NEW CONTEMPORARY STRUCTURAL DECISIONS FOR GASHOLDERS

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Abstract: *Gasholders are well known structures and used in industry for a long time ago. Their purpose, as prompt their name, is to keep and storage gas. Often the gas is waste of another production. Using gasholders that gas could be captured, storage and after that - utilized.*
Classical structure of gasholders is two steel vessels, which could move between them. On this way they change their volume at constant pressure.
With a development of new technologies new structural decisions for gasholders are used. In some gasholders the second vessel is replaced with a moving cellar, in others - with a flexible membrane.

The gasholders are facilities that are well known and have been used for long time in practice.

Their purpose as their name shows is to keep and store gas. This gas is often a wasted product from another activity and the gasholders can keep it stored and later it could be used for another purpose.

Classical structure of gasholders is composed of two steel vessels which can move one towards another. So they can change the volume of the facility (quantity of the stored gas) while internal pressure remains constant.

New constructive solutions for gasholders are discovered due to the development of technologies and constructive materials. Especially considering the increasing aims for ecological production which does not leave waste. In some of them the second cup, which can move, is replaced by floating ceiling and in another - it is replaced by flexible membrane which does not permit the leak of the gas.

1. Gasholder with floating ceiling

The gasholder of this type are constructed and used in Sofia and Stara Zagora. They are “dry type” – there is no water inside. The change of the volume of the stored gas is assured by moving of floating ceiling (fig. 1) around the central telescopic stand.

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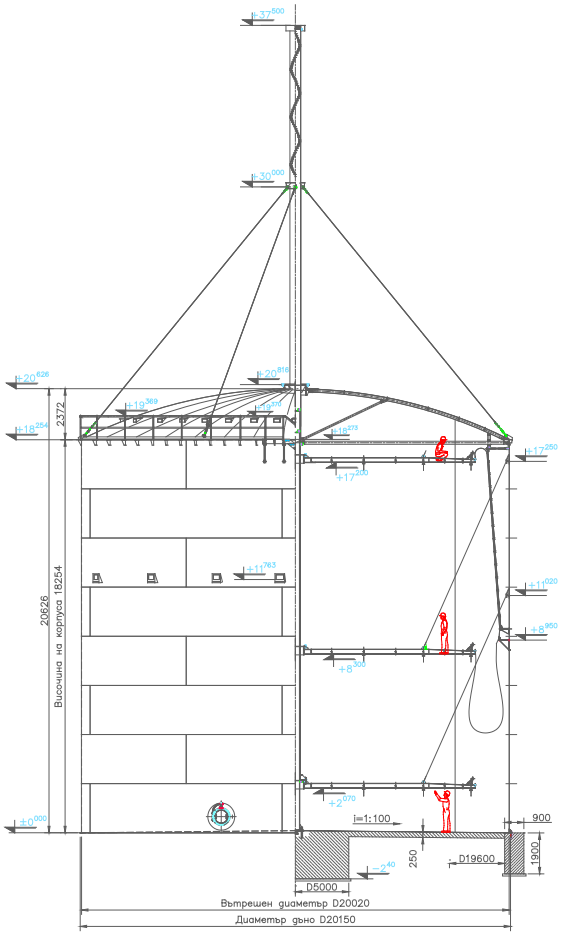

fig. 1 Gasholder with floating ceiling - general view

This type of gasholders is composed of the following main constructive elements.

- **conical steel bottom** with a slope 1 % from the center toward the shell. There is annular bottom plates under the shell, where the bending moments appears resulted from the elastic fixing of the shell in the bottom, and thinner central part. The bottom's sheets are connected with butt welded joints executed on the pad sheets in order to assure complete penetration and fusion;

- **cylindrical vertical shell**, which is constructed of many bended on appointed radius steel sheets (fig. 2). They are jointed by many butt vertical and horizontal welded joints with full penetration and fusion.

fig. 2 Cylindrical vertical shell

Openings are made in the upper part of the shell and the atmosphere air pass through them when the floating ceiling moves up - down.

- **spherical dome roof** with radial girders and circular elements, composed roof structure and welded to it cover plates, which thickness is of t_{ro}= 5 mm. Radial girders are bended on determined radius. Circular elements are straight, forming a polygon. The spherical roof is made of steel S235;

- **floating ceiling**, which moves vertical to his axis, inside in the gasholder. It is composed by radial girders (fig. 3) and ring elements with cover plate which thickness is t_{ro}=5 mm. The cover plate sheets are connected with butt welded joints. This ceiling can change the volume of gasholder and guarantee the gas storage under constant pressure. Floating ceiling is made from steel S235.

In order to guarantee the design working over pressure, additional loads are put on the ceiling;

fig. 3 Floating roof with central standing

- **reinforced flexible gas-proof membrane**, resistant to the stored in the gasholder gas methane. It must be able to bear the accidental pressure up to 4,5 kPa in the vessel. The membrane is connected with bolts to the floating ceiling on one side and to the cylindrical shell on other. The one side of the membrane moves together with the roof and actually the membrane detaches the lower part of the gasholder where is stored gas, from upper, open to the atmosphere part;

- **central telescopic stand**, which is positioned in the middle of the gasholder and guide the movement of the floating ceiling. It is composed of three parts. The most insider part is fixed to the foundation. And the outsider part is connected to the spherical roof (fig. 4). The middle part is connected to the floating ceiling and moves together with it (fig. 3). The different part are sliding one to another with brass rolls in order to avoid rubbing of the steel part one to another which can cause the appearance of the spark and than explosion;

fig. 4 Central telescopic stand with tights

- **supporting grate**, it is mounted in the upper part of the shell and is composed of bended pipes (fig. 5), connected with flanges and bolts or with welding. They form rings on which are hooked vertical guides on which the reinforced membrane slides. In order to avoid the corrosion on the grate, steel elements are hot-dip galvanized.

fig. 5 Supporting grate

2.Gasholder from flexible roof membrane

This type of facilities is built from steel or reinforced concrete cup on which upper end is attached flexible gas-resistant membrane. (fig. 6). The cup is filled with a mix of agricultural wastes and water which ferment and generate gas methane. The generated gas goes to the membrane which inflates itself depending on the quantity (pressure) of the gas in the vessel.

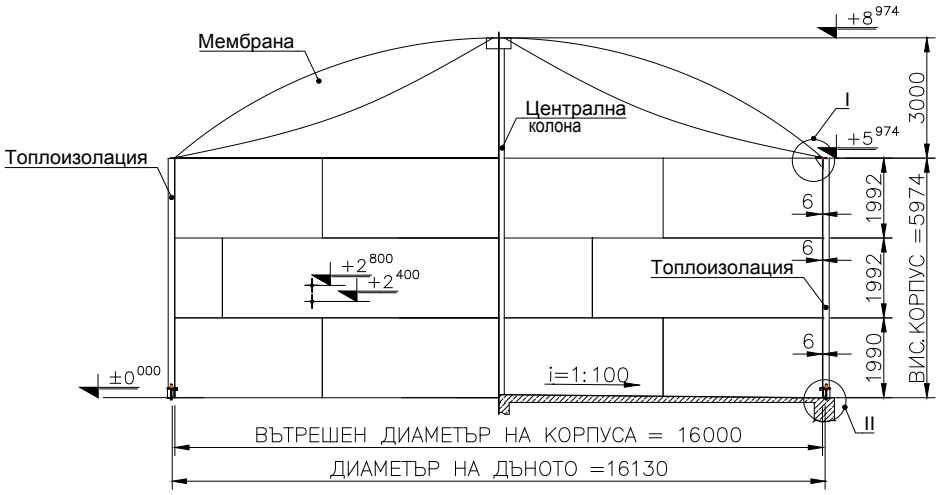

Fig. 6 Gasholder with flexible membrane – general form

This type of gasholders is made by the following constructive elements:

- **conical bottom** with inclination of 1% from the center to the shell. It can be made from reinforced concrete or steel. When the material on the bottom is steel, there are thicker peripheral area under the shell and thinner central part there. The sheets of bottom are connected with lap welded joints;
- **cylindrical shell,** which can be made from reinforced concrete (fig. 7) or from steel (fig. 8). The last one is a better decision because it is more technological and additional measures for water resistance are not necessary..

fig. 7 Shell from reinforced concrete

fig. 8 Steel shell

It is not compulsory that the bottom and the shell are made from one and the same material. There are executed projects in which shell is steel made and the bottom - from reinforced concrete;

- **spherical roof,** it is a flexible gas-resistant membrane (fig. 9), attached to the upper end of the shell. The fermenting process generates a gas which goes to it. Depending on the quantity (pressure) of the gas, the membrane has a different degree of shifting.

fig. 9 Roof domes from flexible membrane

- **supporting grate,** which is located under the flexible dome. It is attached to the upper end of the shell and to central column. (fig. 10). The purpose of the grate is to support the membrane and do not allow membrane to drop in the liquid when there is not gas on pressure in the vessel.

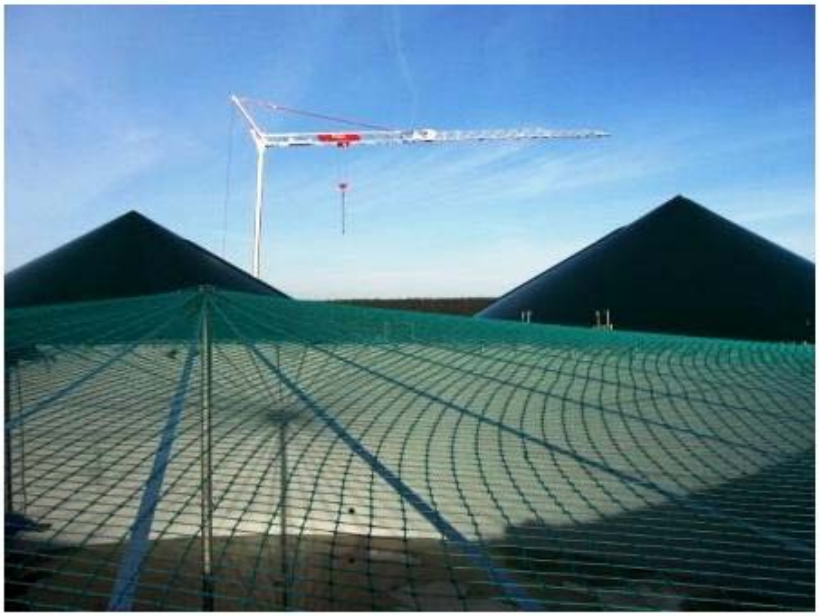

fig. 10 Grate supporting the dome

3. Conclusion

With the development of the new constructive materials and technologies a new gasholder with completely new construction are designed such as the above shown two types. A new constructive element comes into us – flexible gas-resistant membrane which detaches the stored gas from the atmosphere. Due to this membrane the number of the moving elements, respectively mass was decreased or there are not at all. Due to this reason these types of gasholders are more simple for execution and easier for exploitation.