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ON THE ISSUE OF GAS HOLDERS DESIGN FOR GAS STORAGE

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The generalized classification of gas holders is given. Particular attention is drawn to the types of spherical gas holders. The analysis of cutting sheets of surfaces of spherical gas holders is given, their advantages and disadvantages.

Gas holders are widely used for storing, mixing, leveling the composition of gases in the petrochemical, chemical, metallurgical industry, light and textile industry. They are included in the gas network between the sources of gas and its consumers as a kind of battery.

The history of gas holders started in 1775 with gas holder of Neret (Fig. 1).

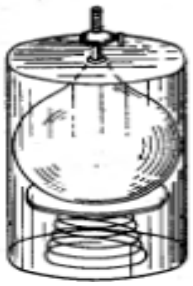


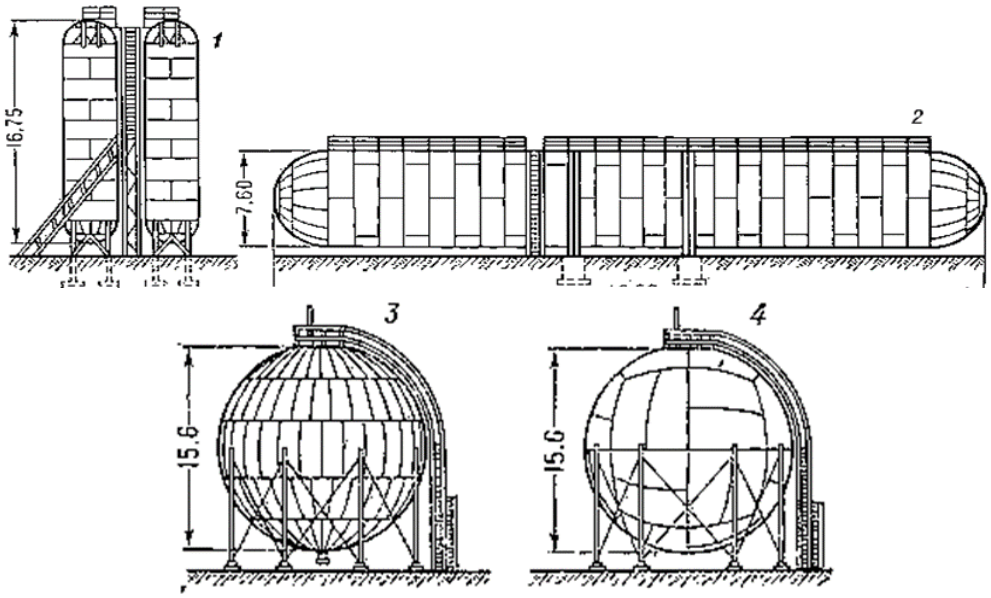
Figure 1. – Gas holder of Neret

The rapid development of the chemical industry nowadays makes special demands on the structures of gas-holders, since various types of gases are used. Wet gas holders, dry gas holders, including ones with a flexible section, are used for gas storage. [2].

Depending on the applied pressure, gas-holders can be divided into two main classes – of low and of high pressure. Low pressure ones, as a rule, are of constant pressure and can be further divided into two groups - wet and dry.

Geometrically gas holders of constant volume are divided into two main types, Figure 2:

- cylindrical gas holders with spherical bases;
- spherical gas holders, built on individual racks or on a special glass.



1 — vertical cylindrical; 2 — horizontal cylindrical; 3 — spherical of five belts; 4 — spherical of football cut
Figure 2. – Gas holders of constant volume (sizes are in metres)

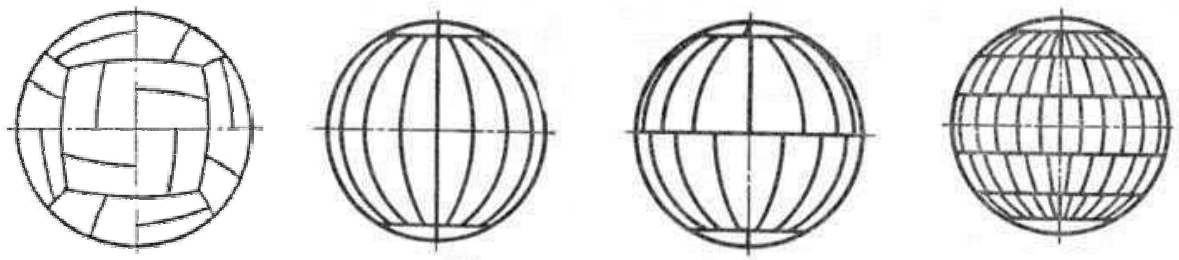
In constructive terms, cylindrical gas holders have much in common with vertical tanks designed for the storage of petroleum products. In this regard, they are manufactured and assembled according to the same technological rolling schemes as steel tanks. The sequence of works is as follows: manufacturing of roll panels of bases and walls, delivery, unfolding and installation of rolls, welding of rolls and steel roof elements, etc.

Spherical gas holders, built on individual racks or on a special glass, have a more sophisticated manufacturing technology than cylindrical, but with such a form, the stress in the structural elements of the liquefied and compressed gases is more evenly distributed, [3]. Therefore, spherical gas holders in comparison with cylindrical ones of the same capacity have the following advantages: less weight and materials cost; less floor area.

In the Republic of Belarus, spherical gas holders with a volume of 600 m3 are mainly used. Advantages: simplicity of design and maintenance. Disadvantage: limited volume of stored gas. Spherical gas holders are used in order to create emergency gas reserves: air for instrumentation and automation systems, nitrogen for fire extinguishing systems, air and nitrogen for purging process equipment, etc.

The cutting of spherical gad holders surface is quite specific. Separate types of cutting are given in Figure 3.

a) b) c) d)



a) – cutting according to the Plato's bodies ("football ball" type);
b) – meridional cutting; c) – equatorial-meridional; d) – mixed type of shell
Figure 3. – Development drawing of gas holders

The shell of the spherical reservoir is usually constructed from petals of double curvature. The choice of the type of the shell cutting is of great importance not only for the economical use of the metal, but also for reducing the labor intensity and the duration of the installation work. Petals should be as large as possible, of the same type and interchangeable. When assembling the shell of petals, the design geometric shape of the shell should be provided without fitting operations during installation.

When choosing the most rational method of cutting the shell, the following tasks are set: making petals from sheets of the same width and length; reduction of the length of welds, including assembly; reducing the number and types of mounting elements; reduction of waste losses; the location of the welded joints of the shell should provide ease of installation.

When cutting the shell according to the "Plato's bodies" type, all sheets have the same configuration, their edges and corners are equal to each other. This is usually a tetrahedron, hexahedron or octahedron.

Meridional cutting is most convenient for automatic welding, since in this cutting there are long, equally directed seams and there are no equatorial and circular seams.

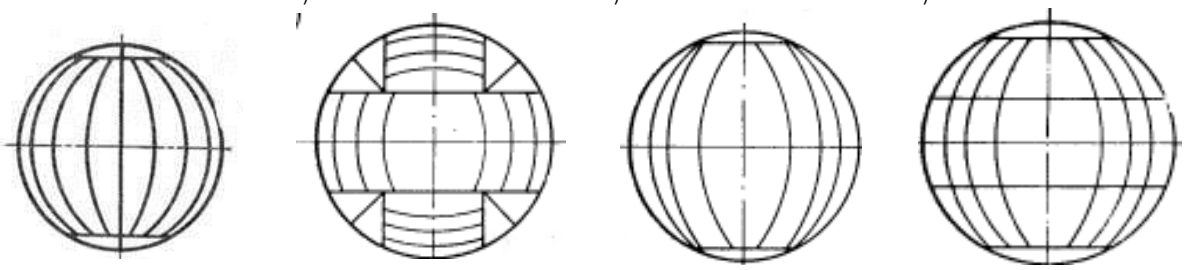
Equatorial-meridional type of cutting is most often used in the construction of large-diameter spherical tanks. Such tanks are always divided into belts.

Mixed type of cutting is rarely used.

In this regard, the research task is to determine the most efficient cutting, including the minimum amount of metal waste and the length of the welds.

The investigated types of cutting are presented in Figure 4.

a) b) c) d)



a) – one-belt type; b) – one-belt mixed type; c) –two-belt type; d) – three-belt type
Figure 4. – Types of meridional cutting

Because of the most massive use of these types of cutting, they were taken for comparing the options. The results are in the table.

Table – Comparison of tanks cutting types

Cutting type	Size of panels, mm	Steel waste when cutting, %	Weld length, м
Three-belt meridional cutting	2300x6000	24	520
	2600x7000		
	2300x5500	20,1	531
	2600x7000		
	2600x8300	10,9	556
	2100x7000	7,4	650
	2600x7000		
	1600x7000	7,7	807
	2500x7500	8,8	616
	2100x7000	8,6	750
Two-belt meridional cutting	2000x8400	21	597
One-belt meridional cutting	2600x8000	14,5	488

Based on the above and the results obtained from the carried research (table 1), we can draw the following conclusions:

- minimal steel waste in a three-belt type of cutting, but the length of the weld is large;
- the minimum length of the seam in one-belt mixed type of cutting, however, the steel waste exceeds twice in the previous type of cutting.

Thus, the best option for the cost of electric power is a three-belt meridional type of cutting.

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