WATER TREATMENT BY ENHANCED COAGULATION
Operational status and optimization issues

Introduction

The application of nanofiltration (NF) in drinking water treatment for various types of source water, such as soft and hard surface waters and ground water, have many common features. All natural water sources contain some NOM and it is usually desired to reduce the concentration of this component. Additionally, especially in polishing, other organic components are targeted for removal too, for instance micro-pollutants. In softening (ground water) application, hardness removal is a primary treatment target. In all these NF applications NOM is a potential fouling agent for the membranes and the major efforts to secure good practice in the plants concerns this and other types of fouling, like silt and calcium scaling, and how to facilitate steady operation and good product water quality.

Importance

Membrane filtration, of which NF is a major variant, is one of the few treatment methods that can facilitate steady treatment efficiency without the use of chemicals in the process and with low sensitivity of the efficiency to the feed water quality. With time local source water often gets scarcer and quality declines due to society development and increased pressure on available sources. In this situation NF, together with RO for desalination of seawater, is the most general method for providing good and secure drinking water in the future.

Approach

This study takes advantage of the experiences from 25 years of development of the method for the treatment of surface water in Norway. The experiences are achieved through pilot studies and close observation of the operation of plant in full scale since 1989. Further, a theoretical study on the mechanisms for fouling and filtration was performed in the period 1996 – 1999, which was followed by pilot studies in 2000 – 2003 to verify important results from the study. The part on groundwater and softening is mainly based on a review of the comprehensive literature that exists on this subject.

Results

It was shown that nanofiltration can be used for the removal of a wide range of pollutants from groundwater and surface water in drinking water production. Softening and NOM-removal are major applications, but NF is frequently applied for the combined removal of NOM, micro-pollutants, pesticides, arsenic, iron, heavy metals, sulphate, nitrate and bacteria and viruses. Reduced THM-formation potential can also be achieved. Full-scale installations have proven the reliability of NF in these areas.

The main challenge in NF for water treatment is to control fouling of the membrane by NOM, silt, scaling etc. The fouling rate increases significantly with the flux and there will always be a maximum flux that can be applied in long term stable operation and therefore the flux should not exceed this value. This critical flux is usually lower than the maximum flux capacity of the membrane and therefore there

is a significant potential reduction in treatment costs to gain from better fouling control.
There is a need for better understanding of the connection between source water characterisation and proper plant design and operation, in particular the value of the critical flux. Fouling is primarily caused by particles that are 0.1 to 3 µm in size and better prefilters for this range are needed.

More knowledge of the rejection of typical and specific and important water pollutants and groups of pollutants for various types of membrane material would be useful. For softening and groundwater applications criteria for anti-scalant or acid dosing should be developed. There is a need for evaluation of waste disposal options and to assess the environmental impact of discharge.

More information

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