

## ABSTRAK

Gading Faraz Syahputri. 2025. *Analisis Teknis dan Ekonomis Perbandingan Ballast Water Treatment System Antara Metode Elektrolisis, Ultraviolet, dan Disinfektan Kimia Pada Jenis Kapal Bulk Carrier*, Skripsi. Tanjungpinang: Jurusan Teknik Industri dan Maritim, Fakultas Teknik dan Teknologi Kemaritiman, Universitas Maritim Raja Ali Haji. Pembimbing I: Muhd. Ridho Baihaque, S.T., M.Sc. Pembimbing II: Ir. Eko Prayetno, S.T., M.Eng.

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Penelitian ini dilakukan untuk mengevaluasi dan membandingkan jenis *Ballast Water Treatment System* (BWTS) yaitu, metode elektrolisis, ultraviolet, dan disinfektan kimia yang akan diterapkan pada kapal jenis *bulk carrier*. Analisis dilakukan dengan membandingkan aspek teknis dan aspek ekonomis. Dari sisi teknis, dilakukan peletakkan dan konfigurasi komponen utama masing-masing sistem BWTS menggunakan *Piping and Instrumentation Diagram* (P&ID) serta tata letak komponen pada ruang mesin (*engine room layout*). Pemodelan ini bertujuan untuk menilai kesesuaian sistem terhadap ruang mesin yang tersedia, dan kebutuhan modifikasi yang mungkin timbul selama proses retrofit. Pada aspek ekonomis, analisis dilakukan dengan menghitung dan membandingkan biaya instalasi awal, biaya operasional, dan nilai masa depan. Selain itu, dilakukan analisis pembobotan terhadap lima kriteria utama: kinerja sistem, kemudahan instalasi, operasional, reputasi vendor, dan biaya. Hasil perhitungan menunjukkan bahwa sistem elektrolisis memperoleh skor tertinggi sebesar 97,16% diikuti oleh sistem disinfektan kimia sebesar 91,50% dan ultraviolet 72,83%. Skor ini menunjukkan bahwa sistem elektrolisis memiliki kinerja paling optimal berdasarkan seluruh parameter teknis dan biaya.

**Kata kunci:** *Ballast Water Treatment System*, BWTS, elektrolisis, ultraviolet, disinfektan kimia, *bulk carrier*, analisis teknis, analisis ekonomis, pembobotan kriteria.

## ABSTRACT

Gading Faraz Syahputri. 2025. *Technical and Economic Analysis of Ballast Water Treatment System Comparison Between Electrolysis, Ultraviolet, and Chemical Disinfection Methods on Bulk Carrier Vessel Type*, Undergraduate Thesis. Tanjungpinang: Department of Industrial and Maritime Engineering, Faculty of Engineering and Maritime Technology, Maritim Raja Ali Haji University. Supervisor: Muhd. Ridho Baihaque, S.T., M.Sc. Co-supervisor: Ir. Eko Prayetno, S.T., M.Eng.

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This research was conducted to evaluate and compare types of Ballast Water Treatment System (BWTS) namely the electrolysis, ultraviolet, and chemical disinfection method, which are to be implemented on a bulk carrier vessel. The analysis was carried out by comparing technical and economic aspects. From the technical aspect, the placement, and configuration of the main components of each BWTS system were carried out using Piping and Instrumentation Diagram (P&ID) and component layout in the engine room space and any modification needs that may arise during the retrofit process. In the economic aspect, the analysis was performed by calculating and comparing initial installation cost, operational costs, and future value. In addition, a weighting analysis was conducted on five main criteria: system performance, ease of installation, operation, vendor reputation, and cost. The results showed that the electrolysis system obtained the highest score of 97,16%, followed by the chemical disinfection system with 91,50% and ultraviolet with 72,83%. These scores indicate that the electrolysis system has the most optimal performance based on all technical and cost parameters.

**Keyword:** Ballast Water Treatment System, BWTS, electrolysis, ultraviolet, chemical injecton, bulk carrier, technical analysis, economic analysis, criteria weighting.