

Save Energy on a Heated Outdoor Pool:

Using EnergyGuard™ Selective Transmission to Reduce Pool Costs

2022 saw global energy prices increase considerably. As such, people all over the world have since been forced to assess their current energy consumption and find ways to mitigate against the unprecedented price increases. Reducing unnecessary energy consumption has become commonplace in many aspects of day-to-day life, which has been echoed throughout the pool and spa industry for both pool owners and retailers alike.

Ensuring that a swimming pool is covered whenever not in use is key to ensure energy is not needlessly wasted. Furthermore, selecting the right high-performance cover for your pool can save a pool owner a significant sum off their pool heating and maintenance bills.



Fig 1: EnergyGuard™ Selective Transmission with GeoBubble™ Technology

General cover benefits:

- **Eliminate water evaporation by 98% +**
- **With GeoBubble™ technology**
- **Reduce debris contamination**
- **Reduce the pool's carbon footprint**

EnergyGuard™ Selective Transmission specific benefits:

- Award-winning material
- Increase water temperature by up to 7°C
- Inhibit algae growth
- Reduce energy consumption by up to 60%
- Reduce chemical consumption by up to 60%
- Reduce filtration time by up to 50%
- Can be used as both a summer and winter pool cover
- Pay back the cost of a cover within 1 year
- 8+ years expected lifespan
- 8 years manufacturer's pro rata warranty
- Available with reinforcing weave

What is EnergyGuard™ Selective Transmission?

EnergyGuard™ Selective Transmission is the GeoBubble™ swimming pool cover material scientifically engineered to inhibit algae growth, by absorbing and filtering out the visible light which ordinarily promotes algae photosynthesis and growth. Instead EnergyGuard™ Selective Transmission absorbs this energy and re-emits it as useful thermal energy through the process of conduction, heating the pool water below. EnergyGuard™ Selective Transmission simultaneously allows for the direct transmission of Infrared Radiation (IR) from the sunlight into a pool. This is the energy that we perceive as "heat" and is the most efficient method of solar heating.

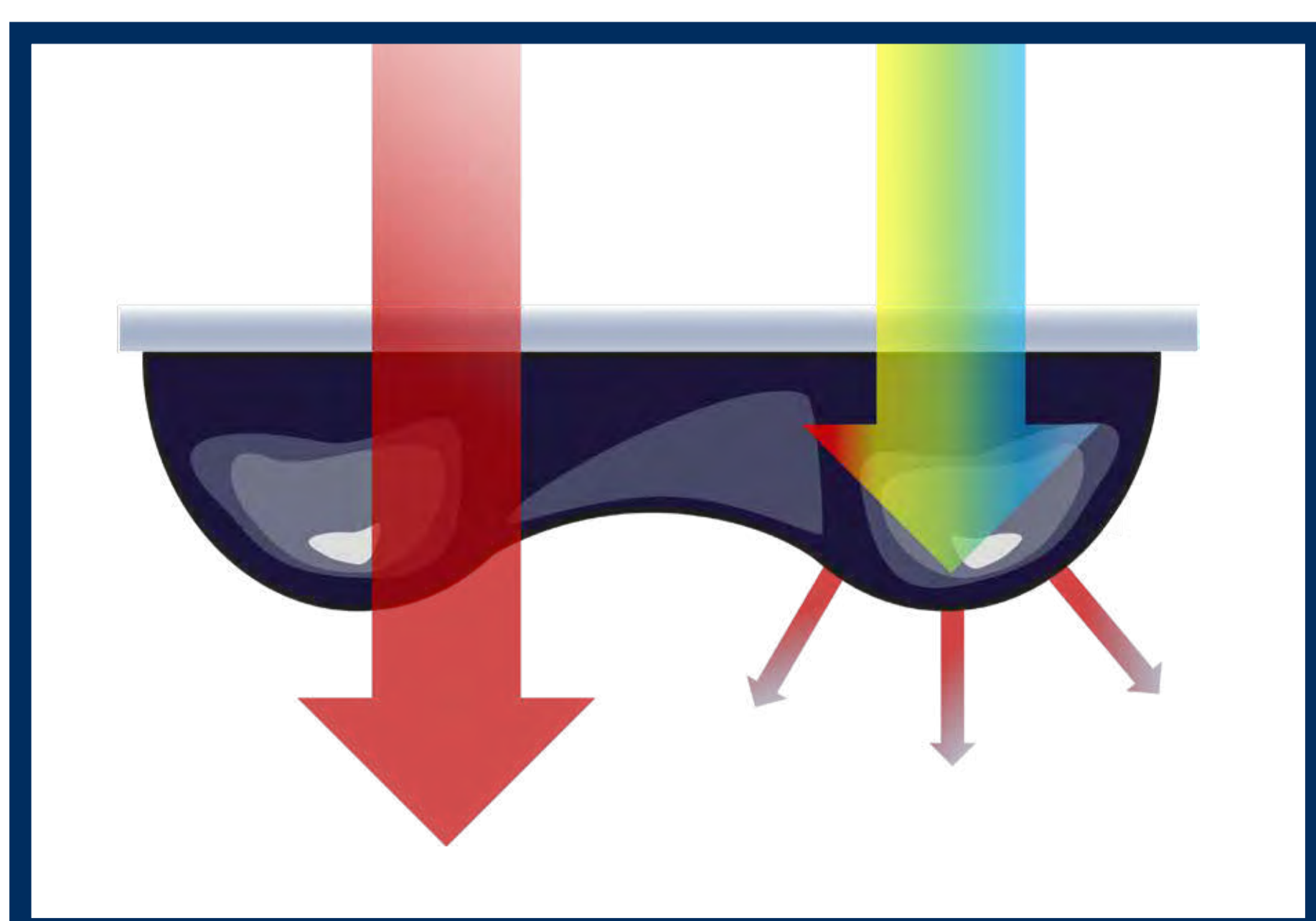


Fig 2: Illustration depicting the Selective Transmission properties of the material

Our own historic testing has also shown that an EnergyGuard™ Selective Transmission pool cover can increase the temperature of a swimming pool by up to 5°C, based on typical UK summertime weather conditions. The actual increase in temperature can be as much as 7°C in warmer climates, such as southern Europe. The combined solar transmission and conduction heating effect of EnergyGuard™ Selective Transmission can help to reduce energy consumption for heating by up to 60%, whilst pool maintenance costs can also be reduced by up to 60% for chemical consumption and up to 50% for filtration requirements – all thanks to the algae inhibition.

As with all GeoBubble™ products, EnergyGuard™ Selective Transmission pool covers almost completely eliminate evaporation from the surface of a swimming pool, which is ordinarily the main cause of heat loss from any pool. By providing a physical and impermeable barrier, an EnergyGuard™ Selective Transmission cover with GeoBubble™ Technology can reduce the rate of evaporation by 98% - helping you to preserve water and reduce heat loss from the pool by around 70%.

Experimental Procedure

During August 2022, testing was conducted on two identical outdoor test pools insulated to Part L building regulations, located at our state-of-the-art testing facility in the south-east of the United Kingdom. The scope of these tests was to determine the benefits of covering a heated outdoor pool with an EnergyGuard™ Selective Transmission pool cover, with respect to energy and chemical savings.

In order to achieve this one test pool was fitted with a 500 Grade EnergyGuard™ Selective Transmission cover fabricated in house, and another left uncovered to act as a control.

All test pools at our facility measure 8m x 4m, having been designed to be representative of an average sized, privately owned pool. The pools have a volume of 41,600L and each contain an array of 6 type-T thermocouples at their centre, continually logging water temperature at incremental depths and calculating the average water temperature. Logging and compilation of the temperature data is completely autonomous, maximising accuracy and reproducibility of results. A bespoke computer programme was developed to achieve this and was coded using specialist LabView™ software. This programme was designed by Plastipack engineers in close collaboration with experts at the University of Surrey.

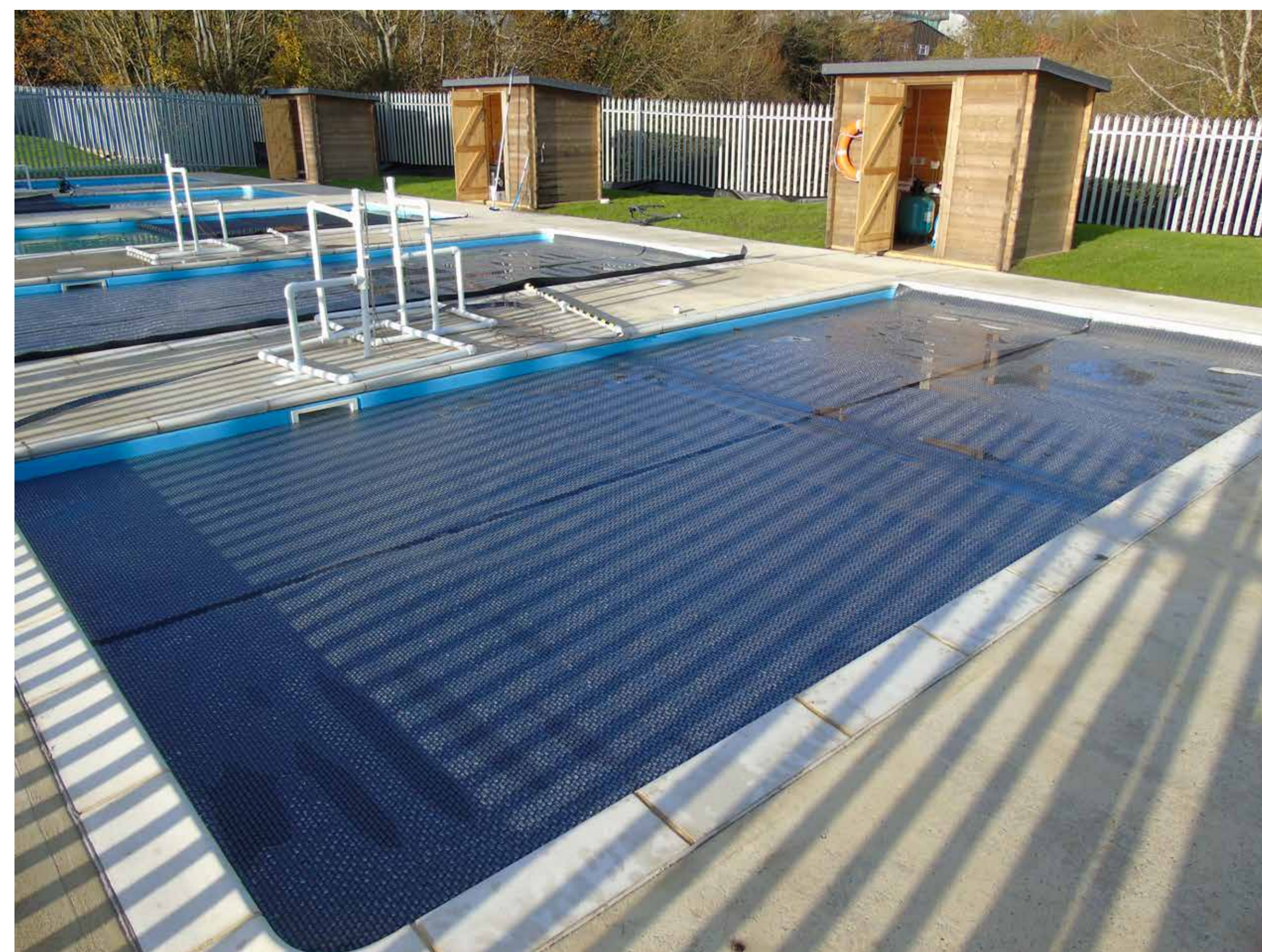


Fig 3: Test pools on the Plastipack premises

Each pool is serviced by its own 0.75kW filtration pump and heated using identical 12.5kWh heat pumps, which were on timers and set to 28°C. The filtration pumps were also set by timers to be running continuously between 07:00hr and 21:00hr, whilst the heat pumps ran between 08:00hr and 20:00hr. This filtration and heating pattern was selected as it most efficient for heating purposes. By ensuring that water is circulating sufficiently around the pool and through the filtration system prior to the heat pumps starting, heated water is quickly and efficiently distributed throughout the pool. The energy consumption of both the filtration pumps and heat pumps were recorded twice daily, at 08:00hr and 14:00hr. This data was then compiled to provide us with energy consumption data for both the test and control pools.

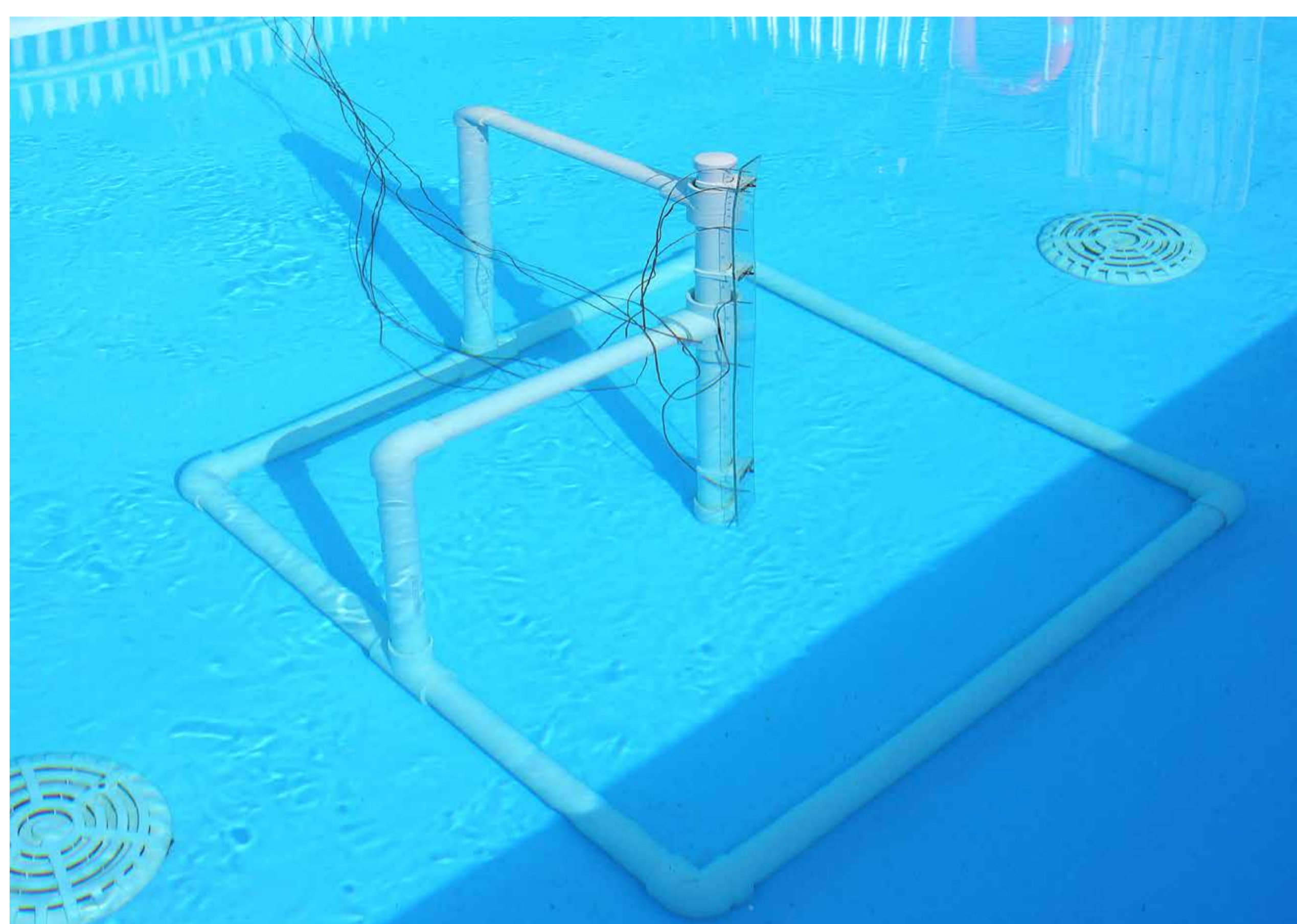
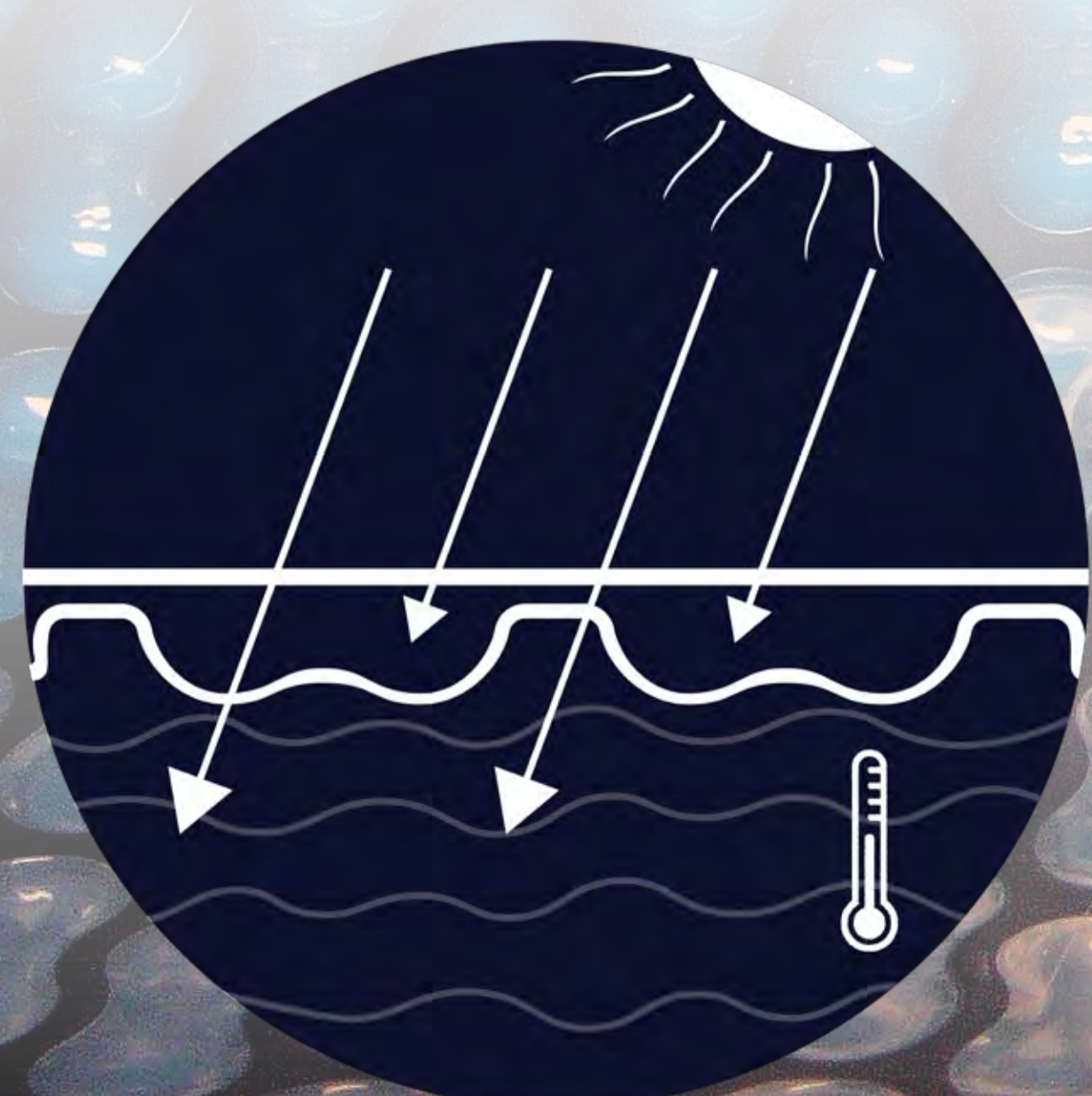


Fig 4: Thermocouple rig in one of the test pools on the Plastipack premises

Water chemistry samples were taken every other day to ensure that chemical balance of each pool remained within the accepted industry standards. pH, free chlorine, and combined chlorine concentrations of the pool water were logged digitally using a specialist photometry device. Any chemical additions required to restore and rebalance water chemistry to within the acceptable limits were recorded. These records were used to build a detailed dosing regimen for each test pool to allow for a comparison of chemical consumption.

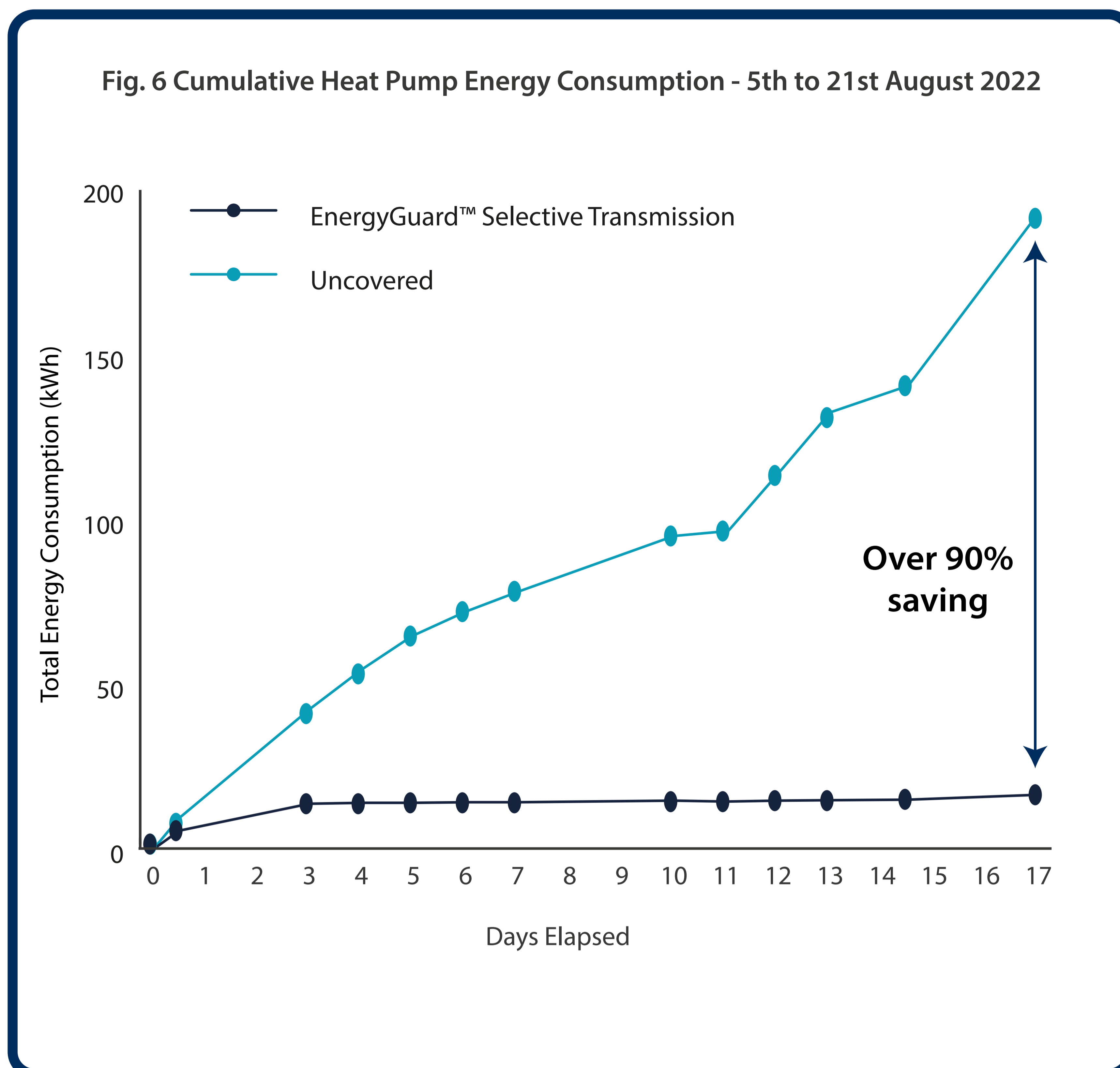
Previous testing was conducted to determine the effects of GeoBubble™ products with respect to controlling evaporation from the surface of a pool. A test was devised whereby two unheated tanks, with a surface area of 1m x 1.5m were each filled to a depth of 0.435m.

One tank was subsequently covered with a 400 Grade standard GeoBubble™ product, and the other left uncovered before being positioned outdoors in direct sunlight for 3 days during summertime. At conclusion of the test the water depths of both tanks were measured and used to calculate the water remaining in each tank. Percentage water lost by evaporation was subsequently calculated for comparison.



Energy Consumption

Although a 3-4° C increase in temperature may sound modest, Figure 6. shows the how covering a pool with EnergyGuard™ Selective Transmission can make a significant impact on the heating costs associated with running a heated pool.



It was found that the heat pump servicing the uncovered pool consumed far more energy than the heat pump servicing the pool covered by EnergyGuard™ Selective Transmission. After 17 days of testing the pool covered with EnergyGuard™ Selective Transmission had consumed 16.55KWh of energy, whereas the uncovered pool consumed 192.98KWh. These results represent an energy saving of 85% for the pool covered with EnergyGuard™ Selective Transmission. This further shows the importance of retaining heat overnight and maximising solar gains during the day by covering a pool with a high-performance solar cover.

This enormous saving is explained by the fact that the pool covered by EnergyGuard™ Selective Transmission had reached the heat pump thermostat set point of 28°C by day 2 of the test and maintained it until the weather turned less favourable after day 12. This is down to the heat retention overnight and through evaporation control, as well as maximising solar gains throughout the day.

For the 16 days that the test was running the cost of heating the uncovered pool was £65.62, whereas the pool covered by EnergyGuard™ Selective Transmission would have cost just £5.64*.

*These prices were calculated in accordance with Ofgem's Energy Price Cap in the UK, which was set at 34.0p/kWh at the time of publication (February 2023) - <https://www.ofgem.gov.uk/publications/latest-energy-price-cap-announced-ofgem>

What is GeoBubble™ technology?



GeoBubble™ is the geometric bubble design, developed specifically to improve the performance and lifespan of floating swimming pool covers.

Traditional bubble covers have offered little design innovation since first being introduced to the swimming pool market. It is common for a traditional bubble cover to exhibit excessive thinning in the bubble profile, resulting in a material that is susceptible to premature degradation and with a significantly reduced useful lifespan.

The unique shape of our patented GeoBubble Technology™ eliminates these weak points, presenting a bubble profile that is 50% thicker at its thinnest point vs conventional bubble covers. Inclusion of a larger air cell and supporting structural arch allows GeoBubble™ products to better withstand bubble collapse and allow greater room for internal air expansion. This means that the expected lifespan of GeoBubble™ products are up to 25% longer than any existing equivalent material incorporating a traditional bubble design.

Chemical Consumption

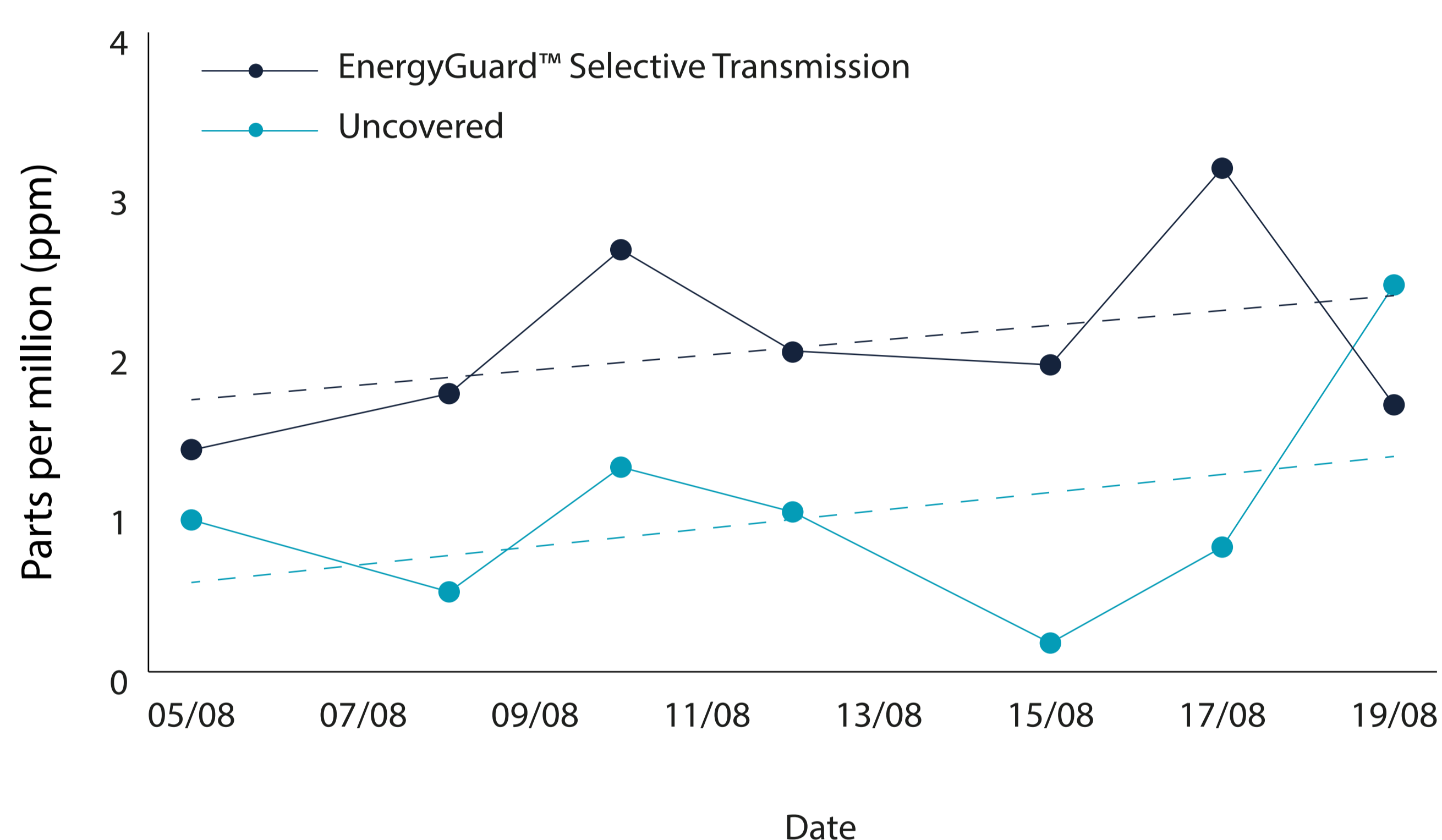
Chemical additions to the test pools were closely monitored over the testing period within August. This allowed the performance of the EnergyGuard™ Selective Transmission cover to be assessed with respect to chemical savings. Pool water samples were taken on alternating days and stabilised chlorine was added accordingly to balance the water concentration to within industry standards (2-4 parts per million). The 'chemical consumption' of each pool was assessed by recording the additions of stabilised chlorine each pool required to remain within this range. During this test, granulated chlorine was added to a test pool if water concentration of free chlorine dropped below 4 PPM.. Ordinarily the test pools would have been maintained at 3 PPM, however the regimen was increased to account for the heatwave conditions – warmer water will significantly increase the rate which free chlorine is depleted from a pool.

Figure 8 details how chlorine levels changed throughout the course of the test. On 10th August the pH of the uncovered pool spiked outside of the acceptable limits (pH 7.2- 7.8) - to combat this 500g of pH minus was added, bringing the pool back into balance.

Figure 9. shows that over the duration of the test period, 928g of stabilised chlorine granules was added to the pool covered by EnergyGuard™ Selective Transmission, whilst 1528g was added to the uncovered pool. These results represent a 39% reduction in chlorine additions for the pool covered by EnergyGuard™ Selective Transmission.

During the test period the uncovered pool will have consumed £21.24 in chlorine granules whereas the pool covered with EnergyGuard™ Selective Transmission consumed just £12.90*. In addition to this, the uncovered pool would have consumed an additional £5.50 in pH- treatment – added on 10th August 2022 (day 5 of test)

Fig. 8 Recorded Free Chlorine in Test Pools (5th - 19th August 2022)

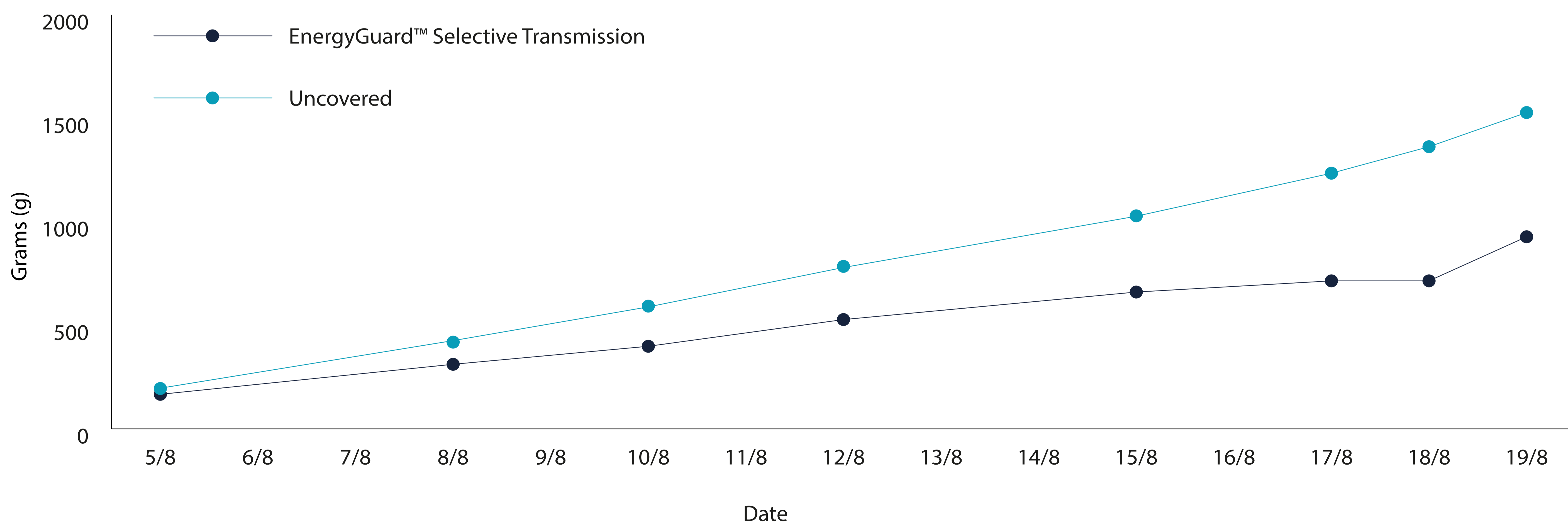


* Based on a UK RRP of £69.50 for 5kg of stabilised chlorine (February 2023) - <https://www.poolwarehouse.uk.com/index.php/product/chlorine-granules-5kg/>

The reduction in chemical consumption is due to the EnergyGuard™ Selective Transmission cover filtering out the visible light used for algae photosynthesis and growth. By reducing available light, less free chlorine was consumed for the purposes of eliminating algae and maintaining balanced water chemistry.

Our previous testing has shown that the chemical savings for EnergyGuard™ Selective Transmission can be as high as 60%, however during this test under heatwave conditions it is for this reason also that EnergyGuard™ Selective Transmission makes an excellent winter cover – during the winter months an EnergyGuard™ Selective Transmission cover is best left in situ where it will continue to inhibit algae growth, resulting in a far quicker and easier pool start up at the beginning of the swimming season.

Fig. 9 Cumulative Stabilised Chlorine Additions - 5th to 20th August 2022



Results and Discussion

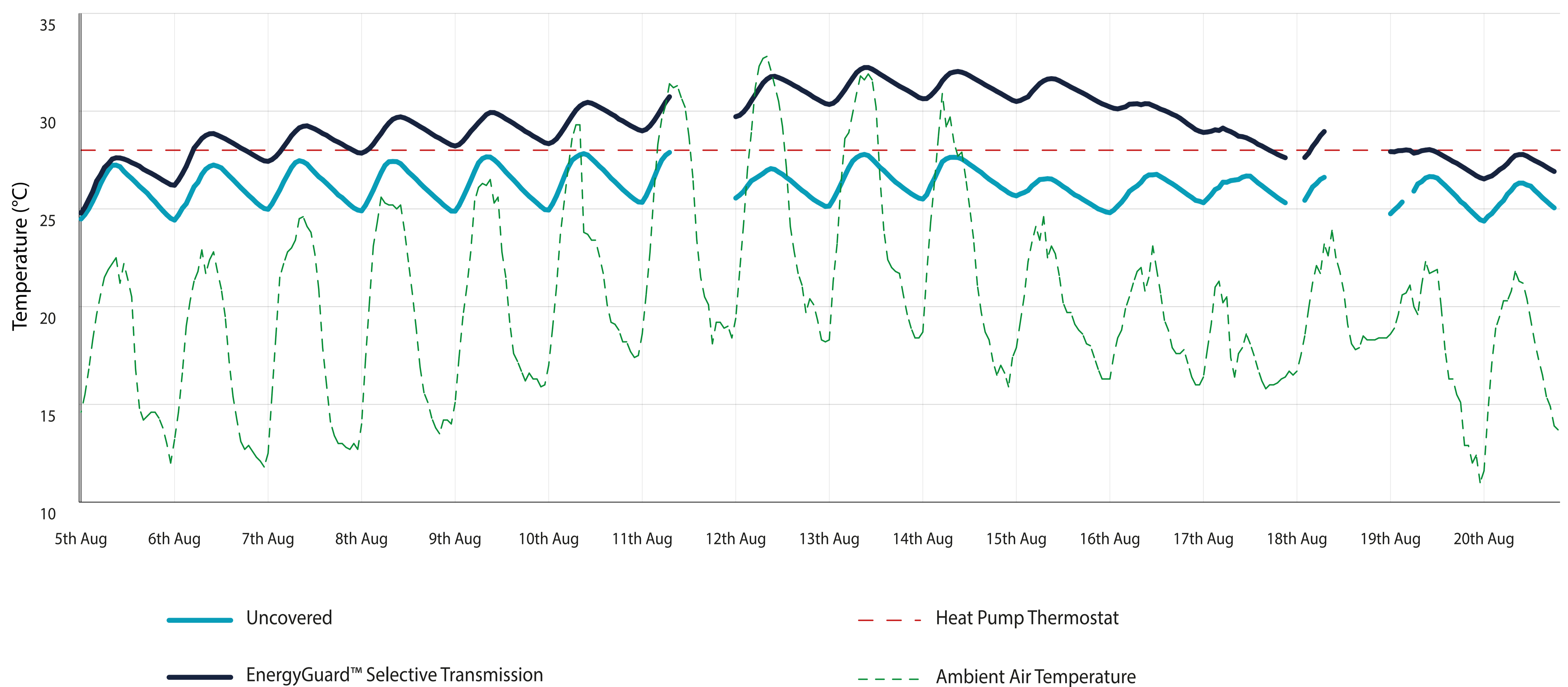
Temperature Regulation

For the duration of the 16 days that the test was conducted, the pool covered by EnergyGuard™ Selective Transmission was consistently warmer than the uncovered control pool, by 3.1°C on average. Figure 5 details the average temperature of both pools for the duration of the test.

Note: The decline in temperature observed for the pool covered by EnergyGuard™ Selective Transmission after day 11 was caused by a sudden drop in ambient daytime temperature, following a heatwave period.

It was found that during the day both pools saw an increase in average temperature, thanks to a combination of solar gains and electrical heating from the heat pumps servicing each pool. Similarly, both pools saw a reduction in temperature overnight when the heat pumps were not running. The uncovered pool consistently lost almost all the heat it gains during the day when the heat pump was running, whereas the pool covered by EnergyGuard™ Selective Transmission retains its heat overnight, allowing the temperature to rise steadily over the duration of the test.

Fig 5. Average Heated Pool Temperatures - 5th to 21st August 2022



Overnight heat retention paired with the elimination of evaporation and transmission of solar energy during the day meant that the pool covered with EnergyGuard™ Selective Transmission reached a maximum average temperature of 32°C, whereas the uncovered pool peaked at just 28°C. The uncovered pool was unable to utilise solar gains effectively to increase water temperature above that of thermostat set temperature. This is because the cooling effects of evaporation can be responsible for up to 70% of the heat loss from a pool, potentially higher during heatwave conditions when the evaporation rate is higher.

This is an excellent example of the consequences of leaving a pool uncovered whilst not in use and why it is always best to cover a pool when looking to maximise water temperature. Selecting the right cover is also important, as the colour and opacity will directly effect the efficiency of energy transfer of the free solar energy hitting your pool. (Link to selecting the right cover?)

Evaporation Control

It has been found during previous testing that a tank covered with GeoBubble™ materials exhibited a 98% reduction in water loss, when compared to the an identical uncovered tank. This means that for an average sized pool of 4m x 8m in the UK, covering it with GeoBubble™ products equates to a water saving of approximately 32,000 litres per year versus leaving it uncovered. This saving will be greater in hotter, dryer climates or regions subject to high winds. Further detail of this test is available in our 'Evaporation Report'

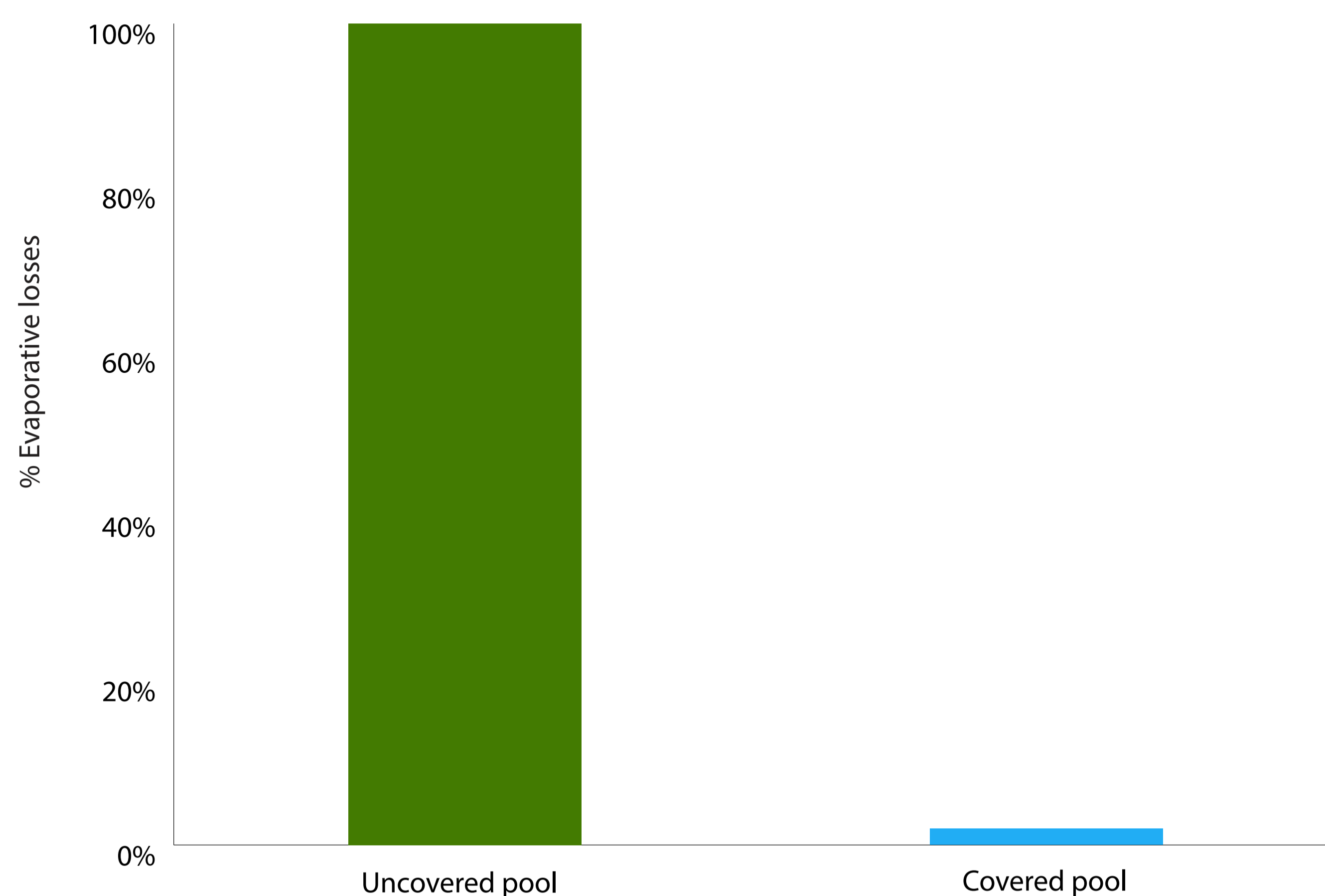


Fig. 10 Percentage evaporative losses from uncovered vs. covered pool

It is important to state however that evaporation is only prevented when the cover is in situ. A study by California Polytechnic State University* has shown that the degree to which a cover prevents evaporation, is directly proportional to the proportion of the water surface which is physically covered. A GeoBubble™ pool cover eliminates almost all evaporation by acting as an impermeable physical barrier. This prevents water being needlessly wasted and eases demand in regions where water supply is limited. Preventing evaporation from a pool's surface will also result in a warmer pool as it will significantly reduce the effects of evaporative cooling, the mechanism responsible for up to 70% of heat loss from a pool. Without the natural cooling that occurs when water is vaporised and released into the atmosphere, surface energy is retained as heat promoting a more stable water temperature.

**Effectiveness of Pool Covers to Reduce Evaporation from Swimming Pools: Misgana Muleta, Department of Civil and Environmental Engineering, California Polytechnic State University, Jan 2016*

Summary

During the experiment it was found that the EnergyGuard™ Selective Transmission covered pool had a reduced energy consumption when compared to the uncovered pool. The reduction in energy consumption is achieved by reducing heat loss and evaporative cooling whilst simultaneously increasing solar gains. This increased the total thermal energy within the covered pool. Covering a pool with EnergyGuard™ Selective Transmission can reduce heating costs by up to 91.4%. It was found that the EnergyGuard™ Selective Transmission cover promoted an average temperature increase of 3.1°C above that of the uncovered control.

EnergyGuard™ Selective Transmission achieves high transmission of solar energy despite appearing to have a high opacity, this is because it selectively absorbs the visible light and transmits heat via conduction, whilst remaining transparent to the solar IR energy which is responsible for the majority of the heating effect. As a result of EnergyGuard™ Selective Transmission selectively absorbing visible light, it simultaneously inhibits algae photosynthesis and growth. The reduction in algae growth reduces chemical consumption within the pool covered by the EnergyGuard™ Selective Transmission cover by 39%. The reduction in chemical dosing requirement reduces both the cost and time associated with maintaining a properly balanced pool.

Find out more at www.geobubble.co.uk/energyguard-st/



RaeGuard™ material uses scientifically proven techniques and innovations like the GeoBubble™ to make the product a resource saving material.

All testing was carried out using strict scientific methods, to ensure the findings of this report are accurate. To see more information about CoolGuard™ covers please visit

www.plastipack.co.uk/raeguard.php

CoolGuard™, EnergyGuard™, Sol+Guard™ and VapourGuard™ materials are manufactured by Plastipack Limited. EnergyGuard™ is a Registered Community Trademark No. 007290241.

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