

INCREASE OF THE SECURITY OF THE STEEL TANKS IN EXPLOITATION

Lyubomir Zdravkov
mag. "Строителство", 5, 2003

1. Common positions.

The fast development of tank constructions abroad /till recently in Bulgaria and in the ex USSR/ and also the experience concerning the tank accidents are the reason for the following conclusion:

Even the AST which are projected under higher safety measures in their exploitation and for their longer use, they are not perfect and it is necessary to carry out complement research during their projecting, construction and exploitation [2]. It is important to mention that AST which are projected and executed correctly according to the last achievement of the science, can be damaged by accident and even destructed due to the errors in their exploitation. The complex assessment of the tanks status and different activities are necessary for increasing the tank security. These activities must be organizational, constructive and chemical.

2. Organizational activities [4].

2.1 Registration of all available steel tanks with their main dimensions. Issue of technical passport of each tank and assessment of technical conclusion for its status up to date of it's including in the catalogue.

2.2 Issue of the legislation of technical inspection, repairing and constructing of the AST which must include the last science achievement in the world in the field of tank construction.

3. Technological activities

3.1 It is necessary to put flexible compensators where tanks are joined to pipeline. One of the most known damage is deformation of the shell in the spot of joint with the pipeline.

These damages are result of the settlement of the foundation under the shell and also of the seismic influence because the tanks and the pipeline have different movements. It is possible even breakage of the shell during the earthquake on the spot where the pipelines join the shell.

The flexible connections are important especially for tanks with big diameters. When the compensators are mounted the efforts transferred from the shell through pipelines are decreased to minimum.

3.2. Implementation of the precise measuring facilities in the tank which grant that the real level of the liquid will not exceed the planned one after the analysis.

Maximal level for the filling up H_t must be calculated by:

- technological requirements;
- the check of the toughness of the shell of the tank which is made thinner by corrosion;
- the necessary free space between free surface of the liquid and roof of the tank should be determined by seismic influence.

The smallest from the calculated values can be accepted as maximal level of filling up H_t .

3.3 Put of precise, continuously worked equipment on the roof of the tank which have necessary area. The appearance of unplanned vacuum in the tank is one of the main reasons for unacceptable deformations of the upper course of the shell.

3.4 Put of the systems for liquid mixing.

During the long exploitation of the tank residue of tars is formed on the bottom and this residue must be removed periodically because:

- it decreases the used volume of the tank;
- the separation of the water in the tank which is above to the bottom becomes more difficult;
- the risk for bottom corrosion increases.

- the different sources have controversial opinions referring the accelerated corrosion on the bottom. Some of them insist that the residue film upon the bottom is favorable for it and the corrosion speed is decreased.

The mixing of the product of the tank can be done in two ways:

- a) with mixers, which are mounted on the first coarse on the shell.

The quantity and the position of the mixers depend on the tank diameter and the kind of liquid in order to homogenize stored product on all the bottom space.

- b) with so called **Spider system** – this is the system which can be put on the incoming pipeline as well as on the outgoing one.

Spider system for incoming products is made by put in circle pipelines from which the nozzle directed in one direction. So the coming in the tank product turns itself and homogenizes the bottom residue.

Spider system for outgoing product is a system from radial pipelines through which it is possible to get product from several spots in the same time. In this way the bottom zones where the movements of the liquid are very slow decrease.

4. Constructive activities

4.1. Preventive strengthening (bandage putting) of the shell. This method can be used for tanks for hot water without considering whether they are used or new build.

According to [4] preventive straightening must be applied for all tanks for hot water without considering whether they are exploited or new build.

The practice shows that this straightening has several failings [1]:

- difficulties with maintenance of the anticorrosion layer on the shell;
- penetration and keeping of moisture between bandage and shell which can cause the corrosion;
- the fixing and the full attachment of the bandage belts must be done through many welding joints;
- they connect cyclical shell with many bandages and it increases the risk of fragile destruction.

4.2. Anchorage of the tanks when the check for earthquake proved that it is necessary or when there is increase of the pressure as a result of change of exploitation conditions.

4.3. Erecting of complementary second shell of the tank.

This solution usually is applied when the conditions are narrowed or the requirements for ecological safety of the facility are increased [2].

The space between the two courses should be approximately 1,8 – 2,5 m, distance needed for free movement of the personnel. The space bounded by the external shell must be enough for all stored in the tank product.

g) erecting of the double bottom of the tank. The different systems for leaks on the bottom discovery are shown on [2], [3] and [5].

The double bottoms of the tanks can be classified by the following criteria:

- according to the material for second /complementary/ bottom:
 - from steel;
 - from polymer material;
- according to the kind of the leaks discovery system:
 - passive system. They are pipelines through which the fallen between two bottoms product comes out on an outsider place, easily accessed and determined for this purpose. The liquid moves under the influence of its own weight. In this reason the discovery of the bottom leaks delays.
 - uninterruptedly functioning vacuum system. It is necessary to watch for increase of pressure between two bottoms. The leaks on the bottom are discovered immediately.

d) replacement of damaged or/and corroded steel roofs with aluminum roofs (fixed or floating). So the pressure upon the roof is decreased as well as the risk from loss of stability by longitudinal direction (fixed roof) or so the additional tension efforts in the shell caused by the weight of the roof floating roofs are decreased.

There is methodology for calculation of spherical aluminum roofs in [5].

e) to put the additional stiffening and granting the project form girders upon the membrane of the floating roofs.

As a result of errors during the erection and the continuous exploitation the membrane of the single deck floating roofs is deformed. The part of the water does not reach the roof drain and rests on the roof and increases the speed of the corrosion. The additional stiffening girders make the form to be closer to the projected one.

These ribs also stabilize the roof during the wind loading when there is sucking and waves appear in the roof membrane.

f) it is necessary to put intermediate wind rings in order to stabilize the shell made thinner by corrosion and to prevent loss of stability. The methodology for their calculation is mentioned in [5]. It is necessary to mention that according to this methodology radial rings do not prevent the loss of stability.

g) removing of existing vertical mounting joints in shell which are executed as lap joint and their new execution with full penetration and fusion.

5. Chemical and electrochemical activities.

Outsider and insider surface of the tank could be secured by bringing on it highly effective emulsions.

The use of defense of high quality and anticorrosion covering which is usual for leading in this field western country assures the possibility for longer use of tanks [2].

The defending emulsions which are put on the insider side of the tank must have high quality and their minimal term of exploitation must be longer then the term between two full inspections of the AST (10 years). During the regular full inspections of the tanks when they are emptied, cleaned and gas cleaned, the personnel have the possibility to assess the status of insider defending anticorrosion covering and to replace or repair it if necessary.

Literature:

1. Билецкий С.М., Барвинко Ю. П. Международное сотрудничество в Украине при проведении ремонта резервуаров для хранения нефти и нефтепродуктов, Gdansk, 1994.
2. Бордовский, А. М., Медник, Б. М., и др. Тенденции в развитии комплексных требований к резервуарам для хранения нефти (зарубежный опыт), Основа, 2000.
3. ЗДРАВКОВ Л. А., Стоманени ВЦР за нефт и нефтопродукти с двойни дъна, Строителство, кн. 1, 2003.
4. Инструкция за проектиране на СВР с обем от 100 до 10 000 м³ за системата на енергетиката, Енергопроект, 1995.
5. API Std 650, Welded Steel Tanks for Oil Storage, tenth edition