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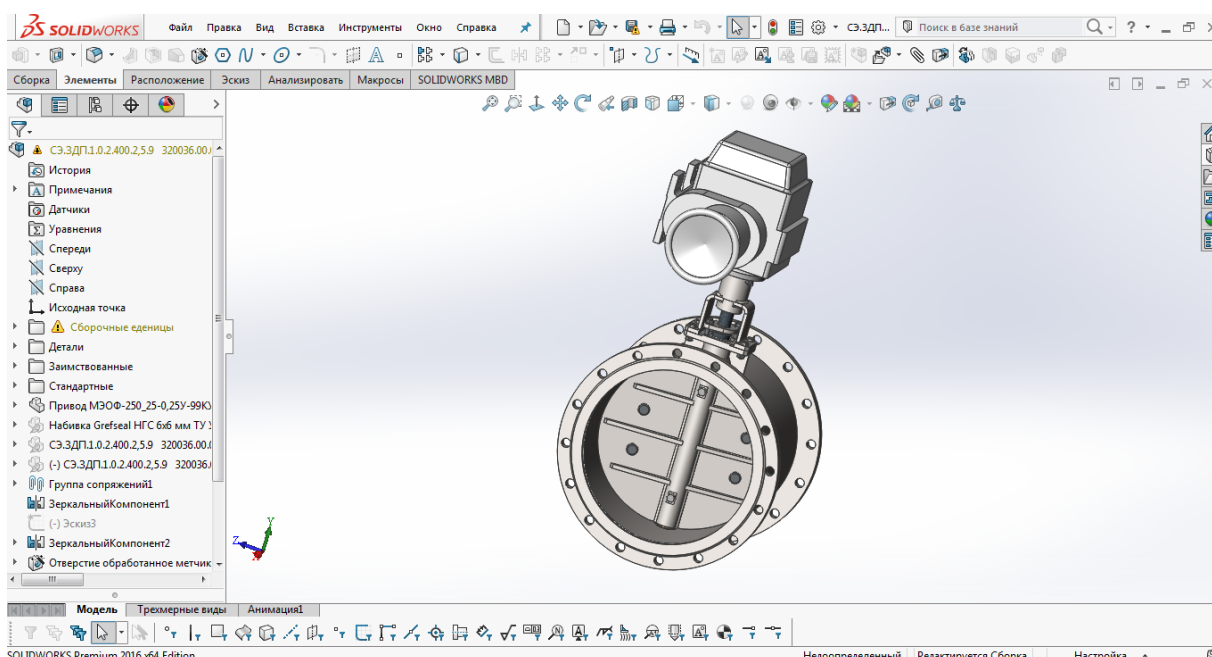
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Methods for Improving the Design of the Shutter for Coke Furnace Pipelines

The shutter in question is used to regulate the throughput of pipelines that transport coke gas produced during coal coking from the furnace chambers to the gas compartments for further capturing and processing.

The main structural units of this device are the housing, the disk and the bearing housing. The housing is the connecting medium for all other units and parts. It is also intended for connecting the shutter to a gas pipe. The disk shutter consists of two half-discs welded to a special pipe. The shutter shaft is placed inside this pipe. The shaft is connected to the output shaft of the electric drive. Single-turn electric actuator rotates the shutter shaft. When the shaft moves, the disk also rotates, thus changing the size of the pipeline clearance. The angle of rotation of the disk is 75° . The disc can take two extreme positions: in the first one, the tube clearance is completely blocked (the shutter is closed), and in the second one, the cross-section of the pipeline is completely free (the shutter is open). The bearing housing hermetises the gas chamber and transmits the torque from the actuator to the shutter shaft.

Here you can see the three-dimensional model of the shuttle made in the solid modeling computer-aided design (CAD) and computer-aided engineering (CAE) SolidWorks program.



Picture 1. The assembly unit “The pipeline shuttle” in the SolidWorks window

The shutter disc undergoes pressure of the coke gas. Welding joints are potentially dangerous places. Half-discs themselves can also be deformed as a result of the action of bending stresses. To avoid deformation and destruction of the shutter, the following design parameters must be selected correctly:

- 1) the thickness of the disk;
- 2) the characteristics of the stiffeners installed on the disc, namely: thickness, height, shape, quantity.

The research objective is to study the stress-strain state of the shutter in the process of its operation and the selection of the appropriate design parameters. Water and air (not coke gas) are taken as a medium because they are used in the test of endurance of the shutter according to the design documentation. The process of performing the work can be divided into the following stages:

- 1) designing the 3D model in SolidWorks, which is the combination of the housing unit and the disk unit with associated parts;
- 2) closing the inlet and outlet of the housing with plugs so that the contour of the housing is closed;
- 3) researching the medium motion in the shutter housing in the supplement SolidWorks Flow Simulation, including the stages of setting the boundary conditions (medium temperature, velocity and direction of medium movement) and determining the gas pressure on the shutter disk;
- 4) researching the stressed-deformed state of the disk arising under the action of the defined pressure in the supplement SolidWorks Simulation;
- 5) making the appropriate design changes in the 3D model;
- 6) verifying the stress-strain state of the modified model under the action of the same pressure in SolidWorks Simulation (the model must satisfy the strength requirements).

The above-given technique allows to improve the design of the shutter for gas pipelines of coke and chemical plants in order to ensure its reliable and durable operation.

References

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