

SOLVAY

PROGRESS BEYOND



AQUALISAN

A premium, effective and environmentally friendly water conditioning solution for aquaculture

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Summary of AQUALISAN®

AQUALISAN® is an environmentally-friendly, broad-spectrum disinfectant and water conditioning agent for shrimp aquaculture.

AQUALISAN® rapidly oxidizes the cell walls and membranes of viruses, bacteria, protozoa, spores and other harmful microbial communities; thereby killing them or rendering them innocuous.

AQUALISAN® is safer to use, easier to handle, and significantly more effective compared to existing options in the market. AQUALISAN®'S unique properties make it a universal disinfectant against disease including WSSV, YSV, EMS, and EHP, among others.



AQUALISAN[®]

Introduction

Supplying the Aquaculture industry with a wide range of solutions

Solvay plays a crucial role in aquaculture to ensure healthy farms and safe food. With our solutions and guidance, farmers are able to maintain healthy ponds, robust aquatic life and a sustainable business. Solvay's expertise provides partnership and support to farmers across the globe.

Our promise

Farmers face a two-fold challenge. They must ward off disease outbreaks in their ponds and simultaneously ensure that their output meets the strict quality standards required of seafood intended for human consumption. This requires solutions that are both extremely effective against disease, yet safe for shrimp and subsequent consumption.

At Solvay, we have spent years testing our solutions across farms, geographies, and situations to ensure optimal results. We are dedicated to providing sustainable disinfectant solutions that are highly effective and safe. That is our promise!

Our Aquaculture Solution for Shrimp farming

Disease outbreaks can spread in less than 5 days and result in high mortality rates and total wipe-out of a farm. For farmers, this accounts to a complete loss of income. For the industry, this accounts to billions of dollars in lost revenue.

In many countries, shrimp aquaculture production is depressed by disease, particularly caused by viruses, bacteria,

protozoa, spores and other harmful microbial communities. Antibiotics and generic disinfectants have been used excessively, and are now largely considered ineffective. In some cases, resistance behaviors have started to appear in shrimp farming.

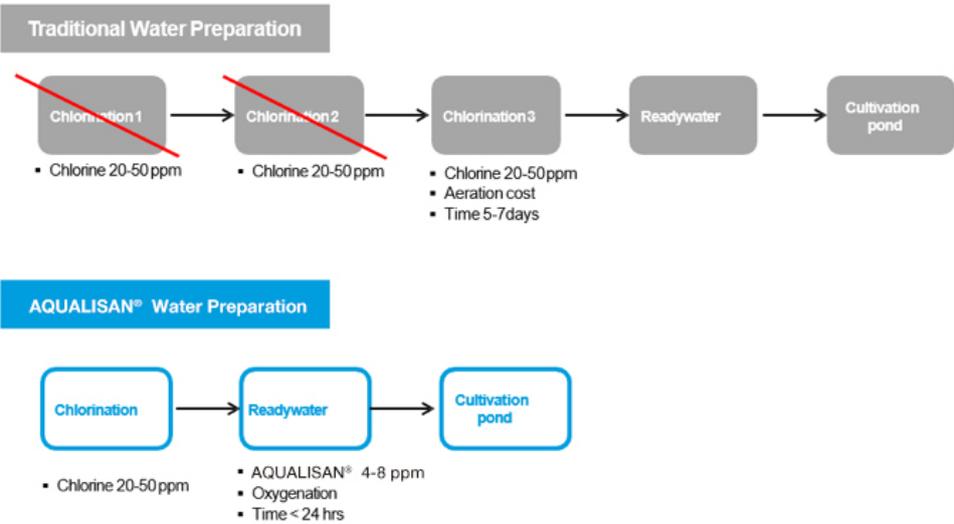
With this in mind, we have worked with local experts and research institutions to develop a deep understanding of the shrimp farming process. As a result, we have developed a premium, highly effective, and environmentally friendly disinfectant solution, AQUALISAN®. When added to ponds, AQUALISAN® quickly eliminates a wide range of waterborne pathogens and kills bacteria likely to cause shrimp disease. Proper use of AQUALISAN® has led to higher pond success rates, faster pond preparation time, higher survival rates and a cleaner end product. Aquatic life thrives in AQUALISAN® ponds, giving farmers the peace of mind that they need to efficiently run their businesses and harvest larger, healthier shrimp.

How to treat shrimp ponds with AQUALISAN®

1 Part During pond water preparation

It has been demonstrated that administering AQUALISAN® at 4-8 ppm during pond water preparation reduces the time spent during this phase by 7-10 days.

During extensive field trials that compared water preparation phases of “AQUALISAN®” administered ponds vs “conventional” chlorine (cal-hypo 65%) administered ponds, Aqualisan proved to eliminate 2 steps in the water preparation process demonstrated in the figure below:



The economic benefits include an increase in shrimp weight resulting from an early cultivation, and a +60% savings on average chlorine spend.

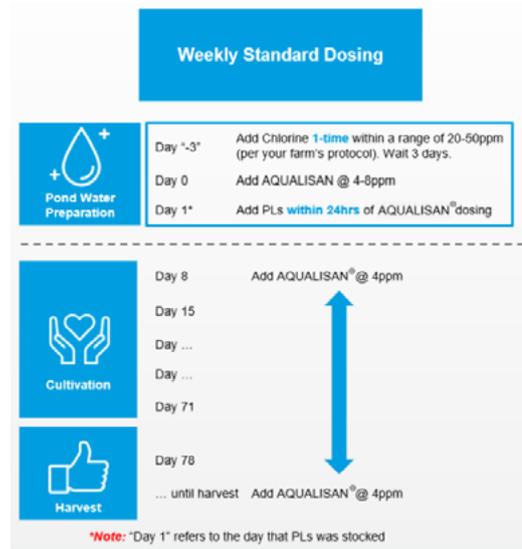
	Traditional Water Preparation	AQUALISAN® Water Preparation	Benefits
CalciumHypochlorite 65%	192	64	+60% Savings
Aqalisan	0	6	N/A
Time	15-20 days	7 days	increase in shrimp weight (from early cultivation)
Electricity	7-10 days	1-2 days	7 days of electricity saved

2 Part During cultivation

AQUALISAN® is designed to preserve healthy water conditions and prevent disease transmission. To ensure optimal results, we recommend that AQUALISAN® is dosed on a recurring, weekly basis, as illustrated below.

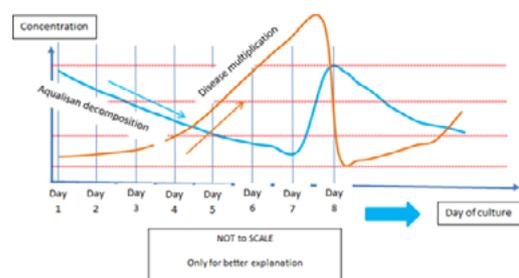
Based on extensive field trials conducted on an AQUALISAN® dosing program at 4 ppm per week, the following sequence of events have been observed:

- Observation 1:** When AQUALISAN® is first dosed at any given week, disease in the pond is immediately suppressed, as AQUALISAN®'S active ingredients - and powerful disinfectant properties - are activated.
- Observation 2:** As the concentration of AQUALISAN® slowly wears out over the course of the week, the probability of disease gradually picks up.
- Observation 3:** When AQUALISAN® is dosed again in the following week, disease is again suppressed, and the sequence of events (in observations 1 and 2) is repeated.



Maintaining this weekly dosing program will ensure optimal disease control for the entirety of the cultivation cycle (as illustrated in the figure below). However, in the extreme event that a disease outbreak emerges - even if the AQUALISAN® program is followed - the AQUALISAN® dose must be doubled to 8 ppm and administered in 3 day intervals until the transmission of disease has been killed or controlled.

For optimal results, we recommend using our [AI-driven seatru technology](#) that continuously monitors pond water conditions and recommends precise, AQUALISAN®-specific dosing solutions to prevent disease. More details can be found below in “Chapter 6. The seatru Advantage”.



Performance of AQUALISAN® against disease

AQUALISAN® has been proven to control the spread of the following disease listed below, among others. Several trials have been performed to study and validate Aqualisan’s performance, as highlighted in this chapter.

PATHOGEN	DISEASE	APPEARANCE
Yellow Head Virus (YHV)	Yellow head disease	
White Spot Syndrome Virus (WSSV)	White Spot disease	
Vibrio parahaemolyticus	Early mortality syndrome (EMS) hepatopancreatic necrosis syndrome (AHPNS)	
Vibrio harveyi bacteria	Luminescent disease	
Enterocytozoon hepatopenaei (microsporidian parasite)	EHP	

1 Trial Minimum Bactericidal Concentration (MBC) Test of AQUALISAN® against various shrimp pathogen

The MBC procedure is used to determine the lowest concentration of a chemical that is required to prevent visible vibrio colonies from getting formed.

MBC was tested for AQUALISAN® and Chlorine.

AQUALISAN® proved to inhibit bacterial growth of all vibrios (listed below) at significantly lower concentrations (in ppm) as compared to chlorine. Even when tested against different water sources i.e. reservoirs, shrimp ponds, and wastewater, AQUALISAN® was still markedly more effective.

The result was a 70-80% survival rate of shrimp.

Bacteria 5X10⁵ CFU/ml of seawater with 30 ppt salinity was used in this test.

Bacteria	AQUALISAN [®] (Sea water)	Chlorine (Sea water)
Vibrio Harveyi	1.5-8	2-8
Vibrio Parahaemolyticus	1.5-3	8-24
Vibrio Vulnificus	2	3
Vibrio Alginolyticus	1.5	24
Vibrio Dansela	1	6
Vibrio Cholerae	6	8
Water from Reservoirs (7.05x10 ⁴)	3	16
Water in Shrimp Ponds (7.1x10 ⁴)	4	12
Wastewater (6.3x10 ⁴)	8	16

2 The Cohabitation Transmission Control (CTC) Test on WSSV. KKP Final Report

White spot syndrome virus (WSSV) is one of the most virulent pathogens in shrimp farming. Deaths during the first month of cultivation are common in WSSV infected ponds and can result in a 100% mortality rate within the first 4 days of detecting the virus.

The WSSV virus is usually transmitted from neighboring shrimp ponds through seepage during water preparation. To reduce the risk of infection, Chlorine (cal-hypo 65%) is commonly used to sterilize ponds. However, high Chlorine use can produce organochlorine compounds that are harmful to shrimp. AQUALISAN[®] is a superior alternative to chlorine as it is much more effective in eliminating WSSV virus and simultaneously keeping shrimp safe.

The cohabitation transmission control test was carried out to determine the efficacy of AQUALISAN[®] on healthy and WSSV-infected shrimp that are cohabitating in the same water. Healthy shrimp weighing 1-3 grams were put in a container of water (500L). The water was then treated with AQUALISAN[®] at a dose of 4 and 8ppm respectively. Next, two tests were conducted:

- In test A, a batch of WSSV-infected shrimp was added to the healthy shrimp container. The healthy shrimp showed no signs of infection - over a 4 day observation period.
- In test B, water containing the WSSV virus was added to the container of water carrying healthy shrimp. Again, the healthy shrimp showed no signs of infection - over a 4 day observation period.

AQUALISAN[®] proved to control or kill free WSSV vibrio in water and enabled a 100% survival rate for the healthy shrimp. The test results also showed that AQUALISAN[®] treatment did not affect several measured water quality parameters including pH, ammonia, and nitrite. Bacteria was also found in the water, showing that AQUALISAN[®] had no lethal effect on probiotics.

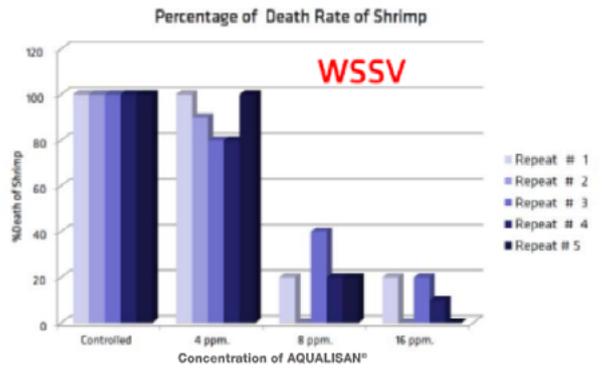
3
Trial

The Efficacy Test on WSSV

AQUALISAN® was administered at different concentrations and repetitions on WSSV infected samples.

At 8ppm, AQUALISAN® proved to inhibit the spread of WSSV.

The result was an 80% survival rate of shrimp.



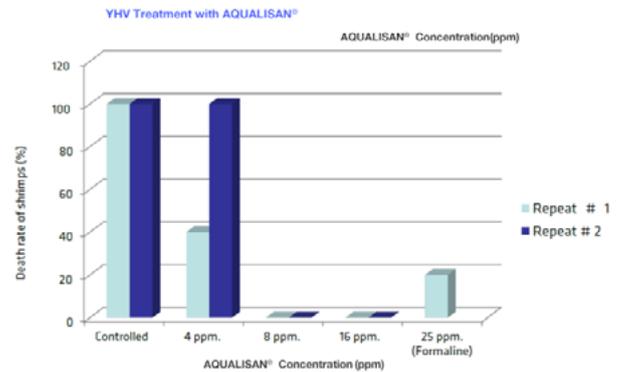
4
Trial

The Efficacy test on YHV

AQUALISAN® was administered at different concentrations and repetitions on YHV infected samples.

At 8ppm, AQUALISAN® proved to inhibit the spread of YHV.

The result was a 100% survival rate of shrimp.



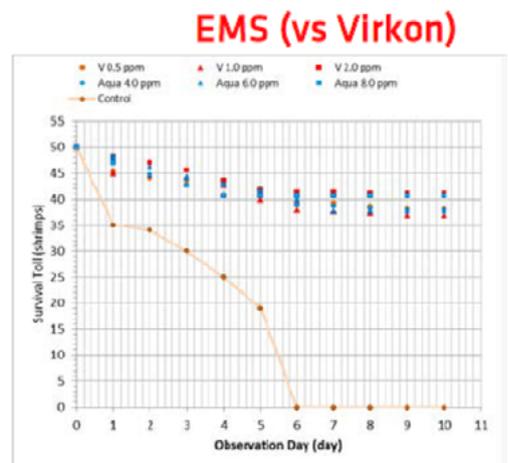
5
Trial

The Efficacy test on EMS

Early Mortality Syndrome (EMS), caused by Vibrio parahaemolyticus, is a common disease affecting shrimp farms. EMS has high mortality rates of up to 90% and infects ponds within the course of 2-4 weeks.

In our test, healthy shrimp were added to a container of water that was then challenged with Vibrio parahaemolyticus. The water was then treated with AQUALISAN® at 4, 6, and 8ppm concentrations. This was then observed together with a control over the course of 10 days.

Survival Rate with AQUALISAN® was 70-80% vs Survival Rate of the control (i.e. without AQUALISAN®) was 0%, by day 6.



VNUA-Vietnam

6
Trial

The Efficacy test on EHP spores

We conducted the first ever disinfectant study on EHP Spores.

The microsporidian *Enterocytozoon hepatopenaei* (EHP) is a spore-forming, intracellular parasite that causes an economically debilitating disease (hepatopancreatic microsporidiosis or HPM) in cultured shrimp. HPM is characterized by growth retardation and wide size variation that can result in economic loss for shrimp farmers.

AQUALISAN® was tested against EHP spores at 20, 50, 100, and 200ppm concentrations with 3 repetitions.

At 50 or 100ppm, AQUALISAN® proved to inhibit the germination of EHP spores within 30 minutes.

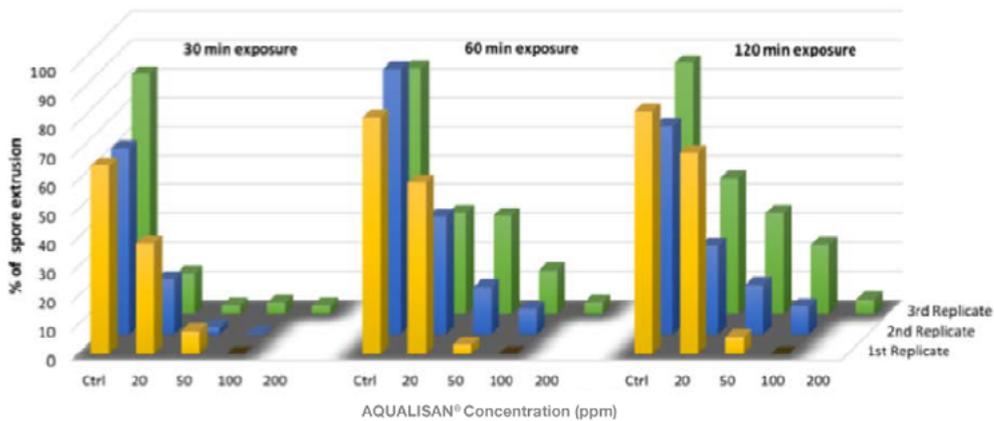
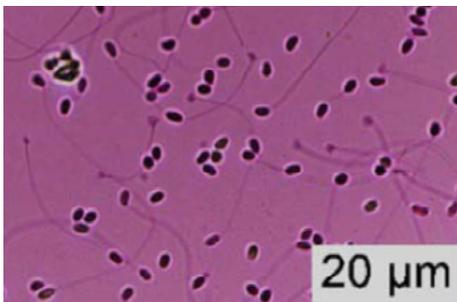
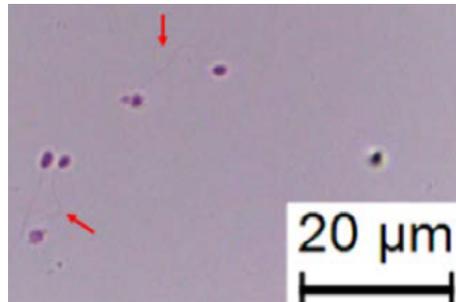


Figure 1: Treatment with 50-100 ppm Aqualisan® for 30 min can inhibit germination of EHP spores

Mahidol Univ-Thailand



Untreated with Aqualisan®



Spores that germinate after 120 minutes exposure to 50 ppm Aqualisan®

Aqualisan - A Versatile Product

In addition to its powerful disinfectant properties against disease, AQUALISAN® is also non-toxic to shrimp and an excellent water conditioning agent for farms.

1 Trial **Trial 1: Toxicity Test of AQUALISAN® on shrimp**

The 24hr LC50 (or “Lethal Concentration 50%) test is conducted to determine the concentration of a chemical required to kill 50% of the test animals during a 24hr observation period.

The 24hr LC50 test was carried out on AQUALISAN® to ascertain if it was safe to administer to young, post-larvae shrimp aged 10 days (P10) and 15 days (P15), respectively.

It was observed that AQUALISAN®, administered at high concentrations of ~225 ppm, can be lethal to shrimp. However, since suggested dosing is never exceeds 4ppm per week, the test was conclusive in determining that AQUALISAN® is harmless to shrimp.

Size of Aquatic animal	24 Hr LC50 (ppm)	Range (ppm)
Shrimp P 10	224	182.13-275.50
Shrimp P 15	225	177.13-286.25
Tilapia (1.5-2.5cm)	6.38	4.06-10.06
Red Tilamia (1.5-2.5cm)	13.75	11.81-16.56

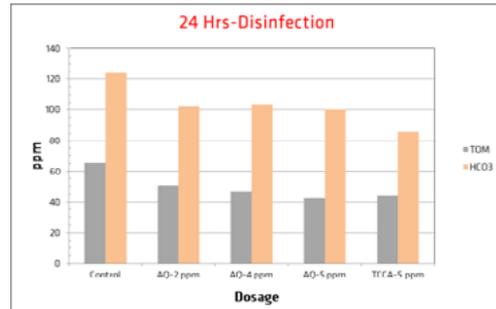
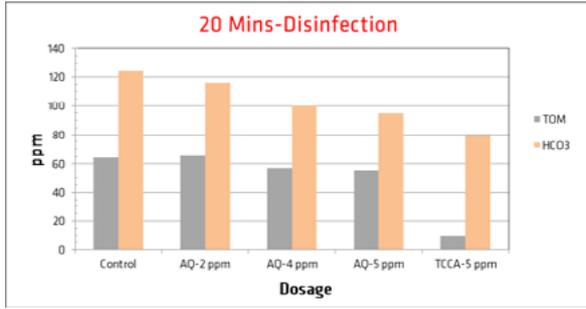
2 Trial **AQUALISAN®’s effect on alkalinity (HCO₃) and other water quality parameters in shrimp ponds**

Shrimp pond water with low alkalinity is easily susceptible to changes in pH. This can affect all elements of the water environment and health of the species.

Shrimp pond water dosed with AQUALISAN® was tested to measure fluctuations in alkalinity (through Bicarbonate, HCO₃, a known buffer / stabilizer of alkalinity) and TOM (temp, oxygen, moisture).

The procedure dosed AQUALISAN® at different concentrations (2, 4, and 6ppm) and studied the effect on water conditions after 20 minutes and then after 24hrs.

AQUALISAN® maintained a stable balance of HCO₃ (between 90-110ppm) and TOM (between 40-60ppm) over the course of the study period. The tests proved AQUALISAN® to be an excellent water conditioner and stabilizing agent in shrimp ponds.



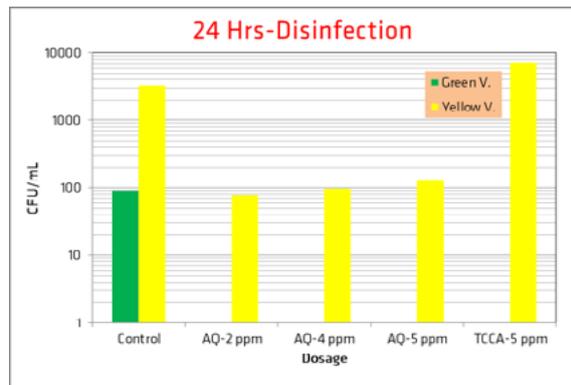
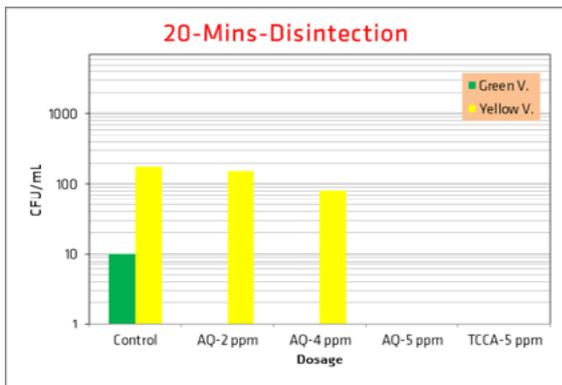
AQUALISAN®'s effect on water contamination in shrimp ponds

Most disease caused in shrimp farms are transmitted through freely-floating vibrio in the water.

In this test, water was injected with commonly found vibrio (green = lethal vibrio, yellow = non-lethal vibrio), and then dosed with Aqualisan to measure its precision disinfectant properties against lethal vibrio.

The procedure dosed AQUALISAN® at different concentrations (2, 4, and 6 ppm) and studied the effect on water conditions after 20 minutes and then after 24hrs.

AQUALISAN® immediately attacked and killed green vibrio at concentrations as low as 2ppm. Thereby proving to be an excellent disinfectant and conditioning agent in shrimp ponds with contaminated water.



4
Trial

AQUALISAN®'s effect on phytoplankton in shrimp ponds

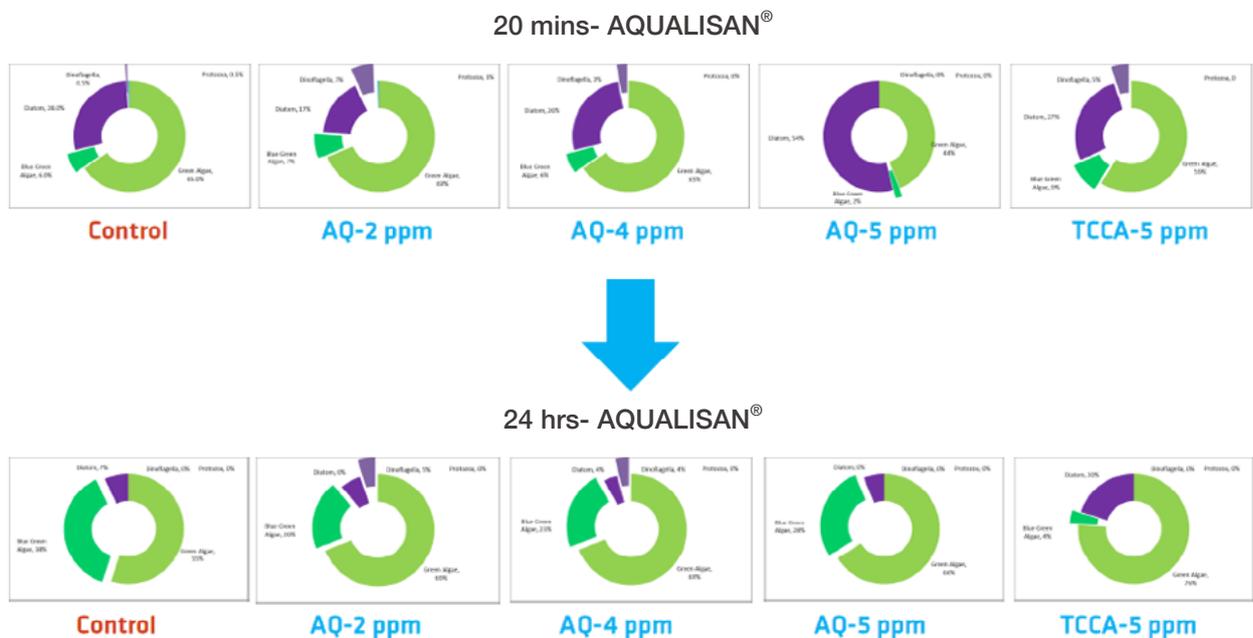
Phytoplankton can be a dilemma in aquaculture. Properly managed populations can be very beneficial to aquaculture production systems, but if inadequately managed, they can proliferate out of control and have significant negative effects.

Phytoplankton species are primary autotrophic producers that are able to produce food from their photosynthetic activity. They are the starting point of natural productivity in pond ecosystems and food chains, and are important natural food sources for the young shrimp post larvae stocked into the ponds. However, inadequate pond management can lead to phytoplankton blooms that can deplete oxygen levels in the water and/or release toxins, both of which are deadly harmful to shrimp.

In this test, shrimp pond water was dosed with AQUALISAN® to measure its effect on phytoplankton populations in the water, primarily green algae, blue-green algae, diatom, dinoflagellate, and protozoa.

The procedure dosed AQUALISAN® at different concentrations (2, 4, and 6ppm) and studied the effect on populations after 20 minutes and then after 24hrs.

AQUALISAN® not only maintained a stable population but also activated a more desirable balance of green algae, blue-green algae, and diatom in the water. Thereby proving to be an excellent water conditioner and stabilizing agent in shrimp ponds. Results are highlighted in the figure below.





AQUALISAN[®]

The Seatru Advantage



Seatru is a proprietary artificial intelligence platform to predict disease outbreaks and improve health management of aquaculture farms.

Seatru brings to light farm conditions that have - until now - remained invisible. By connecting these insights to our award-winning portfolio of prescriptive health management solutions, we help farmers optimize yield.

Seatru offers powerful solutions:

- Water Monitoring: Monitors pond water conditions and recommends AQUALISAN[®] -specific dosing solutions to prevent disease
- Microbial Fingerprinting: Screens for all microbial communities active in the pond and recommends predictive AQUALISAN[®]-specific dosing solutions to contain disease

Seatru's continuous machine learning capabilities provide farmers with a breakthrough prescriptive approach to prevent disease outbreaks and optimize harvest results.

Finally, through Seatru's monthly subscription program, farmers can access our technology and services at practical and economical prices.

Sustainability

The science is clear, global temperatures are constantly rising and a growing number of climate-related events are calling for us to provide concrete actions. Our goal is to reduce the environmental footprint of our operations - across the entire value chain - to protect climate and biodiversity.

Solvay has renewed its commitment to sustainability through the launch of Solvay One Planet. Through Solvay One Planet, we are putting our expertise at the service of the one planet we share, to focus on areas where our innovation and sustainable solutions can have the biggest positive impact, directly and indirectly.

When it comes to climate and biodiversity, our goal by 2030 is to reduce the environmental impact of our operations at planetary-scale and commit to curbing CO2 emissions, improving water use efficiency, increasing waste recovery, and creating more sustainable, eco-friendly solutions.

AQUALISAN® contributes to a more sustainable alternative for the shrimp industry. It is a highly effective disinfectant system that releases no disinfectant byproducts and is non-toxic to shrimp ecology systems.





AQUALISAN[®]

Conclusion

AQUALISAN[®] is a safe, versatile and sustainable product

- AQUALISAN[®] is a powerful inhibitor against a range of vibrio, thereby highly effective in preventing disease outbreaks
- AQUALISAN[®] shows positive results in improving survival rates, increasing pond yield and shrimp weight, and maximizing farmer ROI
- AQUALISAN[®] has proven to be a safe and versatile product that can be used at all phases in shrimp production



Comparative Analysis 1: Pilot Trial in Indonesia

A test with AQUALISAN® - using seatru technology - was performed to verify the effect of the solution across multiple shrimp ponds and farms. The objective was to compare “treated” ponds (using Aqualisan-seatru solution) vs “control” ponds (using conventional products).

The selected ponds were comparable based on pond area, stocking density, and DOC. The following parameters were then analyzed: survival rate, shrimp weight, harvest yield, and feed conversion ratio. Finally, the results were averaged out in order to normalize for deviation. The results can be seen in the table below.

	Control Ponds Average (using conventional products)	Treated Ponds Average (using Aqualisan+ seatru)	Comments
Pond Area(m ²)	1700	1700	comparable ponds and harvest cycles
Stocking Density(PLs/m ²)	120	120	
Days of Cultivation(DOC)	120	120	
Survival Rate(%)	65%	75%	15% increase in SR
Shrimp Weight (g)	27	29	+7.5% weight gain
Harvest Yield (kg)	2957	3421	16% increase in yield
Feed Conversion Ratio(FCR)	1.7	1.4	-17% decrease in FCR



Comparative Analysis 2: Disinfectant Comparison

Aqualisan is widely considered to have high oxidizing power and broad spectrum “killing” potential. The table below is based on extensive field observations and chemical analyses.

Disinfectant comparison

Reactive species	Relative oxidizing Power (Chlorine gas -1)	Benef its	Specific challenges
ozone	2.07	High oxidizing power commercially available	High cost and fast decomposition
Aqualisan (Peracetic acid)	1.81	Broad spectrum of killing oxygenation cost effectiven superior performance	Proper handling required
Hypochlorous acid (HOC1)	1.49	Used to control hosts and carriers	Not used in cultivation low effective at high pHi require aeration to remove DBps
Supersafe (H0202)	1.31	Used to oxygenate and algae control	Not kill disease at low dosage
Permanganate	1.24	Specific usage for bacteria	Less effective in high organic matters
Chiorine dioxide	1.15	-	Not kill disease at low dosage
Chiorine (gas)	1.00	-	Not kill disease at low dosage
Bromine	0.80	-	Not kill disease at low dosage
Iodine	0.54	Specific usage for bacteria	Less effective in high organic matters



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