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Research Paper

Ensuring Safety and Compliance: Material Safety Data Sheet (MSDS) Implementation in On-Board Blending of Pertalite (RON90)

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Abstract

The high public demand for Pertalite (RON90) has significantly increased, causing Indonesia should choose to import, one from Jamnagar Sikka Marine Terminal, India. In application, the loading port uses the onboard blending technique of mixing cargo with additives to achieve the desired octane number. According to the International Safety Guides for Oil Tankers and Terminals (ISGOTT) 6th edition chapter 12.1.6.15, the ship is not designed as a blending instrument, which in its operation experiences several incompatibilities that pose a risk of danger. As mitigation, cargo manufacturers include Material Safety Data Sheet (MSDS) or work safety guidelines before operations begin to be understood and realized by all parties involved. The research method used in this research is a qualitative method with an explanative pattern. The unavailability of personal protective equipment (PPE) by the MSDS, the lack of blending facilities from the terminal and skilled personnel, lack of awareness and familiarization with the MSDS itself cause several impacts during its operation, including health threats, environmental stability, and even material losses that will be obtained by the company. So it is necessary to apply and actualize the implementation of MSDS on board, as well as create good harmonization between the company and the terminal so that this blending procedure can run optimally and produce fuel products that are by specifications.

Keywords *blending, risk, material safety data sheet*

INTRODUCTION

Pertalite is the latest fuel innovation officially launched on April 22, 2015, equipped with the latest technology, namely Electronic Fuel Injection (EFI) and EcoSave. Based on data from the BPH Migas (2022), the use of Pertalite has reached 21.97 million KL (kiloliters) until September 2022, with a maximum capacity for 2022 of around 23.05 million KL which almost reaches the maximum threshold at 95.32%. This high demand is not proportional to the availability of Pertalite in Indonesia because creating Pertalite itself still uses a manual procedure by mixing two finished raw materials between Naphthalene with HOMC (High Octane Mogas Component) which has Octane 92 (Soetjipto, 2015). Currently, there is only Pertamina RU-IV, which can produce Pertalite independently, which then causes Indonesia to choose alternative imports from several oil terminals abroad such as from Jamnagar Sikka Marine Terminal, India by MT. Gamalama can carry ±700,000 barrels or the equivalent of 111,291,110 liters.

In the application of creating fuels with new specifications, petroleum companies use the technique of blending to achieve a certain octane in Pertalite (RON 90) efficiently which is regulated in ISGOTT

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6th edition chapter 12.1.6.16. However, there are many obstacles such as the lack of trained personnel, standardized personal protective equipment, and proportionality of the tools used in the blending procedure. There is also a lack of basic knowledge about accident prevention and occupational safety. The high loading rate of the terminal (4500 KL/H) and the closed system tanker caused circulation problems and high-pressure fluctuations. Therefore, manufacturers provide Material Safety Data Sheet (MSDS) containing important information about chemicals, including material identification, physical and chemical hazards, preventive measures, first aid measures, handling, storage, and disposal information to minimize the risk during the blending process.

This research has main objectives such as analyzing the suitability of applying additive mixing procedures and dopping color dye about safety and prevention of hazard risks and analyzing the positive and negative impacts of the blending procedure on all aspects involved. The benefits of this research are expected to be a source of reference for educational institutions in improving the knowledge and new insight for the readers. In addition, this research also provides a new perspective for the shipping and petroleum industry regarding the procedure for making fuel oil or creating new cargo characteristics through onboard blending techniques by regulations, correct methods, and safety procedures.

LITERATURE REVIEW

Description of Theory

As per SOLAS VI, Regulation 5-2, physical blending is when the ship's cargo pumps and pipelines internally circulate two or more different cargoes to produce a cargo with a new product specification (ISGOTT, 2020: 204). Blending in tankers is the meticulous process of blending different types of liquid materials, such as petroleum, fuel, or chemical products, to create a final mixture that complies with quality standards and market requirements. The process involves combining various components in the right proportions to achieve the desired qualities. Starting with the selection of the type of liquid material to be blended and detailed planning of the desired composition, the next steps involve careful metering and mixing in the appropriate vessel tanks. The blending process is carried out with the help of vessel equipment such as venting systems and high pressure during loading (4500KL/H) should be constantly monitored. blending at MT. Gamalama combines a clear white finished fuel from Reliance Port Industry, and additives in the form of cargo inhibitors and fuel coloring as a market identity, namely azo petromate green dye type RGL 252 from Retort Chemical Pvt, India. according to ASTM standards D2699, the blend creates a 90-octane fuel specification (90% iso-octane and 10% n-heptane) known as Pertalite (RON90).

Blending should be planned to ensure they comply with the MARPOL regulation with the local port requirement, A risk assessment that considers the grades to be loaded, vapor pressure of the cargoes, compatibility of the grades and the crew's experience in blending should be completed. For a safety and mitigation action, In its application, before the loading process begins the cargo manufacturer will provide a Material Safety Data Sheet (MSDS) to be familiarized on board. It consists of a comprehensive guide containing detailed information about a chemical product, such as its properties, handling, hazards, and emergency response. It follows the GHS (Globally Harmonized System) format and has 16 sections with complete information. (ISGOTT, 2020: 10).

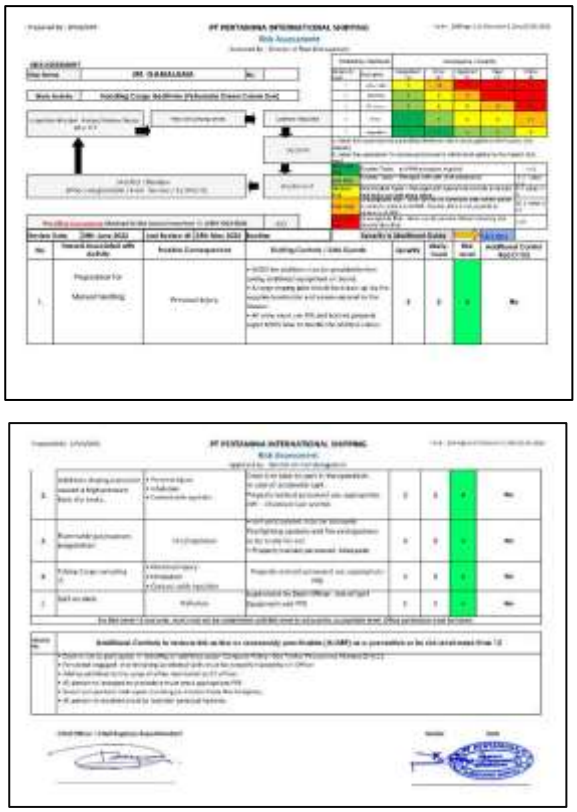

Figure 1. Risk assessment blending on MT.Gamalama
(Source: Personal Documentation)

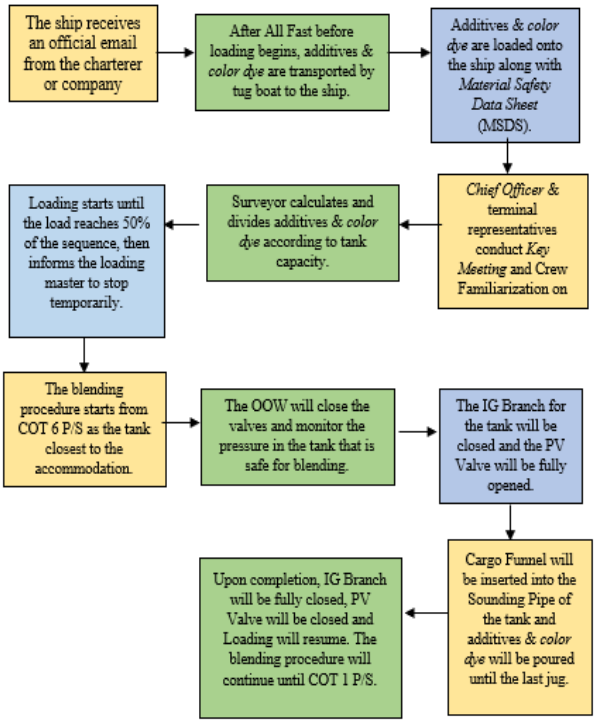

Figure 2. Flowchart Blending on MT. Gamalama
(Source: Personal Documentation)

Research Framework

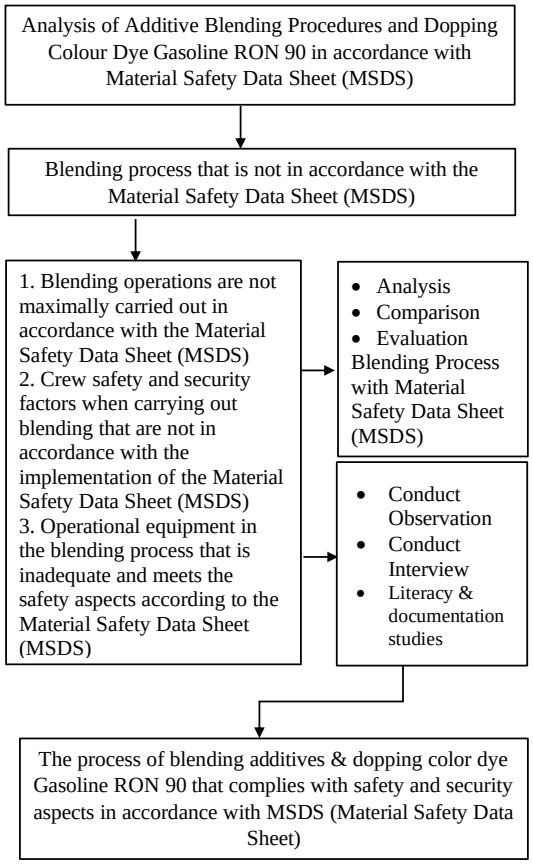

Figure 3. Research framework

METHODOLOGY

Research Method

The research method used is qualitative with an explanative pattern to gain a deep understanding of the phenomenon under study. This research was conducted for 5 months from February to August 2022 during the researcher's sea project period for one year (August 2021- August 2022) at MT. Gamalama. The research utilized primary data through observations and interviews, Secondary data was obtained through a literature study with references, and additional data to find conclusions. This research uses systematic observation with researchers directly involved in observing activities in the field related to blending operations on MT. Gamalama, Semi-structured interviews were conducted with the chief officer of MT. Gamalama is the person in charge of the cargo and its operation, the cargo surveyor who cooperates with the Reliance Port industry regarding blending and cargo distribution information, and the Able seaman is the deck watch representative who is directly involved in the field in the blending process, and documentation to obtain comprehensive and accurate data regarding the use of additives and dye doping on board.

Researchers used data collection, data reduction, data presentation, and conclusions to draw a result from valid research related to load blending procedures at MT. Gamalama uses The credibility test (internal validity), The transferability test (external validity), The dependability test (reliability), and the confirmability test (objectivity) to ensure research results align with the conducted procedures.

FINDINGS AND DISCUSSION

General Application Overview

The findings used have been analyzed using observation, interviews, literature studies, and documentation found several problems that refer to the implementation of the correct blending

regulations by ISGOTT chapter 12.1.6.16, Cargo Operational Manual from PT Pertamina International Shipping A-003/PIS4000/2021-S0 (2021), MSDS Gasoline RON90 and Petromate Green Dye RGL 252. The findings have been identified as follows :

Table 1. Problem Analysis of Blending Procedure

Factors observed	Problems that occurred
Crew Safety	• Not wearing Personal Protective Equipment (PPE) as recommended in the MSDS when mixing procedures and handling volatile cargo. • Crews who do not understand and receive special familiarization on proper blending procedures. • Lack of onshore personnel with specialized competencies in blending operations.
Supporting Equipment	• Unavailability of Wilden Pump from the terminal to create a safe, fast, and clean blending process. • Unavailability of Personal Protective Equipment (PPE) as recommended by MSDS on board the ship
Safe Blending Operations	• Additives were placed in an unprotected place on the deck. • Malfunctioning pressure monitor in the Cargo Control Room (CCR) • Delays in pressure release caused blending operations to take a long time. • Blending procedures were carried out manually using a modified funnel without pneumatic tools. • Pre-loading inspection that was not implemented properly caused hazards.

This discussion is based on analyze the problems that have been obtained based on the regulations relating to MSDS and the cargo itself as stipulated in Resolution MSC.150 (77) (2003) concerning Recommendation for Material Safety Data Sheet For Marpol Annex I (Cargoes and Marine Fuel Oils), OSHA 29 CFR 1910.1200 (g) and Appendix D which indicates the suitability of the procedure for blending additives and dopping color dye Gasoline RON 90 with Material Safety Data Sheet (MSDS) at MT. Gamalama, based on qualitative data analysis techniques, experienced several applications that were not by the implementation of MSDS.

Table 2. Compliance with MSDS

Indicator	Section MSDS that does not comply with
Use of Personal Protective Equipment (PPE) that is not by the MSDS and its unavailability on board.	MSDS Gasoline RON90 section 8 and 8.2 on occupational exposure control.
Wilden Pump is not available as a blending auxiliary equipment and implementation of safe blending operations.	MSDS Gasoline RON90 section 7 on handling and storage sub 7.1 information for safe handling.
Placement of carriers on decks that are not protected and exposed to direct sunlight	MSDS Gasoline RON90 section 7 on handling and storage sub 7.2 on information for storage.
Pressure management through a	MSDS Gasoline RON90 section 8.3 about

venting system that is not properly monitored.	environmental exposure control.

The explanation in the table as MSDS points that experience discrepancies such as crew who direct contact with the cargo only using regular personal protective equipment, and don't use special safety gloves for handling chemical liquids (nitrile), visors, appropriate respiratory protection, or personal gas detector as a mandatory of ISGOTT subchapter 12.1.6.16, that causes risks, acute health problems and potential hazards due to exposure to substances transported, loaded, or added on board. Second, the Terminal does not provide portable Wilden pumps dopping should carried out by manual procedures using a modified funnel which causes a higher risk of contact with the high pressure from the tank which is constantly changed. Third, the Ship does not have a Sample Locker that is sufficient to accommodate tens of carriers made from aluminum and placed on the deck without any protection which causes the potential danger of explosion, fire, and contamination of additives while in contact with water and disrupting the loading process.

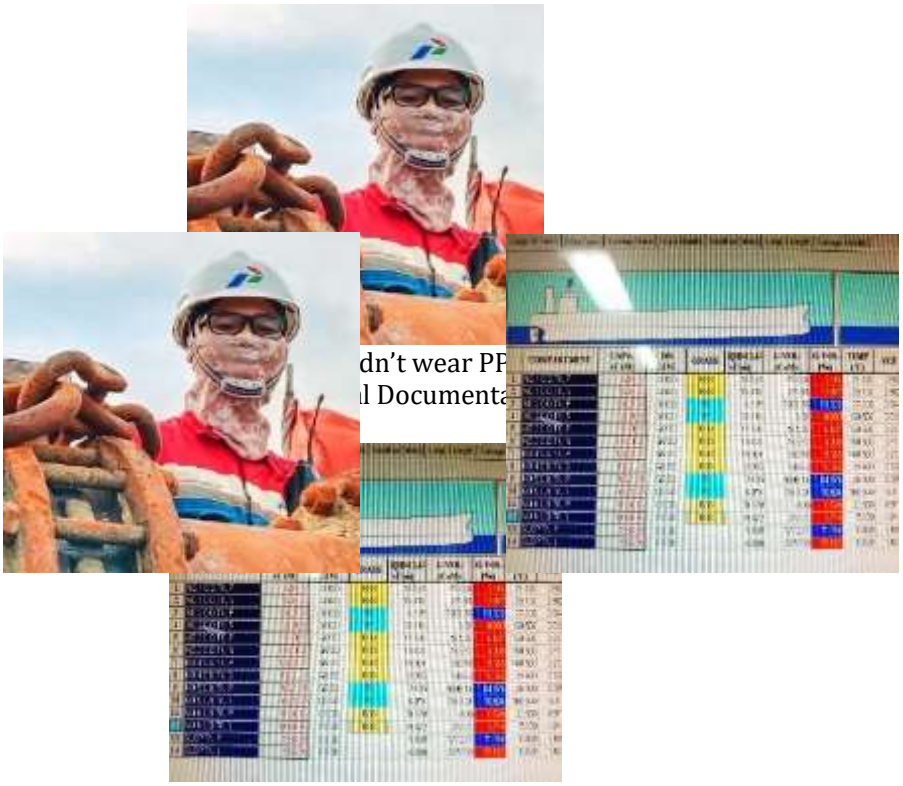

Figure 5. Error Pressure Monitor at CCR
(Source: Personal Documentation)

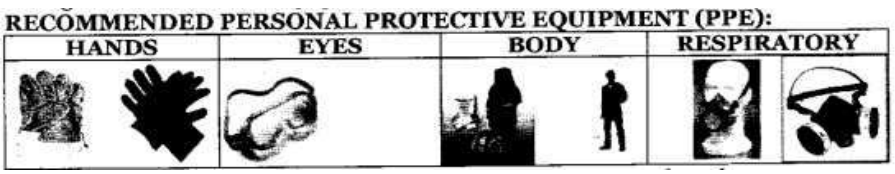

Figure 6. Recommended PPE as per MSDS
(source: section 8.2 MSDS RON90 Reliance Industry, Ltd.)

As qualification of MARPOL 73/78 annex VI (15) regarding the discharge of volatile organic compound (VOC) into the free air from the released tank, pressure management is very necessary because, in addition to polluting the air, it also endangers health which threatens not only the crew on duty on the deck but also other crew members who are carrying out activities in the accommodation and resting.

Then, the impact caused by the procedure of mixing additives & dopping color dye Gasoline RON 90 based on qualitative data collection techniques referring to the Material Safety Data Sheet (MSDS) of Reliance Industry, Ltd at MT. Gamalama can cause matters such as the following :

Table 3. The impact based on MSDS RON90

Affected parameters	Chapter in MSDS	Explanation
Human Health that directly affected.	Section 2 hazard identification, sub 2.1 classification of the substance/mixture: hazard class and category code, GHS category	• Fatal in case of oral contact (acute oral) LD50 ≤ 5 mg/kg. • Fatal in case of contact with the skin surface (acute dermal) ≤ 50 mg/kg because it causes serious skin irritation, damages skin tissue, and causes skin heat and burning. • Fatal by inhalation (acute inhalation) in the form of dust (dust) LC50 ≤ 0.05 mg/L, in the form of gases (gasses) LC50 ≤100 ppm/V, and the form of vapor LC50 ≤0.5 mg/L.
	Section 2 hazard identification, sub 2.2 information about particular danger for human: ingestion	• Ingestion at certain doses causes irritation, diarrhea, and vomiting. • Skin contact causes irritation, dermatitis, and serious effects on epidermal tissue. • Contact with eyes causes red and sore eyes. • Inhalation in the form of vapor causes drowsiness, shortness of breath, or loss of consciousness.
	Section 11 toxicological information, sub 11.2 repeated dose toxicity	Causes long-term chronic effects such as lung and skin cancer, skin allergies, and genetic mutations caused by toxic reproduction.
Impact Damage to the environment caused	Section 2 hazard identification, sub 2.1 classification of the substance/mixture: hazard class and category code, GHS category	Extremely hazardous in 96hr exposure LC50 (fish) ≤1mg/L 48hr or intensity occurring in fish, EC50 (crustacea) ≤1mg/L, 72/96HR or in crab, and ErC50 (aquatic plants) ≤1mg/L or in aquatic plants.

Table 3. The impact based on MSDS RON90 (Continued)

Affected parameters	Chapter in MSDS	Explanation
Potential hazards that can arise.	Section 2 hazard identification, sub 2.1 classification of the substance/mixture: hazard class and category code, GHS category	• Highly flammable and volatile with flash point or flash point <23°C with initial boiling point ≤35°C. • Fire can occur in <45 seconds with fire intensity up to >2.2 mm/second in liquid form during the burning rate test. • Highly flammable in gaseous form, at 20° at 101.3 KPA, it can burn when it reaches a level of 13% by volume in free air and has a firing range of <12% below the standard.
	Section 6 accidental release measures, sub 6.1 person-related safety precautions.	Damage the surface of ship decks by scraping and making them slippery, and also pose a fire hazard in the event of a leak.

There are positive and negative impacts if the blending procedure is carried out in accordance or less by the MSDS. As for the analysis, the impact caused can be classified into two, which are :

Table 4. Impacts caused by implementation

Parameters	Positive Impact	Negative Impact
Crew Safety Effects	Occupational hazards both present and long-term effects related to the safety and health of the crew on duty can be minimized because have met the requirements by using protective equipment by MSDS Gasoline RON90 section 8 occupational exposure control.	• Health hazards ranging from mild to acute (depending on intensity) when inhaled, swallowed, or in contact with the skin within a certain period according to the level of carcinogenicity of the cargo (1B) • Chronic health hazards such as cancer of the lungs and skin due to repeated doses according to MSDS Gasoline RON90 subchapter 11.2 toxicological information.

Impact to Environment	• Creating good environmental awareness. Potential hazards can be suppressed with a storage system or storage that meets the requirements of MSDS Gasoline RON90 section 7 handling and storage. • Environmental sustainability and ecosystem balance are maintained because blending is carried out appropriately to reduce pollution. (MSDS Gasoline RON90 section 8.3 environmental exposure control.)	• Air pollution generated by the venting system by Annex VI MARPOL 73/78 regulation 15 and IMO Resolution MEPC.176 (58). • Pollute the marine ecosystem and harmful to its species due to toxicity as per MSDS sub 2.3 information about particular dangers for the environment.
Potential Risks that occur	Minimize the potential risk of hazards that occur such as accidents, or fires that cause losses because procedures are implemented properly.	Explosion or fire of the substance, contamination due to weather changes by the physiological effects of the carrier.
Continuity of Operations	• The credibility aspect between the charterers by giving full trust to the fleet owner because they have received a concession from the terminal. • Shorten loading time and of course, the ship will arrive in Indonesia faster to carry out unloading or discharge at shore base facilities at Pertamina TPPI Tuban.	• Delays occur that can be detrimental to the company or charterer due to changes in the substance mixed, or changes in intensity due to improper storage. • The mixed cargo becomes inhomogeneous and does not reach the desired octane due to additive contamination.

Figure 7. Dermatitis (Contact with Substance)
(Source: Personal Documentation)

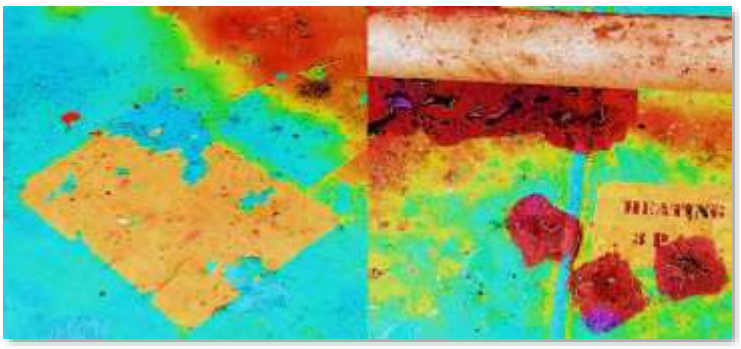

Figure 8. Rusty deck surface due to RON90 spillage
(Source: Personal Documentation)

The procedure for blending additives and dopping color dye Gasoline RON 90 by the MSDS on board the appropriate vessel, must prioritize aspects that have an impact on the health, safety, and sustainability of harmonization in the ecosystem. The procedures for blending have been regulated in ISGOTT 6th edition chapters 12.1.6.15 and 12.1.6.16 Which in general, must prioritize the following aspects such as must not be blended through the tank dome during loading, personnel who blend additives should stand downwind from the side of the tank to minimize the potential for exposure to hazardous gases, injection aids used must have anti-static properties and the use of PPE specified in the MSDS must be fully implemented, including personal gas detectors.

The blending of dopping or additives into the tank must be done alternately, one by one into the tank, and must not be done simultaneously. The vessel should be equipped with an Inert Gas System (IGS), before the dopping procedure is carried out, ensure that the IG branch on the tank to be executed must be completely closed and ensure that the atmospheric pressure in the tank must be depressurized.

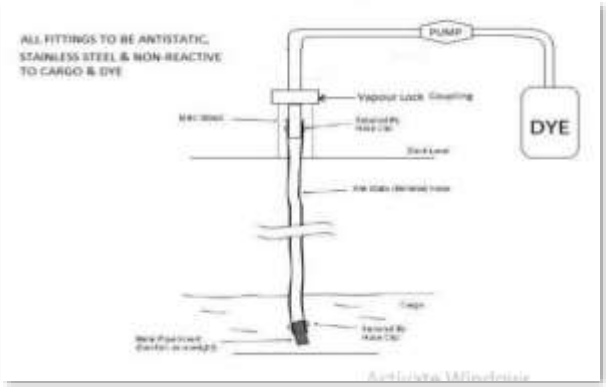

Figure 8. Dopping Illustration
(Source: Cargo Operation Manual, PT. Pertamina International Shipping A-003/PIS4000/2021-S0)

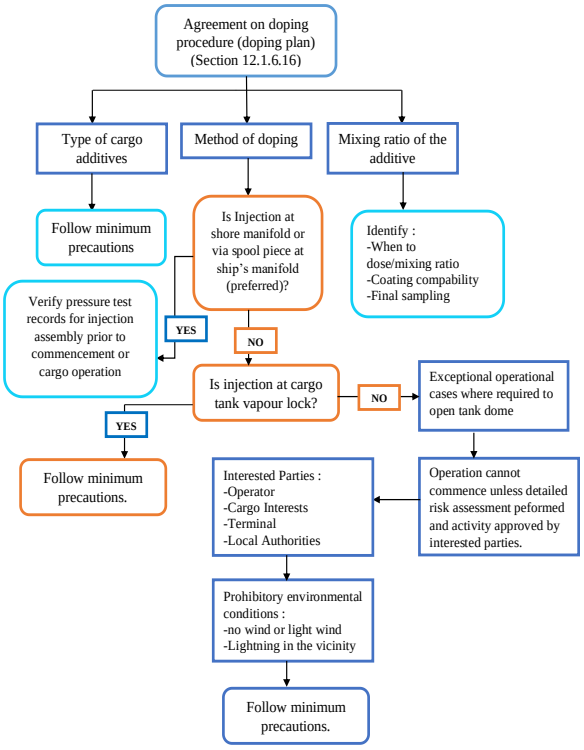

Figure 9. Flowchart Blending
(Source : ISGOTT 6th Edition, Figure 12.1 (2020:206))

CONCLUSION AND FURTHER RESEARCH

There are found non-conformities in the blending process of additives and color dyes on MT. Gamalama, including the lack of personal safety equipment (PPE), appropriate storage, and blending procedures by operational standards that cause any impacts include the potential for serious health hazards, risk of delay, inhomogeneity of the cargo, potential for explosion or fire, and pollution of the marine ecosystem due to residual blending operations. So, it is important to prioritize crew safety is crucial to achieve through wearing proper Personal Protective Equipment (PPE) as per MSDS. Familiarity with manual handling and operational protocols ensures efficient load supervision, consulting the terminal for extra personnel and equipment before blending is advised. Regularly monitoring tank pressures and addressing sensor repairs at the Central Control Room (CCR) is vital for flawless execution.

Limitations were found in terms of documentation due to the prohibition of using electronic devices on board which resulted in minimal data that could be captured (ISGOTT chapter 4.12.5 and 4.13). In addition, the lack of detailed scientific reference sources and limited interviews with the terminal also became obstacles in presenting more complete research results.

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