ABSTRACT

In recent years there has been a huge increase in the demand for Ethylene transport, which has been observed worldwide, mainly by sea. Ethylene carriers are an example of the latest technological achievements. These are LPG ships (Liquefied Petroleum Gas), mostly semi-pressurized, design to carry varied liquefied gas cargoes except LNG (Liquefied Natural Gas). Ethylene ships are equipped with a cascade cycle of reliquefaction plant working on Propylene or R 404A as a medium in Ethylene condenser. These vessels are able to transport fully refrigerated Ethylene at a boiling point of minus 104°C and atmospheric pressure. In order to transport varied LPG cargoes by the sea, there must be made a few operations carried out repeatedly. The most important of all are inerting and gassing-up. First one involves making an inert atmosphere in cargo tanks to prevent explosive mixture creation between Oxygen and a cargo. However, none of the gases used as an inert gas used on ships, Nitrogen or Carbon Dioxide, may be liquefied by the ship's reliquefaction plant, which allows cooling down the Ethylene cargo. This is because the liquefaction temperature of Nitrogen or Carbon Dioxide is much below the critical liquefaction temperature of Ethylene. Therefore, it is necessary before loading a cargo, thorough removal of inert gas from the cargo tank. This possibility is provided by the cargo tanks gassing-up operation by the use of cargo vapor. From the point of view of small density differences between Ethylene and Nitrogen vapour at a particular temperatures, Ethylene is one of the most problematic hydrocarbon in the scope of efficient carrying out gassing-up. Ineffective gassing-up operation and too high Nitrogen concentration left in tanks cause an emergency stop of the cargo compressors due to too high condensing pressure of the gas mixture and drastically reduce cooling capacity of a cascade cycle. In addition, it is associated with an excessive Ethylene loss which is removed together with Nitrogen to the atmosphere. Should be pointed out that Ethylene is one of the most expensive cargoes carried on gas carriers, so removing it from the system leads to the high financial loss.

The above aspects induce to carry out a detailed analysis of gassing-up cargo tanks with Ethylene vapors. A thermodynamic theoretical model of gassing-up one cargo tank has been built, which allowed to determine the range of technical parameters enabling carrying out the gassing-up in more effective way. The results of calculations also made it possible to carry out experiments on LPG gas carriers, efficient gassing-up the cargo tanks reducing cargo loss, as well as the correct work of cargo compressors during this operation. The paper enabled making the proposition of general procedure of gassing-up process on ethylene carriers after inerting by the use of cargo vapour having regard to optimal technical conditions of the process.