УДК 622.271

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DETERMINATION OF PARAMETERS AND DESIGN OF A HYDRAULIC GRATE SCREEN

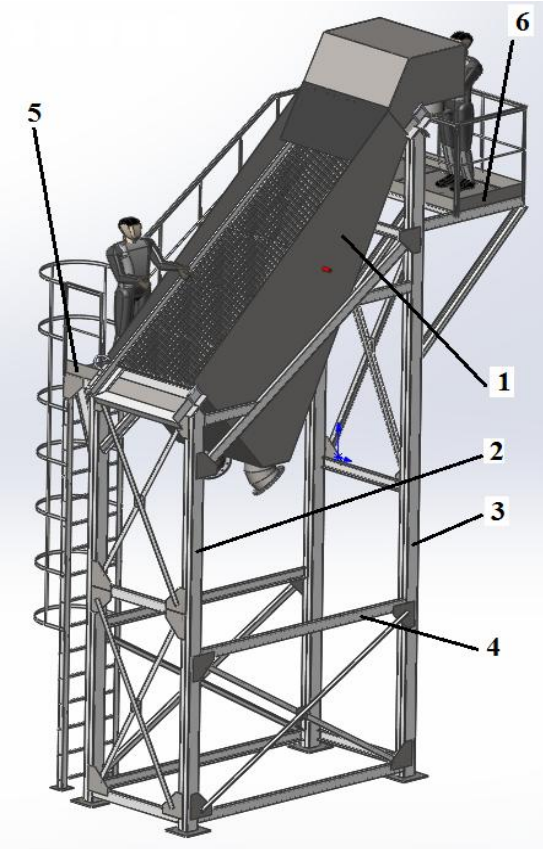

Figure – A hydraulic grate screen:
1 – hydraulic grate screen; 2 – front support; 3 – rear support; 4 – frame brace block; 5 – service platform ladder; 6 – service platform

The installation based on a hydraulic grate screen with a capacity of 1000 m^3/h (figure) is used to clean contaminated natural river pebbles, which are usually mined by floating pump dredgers in flooded quarries, from pebble particles larger than 10 mm, with subsequent discharge of the slurry to a hydraulic dump for dewatering and storage. The use of a hydraulic grate screen is also relevant because such a screen can also work as part of a technological complex with a pump dredger and a slurry transport pipeline [1].

Such a hydraulic grate screen-based installation can also classify other mineral resources by size [2], for example, construction sands: construction sands and gravel from various minerals, glass and molding sands, sands with rare earth minerals, such as ilmenite, staurolite, monazite, silicanite.

In the hydraulic grate screen installation shown, contaminated river pebbles are graded by size on an inclined grate in the slurry stream. Contaminated river pebbles, which can be up to 70 mm in size, are fed to the hydraulic grate screen with a pulp pipeline.

Contaminated natural river pebbles are extracted by a floating pump dredger. So, the raw material, which has the form of a sand-gravel slurry with a concentration of up to 10%, is fed through a slurry pipeline to the inlet of the hydraulic grate screen, and from there it is poured onto the grate. The grains on the grate are classified by size into two classes. After classification, we will have products of the following sizes: over-grid product – more than 10 mm, and under-grid product – less than 10 mm.

After classification by size, natural river pebbles larger than 10 mm will move along the grate beyond the hydraulic grate screen and fall into the hydraulic dump with a size larger than 10 mm. The sub-screened product, which will have a grain size of less than 10 mm, first enters the storage hopper of the hydraulic grate screen, and then, through the drain pipes, it is drained to the hydraulic dump. In this hydraulic dump, natural river pebbles with a size of less than 10 mm are stored and dewatered.

The elements that make up the installation based on a hydraulic grate screen with a capacity of 1000 m^3/h are connected by both detachable bolted joints and non-detachable

welded joints. This type of fastening makes it possible to simplify the maintenance of the screen, the adjustment of its technological parameters, as well as the installation and dismantling of the installation itself, and the replacement of the grate, which wears out under the influence of river pebble particles.

The installation based on a hydraulic grate screen with a capacity of 1000 m^3/h (figure) consists of the following elements: hydraulic grate screen 1; front support 2; rear support 3; frame brace block 4; service platform ladder 5; service platform 6.

All assembly units used in the hydraulic grate screen installation (picture) take into account current standards. They can be manufactured at the facilities available at domestic machine-building enterprises.

One of the main structural elements of the screen, connecting it to the pressure pipe of the pump dredger, is the pipe of the receiving chamber. To determine the calculated diameter of the receiving chamber pipe, we use the following formula:

$$d_{rc} = \sqrt{\frac{4Q_c}{\pi V_n}} = \sqrt{\frac{4 \cdot 0{,}278}{\pi \cdot 3}} = 0{,}343 \text{ m},$$

де Q_c – input slurry productivity, m^3/sec. Its value is determined by the formula:

$$Q_c = \frac{Q_h}{3600} = \frac{1000}{3600} = 0{,}278, \text{ m}^3/\text{sec}.$$

де Q_h =1000 – input slurry productivity, m^3/hr;

V_n = 3 – standard speed for slurry running in pipelines, m/s.

According to the specified calculated diameter of the pipe for the receiving chamber in accordance with DSTU 8938:2019 «Seamless hot-deformed steel pipes», we will take the pipes with an outer diameter of 325 mm. We will take the pipes with an outer diameter of 325 mm. This value coincides with the diameter of the pressure pipeline of the pump dredger, i.e. the diameter of the pipe for the receiving chamber is chosen correctly.

In this work, a SolidWorks solid model was developed, technological and design parameters of the hydraulic grate screen were calculated, and the parameters of its components were substantiated.

References

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