

ABSTRAK

Ketersediaan air bersih merupakan faktor penting dalam operasional industri pangan. PT XYZ yang berlokasi di wilayah pesisir memanfaatkan teknologi *Seawater Reverse Osmosis* (SWRO) sebagai alternatif penyediaan air. Penggunaan teknologi SWRO relatif efisien dibandingkan metode desalinasi lainnya, namun sistem ini tetap memerlukan konsumsi energi yang tinggi dan berpotensi menghasilkan emisi gas rumah kaca yang signifikan. Penelitian ini bertujuan untuk menganalisis dampak lingkungan sistem SWRO di PT XYZ menggunakan pendekatan *Life Cycle Assessment* (LCA), mengidentifikasi tahapan proses yang menjadi *hotspot* dampak, merumuskan alternatif perbaikan melalui metode Diagram FAST, serta menentukan alternatif terbaik menggunakan metode *Analytical Hierarchy Process* (AHP). Penelitian ini turut mendukung pencapaian *Sustainable Development Goals* (SDGs), khususnya target SDG 6.5 mengenai pengelolaan sumber daya air yang berkelanjutan melalui optimalisasi kinerja lingkungan sistem *Seawater Reverse Osmosis* (SWRO) sebagai teknologi penyediaan air bersih di sektor industri. Hasil yang diharapkan dari penelitian ini adalah penurunan konsumsi energi dan nilai GWP ($\text{kg CO}_2\text{-eq/m}^3$) pada sistem SWRO dibandingkan kondisi eksisting. Penelitian ini diharapkan dapat memberikan kontribusi teoritis dalam pengembangan integrasi LCA-FAST-AHP pada sistem desalinasi industri pangan, serta memberikan rekomendasi praktis bagi perusahaan dalam meningkatkan efisiensi energi dan keberlanjutan operasional.

Kata kunci : *Seawater Reverse Osmosis* (SWRO), *Life Cycle Assessment* (LCA), Diagram FAST, *Analytical Hierarchy Process* (AHP), SDG 6.5, *Global Warming Potential* (GWP).

ABSTRACT

The availability of clean water is a crucial factor in the operation of the food industry. PT XYZ, located in a coastal area, utilizes Seawater Reverse Osmosis (SWRO) technology as an alternative source of water supply. Compared to other desalination methods, SWRO technology is relatively efficient; however, it still requires substantial energy consumption and may generate significant greenhouse gas emissions. This study aims to analyze the environmental impacts of the SWRO system at PT XYZ using the Life Cycle Assessment (LCA) approach, identify process stages that contribute the greatest environmental impacts (hotspots), formulate improvement alternatives through the Function Analysis System Technique (FAST) Diagram, and determine the most suitable alternative using the Analytical Hierarchy Process (AHP) method. This research also supports the achievement of the Sustainable Development Goals (SDGs), particularly SDG Target 6.5 concerning sustainable water resource management, through the optimization of the environmental performance of the Seawater Reverse Osmosis (SWRO) system as a clean water supply technology in the industrial sector. The expected outcomes of this study include a reduction in energy consumption and Global Warming Potential (GWP) values ($\text{kg CO}_2\text{-eq/m}^3$) compared to the existing SWRO operating conditions. Furthermore, this study is expected to provide a theoretical contribution to the development of an integrated LCA–FAST–AHP framework for desalination systems in the food industry, as well as practical recommendations for companies seeking to improve energy efficiency and operational sustainability.

Keywords: Seawater Reverse Osmosis (SWRO), Life Cycle Assessment (LCA), Function Analysis System Technique (FAST) Diagram, Analytical Hierarchy Process (AHP), SDG 6.5, Global Warming Potential (GWP).