

LAGOONS
MAINTENANCE



CRYSTAL LAGOONS SUSTAINABLE TECHNOLOGY



Before Crystal Lagoons' technology was developed and patented, there were no large artificial water bodies that could achieve high water qualities and outstanding clarity, transparency, microbiological, and physicochemical properties at low costs and in an environmentally friendly manner. Although there are many artificial water bodies containing large volumes of water, the water quality deteriorates very fast, therefore attaining neither transparency nor clearness characteristics. Moreover, such large water bodies may acquire unpleasant smell; present algae growth, and eutrophication phenomena.

Crystal Lagoons has developed a pioneering concept and state-of-the-art technology which allows building and maintaining unlimited sized lagoons with excellent water quality, anywhere in the world, and using a minimum amount of chemicals and energy. The water quality obtained by using Crystal Lagoons technology easily complies with the bacteriological requirements for direct contact purposes (U.S. EPA Criteria for Bathing with Full Body Contact Recreational Waters). The following table shows water quality analysis performed by the renowned labs SGS AGQ and DICTUC.

Regulation	Enterococci (UFC/100ml)	E.coli (UFC/100ml)	Fecal Coliforms (MPN/100ml)
EPA recreational water	<35	<126	-
Public Bathing Places (new regulations)	<61	<235	<200

Crystal Lagoons	Enterococci (UFC/100ml)	E.coli (UFC/100ml)	Fecal Coliforms (MPN/100ml)
SGS San Alfonso	<1	<1	-
SGS Laguna Vista	<1	3	-
AGQ San Alfonso	<1	<1	-
AGQ Laguna Vista	<1	<1	-
DICTUC San Alfonso	-	-	<2
DICTUC Laguna Vista	-	-	<2

*San Alfonso is seawater and Laguna Vista is fresh water.

Crystal Lagoons' patented technology has been in operation for several years with outstanding results in maintaining large crystal clear water bodies at very low costs, with a track record of more than 10 years. Crystal Lagoons is the only company in the world that can demonstrate these results and show its clients proof

of the concept consisting of several fully operational crystal clear water lagoons around the globe. The first lagoon developed by Crystal Lagoons was built in 1997, and received the Guinness World Record in 2007 as the largest in the world for its 20 acres of water surface. Today, the largest lagoon corresponds to Citystars Lagoon in Sharm El Sheikh Egypt, with a crystal clear 30-acre lagoon using Crystal Lagoons' technology. Today, a 100-acre lagoon is being developed in Dubai, in District One in the Mohammed Bin Rashid City as well. Also, many lagoons are operating throughout the world, such as in the U.S., Jordan, Peru, Panama, Mexico, Brazil, and Singapore among other countries (www.crystal-lagoons.com). Currently, Crystal Lagoons participates in over 400 projects in different stages of development and operation in 60 countries worldwide.

Crystal Lagoons' water treatment technology offers several environmental advantages over traditional water treatment and filtration technologies, as it uses scarce resources such as water and energy in a very rational manner, providing a sustainable and environmentally friendly technology. In some rain-intensive locations, like Florida, it has been estimated that the lagoons can be refilled with direct rainwater and thus they practically do not require make-up water to compensate evaporation. Also, the walls and structure of the lagoons are designed to withstand water overflow.

Crystal Lagoons' patented technology is a comprehensive system for building and maintaining large-scale lagoons with excellent water quality at very low costs. The Crystal Lagoons' patented technology covers all aspects of the maintenance needs of the lagoon, including water quality management, basin cleaning and efficient filtration system, and surface cleaning. Also, Crystal Lagoons provides design consultancy associated with the lagoon, supervising its construction, as well as providing specially designed systems and equipment that is sold exclusively to our licensees under our brand and specifications.

1. WATER QUALITY MANAGEMENT



Crystal Lagoons patented technology uses a pulse disinfection system that has proven to be more efficient than any other known systems. It is based on a chemical treatment that is deployed with a certain time frequency according to the specific growth-cycles of microorganisms. Key water quality parameters are constantly monitored by a telemetric system that uses sensors located throughout the lagoon, which indicate exactly when to apply the additives, in what proportions, and the exact amounts, allowing reducing the amounts of additives in up to 100 times compared to conventional swimming pool technology or drinking water treatment.

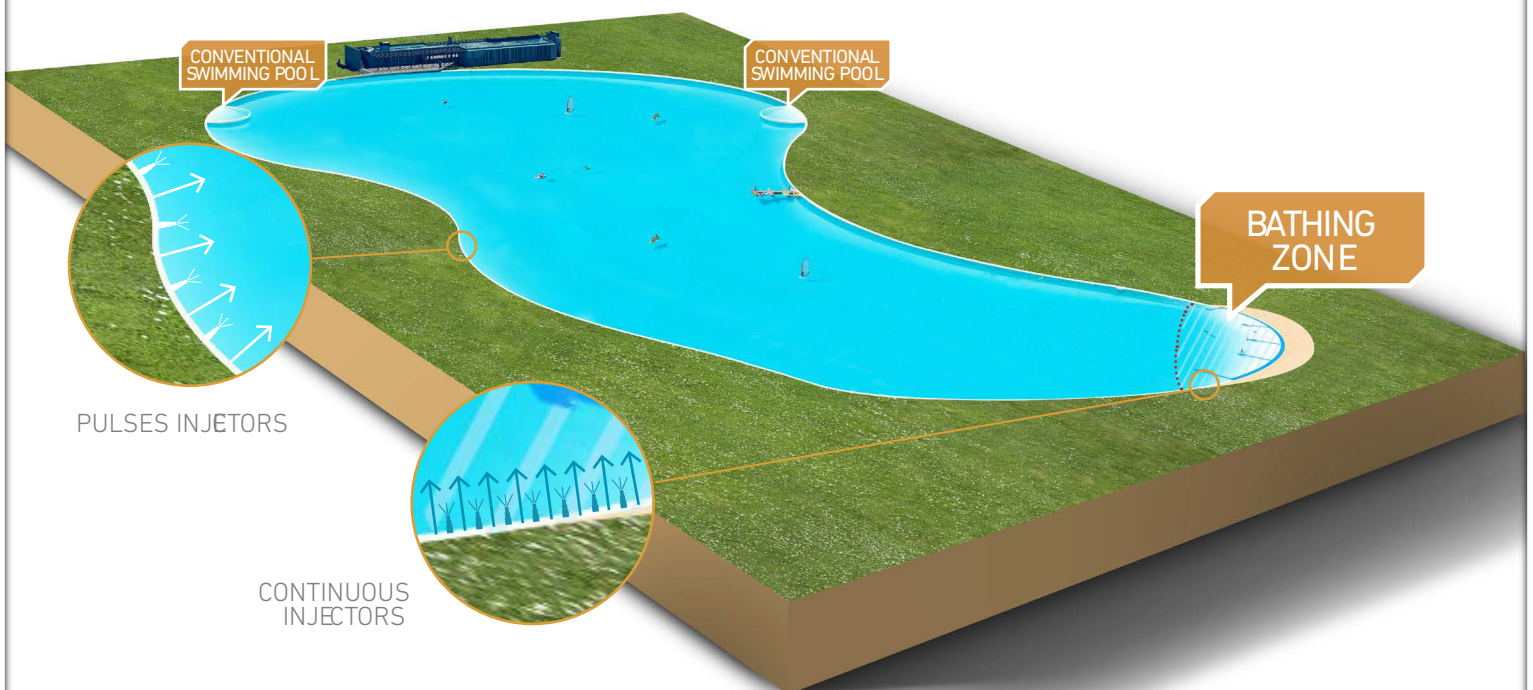
The application of additives is coordinated by a large number of strategically located injectors and sensors. The entire operation is managed remotely through telemetry by the Crystal Lagoons Control Center around the clock. No other lagoons, lakes, or pools around the world have this level of monitoring or control.



The results of this efficient system are that the overall amounts of additives consumed using Crystal Lagoons' technology are up to 100 times less than the amount used for swimming pools and drinking water, thus reducing excessive costs in chemicals and their further environmental damage.

The applied additives comply with NSF60 Standards for drinking water treatment.

Also, when it is necessary, specific bathing zones can be created within the large lagoons, which can be separated by buoys from the rest of the lagoon, and where a proprietary localized disinfection system is used to provide additional disinfection to zones that are exposed to a higher number of bathers. This system has been patented in the U.S. and worldwide.



2. EFFICIENT FILTRATION SYSTEM



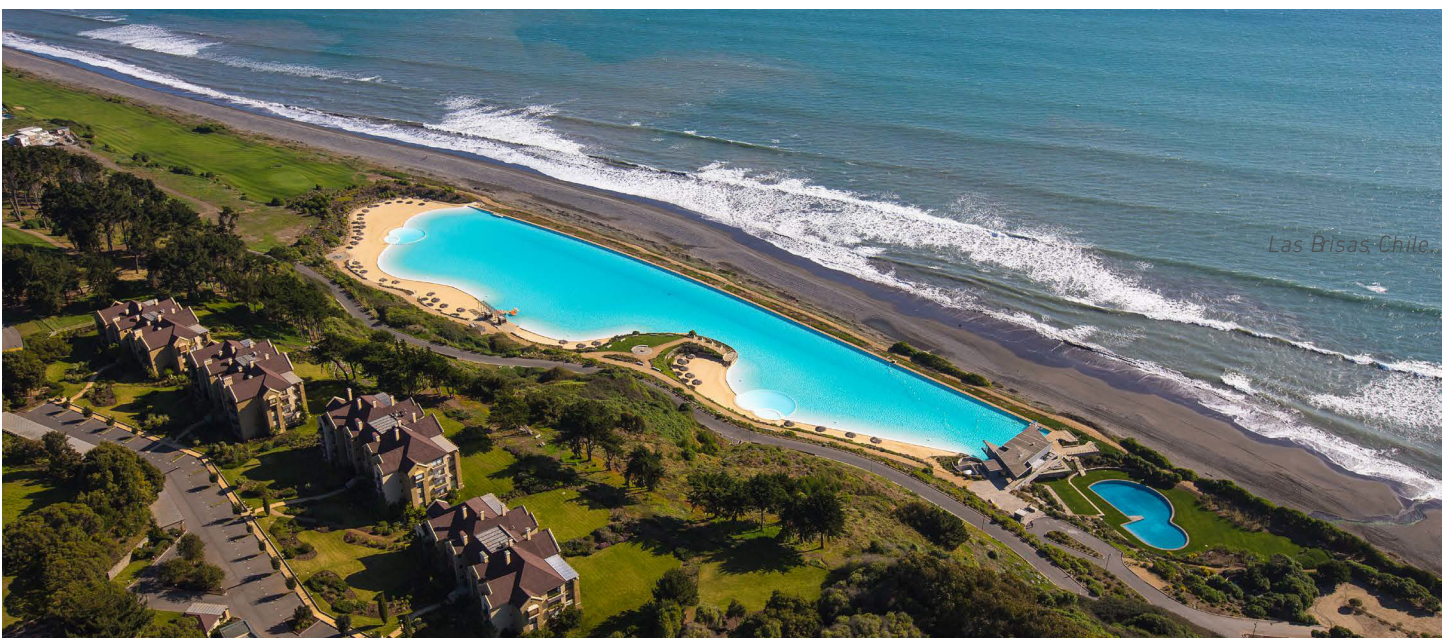
Crystal Lagoons' technology applies specific additives and a combination of different ultrasonic waves to the water in the lagoon, which results in the agglomeration of the contaminant particles into larger particles. The larger particles settle into the bottom of the lagoon, and are suctioned by a specially designed mobile suction device. Then, the suctioned water is sent to a small filtration system, and the filtered water is returned to the lagoon. The efficient filtration process and different types of suctioning devices have been protected through patents in the U.S. and in the rest of the world.

The filtration energy consumption is highly reduced due to two effects:

- The filtration water flow are considerably reduced, resulting in water flows up to 300 times smaller than the flow filtered in conventional swimming pool filtration systems.

- Since the particles contained in the suctioned water flow are larger and compact due to the ultrasonic system, they are easier to remove from the water flow and thus the filtration energy requirements are lowered.

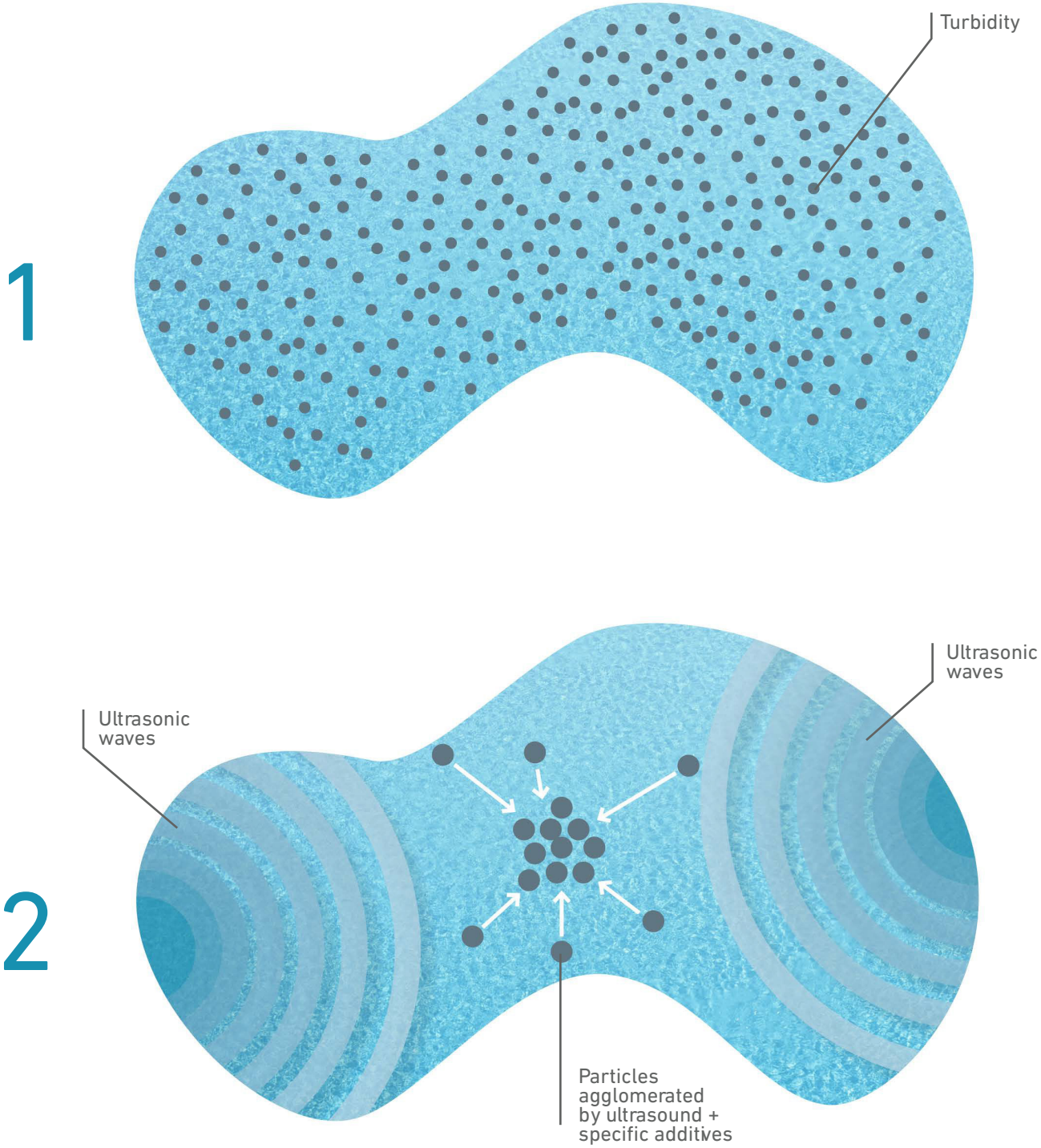
Therefore, Crystal Lagoons' efficient filtration system consumes down to 2% of the energy used for conventional swimming pool filtration techniques. As the energy consumption for the filtration system is reduced by approximately 98%, great environmental benefits are generated, which can go from the reduction of fossil fuel combustion in the world up to a reduction in CO₂ emissions.



Las Brisas Chile.

Las Brisas, Chile.

FIGURE 3: 'CRYSTAL LAGOONS'
EFFICIENT FILTRATION SYSTEM



3. SURFACE CLEANING



To remove all **floating impurities** from the water surface skimmers are strategically located at the predominant wind face perimeter in order to capture the **floating material**. This automatic system is able to deal with external contaminants such as oil spills, sun protection cream, leaves, etc. The skimmer system allows providing excellent aesthetic appearance, by allowing visualizing the outstanding color and transparency conditions of the Crystal Lagoons The Surface Cleaning System is coupled to a water recirculation system in order to create the necessary flows for the operation of the automatic skimmers.



Playa Blanca, Panama

4. BOTTOM CLEANING



The agglomerated sediments and contaminants precipitate into the bottom of the Crystal Lagoons, where they are suctioned by a specially designed vacuuming device that cleans the basin of the crystal clear lagoon. With a fast pace, the vacuuming device is able to deal with settled particles and is compatible with the Crystal Lagoons waterproofing system. As opposed to conventional cleaning devices used in swimming pools, Crystal Lagoons' bottom cleaning device can clean rough surfaces and maintain them completely clean in order to provide an attractive coloration to the water body.

The bottom water flow suctioned by the specially designed vacuuming device is sent into a filtration system, which allows filtering a small fraction of the entire volume of water, up to 300 times less than the flow filtered in conventional swimming pool filtration systems in the same period of time. As the filtered flow is much smaller, the whole filtration system is significantly smaller, decreasing installation requirements in terms of pumps and filter sizes.



Cabo San Lucas, Mexico.

5. CRYSTAL LAGOONS SPECIALLY DESIGNED LINER



The Crystal Clear Lagoons have a bottom covered with a liner as their base. The liner has been developed according to Crystal Lagoons' specifications, and it is exclusively produced in the United States for Crystal Lagoons licensees under our brand. The individual characteristics of the liners vary between projects, and they are defined by an interdisciplinary engineering team considering the particular geographical, geologic and meteorological conditions of the project.

The liner is very important for applying the Crystal Lagoons Patented Technology, as it has to withstand the cleaning work done by the patented Bottom Cleaning System in order to provide excellent color to the water. The liner also has to withstand the UV rays that easily affect the liner's properties, due to the fact that the water is so clear that the UV rays penetrate the layers easily and very intensively.

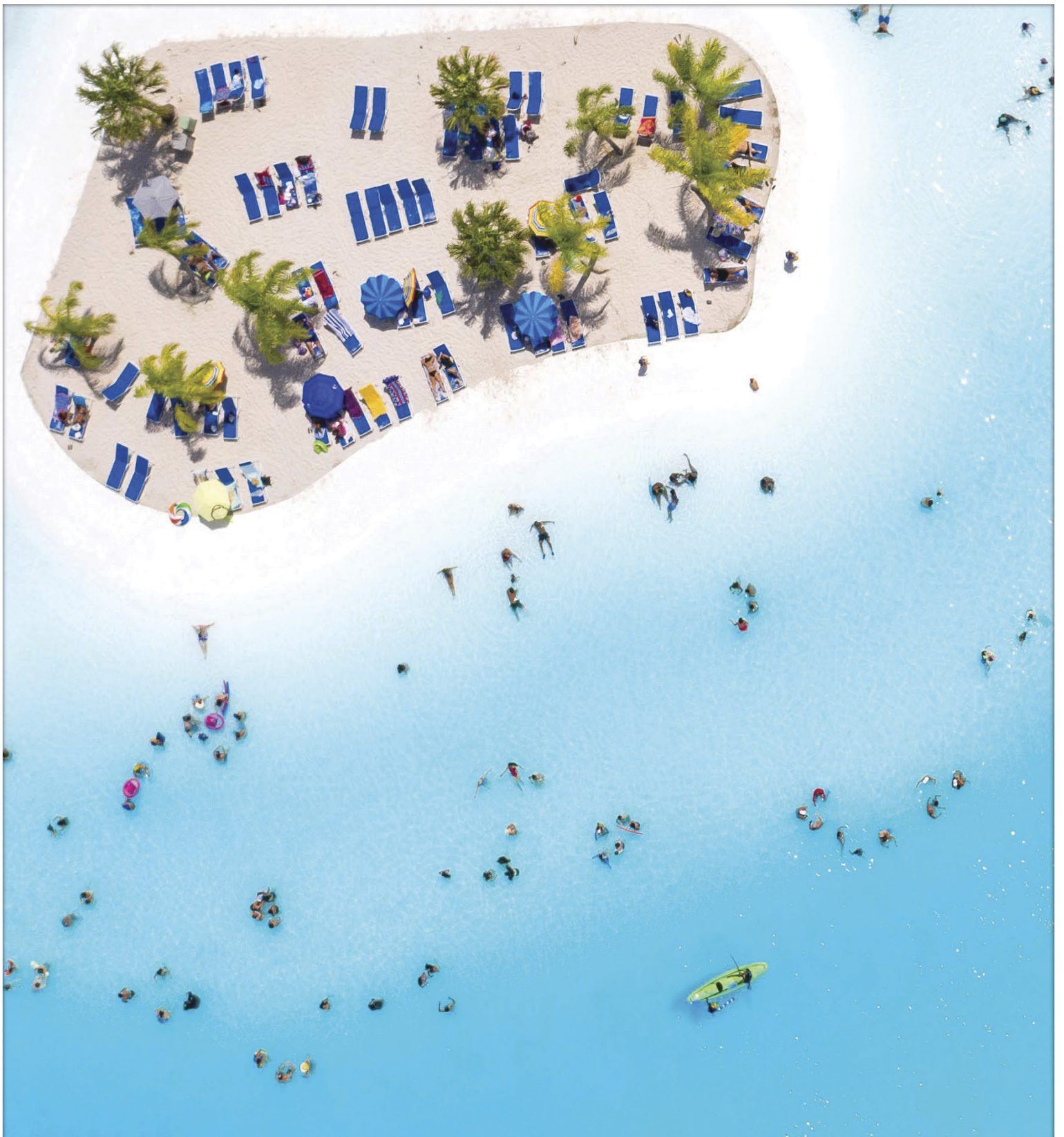
The color of the liner has a determining role in the final water color. The most commonly used liner is made of a special white color developed by Crystal Lagoons' R&D department, which results in an intense turquoise colored water when the sun light reflects in the Crystal Lagoons Liner. However, different tones can be developed depending on the need of the customers.

Some of the advantages of the Crystal Lagoons liner are:

- It has a specific density that minimizes the formation of bubbles or bumps
- It has a resistant UV protection in order to withstand radiation in such clearwater bodies.
- It allows a thorough cleaning of the bottom surface.

**FIGURE 4: CRYSTAL LAGOONS
LINER INSTALLATION**





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