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CONDITIONS OF THE TANKS IN EXPLOITATION IN WHICH WILL BE MOUNTED ALUMINIUM FLOATING ROOFS

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***Scientific field*:** *steel construction*

RESUME

Loses of product are inevitable when it is stored in aboveground steel tank. They are result of evaporation of volatile fraction of liquid from its free surface and escape in air. Possible methods for limiting of lose of product in aboveground tanks with a fixed roof are:

- mounting of recuperating system;
- mounting of internal floating roof;
- combination of abovementioned two methods.

The most used method is mounting of internal aluminium floating roof, Fig.1. It is based on reasons as follow:

- initial investments are comparatively low;
- mounting of aluminium floating roofs is ease and quickly;
- it is not necessary to recalculate steel tanks and their foundations.

Mounting of internal floating roofs in tanks in service often is a task with many unknowns. Their real condition determined by deflections of structural elements, damages in basic metal and welds, poorly executed details, is unclear without full inspection. Often expensive repair and alteration works are necessary to be possible internal floating roof to operate without problems.

top view during the mounting works

view from below

Fig. 1. Internal floating roof from aluminium alloys.

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1. Introduction

SA "State reserve and war-time stocks" decided to put aluminium floating roofs in the following tanks: 3 tanks in PB "Anton" and 11 tanks in PB "Sliven" in order to minimize the benzene losses. All of tanks are with volume V = 5000 m^3. All of them, except one, new made, are in service for a long time. Three tanks in PB "Anton" and one in PB "Sliven" are erected according to lifting method. Other tanks in PB "Sliven" are erected by roll method. The tanks are above ground, made from steel, welded, with fixed roof.

An inspection has been done in order to determine more clearly the conditions of the tanks after many years in service. The thicknesses of elements are determined and presence of damages in the basic metal and welding joints. During the initial inspection a geodesic investigation was not done on purpose to determine declination of the shell' and bottom' geometry. This geodesic investigation is done later, by request of organisation, mounting the aluminium pontoons.

Repairing works, based on the data obtained from the initial research, were done on purpose to repair discovered damages, to increase the security and to increase the period of tanks' exploitation. Later additional repairing works were done to assure that floating roofs would function without problems.

2. Tank's conditions

After selection of tanks where aluminium floating roofs should be mounted, they were inspected visually inside and outside. As the request of mounting organisation, a geodesic investigation of the shell was done.

The inspection of the tanks mounted according to the lifting method shows the following:

- the diameter of the shell in the first shell's course is D_1 = 22 980 mm and the diameter in the last, ninth course is D_9 = 22 870 mm. It shows shrinkage with more than 100 mm. Significant deviations of the shell from its cylindrical shape are not observed.
- presence of the vertical stairs in the internal side of the shell, Fig. 2;

Fig. 2. Vertical stair in the internal part of the shell

- mounting equipment on the shell are present, Fig. 3 and they should be removed still mounting works;

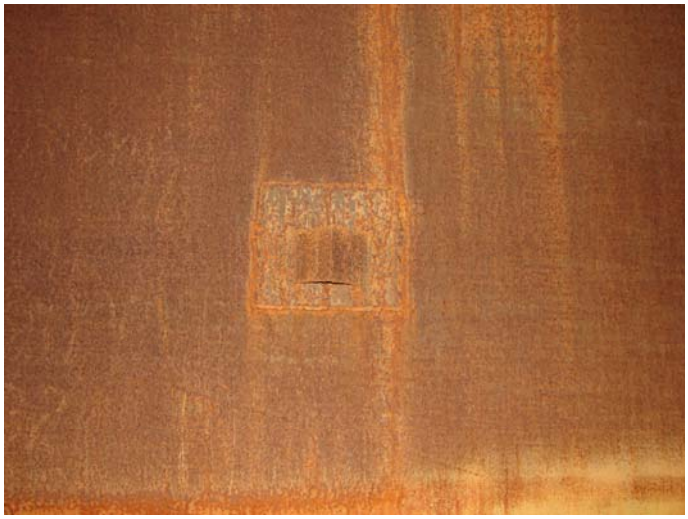

Fig. 3. Mounting equipment on the shell which is not removed

- horizontal joints on the shell are executed as lap welds, where upper course is closer to the tank centre as the lower one. There are not welds on internal side of the horizontal lap joints, Fig. 4;

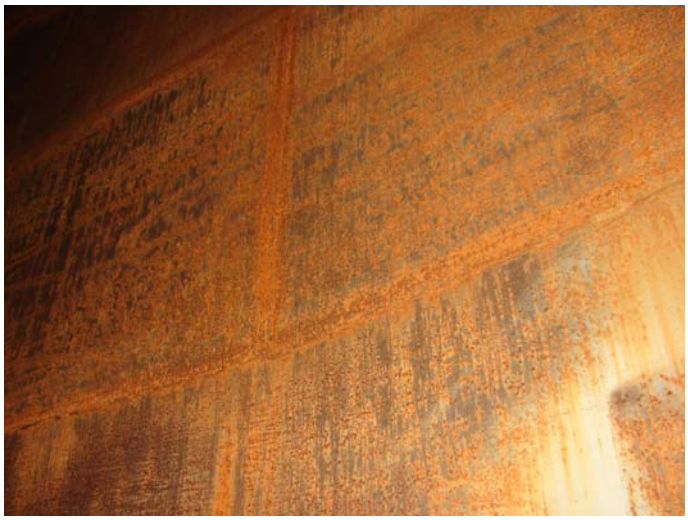

Fig. 4. Horizontal lap joints in the shell
with a single angle weld outside

- presence of the vertical steel belts, put on the internal side of the vertical joint of the shell, Fig. 5.

Fig. 5. Steel belts on the vertical joints of the shell

During the visual inspection of the tanks mounted by roll method in the PB "Sliven" which coincide with the repairing works of the most of them, is noted the following:

- the diameter of the shell is D = 22 800 mm as it was shown in the project. There are not considerable deviations of the shell from cylindrical shape by the project;
- vertical mounting joints are executed as a lap joints with double angular welds, Fig. 6;

Fig. 6. Vertical joint in the shell, done as lap weld

- the executed repairing works worsen their geometry instead to improve it.

Fig. 7. Replacement of sheets in the shell

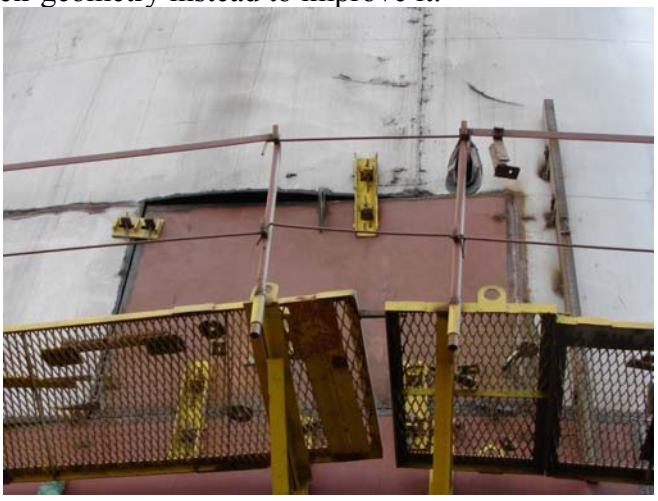

Fig. 8. Gaps between new and old sheets

The additional geodesic investigation of the shells of the 13 old tanks shows that the settlement of the soil and general deviation of the shell are normal. Additional measures to correct it are not required.

3. Put the tanks in the condition which permits use of internal aluminium pontoons

Having in mind the obtained from the inspection results, the following repairing works are necessary to be done:

3.1. In the tanks mounted by lifting method:

- removing of the vertical stairs put in the internal side of the shell;
- removing of all mounting equipment put on the interior side of the shell - approximately 100 ÷ 120 pieces in one tank;
- welding of the horizontal joints on internal side of the shell. Round the inferior edges of the joints in order to facilitate the sliding of sealing - approximately 600 m' of one tank;

- removing the vertical belts from the internal side of the vertical joints and welding of these vertical joints - approximately 90 m' of one tank.

3.2. In the tanks mounted by roll method:

- to round the sharp edges of the vertical mounting joints.

3.3. In all the tanks regardless of way of mounting

- to determine where new nozzles to measure the level and to sampling the liquid will be located on the roof;
- to assure the openings and reinforcing of membrane of the aluminium floating roof in the zone where the pipes pass;
- to prepare a project and to put the vertical pipes used to measure the level and to sampling the liquid.

4. Conclusions

The use of the internal floating roofs made from aluminium alloys is a contemporary trend aiming to decrease the losses of light fraction by evaporation. This type of elements can be used in the new built tanks but also in the tanks which have been used for a long time. In the last one, before to put the aluminium pontoons it is obligatory to carry out a complete inspection in order to ascertain their real conditions and whether it is possible to use pontoons of this kind .

The repairing works, which are based on the results of the inspection, and have the purpose to:

- increase the security of the steel tanks through repairing the damages in them;
- assure free movements of the floating roofs.