After a five year study with UV:

Chlorine-Free in Karlshamn, Sweden

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The contents of seven-day heterotrophic bacteria in the pipe network have fallen since the large water works in Karlshamn went over to UV treatment to disinfect the drinking water.

The contents of two-day heterotrophic, coliform and E-coli bacteria have not changed significantly, but in any case they have not increased. After just over five years of studies, our conclusion is that we do not need any chlorine "for the sake of the pipe network".

The Water Works in Långasjön

The Karlshamn local authority supplies approximately 29,000 people with drinking water and handles sewerage for about 28,000 people. The volume of water produced in 1999 was 3.3 million cubic meters. The water works in Långasjön produces more than 98 percent of this quantity.

The water treatment currently comprises chemical precipitation with sedimentation and rapid filtration with UV treatment. The filtering takes place in the first stage using sand as the filter medium. In subsequent treatment, which takes place before the second filter stage, carbon dioxide and lime are added to raise the pH value and increase the hardness. The other stage of filtering consists of activated carbon. After that, the water is treated with UV light for disinfection. The slurry from the water works is pumped to the sewerage processing works.

The Hanovia UV system was installed by our own personnel and commenced operation in September 1995. It is what is known as the medium pressure type.

A reserve system for chlorination still exists, but has not been used since the UV system was taken into use. No chlorine is stored anymore but instead we have an agreement with the swimming pool to provide sodium hypochlorite if needed.

Tests on the Water Pipe Network

The network consists of 30-40 miles of mains water pipes. Every two months water samples are taken at 20 places in this network. In bacteriological terms, the seven-day and two-day earth bacteria are analyzed as well as the coliform and E-coli bacteria. We have compiled statistics since 1989 which record seven years with chlorine and five years with UV.

Samples are taken at 19 places every second month. Each column shows an average value of two measurements, i.e. 38 values every 4 months. Statistical calculations showed that the content of heterotrophic seven-day bacteria has only been lower during the five years which have passed since we installed the UV illumination than during the seven-year period before that. With 99 percent certainty, the average value in the pipe network was between 300 and 480 seven-day bacteria for every mL during the period before the transition to UV, whereas the average value after the transition was between 27 and 120/mL.
Thus, the content of seven-day bacteria is more than 50% lower than before the transition to UV.

For the two-day bacteria, on the other hand, we have reduced the level of confidence to 70 percent to be able to assert that they too have only fallen in number. With a certainty level of 99 percent, on the other hand, the intervals will overlap each other (1-7/mL before and 0-4/mL after UV).

With regard to coliform bacteria, the intervals overlap entirely: 0.92-1.3/100 mL before and 0.76-1.6/mL after the introduction of UV. That this is the case reflects the very high number of values which are less than 1/100 mL.

For E.coli bacteria we have not produced a diagram or calculations, since pretty well all the results of analysis, both before after the transition to UV, are less than 1/100 mL.

**Variation in the Bacteria Content**

The content of seven-day heterotrophic bacteria has fallen, as we have said. However, a regression analysis shows that the transition to UV only explains about 4 percent of how the content of seven-day heterotrophic bacteria varies throughout the pipe network or 13 percent at a specific place in the pipe network. It is interesting to note that the transition to UV explains 7 percent of the variation in the output from the water network, but also 13 percent at each specific measurement place.

The content of bacteria in the pipe network presumably is to be explained to a significantly higher extent by factors such as hygiene in the tapping points, events in the pipe network (leaks, air/water mixtures, residues from fire hydrants and change of valves), the output content from the water works, temperature and interruption time. During the period, the COD content in the water output from the water works has also fallen a certain amount, which could be a partial explanation of the lower bacteria contents. We are pleased with the performance of the Hanovia Medium Pressure UV System.

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