Commercial operating experiences of chlorine-free water; disinfection in Spa and Wellness Center Sárvár, Hungary

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Introduction

In the small western-Hungarian town of Sárvár, at the beginning of the 1960s water with therapeutic properties was found, first at 43°C, then at 83°C during exploratory drilling for oil. In order to make use of this water the first spa facilities in the town were built in 1968, so the traditions of the culture of bathing go back more than 40 years. Around the turn of the millennium, the municipal authorities set themselves the target of building a new spa that would satisfy twenty-first century needs, replacing the old-fashioned baths which were now totally out of date,. But the aim was not merely to develop the old facilities, but to build a brand-new bathing complex. This resulted in the currently operating Sárvár Spa and Wellness Centre, which was opened in 2002.

The investor and the owner is the Municipality of Sárvár. The value of the investment was 17 M EUR in 2002. The company responsible for operating the facilities is Sárvár Spa and Wellness Centre Ltd, a 100 % municipally-owned company.

Besides the spa, the company is responsible for running a 4-star hotel and a campsite. Both of these are directly connected to the spa itself. Since 2002, the Centre has provided its guests with services which combine high technological standards with outstanding quality. The clientele using the spa is diverse: apart from elderly guests arriving with recovery and rehabilitation needs, families with children and active middle-aged people also make use of the facilities.

The total water surface of the spa is 4300 square meters. The outdoor and indoor therapeutic water baths; the partly indoor and partly outdoor entertainment pool with its multiple massage elements, geysers, waterfall and twister passage and the toddlers' bath work all year round, both in winter and in summer.

Additionally, the open air plage is open from spring until autumn, where a huge, 1800 square-meter swimming-pool with a slide and diving boards; a children's' adventure pool with a pirate ship and a water castle; an outdoor toddlers' splash and a wave-pool provide refreshment for those who seek it.

Amusements for children are provided not only by the pools, but also by a playhouse, where children can spend their time under the supervision of trained kindergarten teachers while their parents are relaxing in the Sauna world or enjoying a massage. Many children's' productions and entertaining shows are organised in the spa, offering interesting experiences other than bathing itself.

Two rheumatologists give consultations in the Healing Centre, recommending customized therapy for people suffering from locomotor disorders. More than 30 types of therapy are available in the cure-centre, particularly for locomotor and respiratory diseases. The special

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treatment involving Sárvár mineral salts is exclusively available in the bath. The salts are dissolved in the bath in the case of locomotor or gynecological problems, they are applied in the form of packs to take advantage of their skin-beautifying effects and they are used for inhalation and in salt cave therapy as well, in cases of asthmatic symptoms and respiratory problems.

Guests can choose from a range of different wellness treatments: more than 20 specific kinds of massage, skin-beautifying body packs and conditioning baths are on offer.

The most attractive, and perhaps the most exclusive section of the Wellness Centre is the Sauna World, an island of calm inside the Centre. Besides traditional Finnish sauna, steam baths, aroma cabins, a Kneipp pool, soft sauna and biosauna all await visitors. Moreover, there is an outdoor sauna courtyard with further Finnish saunas.

The fitness centre has an array of modern equipment and an aerobics hall. Here you can also find an infrasauna and solarium. Trainers are available to offer visitors suggestions and to compile complete training programs. In addition to this, they also organize animated programs.

In the Beauty Saloon more than special face and body treatments are available in addition to the traditional services (hair care, cosmetics, pedicure, manicure) and there are various forms of treatment developed especially for male guests too.

In recognition of the outstanding quality of its services, the Sárvár Spa and Wellness Centre has won the following prizes and awards:

In 2004 the bath won the Prize of the Hungarian Wellness Association in the **Wellness Center** category, and in 2005 in the **Wellness Medicina** category

The **Royal Spas of Europe Association** elected Sárvár a member in 2004. So far, only 10 European spa towns from eight different countries have earned this honour. The association only admits as members those spa towns which have real, certifiable royal connections and which at the same time operate spa facilities and a hotel of exclusively high quality.

In April, 2007 the bath was awarded the **EuropeSpa-med** seal of approval. This is an acknowledgement of quality issued by the **European Spas Association** on condition that a spa fulfils a predetermined set of requirements. The facility owning this prize has met the norms of the European Spas Association relating to therapeutic infrastructure, hygiene and patient safety. The Sárvár Spa and Wellness Centre finished the competition with the 6th best result in Europe and was the first in Hungary to win the prize.

In 2008, **the Qualifying Board of the Hungarian Spa Association** listed Sárvár in the highest, four-star category.

Among the hundreds of medicinal spas in the Carpathian basin, Sárvár excels in the therapeutic qualities of its waters.

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The waters of the Carpathian basin may be grouped according to temperature and to dissolved mineral content. Temperature vary between 25 and 93°C, but most of them are above 37°C. Considering dissolved mineral content, there are many waters which exceed 1000 mg/l.

The Sárvár Spa and Wellness Centre utilizes two different types of medicinal water: the 43°C alkaline hydrogen-carbonated thermal water is used for filling up the swimming-pools. This water arrives from a depth of 1200 meters, and contains mainly sodium-chloride, hydrogen-carbonate microelements, but no sulphur or radon. It is exceedingly beneficial in the case of locomotor disease, rehabilitation and aftercare following sporting injuries, neurological complaints and muscle-relaxing bathing.
The other type of medicinal water comes up from a depth of 2000 meters and has a temperature of 83°C.
This is a water with a high mineral salt concentration and the extracted salt is used in the various locomotor, respiratory and gynecological therapies provided by the Spa Centre.

In the Sárvár Spa and Wellness Centre, the thermal water is drawn from two wells which are quite similar in terms of their parameters: their base depths are 998 and 1293 meters and they have a capacity of 330 and 540 liters per minute respectively. These two wells provide the pools with water in proportion to their capacity.
The well-heads are the property of the spa and are situated at a distance of a few hundred meters from the place of use. In Hungary, the protection of water-tables is carefully regulated, so the maintenance of the protective area is an obligation prescribed by law. The exploitation of water-resources is subject to governmental authorization, with strict regulations about overdrawing and the prevention of pollution, as waters arriving from such depths originally filtered down millions of years ago.

As the water drawn from these wells has a significant methane-gas content, gas removal is required for reasons of labour safety and accident prevention. This is done using the VLV Hungarian method: a flow-over, deflecting plated degasification system.
From the bacterial point of view this is less advantageous than vacuum gas-removers, but in spite of this, it performs adequately.

As the specific total methane content exceeds the value of 0.8 normal liters per cubic meter, reaching 22.3 normal liters per cubic meter, the gas should be removed from the water and the relevant measurements should be repeated every second year.

As we will see later, the water contains enough ammonium ions to prevent traditional chlorination and even hinder breakpoint chlorination. This explains why the alternative of chlorine-free purification had been chosen.

Which parameters explain the choice of chlorine-free purification? It is of paramount importance that the water should preserve its therapeutic properties, and this had to be taken into account. At the same time, it was taken for granted that an excellent bacterial status must be preserved.

It is worth noting that in Hungary bathers most commonly encounter therapeutic waters in pools with discharge-refill systems. The principle that bacteria levels in the water may be kept down at a level which is tolerable for the human organism by adding an appropriate quantity

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of fresh water to the pool, was already well known in ancient times by peoples who enjoyed a developed bathing culture. Unfortunately, this method is not appropriate because the maximum number of bathers allowed by the regulating authorities is often very low. The only advantage of this method is that the properties of the water, at least the mineral salt content, are not changed before the water comes into contact with the bather.

In the case of the Sárvár Spa and Wellness Centre, the discharge-refill water-treatment method could not work either because the pools are too big compared to the quantity of water available. However, if water-circulation technology is applied, disinfectant must be added to the water. If chlorine were added, the iodine and bromine components of the water would be reduced and a significant quantity of chlorine-amines would be created due to the high ammonium content. Moreover, the excessive total alkalinity would have caused problems in terms of reducing the pH to 7.2. As it is, pH is now reduced to between 7.4 and 7.8 for the greater part of the operating hours.

Through the application of chlorine-free DEWAN-50 technology the mineral components of the water remain unchanged, the ammonium content in itself is not harmful for health and its level is continuously measured in the water. In addition, the increase in nitrite levels caused by ammonium does not occur as biofilm growth is carefully controlled during the technology of water-purification and thus, no nitrification can start. The iodine-bromine content remains constant and chlorine-resistant bacteria such as Pseudomonas Aeruginosa cannot be detected in the water.

Most visitors appreciate the fact that the Centre makes use of chlorine-free technology and very often, they choose this safe water-treatment method on the basis of unsatisfactory earlier experiences. Namely, in the most common discharge-refill pools the prescribed limits on spore numbers cannot possibly be respected.

In the Sárvár Spa and Wellness Centre more than 1750 cubic meters of swimming-pool water are treated using the chlorine-free method in 6 pools. These include cold-water pools intended principally for children, because of the regulations that limit the amount of time that younger visitors are allowed to spend in the medicinal waters.

The indoor, 192 m^3 therapeutic pool and the partly outdoor 640 m^3 therapeutic pool are both filled with medicinal water alone. Both of them function as sitting pools with very few experience elements, thus providing opportunities for relaxed bathing.

These pools best demonstrate the application of chlorine-free technology to medicinal water which we intend to discuss today. The purification approach now in use has been applied in virtually the same way 1996. The first medicinal water project was initiated in the nearby Sárvár Danubius Thermal Hotel. On the basis of this project, plenty of experience had been gained by the time the Spa Centre was opened in 2002.

The disinfectant forms a very stable, wide-spectrum complex on a hydrogen-peroxide carrier with complimentary quaternary-ammonium. In its concentrated form, the disinfectant can be stored for at least 2 years, but in fact 5 or 6 year-old samples show no considerable reduction of concentration. Additionally, it remains in the water, even out of use, for as long as 2 weeks, so it displays distinctly different features from chlorine.

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During the past 14 years, all the subsidiary services commonly used with chlorine have become available. There are colorimetric testers, test-strips and photometers to facilitate the work of the operators. Besides this, full automation has been achieved, and thus parameters such as pH and the concentration of the disinfectant can be measured on-line.

For us, of course, the most important point is how effective the purification is, and here performance has been admirable.

The aforementioned cross-effects also seemed to be good, so the test operations could be started without raising safety concerns. It is very important to emphasize that the components seen on the slide are NOT affected by the disinfectant; secondary oxidation of iodide-bromide does not take place, thanks to the low chemical concentration applied. Because of this, the application of the system to medicinal waters is safe.

As the Spa and Wellness Centre opened in November 2002, the first year when full measurements could be taken was 2003. The Centre performed as expected and, as a pioneering example of this kind of spa, it attracted large numbers of visitors, mainly from within the country. In 2004-2005 several new spa facilities were opened within a distance of 100 kilometers from Sárvár and the bathing public was shared between them. Unfortunately, the Wellness Centre developed no new attractions during that time, which resulted in a significant decrease in the number of visitors. A recovery occurred in 2006-2008 when the new attractions – the outdoor slide, the wave-pool, the expanded plage and the 4-star hotel and quality services – received publicity even abroad. As a consequence, the composition of the clientele has changed and its size has been constantly increasing.

The concentration of the disinfectant measured with the value of hydrogen-peroxide was held constant by an automated regulatory system, so correlations can be found with other variable parameters such as the number of visitors and bacteria levels.

This diagram shows that the number of visitors had no effect on bacterial performance. The technology has considerable reserves in terms of its purifying strength, so that even the Coccus values stayed largely with the limits when they departed from the value of zero.

Reviewing four and a half years, it can be seen that the values are always the same, which well illustrates the long-term reliability of the technology.

Each water-circulation system has been built according to Hungarian specifications, but all of these approximately comply with the DIN 19643 standard. The time it takes for the total water capacity of the pool to recirculate is 3-4 hours, the filtration rate is 35-45 meters per hour, and the height of the filter bed is 90 centimeters. The flow rate of the water in the pipeline is 1.5–2 meters per second.

New membrane-separation procedures have been used in industry in the past few decades and nowadays they are also being introduced for drinking water treatment, so again as pioneers we have decided to introduce them in swimming-pool applications.

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In Hungary, in the Sárvár Spa and Wellness Centre we are already operating ultrafiltration equipment, and given the successful outcome of this experiences we are planning to establish new plant.

Ultrafiltration provides a much better water quality than quartz-sand filters. The filtration range is between 0.1 – 0.01 microns; the molecular volume is in the range of 80 kilodaltons.

In this filtration range, floating substances, colloids, bacteria and viruses are retained.
The fundamental point is that this is achieved via purely physical filtration, so the chemical composition of the water remains unaltered.
In spas where no disinfectant can be added, this is the welcome way of removing bacteria.
In other pools, where a certain dosage of disinfectant is required, ultrafiltration can significantly decrease the quantity of chemicals that need to be used.
Our observations show that the combined application of ultrafiltration and the DEWAN-50 chlorine-free disinfectant has proven to be an optimal way of keeping an adequate microbiological status while using only an acceptable quantity of chemicals.

The type of swimming-pools is extended water surface pools with overflow channels and bottom diffusers. The movement of water is satisfactory, the concentration of chemicals is homogeneous in the water. The pools are cleaned by underwater vacuum-cleaner as usual.

It is important to review how much all of this costs: this table can serve as a good basis for other spas with similar features. The diagram clearly demonstrates that there is a minimum cost for the chemical treatment that remains constant, even when there are no bathers at all. This is not surprising. In this case we are discussing the amounts spent are only for chemicals. Until the year 2007, chemical expenses varied with the number of visitors. After that, thanks to the introduction of a rationalization program, significant savings can be observed. This is the consequence of careful supervision by the operating staff and the elimination of wastage.

It can be clearly seen that chemical costs per head are strongly influenced by marketing activity: the reduction of costs can be observed when there are more bathers. This reduction was further intensified by the rationalization program.

You can see that the specific chemical expenses per person fell in 2008, thanks to the introduction of an effective and carefully regulated treatment system.

In Hungary – due to favourable legal regulations which encourage the use of other disinfectants besides chlorine – the hydrogen-peroxide based DEWAN-50 swimming-pool purification technology has started to spread since the end of the 1990s. During the past 10 years or more, it has been demonstrated that the DEWAN-50 technology offers a viable alternative for the treatment of those thermal waters whose composition makes the use of chlorine impossible.

It is our hope that, combined with other new technologies (UV, UF, and RO) which are gradually spreading in swimming-pool water-treatment, the economy of this chlorine-free technology will further improve over time. At any rate, the example of the Sárvár Spa and Wellness Centre shows that the environment-friendly disinfectant which is the core of the technology deserves attention throughout Europe.

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