POST-TREATMENT OF DISTILLATE AND PERMEATE: INTRODUCTION AND OVERVIEW

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Contents

1. Purpose of Post-treatment
2. Composition of Desalinated Water
3. Standards and Guidelines for Composition of Potable Water
4. Processes for Potabilization of Distillate and Permeate
Glossary
Bibliography and Suggestions for further study

1. Purpose of Post-treatment

In order to obtain drinking water quality from the low-salt product water generated by desalination of seawater and brackish water by thermal or membrane processes, post-treatment is necessary.

This post-treatment covers not only adjustment of ion contents and proportions, as set out in drinking water regulations and standards, but additionally the generated drinking water must in its composition exhibit the least possible corrosive influence on the materials of distribution networks and domestic installations.

As a consequence of its low total salt content and low concentration of calcium and bicarbonate ions, in the presence of even very small amounts of carbon dioxide water of this kind is corrosive. In addition, in view of the unbalanced ratio of monovalent to bivalent ions, this water must be potabilized or remineralized to be suitable as drinking water. This is also necessary under the health aspect.

Post-treatment therefore has the following aims:

- To establish a salt content and a ratio of monovalent to bivalent ions as necessary from both taste and health aspects;
- To raise the calcium and bicarbonate contents and adjust the ph to a value where calcium bicarbonate/co_2 equilibrium conditions are obtained, with the objective of rendering the water unaggressive and to impart rust protection properties;
- To guarantee the quality of the product water from the hygiene aspect.

As against conventional post-treatment to obtain drinking water as applied for natural well water and surface water, and for which comprehensive standards, codes and

regulations are available for plant design and for operating conditions, for the post-treatment of product waters from desalination plants particular conditions have to be taken into consideration, these being:

- The much lower salt content in comparison to natural waters;
- The higher temperature of distillates from thermal desalination processes or when surface waters from arid and tropical regions with high temperatures are treated by membrane technologies;
- The particular circumstances for establishing a low corrosiveness of the product water, which in some cases leads to product water ph values of over 8.5 or 9.5, which then impacts the effectiveness of disinfection to produce the hygienic quality of the water needed both for storage and for distribution.

2. Composition of Desalinated Water

Determining factors for the composition of the drinking water produced in a seawater desalination plant are not only the nature and extent of the measures for post-treatment, but also the type of seawater desalination process employed. When considering the product quality of the seawater desalination process itself, a basic distinction has to be made between:

- The composition of the permeate or dialysate from reverse osmosis or electrodialysis plants;
- The distillate composition from thermal seawater desalination processes (msf and med).

In the case of the two thermal processes, the product quality is virtually identical.

The total dissolved solids (TDS) content in the distillate mixture from all the stages of a thermal desalination plant lies normally in a range of 20 ppm, but this can increase due to leaks as the plant ages up to 50 ppm, and even above. The ionogenic composition of the distillate corresponds approximately to the distribution of ions in the seawater. For practical purposes, the contents of alkalinity and carbon dioxide in the distillate are negligible.

The product quality from the membrane processes reverse osmosis and electrodialysis is determined, for a given raw water composition and salt retention of the membranes used, by the permeate or dialysate yield and the inflow temperature to the plant. For treatment of fresh and brackish water, membranes allowing 2-5 per cent of salts to pass through, and for seawater desalination a corresponding value of 1 per cent and below find application. If an even lower product salt content is required, this can be attained by complete or partial secondary desalination of the product from the first stage by means of a second membrane stage. Product waters from membrane plants normally contain residual contents of CO_2 and alkalinity, which exceed the concentrations of these substances in the distillate from evaporation plants. Depending on the pH of the feed, that is the extent of acid dosing, alkalinity (bicarbonate) and liberated CO_2 passes

through the membranes. Carbon dioxide diffuses completely through the membranes. Consequently, product from membrane processes still contains certain amounts of alkalinity and carbon dioxide, which thus need not be augmented in the post-treatment process.

3. Standards and Guidelines for Composition of Potable Water

The post-treatment targets regarding the hygienic and organoleptic quality of the product are stipulated by national and international drinking water guidelines. Foremost among these are:

- WHO, International Standards for Drinking Water (1984).
- EC guideline for the quality of water for human use (1980).

Supplementary to these are national drinking water standards which have to be observed depending on the location of the desalination plants.

To provide guidelines for reducing or preventing corrosion and depending on the materials used for storage facilities and drinking water distribution networks, values for the following are proposed:

- Adjustment of the carbonate CO_2 equilibrium, that is the associated equilibrium ph;
- Specific values for alkalinity, calcium content, oxygen concentration and ph;
- Maintenance of a specified mol ratio between neutral salt concentration and alkalinity.

Also application of the Ryznar Index is common practice in water chemistry. However, its applicability to product waters from desalination plants with low salt contents is a matter of controversy.

The aim of post-treatment is to generate drinking water in compliance with both national and international drinking water standards, but which also exhibits low corrosiveness in drinking water distribution and consumption networks. It is this, which determines the selection of post-treatment processes.

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