

METHODS FOR CAPTURING VAPORS OF PETROLEUM PRODUCTS IN TANK TRUCKS

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This article discusses the problem of the environment protection from the vapors of petroleum products during transportation, the design features of tank trucks, and methods of loading.

The American Clean Air Act regulates atmospheric pollution caused by hydrocarbons from industrial enterprises in the country. Studies have shown that up to 95% of all emissions from fuel transportation can be collected for further processing. As a result, the petroleum industry has begun thorough exploration of gasoline emissions their regulation. Although there have been attempts to modify the vapor recovery system when pouring from above, the introduction of a bottom loading method proved the availability of more advanced vapor recovery technology. Today, vapor recovery technology for bottom loading dominates and is used everywhere. [1]

Vapors recovery involves preventing the release of gasoline vapors to the atmosphere during the fuel loading / unloading process. This is called the first vapor recovery stage. It requires vapors to be collected from the underground fuel tank of a maintenance station and taken to a gas station for processing. To perform this operation, some changes must be made to the design of the maintenance station, the fuel tanker truck and the filling station. These changes include the creation of a separate opening for the transfer of vapor to the underground fuel tank. This is called a "two-step" vapor recovery system requiring separate channels for fueling and for vapor collection. The "one-step" system uses one drain hose both for fueling and for vapors collection through a special coaxial crankshaft. "Two-step" systems are preferable, since they have significantly better performance in terms of fuel discharge time [2].

The second stage of vapor recovery involves preventing the release of vapor from the fuel tanker truck using special nozzles and additional changes in the design of the service station.

Fuel tankers are usually divided into chambers, each of which carries different types of fuel. A safety valve at the bottom of each chamber controls the loading and discharge of fuel to / from the chamber. A safety valve is connected via pipes to the bottom of API charging valve (for loading and unloading fuel) [3].

The hatch on the top of each chamber usually has a sampling hatch (for checking or loading "to the eye-balls") and an air vent that is connected to the vapor recovery system. At this stage, a brief overview of the traditional top loading is needed as a historical explanation of the reasons for a change to to the tank loading system from below [4, 1].

In many countries, the traditional technology of fueling tankers from above is still being used now. These gas stations usually have a lifting platform that allows operators to walk on top of the tank, open hatches and pour fuel into each of the chambers. When unloading at a service station, drivers usually have to climb on top of the tank and open the hatches of the chambers in order to:

1. measure the level with a probe;
2. to confirm the station operator that the tank is fully loaded;
3. In order to allow air to get into the chamber when draining the fuel [5, 2, 3].

Hatches are closed successively after the fuel drain operation is completed. Hatches with pneumatic vents are often used to reduce the need for the presence of an operator at the top of the tank (opening and closing hatches).

The problems that arise when pouring from top;

1. Static / dynamic sparks: bursts and turbulence of the fuel flow is formed in the case of static electricity (even if the tank is grounded). Static and dynamic sparks are extremely dangerous and when combined with fuel vapors can lead to disastrous consequences and explosions.

2. Operator safety: Operators may fall off the tank (height is about 3 meters) and be seriously injured. When pouring from the top, operators also inhale vapors that can cause health problems.

3. Fuel pollution: with the open doors of the chambers, the method of loading from above creates an opportunity for rain, snow and wind to blow off and wash the dirt into the fuel, polluting it. Aviation fuel is extremely sensitive to microscopic forms of pollution. Handles, screwdrivers, and cigarettes — all of these items may accidentally fall into the open hatch of a chamber and cause fuel contamination, damage, or malfunctioning of safety valves or other equipment located at the bottom of the tank.

4. Loss of time: standard top-loading technology requires that only one tank chamber can be filled at a time. During the bottom loading (which will be discussed later), several chambers can be filled simultaneously. A faster discharge process reduces tanker idle time at a gas station and significantly improves delivery efficiency.

The API valve, which was developed for the oil refining industry and fuel transportation technologies with the participation of the American Petroleum Institute (API), plays a key role in tank loading at the bottom. Joint efforts have led to the creation of common technical requirements for the loading valve, as well as to the standardization of connecting elements at filling stations. API valves are located on the bottom of a tank and are connected by a piping system to each chamber. Typically, each chamber has its own API valve. Fuel is pumped through the loading hose of the filling station, through the API valve, pipeline and safety valve into the tank chamber. A safety valve is located at the bottom of each chamber and regulate the loading and unloading of fuel. When loading from the bottom, the chamber is quickly and uniformly filled with minimal turbulence. The unloading by gravity of each of the chambers is accompanied by the installation of drain hoses connected to the API valves, and from the other end to the inlet sleeve of the underground fuel tank [6, 7, 8].

When loading tanks from bottom, it is possible to eliminate all main disadvantages that are associated with loading from above, as well as to catch almost all the vapors of petroleum products while loading and unloading the tank truck [3].

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