

Shade Covers in Water Reservoirs

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Shade objects are small plastic spheres, squares or even hexagons floating on top of a water reserve for environmental reasons. The creator of shade balls in California originally used them to prevent chemical treatments in the reservoir from reacting with sunlight creating bromate, which is a carcinogen regulated by many institutions worldwide (chlorine plus sunlight turns bromine into bromate that is a potentially cancer-causing agent; because shady objects stop bromate from forming below, less chlorine is required to treat the water than without them). More recently, other environmental issues have been associated to the use of shade objects: slowing down water evaporation, preventing algae blooms, avoiding birds landing on bodies of water and promote water heating.

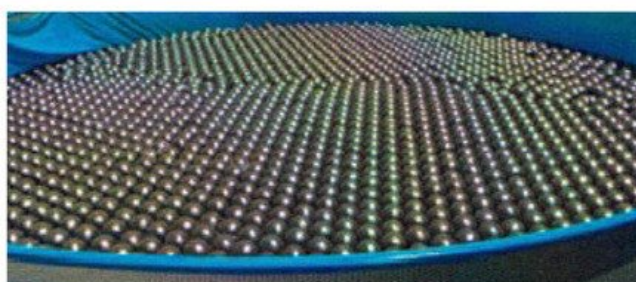
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1. Shade Balls

Shade balls are probably the most used shady objects at the time of writing this review. They are around 4 inches (10 cm) in diameter and usually partially filled with water to avoid being blown by wind (**Figure 1**) (although the second generation of shade balls are heavier than the original balls to provide higher weight instead of gaining weight by filling with water). The manufacturers that sell them as high-performance floating cover highlighting the following benefits and advantages: adjust to variation of the liquid level by spreading and stacking; allow movement of equipment through liquid; water evaporation is reduced up to 90%; deter waterfowl from landing on covered waters (their round shape avoid birds landing, so no feather-borne diseases get in the water); balls are UV resistant and back balls reduce penetration of UV rays (this limiting growth of algae and clogging weeds); fast and effective solution to odour problems (this property allows their use on other reservoirs like those containing purines or industrial wastewaters); heating cost reduced by up to 75%; reduce chemical reactions between products dissolved in water; unaffected by rain water; cheap maintenance; quick and simple to install. Finally, manufacturers state that the balls are made of recyclable plastics, so they can go on to be reused for other purposes once they are removed from the reservoirs. Because of their arc structures, the floating balls are unstable in the wind and waves, which is one of the main disadvantages of these objects because it reduces evaporation suppression efficiency (ESE).



(A)



(B)

Figure 1. Example of shade balls in a domestic water reservoir located in a countryside house (Southeast of Spain). Small experiment carried out by the author during summer 2014. **(A)** Shade balls; **(B)** Small pool covered by shade balls.

A small experiment using shade balls was carried out by the author in collaboration with “Panal Flotante Company” (Alicante, Spain; <https://www.panalflotante.com/>, (accessed on 20 April 2021)) in which three pools (control without shade balls and two pool covered by black shade balls) were monitored during the summer of 2014 (June–September) (**Figure 1**). Parameters like pH, conductivity, turbidity, rate of water evaporation, nitrates, nitrites, ammonium, COD (Chemical Oxygen Demand), BOD (Biological Oxygen Demand) and optical density at 600 nm were measured twice per week (unpublished data). Parameters related to climate (rain, temperature, and wind) in this region during the period in which the experiments were carried out were obtained from the closest meteorological station, (<https://www.meteovillena.es/>, accessed on 10 August 2014); Villena (Alicante, Spain). Optical microscopy was also used to check the samples taken from the pools each two weeks. This study stated that water in covered pool was almost transparent and without organic matter after 4 months of monitorization. However, water from uncovered pool contained small pieces of leaves, small stones, and sand. Besides, water evaporation rates decreased up to 90% when comparing covered and non-covered pools.

2. Shade Squares and Hexagons

Hexagonal or squares floating cover system ensures coverage of up to 99%, which is the main advantage comparing them with shade balls (**Figure 2**). Consequently, the reduction of water evaporation and the water exposition to light is even more efficient compared to shade balls (lower penetration of UV rays which avoids growth of algae, and clogging weeds).

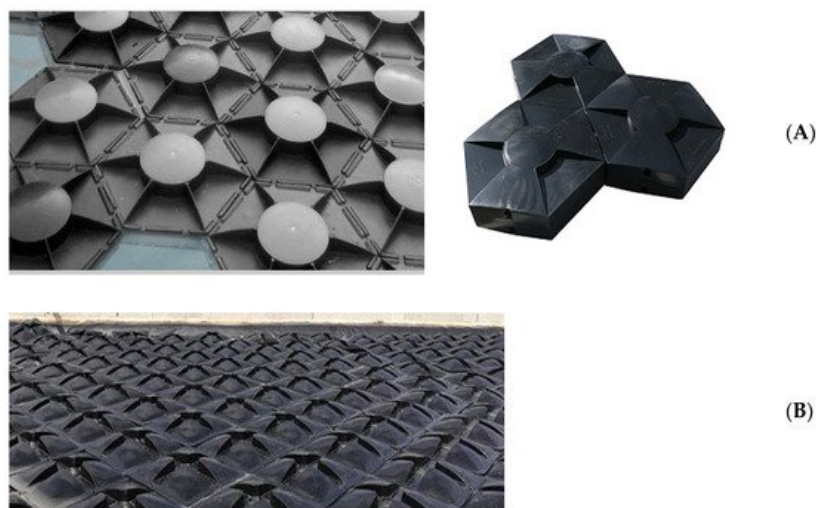


Figure 2. Examples of squares or hexagons used as shade objects. Different models are available at global market. Pictures taken from <https://www.awtti.com/hexprotect-cover-floating-cover/>, (accessed on 20 April 2021); <http://megaplast.cl/sistema-de-cubiertas-flotantes-para-control-emisiones-evaporacion-y-olores/>, (accessed on 20 April 2021); <http://murciadiario.com/art/14721/evapo-control-reduce-la-evaporacion-en-embalses-y-balsas-de-riego-mas-de-un-80>, (accessed on 20 April 2021). **(A)** Examples of hexagons. **(B)** Example of squares-based cover.

Another important advantage is the improvement of odor prevention (it justifies the use of these objects to cover water reservoirs containing industrial waters) as well as their management: as a consequence of their shape, they do not represent an obstacle to static, moving or dipping equipment. The squares/hexagons will keep up with liquid level, rising, lowering and restacking themselves as needed. Consequently, the installation of these objects in the reservoirs minimizes the use of labor, avoids repair and maintenance costs are lower than those derived from the use of shade balls and SSCCs.