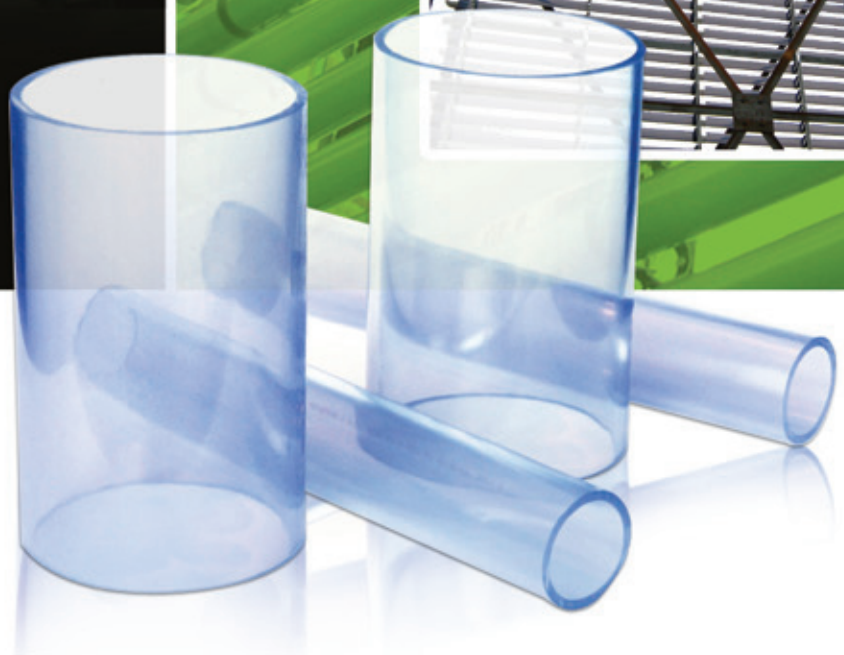
HARVEL®

# Harvel® EnviroKing™ UV

## UV-Resistant Clear PVC Piping

## Ternion Bio Industries relies on EnviroKing™ UV to build photobioreactors



# Harvel® EnviroKing™ UV essential component of Ternion Bio Industries Photo BioReactor

## Scalable technology converts carbon dioxide gas into a clean combination of algae and oxygen

The creators of a unique, patent-pending photobioreactor system, California's **Ternion Bio Industries** is going beyond simply sequestering harmful carbon dioxide ($CO_2$) emissions. Ternion Bio is recycling $CO_2$ emissions as food for algae. Instead of dealing with emissions by burying them underground or at the bottom of the ocean, Ternion Bio's processes allow these emissions to serve as the catalyst for the growth of algae, which then becomes the raw material for a wide range of beneficial products.

Carbon capture has become a major focal point with energy companies, refineries, and large industries. What Ternion Bio provides these businesses with is a way to more easily and cost-effectively deal with the necessary reduction of harmful $CO_2$ emissions, and do so in a way that leads to the production of beneficial secondary products such as biofuels and nutraceuticals, including vitamins. By recycling rather than simply storing these harmful emissions, Ternion Bio is safely turning carbon dioxide into a host of beneficial products.

> **"EnviroKing UV ThinWall 4-inch pipe provided an additional 11-percent better growth environment than any other pipe we tested."**

### A PATENT-PENDING PHOTOBIOREACTOR SYSTEM

Recognized as a pollutant by the Environmental Protection Agency, carbon dioxide is being recycled by Ternion Bio into useful products that can be used across an array of industries. "We do that with our patent-pending Photo BioReactor, which is used to grow algae," says Chris Schuring, Chief Operations Officer at Ternion Bio.

Schuring continues, "Our Photo BioReactor is constructed of steel framing, clear pipe, and pumps in which carbon dioxide is mixed with other nutrients to feed algae. The steel we choose to use for our Photo Bioreactor framework is 100-percent recycled steel made by Cadela Steel. The pipe we rely on is EnviroKing™ UV Clear PVC developed and manufactured by Harvel Plastics."

### THE IDEAL PHOTOBIOREACTOR PIPING SOLUTION

Developed as a clear PVC piping suitable for exposure to sunlight, Harvel's EnviroKing UV is a cost-effective solution for photobioreactors and other outdoor applications, including biofuel processing, sight glass, filtration, and process research and development. EnviroKing UV utilizes an exclusive UV-blocking technology that prevents harmful ultraviolet wavelengths that are damaging to PVC from penetrating the piping surface while allowing light wavelengths that are beneficial to algae growth to pass through.

# Choosing the ideal pipe for photobioreactor construction

Proper pipe design and construction is critical in the building of photobioreactors used for algae production. One of the most important factors that control cell growth in a photobioreactor is light availability—the ideal pipe will provide optimal light transmission and allowance.

The following baseline test was conducted by Ternion Bio Industries in order to determine the PVC pipe most suited to the construction of their patent-pending Photo BioReactor:

## TESTING

To conduct this test, Ternion Bio constructed three closed-loop Photo BioReactors for the purposes of recycling an industrial grade of $CO_2$:

- One constructed from Harvel® EnviroKing™ UV ThinWall™ 4-inch Clear PVC pipe
- One constructed from a competing 4-inch clear PVC pipe with UV protection
- One constructed from a competing 2-inch clear PVC pipe

The intent was to grow algae in each Photo BioReactor in direct sunlight and observe the results relating to both pipe life and algae growth and maintenance. Ternion Bio used gravity-circulated water in the Photo BioReactors to which fresh medium was continuously added, while culture liquid was removed to keep the culture volume constant and provide for testing.

Three species of algae were used with a similar mix of nutrients for each. The overriding goal was to determine the stability and growth potential of each pipe format. Once this test was complete, the proper pipe would be used in all Photo BioReactors to be built by Ternion Bio.

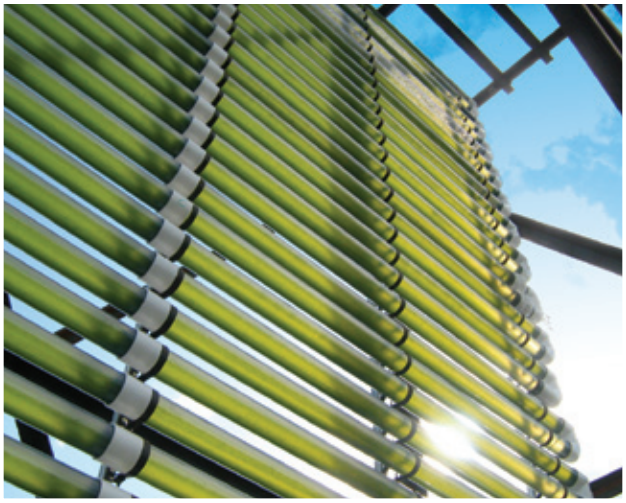
## RESULTS

Pipe testing yielded three sets of subject data: pipe life in direct sunlight, pipe thermal absorbsion properties, and algae growth ability. The pipe that provided the best overall growth medium in all tested conditions was the EnviroKing UV ThinWall 4-inch Clear PVC pipe.

***"EnviroKing UV ThinWall 4-inch pipe provided an additional 11-percent better growth environment than any other pipe we tested. In the ability to be used as a scalable product we feel it has no issue that would make the product unavailable for scaled systems. The demonstrated durability and manageable weight also increase the operational viability of the product. EnviroKing UV ThinWall 4-inch pipe is the standard by which we will measure all others, and we look to use this pipe in all of our scaled Photo BioReactors."***

***Chris Schuring***
***Chief Operations Officer***
***Ternion Bio Industries***

"The reasons we chose EnviroKing UV for our photobioreactor development include durability, performance, and value," says Schuring. "Most important, however, is the fact that EnviroKing UV, although clear, blocks UV light waves that are damaging to conventional clear PVC, making it ideally suited for precisely the type of projects we're conducting here at Ternion Bio. And EnviroKing UV ThinWall™ provides the optimum dimensions for use in photobioreactors. EnviroKing UV not only blocks harmful UV rays, but its unique wall dimensions actually improve the light transmission characteristics beneficial for enhanced algae growth."



*Ternion Bio's BioBlade system turns Harvel EnviroKing UV pipe into a state-of-the-art photobioreactor system.*

## THE BACKBONE OF THE PHOTO BIOREACTOR SYSTEM

Ternion Bio's state-of-the-art Photo BioReactor system is based on a unique design that combines the best of Ternion Bio's own research with what the company has learned from the problems encountered by companies with similar interests. "When developing our Photo BioReactor system," says Schuring, "we examined the problems that other algae companies faced when trying to scale, then adopted a modular approach that overcomes these scalability issues."

*BioBlades are slid into the Photo BioReactor structure in a manner similar to computer server "blades" being slid into a chassis.*

The inner workings of Ternion Bio's Photo BioReactor—the algae and their growing environment—are contained in smaller BioBlade™ units, open metal frames containing stacks of interconnected horizontal runs of EnviroKing UV pipe that circulate the algae. Each BioBlade slides into the Photo BioReactor structure in a fashion similar to a computer server "blade" sliding into a chassis.

The Photo BioReactor system uses more than 700 gallons of treated water per BioBlade unit, and each BioBlade has its own 250-gallon water tank and pump. If one BioBlade experiences mechanical problems, its isolation from the other BioBlade reactors means that the rest of the Photo BioReactor system will not be affected. Each BioBlade unit operates independently from the entire Photo BioReactor, while supporting the entire system as well.

"Our PVC piping system provides the backbone of both each BioBlade unit and each Photo BioReactor unit as a whole," says Schuring. "With that in mind, the pipe we use must be extremely durable and perform well on a daily basis. In addition to its UV resistance properties and its sunlight transmission characteristics, we chose EnviroKing UV due to exceptional corrosion resistance and outstanding pressure-bearing capability."

*Each BioBlade unit features its own 250-gallon water tank and pump.*

*Ternion Bio's modular Photo BioReactor design can be expanded to meet increased production requirements.*

## EXCEPTIONAL HANDLING & INSTALLATION

Handling and installation was also an important consideration when choosing piping for Ternion Bio's Photo BioReactor development. Schuring adds, "EnviroKing UV is also extremely lightweight, making it very easy to handle and install. The pipe within our BioBlade units is joined via solvent-welded joining techniques, resulting in quick, strong, leak-tight seals."

## ABOUT TERNION BIO INDUSTRIES

Ternion Bio Industries is a privately held company dedicated to finding ways to alleviate the environmental damages caused by the necessities of life in the modern world. Ternion Bio's goals include enabling the emitters of greenhouse gases to become part of the solution to the challenges, rather than the problem; generating beneficial raw materials as a byproduct of our carbon recycling process; and becoming a model for a new way of approaching solutions to the planet's shared environmental challenges. For more information, visit **TernionBio.com**.

*Chris Schuring, COO at Ternion Bio Industries, uncovers a container of algae grown using a Photo BioReactor made from EnviroKing UV PVC pipe.*

Chris Schuring photos at right and on front cover by Karina Williams/Reminisce Photography.

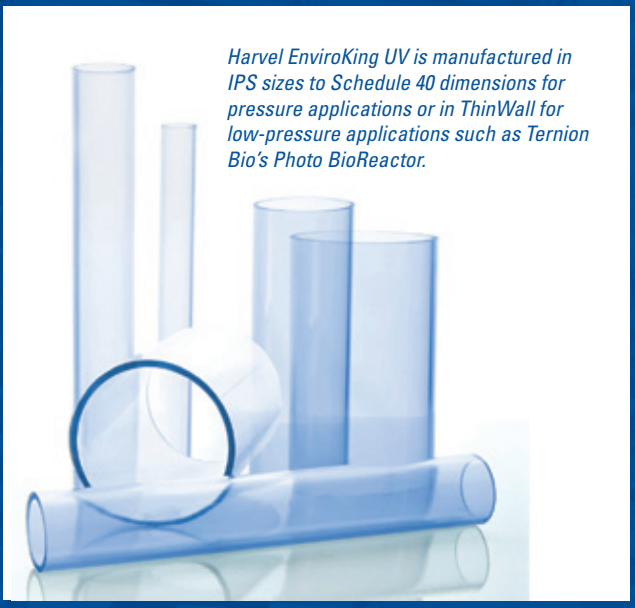
## Harvel® EnviroKing™ UV UV-Resistant Clear PVC Piping

Designed specifically for photobioreactors, biofuel processing, and other outdoor applications, Harvel's EnviroKing™ UV is a clear PVC piping solution suitable for exposure to sunlight. EnviroKing UV's unique UV-blocking technology prevents harmful ultraviolet light wavelengths from penetrating its plastic while allowing beneficial wavelengths to pass through.

- Available in ThinWall™ and Schedule 40 dimensions
- Joined using simple solvent-welded joining techniques
- Manufactured to IPS dimensions—fully compatible with standard PVC pipe, fitting, and valves
- Corrosion-resistant
- Non-conductive
- Lightweight—easy to handle and install
- Lower overall installed cost than glass, acrylic, or other transparent alternatives

EnviroKing UV's unique attributes provide a durable containment vessel that has been optimized to improve light transmission through the pipe without jeopardizing product integrity. EnviroKing UV is a cost-effective solution for photobioreactor tubing and other outdoor applications where transparency is required.

For more information on Harvel EnviroKing UV, call **888-941-3030** or visit **ClearPVCPipe.com/EnviroKing** today.



*Harvel EnviroKing UV is manufactured in IPS sizes to Schedule 40 dimensions for pressure applications or in ThinWall for low-pressure applications such as Ternion Bio's Photo BioReactor.*

HARVEL®
PLASTICS, INC.

PPFA

ASTM

ISO 9001 CERTIFIED

LPCB

UKAS QUALITY MANAGEMENT 007

Harvel Plastics, Inc.
Quality Systems Certificate Nos. 270/455
Assessed to ISO 9001

member iapd
international association of plastics distribution

**Distributed by:**
**Válvulas y Termoplásticos Industriales SA de CV**
**Teléfono 81-8030-5600**

**www.vyt.com.mx Email ventas@vyt.com.mx**