

## Protect your Cargo Tanks against Aggressive and Corrosive Cargoes (Sulphuric and Phosphoric Acids)

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Corrosion can be caused on stainless steel when vessel carrying highly corrosive cargoes, like sulphuric acid and phosphoric acid. But, these problems can be avoided maintaining correct procedures during preparation of cargo tanks for corrosive cargoes, correct loading procedures, proper transportation, correct unloading procedures and correct tank cleaning procedures.

**Sulphuric acid** is highly reactive with water. Acid cause exothermic reaction, that can damage passive layer of the Stainless Steel and leave on the surface of cargo tank black trays. Prior to loading all cargo tanks to be loaded with sulphuric acid must be dry and free of any residues of water, even of moisture. It is very important to discharge all ballast water adjacent to those cargo tanks, because adjacent ballast water can cause condensation inside cargo tank and it is prohibited due to proper cargo segregation ( Compatibility chart USCG CFR 46). Cargo pumps cofferdam (Framo) have to be purged with Nitrogen immediately prior to loading to prevent damage of cargo seal set by exothermic reaction. If heating coils are situated in the cargo tank, heating medium to be purged by N<sub>2</sub>, coils to be dry and blanked. Cargo lines to be purged with Nitrogen as well. Air never to be used for blowing, air can cause condensation and as a sequence exothermic reaction. Loading to be started with minimal and safe loading rate. Sulphuric acid is not toxic, not flammable, but highly aggressive and corrosive. Always proper PPE to be used. After loading all cargo lines to be blown with Nitrogen. It is good practice to maintain Nitrogen blanket inside cargo tank during transportation voyage. Cofferdams of cargo pumps to be purged more often, than it is recommended by Framo. After discharging same procedure for line clearing to be done as after loading. Cofferdams of cargo pumps to be purged by N<sub>2</sub>.

Tank cleaning is most difficult step related to sulphuric acid carriage. Cleaning procedure to be done as soon as possible after discharging. It is always better to use Fresh water for whole tank cleaning operation. Sea water can also be used for tank cleaning, but not during initial step of tank cleaning. It is preferable to start and finalize tank cleaning operation with Fresh water. During initial step, large amount of water to be introduced inside tank. Water will generate lots of heat and Hydrogen gas. It is better to keep closed all hatches to avoid release of gas and to avoid condensation of air inside cargo tank. Never stop cargo pump during tank cleaning, otherwise water, mixed with acid, will collect in the cargo tank and it gives black discoloration around the tank bottom and on the lower parts of tank bulkheads. All period of tank cleaning pH level of washings to be monitored. Cleaning can be stopped, when pH level of washings will reach around "7". Flushing with Fresh water of all cargo lines, venting systems and stripping lines to be done in a way, that they should be free upon completion of any sulphuric acid remaining. After tank cleaning operations, proper ventilation procedure to be done. If some

minor black discoloration detected inside the cargo tanks after tank cleaning, it can be removed by applying of pickling gel.

**Phosphoric acid** can also cause problems for the Stainless Steel cargo tanks. Food-grade phosphoric acid (additive E338), which is used to acidify foods and beverages such as various colas, normally is not corrosive for Stainless steel, due to absence of any impurities and sediment. But wet phosphoric acid is very aggressive. Like with sulphuric acid, phosphoric acid requires correct preparation of cargo tanks, proper loading, discharging and tank cleaning procedures. It is good practice to use diffusers, working with phosphoric acid. However, they will not help much, if you have heating coils inside cargo tank and their layout will obstruct diffusers work. It is not necessary to purge, dry and blank heating coils for phosphoric acid transportation, like we usually do with sulphuric acid.

Before loading temperature of phosphoric acid to be checked. Acid can be safely transported at temperature around 30°C. If temperature is higher, acid could be corrosive for stainless steel. The higher temperature - the more corrosive phosphoric acid. Cargo tanks must be clean and dry, pumps cofferdams purged. If it is necessary, renew cargo seal sets of the pumps.

During transportation enclosed recirculation of the cargo to be done daily. This procedure has to be done to ensure that there is no formation of sediment. Sediment of phosphoric acid is highly corrosive for the stainless steel and it can block impeller of the cargo pump. Prior to recirculation, air blowing of pumps discharge line can give a good result to remove sediment from the well of the pump. Since IBC Code Chapter 17 says that ventilation is of "open" type, cascade discharging can be used in case of too high level of sediment inside cargo tanks. After discharging purge cargo pumps cofferdams immediately to check condition of cargo seal set.

Initial step of the tank cleaning to be started with Fresh water only and after that Sea water can be used followed by fresh water rinsing. If there are some trays of phosphoric acid sediment, remained on the bottom or bulkheads of the cargo tank, they can not be removed by water wash only. Pure phosphoric acid to be used or Metal Bright HD. Metal Bright HD contains 75% of Phosphoric acid and also can be used in this case. Enclosed recirculation, using acid resistant tank cleaning hoses, to be done using additives mentioned above. After recirculation, all lines to be thoroughly flushed with Fresh water. If the mixture of phosphoric acid solution will remain inside cargo lines, it will give pitting of the stainless steel as result. It is essential to carry out Palladium chloride test of stainless steel after tank cleaning. If result shows that passive layer is damaged, passivation of the cargo tank to be done. Find more information about passivation of the stainless steel on our website:

[http://www.tocpro.com/index.php/researches\\_and\\_studies.php](http://www.tocpro.com/index.php/researches_and_studies.php)

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