



CDI Best Practice:
Dosing of Ship's Cargo Tanks

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1. Introduction

In noting the wide and varied differences in practices with regards to how additives, inhibitors, dyes, denaturants etc. are added to chemical cargoes CDI has set out to provide a best practice guide regarding the “dosing” of cargo tanks. Reference should also be made to the CDI “Chemical Tanker Operations for the STCW Advanced Training Course” book including ISGOTT 6, and ICS Chemical Tanker Safety Guide 5th Edition regarding reactivity and self-reactive cargoes in particular.

2. Aims/Objectives

The aim of this document is to provide best practice information for the dosing of ship’s cargo tanks, which may be used by the industry to enhance procedural safety. This document is aimed at Vessel’s Masters, Inhibitor manufacturers, cargo manufacturers, suppliers, charterers, cargo surveying companies and any other parties with an interest in the dosing procedure.

3. Scope

The scope of this paper is to provide guidance to enhance procedural safety and does not intend to over-ride any International or National requirements, a company’s Standard Operating Procedures (SOP) or Safety Management Systems (SMS). Common industry practices have been taken into account and evaluated to provide best working practices and retain a safe working environment when dosing ship’s cargo tanks.

4. Terminology

- 1) For the purpose of this document, the term “additives” will be used to address all of these types of materials, i.e. additives, inhibitors, dyes, denaturants, stabilisers and preservatives unless otherwise specified.
- 2) “Dosing” is used as a generic term for placing additives into the cargo.

5. Roles and responsibilities

- 1) It is critical that it is known and agreed, which party in the cargo custody chain is responsible for determining the amount of additive required, when this will be added and the communication of this with relevant parties (i.e. Vessel Operator, Master, Loading Terminal and Cargo Supplier). This should be determined/ nominated at the contractual stage when the cargo is booked or at least before the start of the loading operations.
- 2) The “Responsible Party” (RP) should coordinate with all cargo chain custodians to determine correct quantities are added. The Master is to ensure the safe carriage of that cargo on that vessel for the intended voyage.
- 3) The RP may delegate additive dosing activities to others (i.e. to cargo surveyors) on their behalf. Instructions regarding the type of additive to be used, the concentration or quantity to be added, should be provided by the RP, to the personnel delegated on their behalf including the Master.



- 4) The RP should ensure that correct documentation is provided to show that the additives have been added to the cargo; how much was added, which cargo tank(s) it was added too, and how long the additive will remain active and any temperature limitations that may affect the life of the additive. If the additive is oxygen dependent, the documentation should include the minimum level of oxygen required in the vapour space for the additive to be effective.
- 5) If oxygen dependent additive is used, the minimum level of oxygen required in the tank atmosphere, so as to ensure the oxygen dependent additive remains active, should be provided to the vessel. If nitrogen is bubbled through cargoes containing oxygen dependent additives, (such as when compressed nitrogen is used to clear the hose after loading), it will deplete the oxygen in the tank and cargo. Bubbling nitrogen through cargo containing oxygen dependent additives should therefore be avoided. Should there be any doubt, additional advice should be sought from the RP or cargo shipper.
- 6) In the case of an additive application, correct content after dosing and completion of loading should be validated by sampling and testing each individual tank.
- 7) In the event of any disagreement, discrepancy in any instructions, or concerns, any party, particularly personnel on the vessel, should suspend operations until such time that those issues are clarified.

6. Types of Additives

- 1) Various types of additives are used within the industry.
- 2) Some additives are included in the cargo prior to loading.
- 3) As part of the loading process, additional additives may be added to protect the cargo and/or to meet required specifications.
- 4) Dosing of additives will vary to meet particular cargo specifications, or to provide additional protection and will consider the maximum ambient temperatures expected during the voyage and duration of the voyage, ensuring appropriate safety margins.
- 5) Compatibility of the additive with the tank coating should be assessed on the basis that the additive is used at its maximum concentration, to ensure compliance with the cargo tank coating manufacturers compatibility requirements.

7. Hazard identification

- 1) Additives may be added to tanks via vapour locks, ullage ports, tank hatches, inline quill injection etc. with each method providing different types of hazards i.e.:
 - a) Cargo Product hazards:
 - i) Flammability
 - ii) Toxicity – acute/chronic
 - iii) Tank inerted atmospheres (limiting options of how the additive can be added).



- iv) Static accumulator products.
 - v) Corrosive cargo.
 - vi) Reactivity (self-reaction, reaction with water vapour, reaction with Oxygen/air etc.)
- b) Additive hazards:
- i) Flammables or flammable dusts.
 - ii) Toxic products.
 - iii) Corrosive products.
 - iv) Static accumulators.
 - v) Dusts (exposure and explosive risks).
 - vi) Environmental conditions.
- 2) A risk assessment should be conducted by the RP, regarding each additive to be used to evaluate whether dosing should be conducted either on the vessel or ashore prior to loading. Along with, the determination of the method to be used for the dosing and how the additive will be thoroughly mixed with the cargo. The risk assessment should be conducted in advance of commencing loading operations and agreed with all parties involved.
- 3) Heated cargoes will be stowed so they are not adjacent to or in the vicinity of heat-sensitive cargoes as the proximity of heated and inhibited cargoes can result in a dynamic situation in which the degree of heat transfer may be complex and difficult to predict.
One tank separation between heated and heat sensitive cargoes might not be sufficient.

8. Guiding Principles of Dosing on the Vessel

- 1) Dosing ashore, before or during the loading process, is always the best practice that industry should follow.
- 2) Vessel's crew should not be responsible for dosing of tanks except in exceptional circumstances.
- 3) Dosing on board a vessel (prior to loading, post loading, or during the voyage), should only be considered on an exceptional basis.
- 4) Cargo dosing requirements, including the method and concentration, should be determined at the contractual stage by all parties when the cargo is booked.
- 5) During the vessel and terminal pre-transfer conference, the SDS and other relevant safety information, will be shared with the vessel. Any dosing of cargo should be verified and agreed during the vessel and terminal pre-transfer conference, including where it will be dosed, how it will be dosed, who will add the dose, the quantity and type of additive to be dosed, the PPE required, the expected duration of the voyage the ambient temperatures expected to be encountered and address expected safe margins in case of any delays in the voyage.



- 6) It should be noted that when dosing using the injection method of additives during the loading process, there are risks of an uneven distribution across cargo tanks due to varied loading and/or injection rates.
- 7) Where a uniform level of dosing is required for a single cargo parcel, and that cargo parcel is loaded in a single operation as a segregated parcel, the preferred practice is to inject the required additive throughout the course of loading.
- 8) Where the injection method during loading is impractical, (e.g. where different cargo tanks have differing consignees, each requiring different dosing levels). Then, dosing of individual tanks may be required to be conducted prior to the start of loading, with the additive dosed to each particular tank on a “tank by tank” basis. When all cargo tank additives are completed, cargo loading can resume as usual.
- 9) Where dry powder additives are added on board, then the preferred practice is to add them after cargo tanks are approved for loading, but before loading. If inerting is required, dry powder additives should be added before inerting is commenced, provided the additive is enclosed in a container or bag so that dust would not be created. Powder additives should be added prior to any cargo being added to the tanks.
- 10) If using powder additives on board then powders should not be dropped through the vapour space where dust may be created, as the possibility of a dust explosion could occur. Powders should be lowered to the bottom of the tank via a safe controlled means, which is then deposited remotely at the bottom of the tank. Powder additives should not be dropped from the cargo tank or manway access hatch.
- 11) Where a vessel is to arrive at the load port in an inerted condition, the powder additives should be provided on the vessel prior to commencing inerting operations. Consequently, in such cases powder additives will need to be provided to the vessel in advance. Powder additives should be encapsulated in a bag to avoid creation of dust during inerting.
- 12) Some powder additives may be dissolved in solvents to allow injection. None the less, mixing with a solvent may create additional hazards.
- 13) Some powder/ liquid additives may be water sensitive. Therefore, care should be taken during adverse weather conditions to ensure that cargo tank insertion areas are covered or otherwise protected from adverse weather. Guidelines should also be in place regarding when to cease cargo operations when using water sensitive powder additives during adverse weather conditions.
- 14) The correct Safety Data Sheet (SDS), should be available for the products being loaded and the additive, in the form that it is handled (i.e. powder additive, versus a powder additive dissolved in a solvent). The inclusion of an additive is unlikely to change the final specification of the product.



- 15) Only trained personnel should handle the additives. These personnel should be trained in the proper procedures for the safe handling of the materials, including emergency response if personnel are accidentally exposed to the products.
- 16) If any Antidote is required for a specific additive, then this should be available on the vessel prior to handling it.
- 17) Where cargo is inhibited, an inhibitor certificate (Complying with IBC 15.13.3 requirements) is to be placed on board prior to loading. If additional additive is added during loading, an updated certificate is to be issued prior to the vessel departing the berth.
- 18) The inhibitor certificate will include actions to be taken should the length of the voyage exceed the effective lifetime of the additives. However, in the event of the cargo falling outside the manufactures oxygen/ temperature limits or any indication of the onset of run-away reaction/ polymerisation of an inhibited cargo, the RP should be contacted for technical support.
- 19) In some instances, a third party terminal may be delegated as the RP for the addition of the additive. In such cases the primary RP may find it beneficial to refer to this best practice guidance as part of their agreement/ contract with the third party terminal.
- 20) It should be agreed with the RP if additional additive is to be placed on board the vessel and the conditions regarding the correct storage of the additional additive.
- 21) Information should be provided to the vessel by the RP containing emergency contacts.
- 22) In exceptional circumstances where dosing on board may be necessary;
 - i. A formal risk assessment should be conducted prior to the dosing of cargoes on board the vessel. This Risk Assessment should address and provide for correct and safe dosing procedures, personnel safety and designate appropriate Personnel Protective Equipment (PPE).
 - ii. To minimise personnel exposure and environmental emissions, dosing of cargo tanks should be conducted with a closed process. Consequently, dosing through an open hatch, restricted hatch or sounding pipe is not recommended, (i.e. due to static accumulation, risks of dropping liquids through flammable liquids, inadequate mixing of the additive with the cargo).
 - iii. If the additive has to be dosed when the cargo is on board the vessel, the preferred method is to add the additive via the cargo drop line/pump stack in a manner that allows the additive to be injected in-line and mixed within the tank during cargo loading, (or if added after loading, mixed in the tank via in-line injection at the cargo pump/stack). Note IBC 16.4.1 states *“During handling and carriage of cargoes producing flammable and/or toxic vapours or when ballasting after the discharge of such cargo, or when loading or unloading cargo, cargo tank lids should always be kept closed”*.



9. Records to be maintained

- 1) Document with the name of the additive and its concentration.
- 2) An SDS for the additive should be provided to the vessel either when the additive is added on board the vessel or if the additive is carried on board as a precaution for later addition if needed.
- 3) For inhibited cargoes, an inhibitor certificate should be issued to the vessel as per the requirements of IMO and where applicable, by other agencies.
- 4) A copy of the risk assessment, for dosing plans and or procedures, whether on shore or on the vessel.
- 5) A record of the pre-transfer conference, including details regarding dosing application, additive quantities and responsibilities. Any modifications to the plan should also be discussed and documented.
- 6) In case of inhibited cargo, an elevated temperature can reduce the effectiveness of the inhibitor or reduce its effective life. It is therefore essential that the temperature of cargo should be closely monitored and recorded on at least a daily basis, or more frequently, if recommended by the cargo manufacturer or shipper or RP.
- 7) The oxygen content may also have a detrimental effect on the inhibited cargo and should be closely monitored and recorded on at least a daily basis, or more frequently, if recommended by the cargo manufacturer or shipper or RP.

10. Disclaimer

The information, specifications, procedures, methods and recommendations herein are presented in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. No representation, guarantee or warranty is made as to the accuracy, reliability or completeness of said information, specifications, procedures, methods and recommendations or that the application or use of any of the same will avoid hazards, accidents, losses, damages or injury of any kind to persons or property or that the same will not infringe patents of others or give desired results. Readers are cautioned to satisfy themselves as to the suitability of said information, specifications, procedures, methods and recommendations for the purposes intended prior to use.