

博士学位論文内容要旨  
Abstract of Dissertation

専攻 Major	応用環境システム学	氏名 Name	サングット <sup>△</sup> イェニ ウィグ <sup>△</sup> エ
論文題目 Title	Study of ballast water management in Nigeria challenges and recommendation		

The discharge of untreated ballast water into the marine coastal waters results to major environmental risks, as invasive species, sediments, and contaminant discharged from ballast waters causes devastating effect on human health, the maritime ecosystem and economy of coastal states. This problem has attracted the attention of both the industry and national authorities and in responses, the international maritime organization (IMO) has created the D2 ballast water performance standard, which will come into effect in September 2024 and ships are mandated to manage their ballast water by install ballast water treatment system. Furthermore, Nigeria had ratified the Ballast water management convention (BWM) on October 22, 2005, but several challenges are still facing the maritime industry in the implementation and compliance of the convention.

Thus, this study examines the challenges of ballast water in Nigeria, with the objective of assessing the compliance status of shipping operators and the risks posed to the maritime environment in the region. An essential part of the research methodology employed during this study is the analytic hierarchy process (AHP) for evaluating and ranking the various challenges and the field sampling samples and analysis of ballast water from four different ships for the investigation of physiochemical characteristics.

Chapter1 gives a brief background of the study and introduce ballast water management system and risks implication of invasive species spread and sediments transfer through ballast water. The study objectives, methodology to be followed in achieving it are also discussed. Also, the thesis structure and all terms and definitions stated in the study are explained in this session. Finally, the problem statement, study motivation, as well as research aims, and objectives are also discussed in this chapter. Nigeria is a developing country, located in a strategic geographical position, where oil exploration and rapid trade relationship with other countries, have helped witness a faster maritime growth, with the influx of various kinds of ships, accompanying with their ballast water exchanging operation into its maritime space. The issues of ballast waters transfer, and the impacts associated with the invasive species and heavy metals sediments concentration contained in the ballast tanks of ships, has become a major global concern and is currently a major issue facing the coastal waters regions in Nigeria; hence, this study has become necessary and important to understand the current problem in the study region. The major motivation behind this study assumes that, the coastal waters in the Nigeria are most like at greater risks and vulnerable to the problems associated with the ballast water transfer operations, due to the high shipping traffic, poor regulatory standard, lack of enforced IMO regulation, as well as the lack of financial and technical resource witness among local shipping companies in the region. Furthermore, as the Nigeria government have recently proposed the concept of ports with acceptable risks, at the MEPC 74 session, aimed at larger tankers calling at Nigerian ports to load crude oil, takes by taking advantage of the exemptions in BWM Convention regulation B-3. To the best of my knowledge, I strongly believe that this steps and proposition already taken, indicates a positive effort in the right direction which is aimed towards managing the problems posed by the ballast water operation and achieving the compliance of the ballast water management convention in the region. Hence, there is a greater need for more studies and research to be focus on the areas of ballast water, especially as we are fast approaching the IMO schedule deadline of September 2024, for all ships to meet up with the D2 ballast water performance standard.

Chapter2 describes the international convention for the control and management of ship's ballast water and sediments, its generalities, and key drivers. Also, the review study of the various ballast water treatment technologies is presented in this chapter to assess their efficiency and possible limitations.

Chapter3 discussed that ballast water compliance in Nigeria is studied to identifies the various challenges hindering the ship operators in the region from complying with the ballast water management. The qualitative method is employed using semi-structured interview and survey study using questionnaire were distributed among selected maritime experts and shipping operators to identify the various challenges and facilitate pairwise comparisons with respect to the different challenges with regards to each evaluation criterion. The AHP multicriterial analysis method is employed to prioritize the barriers to assist policy makers in understanding areas for consideration in decision making process. Three-stage approach was applied in the collection of information, assessment, and analysis to enable us to understand the problem and obtain our study objective. To evaluate the implementation BWTS in Nigeria in terms of the key barriers influencing the compliance of ballast water in Nigeria, a stratified survey study among ship operators in the region was conducted. We developed and sampled electronical questionnaire to selected ship operators to assess their ballast water management compliance profile and challenges faced in their implementation. The information collected include ship type, BWTS type, place of installation of BWTS and BWTS issues and the challenges faced to obtain compliance. A total of 350 respondents from the registered ship owners operating in Nigeria were contacted from (December 2021-January 2022) and a total of 160 responded to our questions through email address, showing that the response rate is approximately more than 60%, which represents a highly successful outcome for our assessment. All the data obtained were explored to provide a statistical view of the status of the problem.

Chapter4 is based on the results of the previous studies, to further check the compliance of the BWMS, in terms of risks of physiochemical parameters discharged in the region. The sampling method is employed to analysis the ballast waters introduced in the port to further assess their compliance status and risks posed to the coastal maritime ecosystem in the study region. Chapter5 is conclusion of this theses with recommendation included future work in this study.

The result of the survey study reviews that, both technical challenges (TS's), environmental challenges (ENC's), economic challenges (ECC's), and other challenges (OC's) contributes towards the noncompliance among the selected shipping operators. The OC's, which includes both external and internal influences on ship operators, ship type, age, and trading route, obtained the highest rank (0.3666), followed by ECC's (0.3648) and TC's obtaining the third rank (0.1456). Also, ENC's were regarded as the least concern (0.1223) for shipping operators' decision towards achieving compliance with the Ballast water management convention. In terms of assessing the risks of heavy metals composition and establishing the pollution status caused by the discharge of ballast water, the result of the investigated parameters shows that includes water temperature, salinity, total suspended solids, concentration of hydrogen ions, dissolved oxygen, and heavy metals.

The result shows complex correlation among the parameters and confirms the presence of heavy metals among samples at different concentration levels in increasing order from ship 4 > ship 3 > ship 2 > ship 1 ( 27.897 > 20.941 > 16.636 > 16.586) based on their distance from the loading ports to ships destination port. This study will be useful for policy makers and maritime regulators, towards prioritizing management measure, as well as the needs in monitoring the qualities of discharged ballast waters and taking decision to promote compliance and achieving a sustainable maritime environment.