# Main features of lagoons development for agricultural purposes

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ABSTRACT: The classification of a special agricultural structure – lagoon by different parameters: location, depth of development, plan shape and size, conditions of interaction with the environment, material is given. The main technological processes witch influence on design, construction and exploitation of lagoons are described. Basic requirements to materials (geotextile, geomembrane), as well as basic instructions for their use for creating a waterproofing shield during constructing lagoons are presented.

## 1 INTRODUCTION

Territory of Ukraine has in many cases for a long period of time been used and is using for agriculture purpose not only for Ukrainian population but also for export. Agriculture is one of the most important world economy branches and it has a significant influence on human life. The main aim of agriculture is to satisfy the needs of the population for food, and industry - for raw materials.
In our country we can see a positive trend of attracting foreign investment to upgrade the material and technical agricultural base. This encourages us to keep the existing, update and gain new experience in designing and building constructions for such purposes. That's why we decided to provide introductory information about technological features and constructions of agricultural buildings on the example of lagoons.

## 2 MAIN PART

The lagoon in agriculture industry is a small artificial structure - a reservoir, which is designed for the accumulation and storage of animal life products for further processing and subsequent use - as organic fertilizers.

According to the location lagoons divided on: field and farm.

By the depth of development lagoons divided on:

- ground based and half-dipped, with a depth up to 2 m. They used to storage solid substances;
- deepened, with a depth up to 13 m - for storage of liquid substances.

Proper design of manure storages and treatment lagoons is important for safe and efficient handling of manure, wastewater and requires using proper design of it (Jones 2008). In most cases, lagoons have square or rectangular shape in plan with a side up to 70 m.

According to a conditions of interaction with the environment, lagoons are divided into open and closed. They characterized by the presence of a special elastic polyethylene cover of 1 mm thick, which hide organic substances and prevents the spread of odors, infections, nitrogen evaporation and get liquefaction under the influence of precipitation (Vinogradov V.N. 2009).

According to the material from which lagoons can be made they divided onto:

- reinforced concrete, which characterized by high construction costs;
- ground-made in the form of a dam - are arranged on a natural basis with the use of special geosynthetic materials.

The use of ground-made lagoons as an earth dams using geosynthetic materials provides a 100% anti-leakage barrier, their cost is reduced up to 10 times in a comparison with reinforced concrete, the installation speed is increases and the ability to perform the work in winter conditions is appears, they are characterized by long service life and lack of requirements for the dimensions of the lagoon in the plan by length. During designing and building constructions (geotechnical constructions) for any technological processes, we have to know main features of work performance on a given technological object. Given technological processes can cause appearance of additional load on constructive elements. That's why it is important to know about transportation methods of organics into the lagoons. It can be:

- deepened - organic fertilizers are moved underground through the pipeline which is connecting with a lagoon and then pipeline comes out through the bottom of a lagoon;
- semi-deepened – the pipeline comes to the lagoon underground and goes out through the top or everywhere in the slope of the dam
- lay on surface - the pipeline lay on a ground with a certain slope to the surface of the dam.

There is also another important technological process. It is the removal of organic fertilizers, which takes place twice a year. After 6 months of coming organic fertilizers into the lagoon stratification occurs, a compacted solid layer is formed on the surface, and there is a liquid near the bottom (Chastain 2001). To remove such formed mass, it is necessary to mix it with special mixers. Such equipment can affect the quality of the lagoon base (possible damage to the base waterproofing), create additional load on a side dams and needs to be taken into account during the design of a lagoon.

An additional factor to which we need to pay our attention for is geoecological requirements. There are pos-

sible accidents in which there will be leaks of wasted substances into the ground base when the waterproofing of the bottom is damaged, or when substances overflow through the top of the lagoon and then spread in the surrounding area. Particular attention should be paid to this factor on a construction sites with high groundwater level, which can further complicate the process of arrangement and operation of lagoons.

It is necessary to take into account the type of soils which is lie on the lagoons base. Because they significantly affect on inclination angle of the ground dam and the ability of the soil to withstand the load that is applied to the slope dam surface from the mixers and technological vehicles. In addition, it is rational to use the dug out soil from the pit for construction of a closed in plan ground dam. In general the angle of the pit slopes can be: for loam - 45°; for sand - 25°.

Isolation of dipped in the ground construction is performed by using a geosynthetic shield. It consist of two layers. The main task of the first layer is to protect isolation membrane from damage. For these purposes a protective layer of needle-punched non-woven geotextile is used. It made of 100% polypropylene with a static puncture strength of more than 4 kN and surface density more than 300 g/cm2. Surface on which the geotextile is laying has to be flat and free of construction debris. The amount of overlap along the width during laying is 0.3 m. The overlap in length is 0.50–0.70 m. Geotextiles laid without tensions, waves, folds. Fastening of the material to the base is carried out using anchors. They are installed every 1.5-2 meters. Geotextiles has to be UV protected.

The second layer is waterproofing geomembrane. It is high density polyethylene with the addition of soot, antioxidants. Membrane thickness should be at least 1mm with a density of 0.9 cm3. It has to be durable and resistant to aggressive environment (pH 0.5–14) like sulfuric and hydrochloric acids, potassium sulfates, including natural gas condensation. The service life of the geomembrane must be at least 30 years. It must be resistant to temperature changes in the range from –40° C to + 50°C, safe for the environment and human health.

Depending on the purpose, geomembranes are divided into smooth, textured and profiled. The texture presents a rough surface on one or two sides. It provides better adhesion of the membrane to the ground base. Such canvas does not slip and it can be mounted on a slope. Therefore, textured geomembranes are useful for waterproofing slopes and bases with a complex geometric shapes.

The connection of the geomembrane to each other is carried out by melting the thermoplastic material under the influence of high temperature. Connections can be: welded, glued, castle. The weld overlap width has to be at least 150 mm. During welding work, control channels are left to check the quality with a help of compressed air. It is recommended to avoid welding in the corners and they should be parallel to the dam slopes.

As an example fig. 1 shows two ground-made lagoons that were designed and built to serve a pig farm near the town of Korosten in Ukraine.

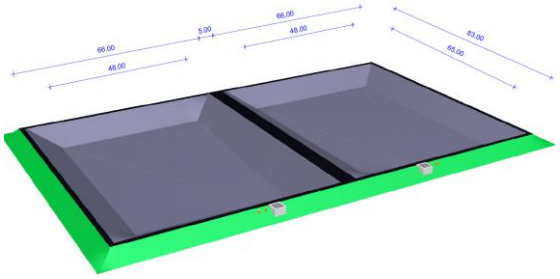

Figure 1. Geometric characteristics of designed lagoons

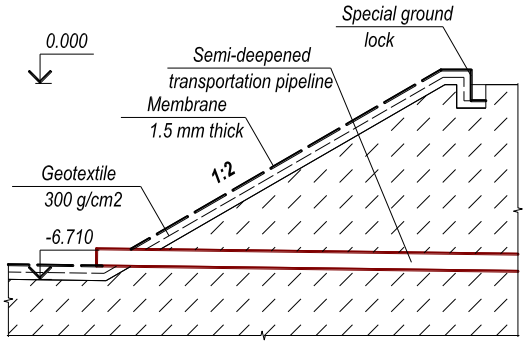


Figure 2. Arrangement of the open type lagoon base

Soil conditions of the site where the construction works took place are represented by loose soils - construction debris, sand, loam with a thickness of 0.5 m, under which lay a layer of greenish-gray, light brown, sandy loam with a thickness of 8 m, below – a layer of fine dark gray sand, medium density with a thickness of 1.1 m, and greenish-gray plastic sandy loam, with silicon inclusions up to 30% to a depth of 15 m. Groundwater is fixed at a depth of 8 m, and does not affect the conditions of construction of the lagoons.

The dimensions of the open lagoons in the plan are 66 x 83 m. The depth of the lagoon (Fig. 2) was 5 m in a comparison with a natural ground surface, and 6.71 m from the top of the dam. Isolation of deepened into the ground constructions was carried out by using a geosynthetic shield. There was a membrane on the bottom of the lagoon with thickness of 1.5 mm and a density of 0.94 g/cm3, maximum value of strength is 42 kN/m, soot content is 2.5% and width is 8 m. To protect membrane, a layer of geotextile with a surface density 300 g/cm2, puncture strength 4.2 MPa was laid under it.

Thus, the main features of the lagoons and ground base protection shield construction were shown.

## 3 REFERENCES

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