USA AND EUROPE: Two Different Worlds of UV for Drinking Water Disinfection?

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ABSTRACT

The use of ultraviolet disinfection for drinking water as an alternative or supplement to chlorination is well recognized on both sides of the Atlantic Ocean. However, the backgrounds which led toward this development were different and therefore one can get the impression that there are two different worlds of UV for drinking water disinfection.

KEYWORDS: *Cryptosporidium*, DBPR, DVGW W 294, LTESWTR, Multi Barrier, ÖNorm M 5873, USEPA Guidance Manual

STATUS OF UV FOR DRINKING WATER DISINFECTION

Europe

In the early 1990's German and Austrian research groups completed a study concerning UV disinfection in drinking water. This study was mainly financed by governmental authorities and was supposed to analyze the potential of UV disinfection for surface water treatment plants. Before that time, UV was considered to be an "exotic" option for small ground water supplies only.

After the successful completion of the research project, both countries moved into a standardization approach for the technology. This was headed by the local water supply organizations DVGW (German Association for Gas and Water) (DVGW 1997) and ÖVGW (Austrian Association for Gas and Water) (ÖNorm 2000), which are comparable to the AWWA in the US. In both standards, the core is biodosimetric evaluated systems that require large test facilities, which are located in Siegburg, Germany and in Vienna, Austria. Although the standards were already very similar in the first versions, some small differences were reason enough for not letting the test results of each facility be accepted by the other. Meanwhile both standards have gone through a revision and the latest status is that both organizations accept tests from the other.

Whereas the Austrian ÖNorm (ÖNorm 2000) had a binding character from the beginning, the German standard (DVGW 1997) had more the character of a guideline. However, most water supplies in Germany are following guidelines of their own association. Now, this has changed in Germany as well: UV is listed in the revised drinking water act. As a part of that act, starting from the end of 2005, every UV system has to comply with the German or Austrian Standard. Parts of the ÖNorm are now going to be implemented in a new European wide standard for point of use treatment systems. Today UV disinfection is a well received method for even large surface water supplies. Recently UV is facing competition from Membrane Filters. Other countries in Europe are currently showing increasing interest in the use of UV for drinking water, e.g., France and UK. In Norway, Sweden and Finland, UV technology has also gained market share in recent years, but was already used for drinking water disinfection for decades in small water supplies similar to Germany and Austria.

USA

In contrast to Europe, UV disinfection was well established in waste water, but had more or less no existence in drinking water in the early 1990's. This situation dramatically changed at the end of the decade:

After the *Cryptosporidium* outbreak in Milwaukee, UV disinfection faced a tremendous amount of interest. Furthermore, regulations introduced by EPA on the reduction of disinfection by products caused by chlorination were additional reasons for the fastest growing UV market in the world at present. Coming from almost zero at the beginning of the decade, the amount of UV disinfected drinking water is probably already higher than anywhere else in the world, and large cities, such as New York, are not even in that comparison, although the plans to implement UV there are already a reality. Nevertheless, the percentage of water supplies using alternative methods to chlorination is still low. This is because of the fact that the new regulations are not yet officially in place and that those who switch to alternative disinfection technologies, are somehow under pressure of public or regulative bodies. The standardization of the technology and its application is undergoing a detailed EPA approach (USEPA 1998, 2003a). The UV Disinfection Guidelines (draft version)

has already been published (USEPA 2003b), and the goal is to have the final version available in 2005. Although the guidelines have not even been officially implemented, most of the water supplies already aim to install UV systems fully compliant to this standard.

The execution of the biodosimetric testing process is different from Europe, where the test facilities are linked to the authorities, In the US, the test facilities are an "emerging market" owned predominantly by water industry consultant firms, which are also responsible to manage and conduct the tests according to the EPA guidelines.

DIFFERENCES

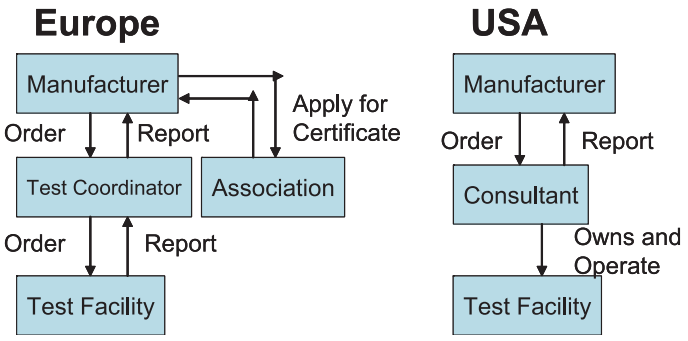
Concept

There are some conceptual differences between the European standards and the EPA guidelines: The European standards specify some technical features, e.g., the ultraviolet measurement system (sensor) to a highly detailed extent. In contrast, the US guidelines are more focussed on the functional specification rather than the technical solution. The European standards also specify one UV dose, whereas the US guideline uses a UV dose table. In the US standard, depending on the treatment situation at a certain location, UV dose requirements can be very different from case to case. Substantially different are the approaches of bias and safety factors, which shall not be explained in detail here. However interesting enough is, although the concepts are quite different about that point, the resulting required UV doses are similar in the end, which makes the required sizes for UV systems comparable.

Also worth mentioning is the fact that the US guidelines have incorporated parts of the European standards, which would make it possible to have the European standard accepted under the EPA validation rules but not vice versa.

Execution

Because of the major differences, the ways in which the standards are executed are should be explained in detail. The following process maps are illustrating the different approaches:



In Europe[1] - as can be seen on the left view – it is more complex to go through the process:

- The manufacturer has to contract the agency with which the water association is related (DVGW or ÖVGW).
- This "test coordinator" contracts a test facility, which is in Germany and Austria there is just one each.
- The test facility writes a report to the coordinator after the tests have been conducted.
- Afterwards the coordinator sends a report to the manufacturer, who sends this to the association and applies for a certificate. This is what he needs for his customer to operate a UV system.
- The certificate then has to be sent to the local health authorities by a water supply utility.

In the US, the process is much less complex:

- The manufacturer contracts a consultant to validate a system according to the EPA protocol.
- The consultant company runs a test facility or runs the test at a certain water supply individually (on site).
- After test completion, the consultant sends a report back, which the manufacturer transfers to his client.
- There is no official approval involved (although something similar to Europe exists for some states, e.g. California).

BACKGROUND FOR DIFFERENCES

In order to understand the differences, one has to consider the circumstances under which the standards were established: Europe in the early 1990's was not under pressure. *Cryptosporidium* was not an issue and any alternative to chlorine would not be "warmly welcomed". Despite some public concerns on chlorine in general, pressure from this side was also comparably weak at that time.

It seems to be clear, that under those circumstances, a technology like UV would have to face enormous obstacles and would have to undergo detailed evaluation and standardization before one would use it. The central question was: Why should anybody use UV? Or in other words: Why should anyone risk the safe disinfection he has for something new? If so, it must be more than safe, it must be "certified" (something which nobody would ask for a chlorine disinfection, which is supposed to be safe).

What a difference in the US: After the worldwide most serious outbreak of Cryptosporidiosis, the water supply and health authorities were under tremendous pressure to

[1]Actually, at present only Germany and Austria have defined regulations; however, other countries in Europe will probably follow the lead of Germany and Austria.

find alternatives to classic disinfection and treatment options. Several research groups and universities were looking for different options, while regulators are trying to manifest substantial changes in water treatment. With this background, it is understandable that the specification for alternative disinfection technologies would allow a maximum amount of flexibility in order not to delay or even stop any potential candidate on the way to solve the water treatment problem.

Maybe this aspect is not the only one to explain the major differences of the approach to standardize UV disinfection for drinking water. There were for sure some political and cultural differences as well. But different backgrounds like this have different consequences for handling the same issue: standardization of UV technology for drinking water disinfection.

Some other examples may support this thesis: The UK and France did not consider UV at the same time like Austria and Germany. Therefore they got aware about UV when the results about *Cryptosporidium* were published. Both countries had already some regulation in place for managing the *Cryptosporidium* problem, but UV seems to be an attractive option now. Under those circumstances, in both countries there is now some discussion about the standardization of UV disinfection. It seems that these efforts are also focussed on a maximum of flexibility and therefore they follow more the US approach.

It seems that there is a pre- and post *Cryptosporidium* time for UV disinfection, and that determines how regulators defined UV technology for drinking water disinfection.

THE MULTI BARRIER APPROACH

One major aspect to look at the standards is the perspective of a multi barrier approach, which is widely discussed in today's "water treatment world".

Surprisingly there seems to be a paradox: The US standard provides flexibility to a huge degree and therefore provides options to see a UV system in concert with others in a treatment train. Under US practical conditions in most of the cases UV would be a stand alone solution. It has to be combined with chlorination, but arguably this is not a "multi barrier treatment" in the sense of original meaning of the word. In contrast, the Austrian and German standards provide no flexibility, although in most of the cases the disinfection comes together with other treatment steps, which would allow and count for different options to use the UV disinfection system in terms of UV dose, log credits for various microorganisms, and other related issues. With that perspective, the existing German standard would be somehow probably be better applied in the US, whereas the US standard would be a wonderful fit into the German "water world".

MERGING THE UV WORLDS

The probability of finding a leverage to merge the different standards is high from the technical point of view. Starting with the point of view that the US guideline is already open to accept the German and Austrian validation results, it can be strongly recommended to find ways as to how this could be turned in the other direction. As a first step, it would be helpful if the DVGW and ÖVGW officials would accept the test facilities in the US. This would open the possibility to validate systems according to DVGW and ÖNorm standard at US locations. The second step would be to take results from different test locations and compare them. It makes no sense that different locations would come to different results based on the same biodosimetric validation approach. This would be a wrong way of creating competition between the test locations.

In a third step, and if all test locations are delivering the same results, there is no more reason to be reluctant to accept the standards and test locations of others. In this case, a UV manufacturer could go with any system to the US and get a German DVGW certificate or vice versa, whichever is easier.

Whether or not this scenario would be realistic cannot be answered, but for sure it would be a benefit to all stakeholders of the "UV world": regulators, operators, consultants and manufacturers. Consulting companies and manufacturers work on a global scale these days, and it would be much faster and more cost efficient to have countries accepting each others' standards. For regulators and operators there is also a safety issue: they can compare results and systems on a global scale and can share this information. In some countries, this is almost a reality: In Scandinavia, the health authorities accept US and European test reports, while not having their own national test facility. This shows that the above created "vision" is by no means completely unrealistic.

SUMMARY

Due to different "historical" backgrounds, different worlds of UV in Europe and the US exist to a certain extent. However, it might be worth to invest some effort on harmonization of the differences, which would be beneficial to all

stakeholders in the process. The harmonization would include acceptance of the standards in each of the countries, but could also be widened to some of the details in the standards, e.g. a common UV sensor approach (use DVGW) or more flexible UV dose requirements (use EPA guideline).

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