Chapter 15
Reverse Osmosis Membrane Desalination Technology and Process:
Case Study on Small-Scale Brackish City Polluted Water Treatment

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ABSTRACT

This chapter gives an overview about reverse osmosis membrane desalination technology and process. Desalination process can be considered as one of the crucial processes in obtaining fresh water to meet the increasing fresh water demand throughout the world. Desalination process begins with the intake of seawater or brackish water. The intake system usually comprises a pump and piping system. Then, the seawater goes through pre-treatment process. From there, the treated seawater will go through desalination process. The most widely used desalination is membrane desalination utilizing reverse osmosis membrane. After desalination process, the fresh water will go through more filtration and a series of post-treatment. Post-treatment consists of conditioning and stabilizing the water for distribution. This chapter concludes with a case study to illustrate the operation and sustainability of a small-scale desalination plant that utilizes brackish city polluted water as source.

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INTRODUCTION

This chapter gives an overview about reverse osmosis membrane desalination technology and process. Water is one of the important necessities for living organisms on this planet Earth. The whole population on Earth keep increasing from time to time. As a result, the demand for freshwater supply will increase and the current freshwater resources and reservoirs will not be able to keep up with the high demand soon. Alternatively, seawater can be used as new water supply. However, seawater consists of high content of salts and other impurities. To overcome this, desalination technology has been developed to separate the pure, fresh water from the high content of salts and impurities. Desalination refers to the removal process of salt and other minerals from the seawater to produce freshwater supply for human consumptions and industrial use. Many countries are now considering desalination as an important source of water supply as desalination process able to produce large quantities of water in excellent quality. To meet the demands for freshwater, worldwide capacity in desalination has increased significantly overtime. In 2000, the capacity has rose up to 130 million cubic meters per day. Desalination process can be considered as one of the crucial processes in obtaining fresh water to meet the increasing fresh water demand throughout the world. Without it, areas with fresh water scarcity will have to transport water from other places or find new freshwater alternatives. Desalination process begins with the intake of seawater or brackish water. The intake system is usually comprised of pump and piping system. This intake is crucial in water desalination plant whereby it can be a method of controlling the quality of the seawater that actually goes into the plant itself. This can be as the first step of pre-treatment which is known as filtering or screening. The seawater will go through pre-treatment process. In pre-treatment processes, the seawater is then again treated and filtered to remove any debris, sedimentations and microscopic organisms. From there, the treated seawater will go through desalination process. Common types of desalination processes are distillation (thermal-based) or membranes desalination process. The most widely used desalination is membrane desalination utilizing reverse osmosis membrane. Membrane desalination is popular due to many reasons, the main one is being more energy efficient than thermal desalination which utilize fossil fuel as energy source. Membrane desalination can be paired with renewable energy source such as solar, wind or wave energy for more environmentally sustainable. After desalination process, the freshwater will go through more filtration and a series of post-treatment. Post-treatment consists of conditioning and stabilizing the water for distribution. The post-treatment processes may contain of pH adjustment and disinfection of product water. If the product water is blending with other sources, it is essential to ensure similar water quality in both water sources. This is to ensure that the blended water meets health, aesthetic and anti-corrosion standards. This chapter concludes with a case study to illustrate the operation and sustainability of a small-scale desalination plant that utilizes brackish city polluted water as source.

CURRENT AND FUTURE OF WATER AVAILABILITY

Global warming is a global issue and may be humanity's greatest challenge (Karl & Trenberth, 2003). Indeed, global warming has already negatively impacted the environment, economy, and human health (Bosello et al., 2006; Luber & Prudent, 2009; O'Brien & Leichenko, 2000; Reuveny, 2007), and particularly on fresh water availability (Arnell, 1999; Intergovernmental Panel on Climate Change, 2008; Martínez-Alvarez et al., 2016; Payne et al., 2004). The mechanics of global warming and climate changes is well-defined in relevant published journals and shown in Figure 1.1. Global warming leads to an in-