2.1 Drinking Water Production: Processes and Emerging Technologies

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Abstract

In the field of drinking water production it is necessary to establish new regulations and guidelines, due to the decrease of the resource water quality. The paper presents the regulations in Europe and in the US, and the consequences on the evolution of the water treatment plants, depending on the water quality objectives and the quest for quality. Then two new technologies are proposed, concerning the using of membranes and ozone. The membrane processes are described and their application at some full scale plants are presented. The using of ozone as oxidation and disinfection agent is presented with the effect of the hydraulics on the quality of the water. The advantages of these two technologies are also described.

2.1.1 The Regulations

In the field of drinking water production, the development of even more specific and efficient analytical methods and apparatus, the increasing quest for quality, and the decrease in adequate resource water have pushed towards the establishment of new regulations and guidelines in Europe and in the US.

European Regulation

To characterize the required quality for a drinking water 62 parameters have been identified, which can be classified as organoleptic, physico-chemical, toxic and microbiological parameters and pesticides.

For each of these 62 parameters the European regulation sets the maximum level and defines the analytical method and sampling frequency that must be used.

• The turbidity guide line is 2 NTU.
• The maximum content of total pesticides is fixed to 0.5 µg/l, with a maximum of 0.1 µg/l per pesticide. More stringent values concern some specific pesticides like aldrine, dieldrine and hexachlorobenzene (respectively 0.03, 0.03 and 0.01 µg/l).

Concerning the microbiological parameters, sampling volumes are regulated (Table 1) and European regulation does not consider, at this time, contaminants like Giardia Cysts.
Table 1. European Regulations on microorganisms in drinking water

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Unit</th>
<th>Regulation level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total coliforms</td>
<td>N/100 ml</td>
<td>0 for 95% of the measurements</td>
</tr>
<tr>
<td>Thermotolerant coliforms</td>
<td>N/100 ml</td>
<td>0</td>
</tr>
<tr>
<td>Fecal Streptococcus</td>
<td>N/100 ml</td>
<td>0</td>
</tr>
<tr>
<td>Clostridium</td>
<td>N/100 ml</td>
<td>5</td>
</tr>
<tr>
<td>Pathogenic Staphylococcus</td>
<td>N/100 ml</td>
<td>0</td>
</tr>
<tr>
<td>Salmonella</td>
<td>N/5 l</td>
<td>0</td>
</tr>
<tr>
<td>Entero Viruses</td>
<td>N/10 l</td>
<td>0</td>
</tr>
</tbody>
</table>

**US Regulation**

The US Environmental Protection Agency (USEPA) is currently developing regulations, including enforceable maximum contaminant levels (MCLs), for numerous drinking water contaminants. Certain waterborne contaminants in drinking water may be limited by a maximum contaminant level (MCL) or by a treatment technique set by USEPA. For each MCL promulgated, USEPA must specify best available technologies (BATs) which are feasible and effective for removal of the contaminant.

The Surface Water Treatment Rule (SWTR) requires all systems using surface water sources or underground waters under the influence of surface waters, to disinfect providing a multi-barrier treatment including both filtration and disinfection. The aim is to achieve a minimum reduction of 99.9 percent (3 logs) in Giardia Cysts and 99.99 percent (4 logs) in viruses. Regardless of the technology employed, the treatment must meet turbidity performance criteria. The filtered water turbidity must be <0.5 NTU in 95 percent of the measurements collected each month with no sample having a turbidity > 5 NTU.

The USEPA is developing a regulation for disinfectants and their by-products. The final rule is expected by June 1995. Presently, the only disinfection by-products regulated are the trihalomethanes (THM). The current THM regulation is 100 μ/l, as the sum of all THM species present.

The California SWTR has listed technologies approved to treat surface water. For example, four filtration processes are enabled: conventional filtration, direct filtration, diatomaceous earth filtration and sand filtration.

Other or new technologies can only be used if they have been specified BAT by USEPA; that means they must meet the following stringent criteria:

- have the removal efficiencies required
- be demonstrated at field scale
- be compatible with other treatment technologies
- have a reasonable lifetime
- be commercially available
- be affordable to large utilities

Concerning the underground waters, USEPA is developing a Ground-Water Treatment Rule (GWTR) that will be promulgated in June 1995. Some ground-water treatment plants will be required to install disinfection and a 4 logs removal or inactivation of viruses may be used as a criterion, as for the surface-waters.