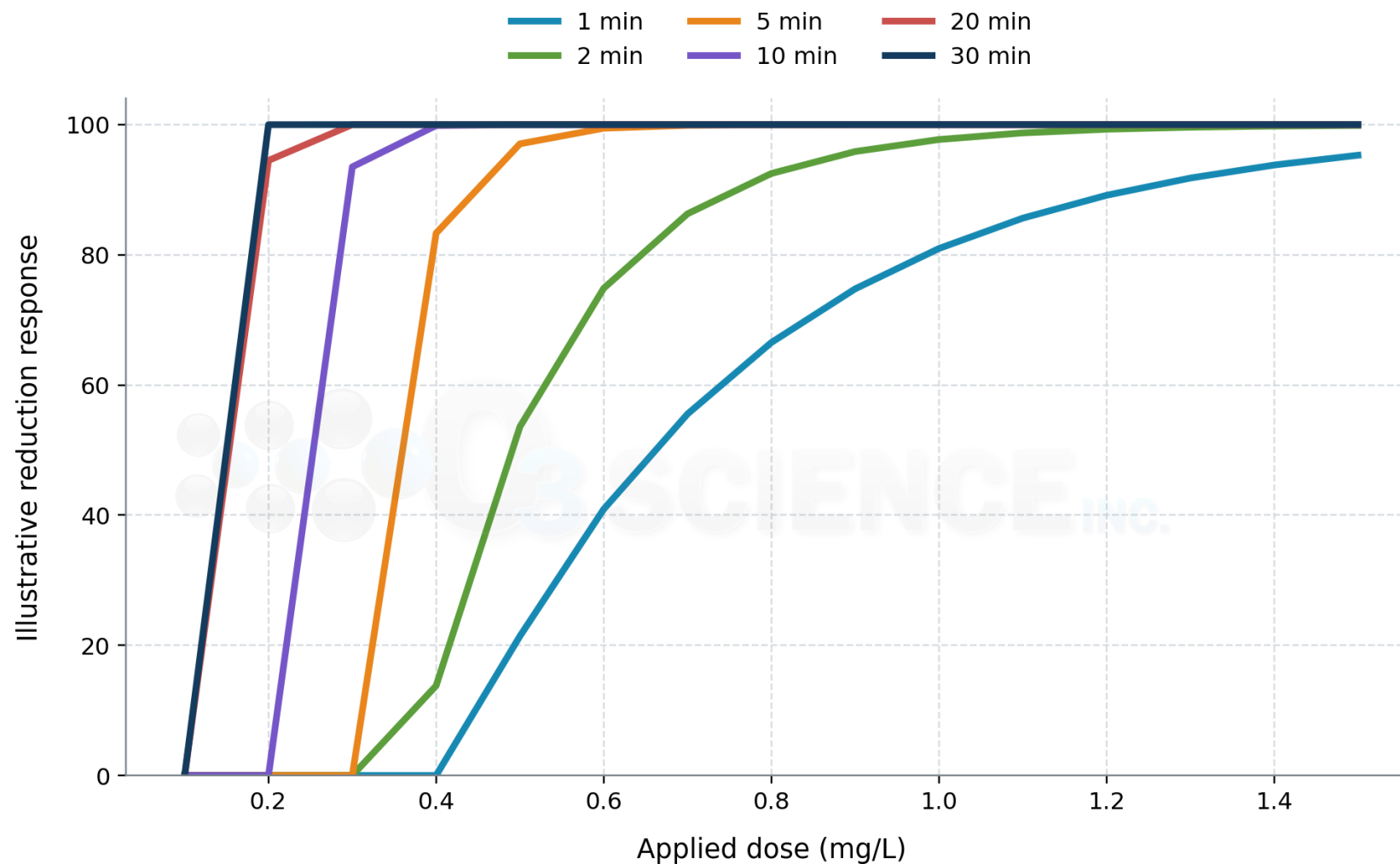
Why the curve can accelerate

At the beginning of treatment, part of the delivered ozone is consumed by the existing oxidizable load. As that load is reduced, ozone demand falls. A larger share of the next delivered dose can then remain available as usable residual and reach the remaining target.

With a controllable high-output O3 Science system, increasing the delivered dose can therefore change more than the starting concentration. It can shorten the time required to overcome demand, increase the residual available for the next reaction and move the process toward the selected endpoint more quickly.

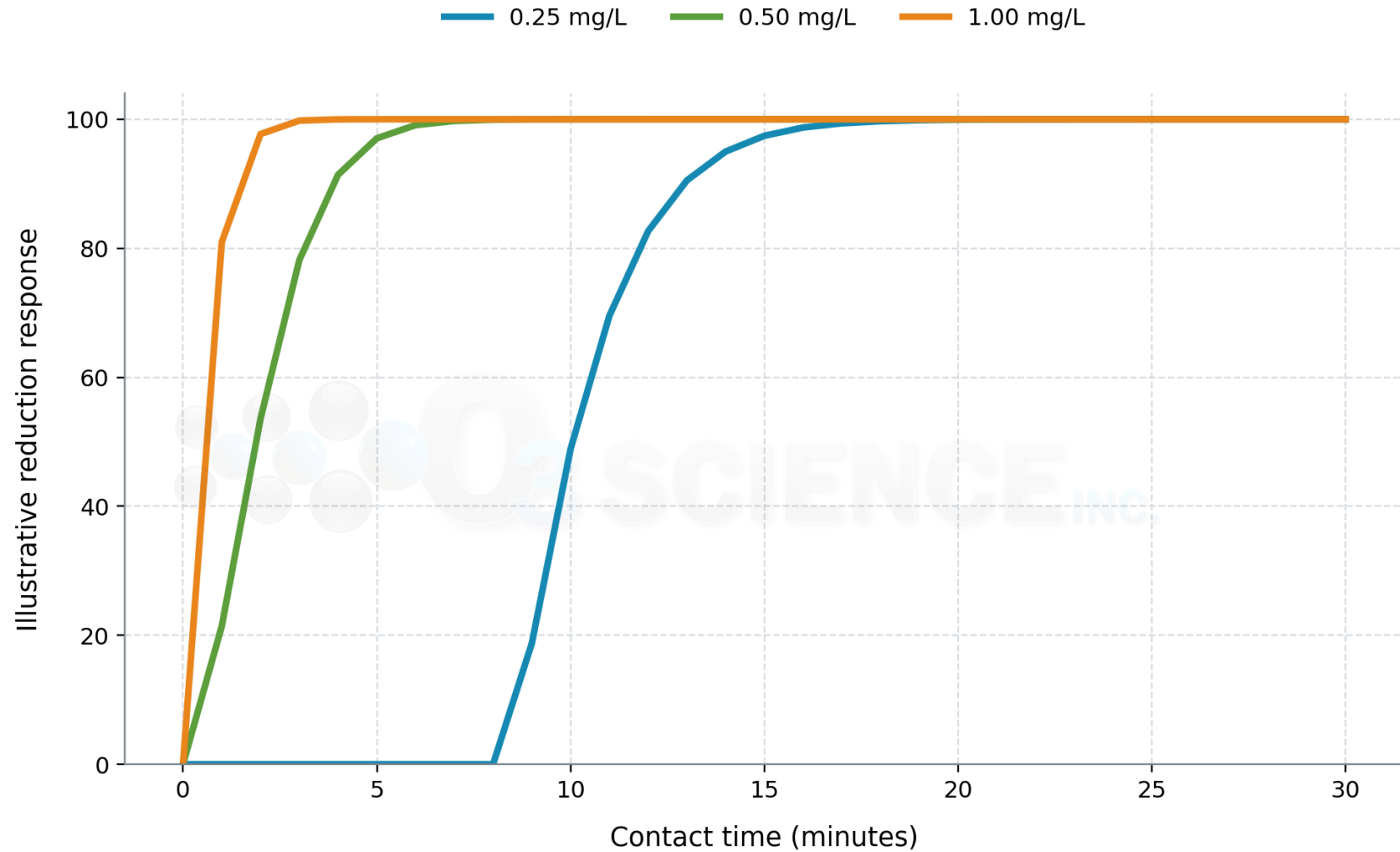
The effect is still measured, not assumed. Flow, transfer efficiency, temperature, chemistry, load, contact pattern and monitoring determine how the curve behaves in the actual installation.

More controlled dose increases the reduction response



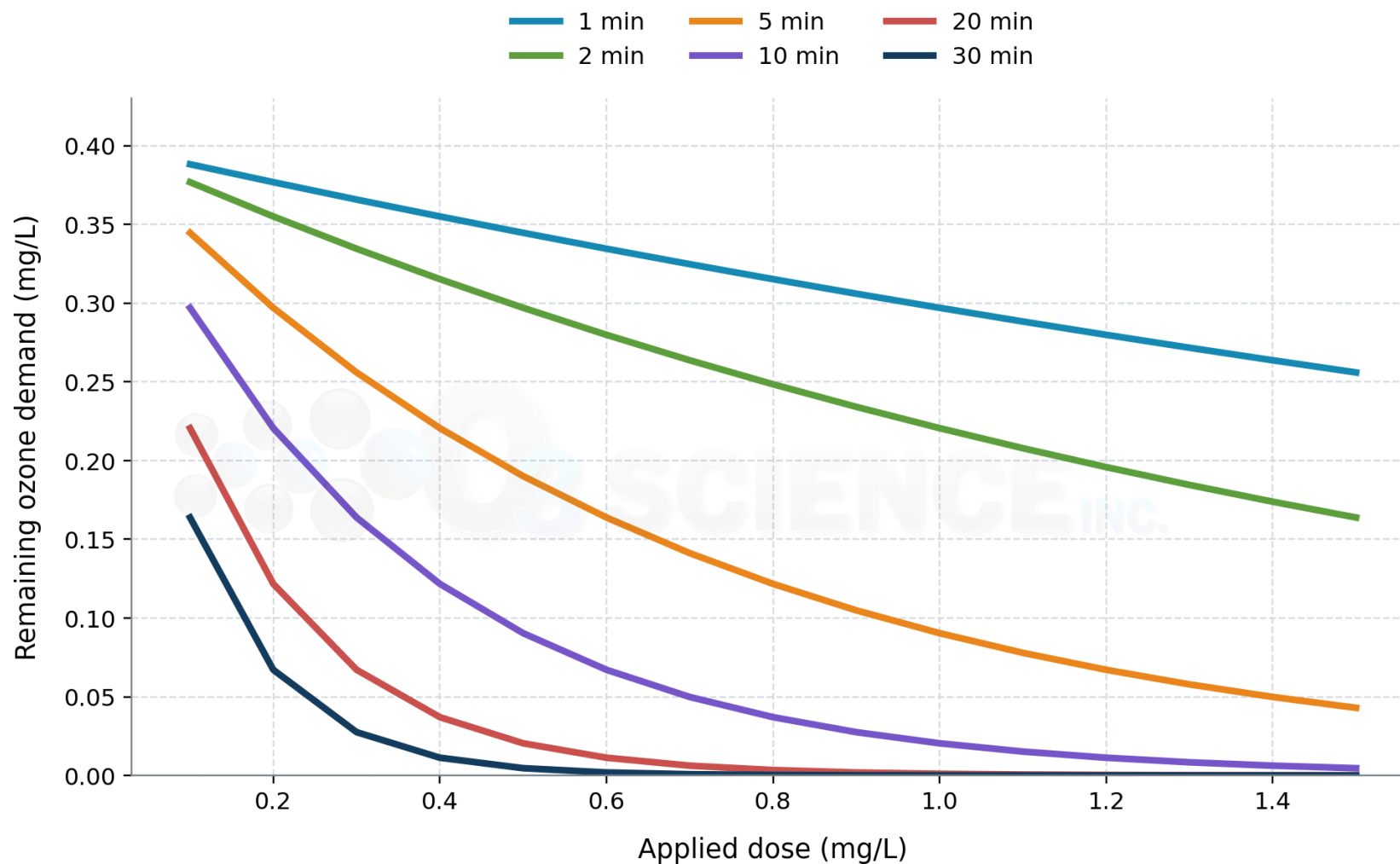
Illustrative response across 1, 2, 5, 10, 20 and 30 minutes. The curves teach the interaction; they are not assigned to a particular organism.

Higher dose reaches the selected response sooner



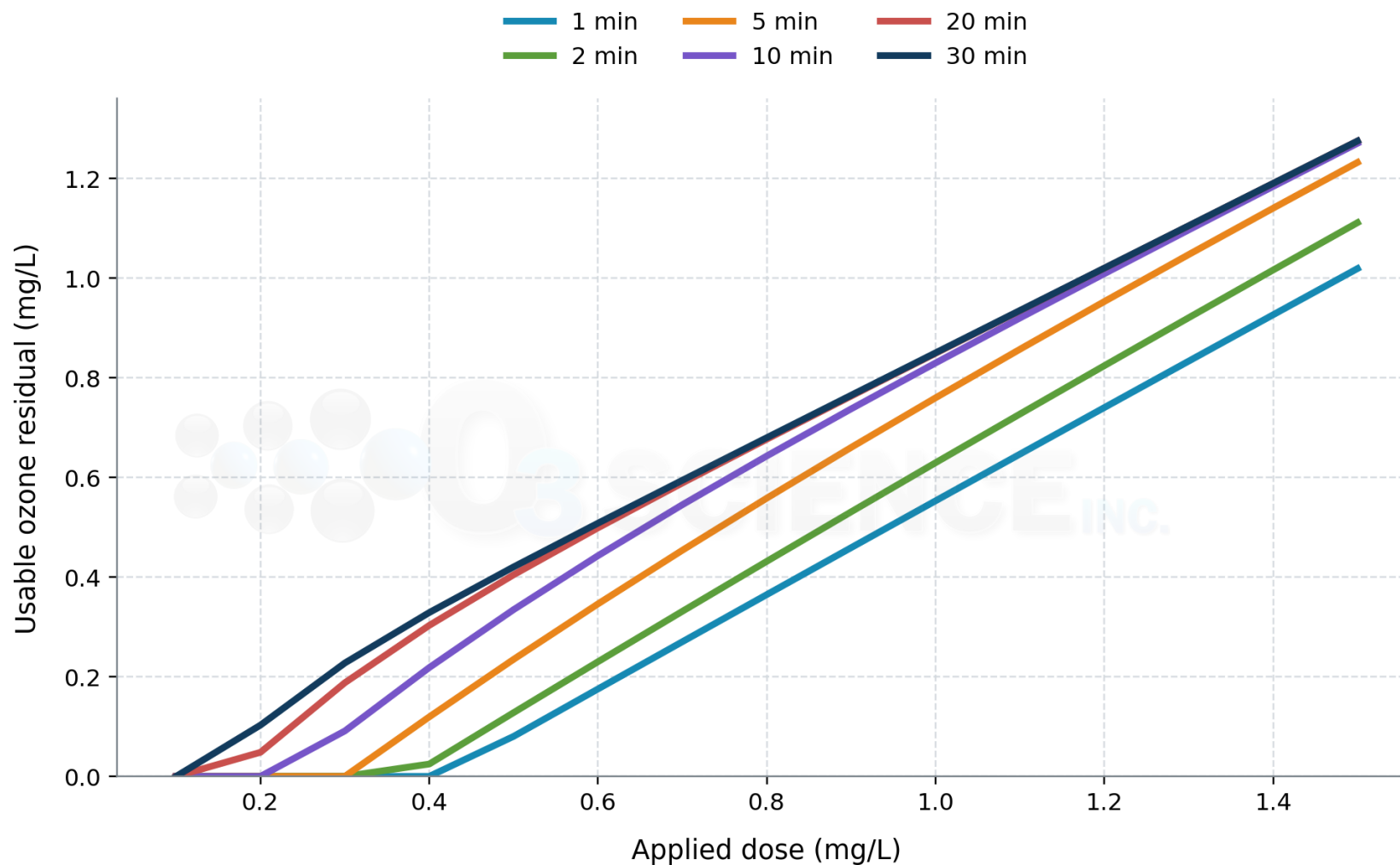
Illustrative comparison at 0.25, 0.50 and 1.00 mg/L. The chart shows why contact time and delivered dose must be considered together.

Ozone demand falls faster as controlled dose increases



As oxidizable load is consumed, remaining ozone demand can decline more quickly at higher controlled dose. Actual behavior is site- and load-specific.

Usable ozone residual rises as demand is overcome



Once demand is overcome, more of the delivered ozone can remain available to support the intended reaction. Measurement and control are essential.

Part 4 - Exact-order recovered source sheet

The following appendix reproduces the recovered Ozone Effects entries in their original order. It retains source terminology, spelling, capitalization and result wording so the reorganized presentation can always be checked against the recovered sheet.

OZONE EFFECTS ON SPECIFIC BACTERIA, VIRUSES AND MOLDS

Bacteria are microscopically small, single-cell creatures having a primitive structure. The bacteria body is sealed by a relatively solid-cell membrane. Ozone interferes with the metabolism of bacterium-cells, most likely through inhibiting and blocking the operation of the enzymatic control system. A sufficient amount of ozone breaks through the cell membrane, and this leads to the destruction of the bacteria.

Viruses are small, independent particles, built of crystals and macromolecules, Unlike bacteria, they multiply only within the host cell. They transform protein of the host cell into proteins of their own. Ozone destroys viruses by diffusing through the protein coat into the nucleic acid core, resulting in damage of the viral RNA. At higher concentrations, ozone destroys the capsid, or exterior protein shell by oxidation so DNA (deoxyribonucleic acid), or RNA (ribonucleic acid) structures of the microorganism are affected.

1-mg/l = 1-PPM

Target	Reported result / dosage - source wording
Aspergillus Niger (Black Mount)	Destroyed by 1.5 to 2 mg/l
Bacillus Bacteria	Destroyed by 0.2 m/l within 30 seconds
Bacillus Anthracis (causes anthrax in sheep, cattle and pigs. Also a human pathogen)	Ozone susceptible
Bacillus cereus	99% destruction after 1-min at 0.12 mg/l in water
B. cereus (spores)	99% destruction after 1-min at 2.3 mg/l in water
Bacillus subtilis	90% reduction at 0.10-PPM
Bacteriophage f2	99.99% destruction at 0.41 mg/l for 10-seconds in water
Botrytis cinerea	3.8 mg/l for 2 minutes
c. difficile	99.999% destruction at 0.6 mg/l for 2 minutes (in water)
Candida Bacteria	Ozone susceptible
Clavibacter michiganense	99.99% destruction at 1.1 mg/l for 5 minutes
Cladosporium	90% reduction at 0.10-PPM for 12.1 minutes

Target	Reported result / dosage - source wording
Clostridium Bacteria	Ozone susceptible
Clostridium Botulinum Spores. Its toxin paralyses the central nerve system, being a poison multiplying in food and meals.	0.4 to 0.5 mg/l threshold value
Coxsackie Virus A9	95% destruction at 0.035 mg/l for 10-seconds in water
Coxsackie Virus B5	99.99% destruction at 0.4 mg/l for 2.5-minutes in sludge effluent
Diphtheria Pathogen	Destroyed by 1.5 to 2 mg/l
Eberth Bacillus (Typhus abdominalis). Spreads typically by aqueous infection and causes typhoid.	Destroyed by 1.5 to 2 mg/l
Echo Virus 29: The virus most sensitive to ozone.	After a contact time of 1 minute at 1 mg/l of ozone, 99.999% killed.
Enteric virus	95% destruction at 4.1 mg/l for 29 minutes in raw wastewater
Escherichia Coli Bacteria (from feces)	Destroyed by 0.2 mg/l
E-coli (in clean water)	99.99% destruction at 0.25 mg/l for +/- 30 seconds
E-coli (in wastewater)	99.9% destruction at 2.2 mg/l for 19 minutes
Encephalomyocarditis Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l.
Endamoebic Cysts Bacteria	Ozone susceptible
Enterovirus Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l.
Fusarium oxysporum f.sp. lycopersici	1.1 mg/l for 10 minutes
Fusarium oxysporum f.sp. melonogea	99.99 % destruction at 1.1 mg/l for 20 minutes
GDVII Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l.
Hepatitis A virus	99.5% reduction at 0.25 mg/l for 2-seconds in a phosphate buffer

Target	Reported result / dosage - source wording
Herpes Virus	Destroyed to zero level in less than 30 seconds wit 0.1 to 0.8 mg/l.
Influenza Virus	0.4 to 0.5 mg/l threshold value
Klebs-Loffler Bacillus	Destroyed by 1.5 to 2 mg/l
Legionella pneumophila	99.99% destruction at 0.32 mg/l for 20 minutes in distilled water
Luminescent Basidiomycetes (species having no melanin pigment).	Destroyed in 10 minutes at 100-PPM
Mucor piriformis	3.8 mg/l for 2 minutes
Mycobacterium avium	99.9% with a CT value of 0.17 in water (scientifically reviewed document)
Mycobacterium foruitum	90% destruction at 0.25 mg/l for 1.6 minutes in water
Penicillium Bacteria	Ozone susceptible
Phytophthora parasitica	3.8 mg/l for 2 minutes
Poliomyelitis Virus	99.99% kill with 0.3 to 0.4 mg/l in 3-4 minutes
Poliovirus type 1	99.5% destruction at 0.25 mg/l for 1.6 minutes in water
Proteus Bacteria	Very susceptible
Pseudomonas Bacteria	Very susceptible
Rhabdovirus virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l
Salmonella Bacteria	Very susceptible
Salmonella typhimurium	99.99% destruction at 0.25 mg/l for 1.67 minutes in water
Schistosoma Bacteria	Very susceptible
Staph epidermidis	90% reduction at 0.1-ppm for 1.7 min
Staphylococci	Destroyed by 1.5 to 2.0 mg/l
Stomatitis Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l
Streptococcus Bacteria	Destroyed by 0.2 mg/l within 30 seconds

Target	Reported result / dosage - source wording
Verticillium dahliae	99.99 % destruction at 1.1 mg/l for 20 minutes
Vesicular Virus	Destroyed to zero level in less than 30 seconds with 0.1 to 0.8 mg/l
Virbrio Cholera Bacteria	Very susceptible
Vicia Faba progeny	Ozone causes chromosome aberration and its effect is twice that observed by the action of X-rays

Recovered threshold statement

The effect of ozone below a certain critical concentration value is small or zero. Above this level all pathogens are eventually destroyed. This effect is called all-or-none response and the critical level the "threshold value".



Source and use notes

Recovered source: Ozone Effects.odt. Supplemental application source: Ozone Shock Systems 091021.odt. Legacy reference findings, supplemental application evidence and O3 Science engineered-system results remain clearly separated so each statement can be read with its supplied conditions and evidence class.

Use each result only with its stated organism, dose, contact time, medium and endpoint. Entries such as ozone susceptible, very susceptible, threshold value or a dose/time without a numerical endpoint are qualitative or incomplete and should not be converted into a percentage claim.

For an O3 Science sanitation plan, the operating dose is engineered to the application and verified against the intended result. Water designs account for flow rate, pipe size, water quality, chemistry, temperature, transfer, contact and load. Facility air designs account for air quality, room volume, humidity, temperature, ventilation, distribution, occupancy controls, monitoring and re-entry. Dosing recommendations and system engineering can change when those conditions change.

What this booklet intentionally excludes

Private manufacturing operations and private service-program details are not included.

Independent supporting studies

Shin and Sobsey, University of North Carolina at Chapel Hill, Reduction of Norwalk Virus, Poliovirus 1, and Bacteriophage MS2 by Ozone Disinfection of Water, Applied and Environmental Microbiology 69(7), 2003. DOI: 10.1128/AEM.69.7.3975-3978.2003

Bialoszewski et al., Medical University of Warsaw, Activity of ozonated water and ozone against Staphylococcus aureus and Pseudomonas aeruginosa biofilms, Medical Science Monitor 17(11), 2011. DOI: 10.12659/MSM.882044

Wen et al., Xi'an University of Architecture and Technology and Suzhou University of Science and Technology, Inactivation of fungal spores in water using ozone: Kinetics, influencing factors and mechanisms, Water Research 185, 2020. DOI: 10.1016/j.watres.2020.116218

EPA, Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources. Ozone guidance addresses CT, residual measurement, mass transfer and contactor configuration.

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LAB RESULTS. ENGINEERED SYSTEMS. SITE-SPECIFIC DESIGN.

This booklet brings together reported laboratory results and results from actual O3 Science engineered systems. Every system is engineered for the conditions at the site. Dose, transfer, distribution, contact time and monitoring can change with water and air quality, flow, pipe size, room volume, humidity, temperature, organic and microbial load, facility process type, materials and the required endpoint.

Evidence points guide the design. Site conditions determine the engineered operating setting.

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