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UV IN AQUATICS: WELLNESS FOR THE NOSE - BREAKDOWN OF CHLORAMINES IN PUBLIC BATHS

from **Heraeus Noblelight, Hanau, Germany** www.heraeus-noblelight.com

Humans love to relax and soak the body and soul in warm water and loose the cares of the day in the whirlpool. Now, imagine the happy sounds of children on the water slide and seeing the really small splash about gleefully in comfortably warm baby pools. Today, modern public baths are often much more than pure sports facilities, they are places for relaxation and well-being for big and small alike. The typical swimming pool chlorine smell, which formerly used to sting our nose when we entered the swimming pool, along with the red and irritated eyes of children, are no longer in tune with the wellness concept of modern swimming centres.

CHLORAMINES AS TRIGGERS

Chlorine is routinely used for disinfection in public baths. The classic disinfection mechanism cannot be completely substituted, as with other solutions the high disinfection power and the necessary germ killing speed cannot be achieved. In the on-going operation of baths using chlorine, chloramines such as NH2Cl (Monochloramin) are produced as by-products of the disinfection process through free chlorine and reactions with substances such as skin shedding into the pool water. These chloramines, also known as "combined chlorine", are responsible for the typical swimming bath smells and irritation of the eyes and the mucous membranes under contact with the water. The concentration of the chloramines is dependent on several factors: water temperature, pool temperature, number of bathers and their level of activity and the process of water treatment. Theoretically, the greater the number of bathers, the greater their level of activity, the higher the water temperature and the smaller the pool size created higher chloramine levels. The upper limit of combined chlorine is given in German DIN 19643 at 0.2 mg per litre (mg/L).

Fig. 1: *The Chlorominator uses modern UV technology to break down chloramines photochemically and disinfect swimming pool water. (Copyright: Grünbeck GmbH, Höchstädt/Donau, Germany)*

Fig. 2: *Example of a 400 Watt UV medium pressure lamp (Copyright: Heraeus Noblelight GmbH, Hanau, Germany)*

PHOTOCHEMICAL REACTION WITH UV RADIATION

One good option for reducing the concentration of disinfection by-products in the water circuit is the so-called Chlorominator from the water treatment specialist Grünbeck in Höchstädt an der Donau. In this system, the combined chlorine is broken down photochemically. With the help of "high energy" UV emitters, the molecular bonds of the chloramines are broken, resulting in harmless substances such as chloride and nitrogen. In practice, the system consists essentially of a pressure tube with two overlapping UV irradiation zones. In the influent zone, according to the capacity of the system, there are up to six 400 Watt UV medium pressure lamps from the specialist light source manufacturer Heraeus Noblelight. Because of the polychromatic lamp spectrum in the UV-C spectral range from 200 to 280 nm, which is effective for the application, and because of a specific electrical emitter power of more than 45 W/cm, the UV lamps break the chloramines molecular bonds and so destroy the combined chlorine in the bath water (Add Fig. 3). As this process relies exclusively on the application of UV technology and requires no additional substances, the chloramines destruction is extremely environmentally friendly. Virtually all of the heat generated is fed to the bath water and this makes the process

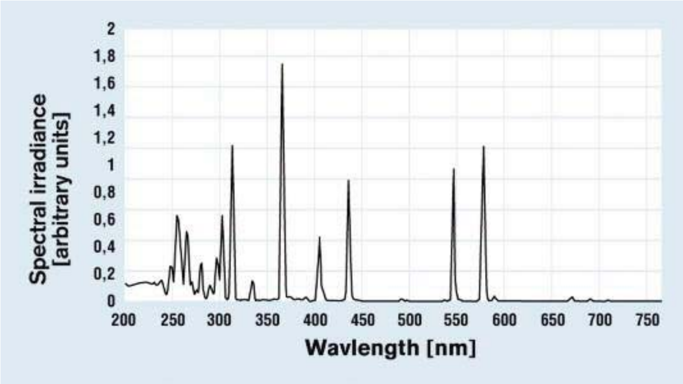

Fig. 3: ***Typical polychromatic lamp spectrum of UV medium pressure lamps. (Copyright: Heraeus Noblelight GmbH, Hanau, Germany)***

energy-efficient and economical. The high radiation flux of the UV medium pressure lamps allows the construction of compact water treatment systems. Specifically, the 400 Watt UV medium pressure lamps are only 140 mm in length with a diameter of around 16 mm.

UV TECHNOLOGY REDUCES THE USE OF CHLORINE.

As well as destroying chloramines, the use of UV lamps also allows for a reduction in the amount of chlorine required. The treatment of water with UV radiation is a very effective physical process for the disinfection of water and the destruction of pollutants. "High energy" UVC radiation in the range 200 to 280 nm is very effective at destroying the bonds of the DNA helix. This means that UV radiation inactivates in seconds the cells of pathogens such as viruses, bacteria and microbes which can be present in water. These same pathogens are also unable to develop a resistance against UV light at dechloramination dosage. Consequently, the germ count in the swimming bath water can be reliably reduced and there is need for less chlorine.

To further increase this effect, the Chlorominator also features up to 12 Heraeus Noblelight low pressure Amalgam lamps as well as the UV medium pressure lamps and these are located in the outlet of the irradiation chamber. With their quasi- monochromatic spectrum of 254 nm and high efficiency of around 35%, they are well suited to disinfection of the water in swimming baths Compared with conventional mercury low pressure lamps of the same geometry, Amalgam lamps offer significantly greater power. While mercury low pressure lamps typically have a specific electrical power of 0.3 to 0.5 W/cm of illuminated length, Amalgam lamps approach 6 W/cm. The reason for this is the different pressure/temperature ratio. Mercury low pressure lamps achieve their optimal mercury vapour pressure of 0.8 Pa, and hence their maximum UVC output, at around 40°C. Increasing or reducing the temperature by increasing or reducing the electrical input power only leads to a reduced UVC output. The Amalgam lamp also reaches its optimum vapour pressure at 0.8 Pa, but this is at a corresponding temperature of 90 - 130°C (dependent on model). This higher temperature level is responsible for the higher specific electrical power of the Amalgam lamp and thus for its higher UVC output per centimetre of illuminated length. This means that Amalgam lamps are much more compact than mercury lamps of the same output. Consequently system builders can scale down their equipment, as they need fewer lamps and casings and hence less space. A smaller number of power supply units is also another area of potential saving.

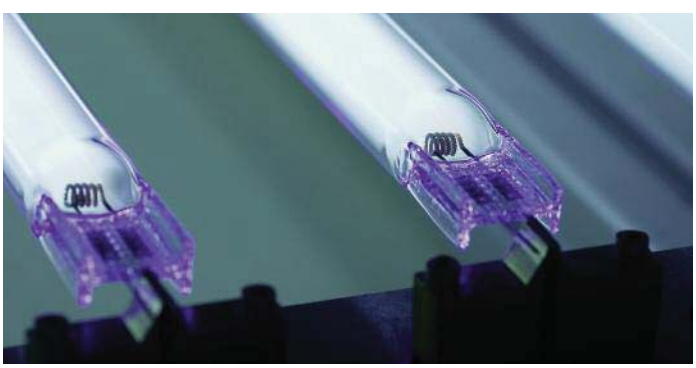

Fig. 4: ***Amalgam low pressure lamps are very effective in killing viruses, bacteria and pathogens in swimming pool water. (Copyright: Heraeus Noblelight GmbH, Hanau, Germany)***

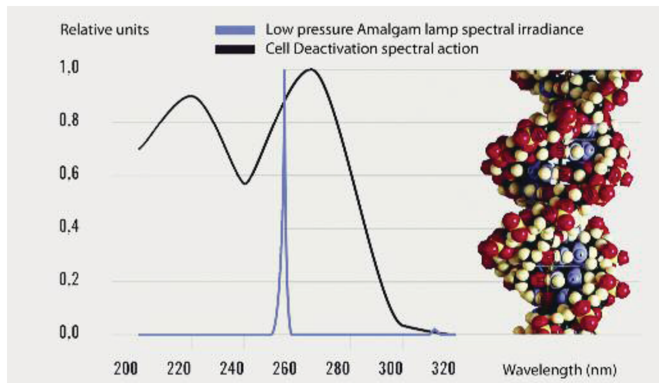

Fig. 5: ***254nm spectrum of a UV Amalgam lamp and an effective spectrum for killing bacteria (e-coli as in DIN 1031 Part 10). (Copyright: Heraeus Noblelight GmbH, Hanau, Germany)***

CASE STUDY

The Chlorominator, with its advanced UV technology, is already being used in a large number of swimming bath installations. Recently, the newly built spa centre at Bad Liebenstein in Thuringia, Germany received two Chlorominators. This new spa will be opened in Spring 2009. Amongst other things, it offers a swimming pool, specialty showers, a sauna suite with ice tubs and immersion pools and relaxation baths using the local spa water. Here the oldest spa and curative bath in Thuringia, (the healing and curative effect of the water from the Casimir spring has been acknowledged since 1601) is now using modern water treatment with UV technology. Medium pressure and Amalgam low pressure lamps reduce the chloramines in the water and help water disinfection, so that the users of the facilities can safely and peacefully relax, from top to toe, and already start to look forward to their next visit.

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