Russian National Committee on Irrigation and Drainage

Problems of Long-Term Use of Drained Lands: the Case Study of Heavy Soils of the Central Part of Russia

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Introduction

Currently, there are 9.3 million ha of reclaimed lands in the Russian Federation, of which 4.8 million ha are drained; the balance cost of systems of all the forms of ownership totals 307 billion roubles.

Out of the total area of drained lands 3.0 million ha, or 62 %, are represented with closed drainage systems, including 2.6 million ha in 29 subjects of the Russian Federation located within the Nonchernozem Zone, the remaining land areas are located in the regions of Siberia and Far East.

Statistic of reclaimed lands areas in the Russian federation

	year					
	1980	1985	1990	1995	2000	2005
Reclaimed Lands, total, ml. ha, included:	8,80	10,60	11,54	9,79	9,10	9,28
Irrigated, ml. ha,	4,96	5,80	6,16	5,00	4,47	4,50
Drained, ml. ha,	3,84	4,80	5,38	4,78	4,63	4,78
Agricultural lands, ml. ha	216,0	215,0	212,2	185,3	197,6	192,6
% reclaimed lands	4,1	4,9	5,3	5,3	5,1	4,8

The Non-Chernozem Zone covers a vast area and is referred to the regions of low biological productivity of lands caused by the fact that the greater part of agricultural land areas is located in the regions of increased wetting and over wetting. In addition to this, pollution of soils, surface water and groundwater with chemicals exceeding the ultimate permissible concentrations is observed in some areas of this zone, the pollution being caused by the impact of industry, municipal utilities, and other factors.

Large-scale work related to the agrarian transformation in this zone was carried out over the period of 1974-1990. These transformations were based on multipurpose land reclamation. The lands of this zone needed drainage, removal of brush and stones, liming, cultivation; it was necessary to construct roads, dwelling facilities and to provide production and social infrastructure. Great volumes of works were implemented over the period in question. The Government was responsible for financing of transformations stipulated by the programme

The principal objects of drainage

The principal objects of drainage were overwetted boggy podzolic soils widely spread in the zone under study; the productivity of such soils could be rather rapidly increased through regulation of their water and air, nutritive and thermal regimes. Drainage complete with the system of cultivation and enrichment of soil with organic matter, liming of acidic soils and other measures permit the optimization of fertility of low-productive lands. Another, less topical and having limited spreading, object of land reclamation was peat soil of lowland type. Such soils are rich in organic matter and are referred to potentially fertile lands.

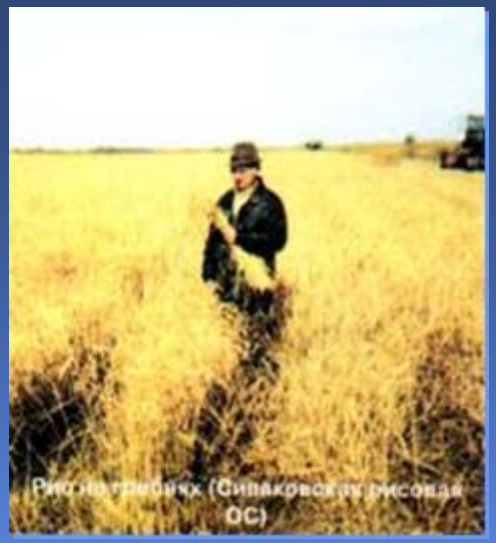
The goal-oriented programme was aimed at developing the system of rational agromeliorative practices for long-term operation of reclamation systems on heavy soils with the use of drainage and rehabilitation of the humid zone soils polluted as a result of human activities. This problem was successfully solved. The assessment of theoretical findings, experimental works and results of their practical use were carried out in some land reclamation project areas of the Non- Chernozem Zone and also in the Republic of Belarus having similar climatic and other conditions.

Land reclamation areas in the Russian Federation

	Total, thousand. ha	Land reclamation conditions (on 01.01.2006 г.)		
		good	satisfactory	Non-satisfactory
Irrigated lands	**4497,0**	**2558,4**	**1024,3**	**914,3**
Drained lands	**4778,5**	**917,2**	**2470,6**	**1390,7**
Total	**9275,5**	**3475,6**	**3494,9**	**2305,0**

Heavy soils of different degree of bogging referred to the podzolic and boggy podzolic types are widespread in northwest and central regions of the Non-Chernozem Zone and in the Republic of Byelarus as well. The agricultural use of these soils is possible only after their drainage. However, it is worth mentioning that drainage of heavy soils is a complicated problem because of the specific physical properties of a soil profile. This is particularly true, when the object of drainage are dense, structure less and gleyed soils with a waterproof subsoil layer ($K_{seepage}$<0.1-0.01 m/day). The problem of drainage of such kind of soils is also observed in other countries.

Agricultural productivity On drained lands in Non-Chernozem zone of Russia



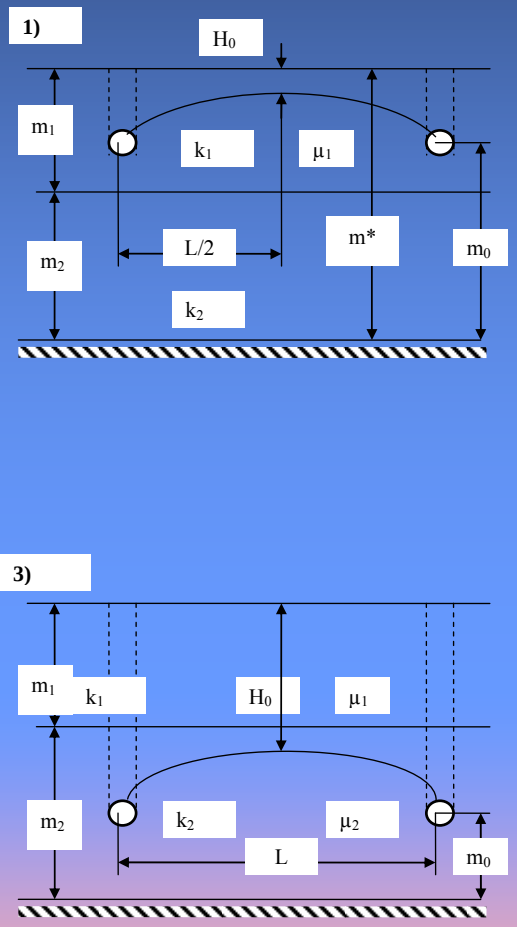
Cereals

Corn under irrigation (Tver district)

Potato on drained lands

Engineering calculations of drainage in heavy mineral soils

Pic.2. Calculation schemes for systematical drainage system design.
L – drainage spacing;
k1, k2 –seepage coefficients
 soil and subsoil layers;
μ1 , μ2 – storage coefficients soil
 and subsoil layers;
H0 – drainage rate;
m0- depth of drain under waterproof layer;
 m1 ; m2 – depths of soil and subsoil layers
 (to waterproof layer);
m* - total (maximum) depth of ground water table



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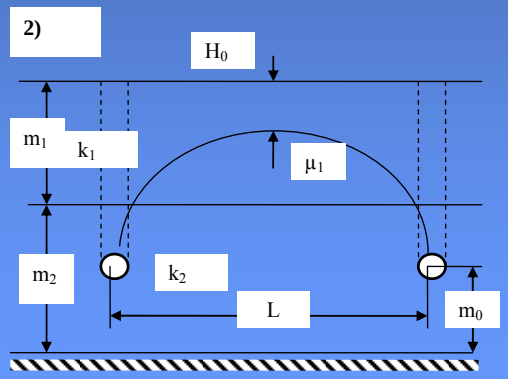


Existing practice

According to the existing practice in the Russian Federation, in case of drainage of overwetted soils using the closed drainage system the recommended drain spacing varies within the limits of 15-40 m depending on the type of bogging and soil properties. As to the world practice of drainage construction, the closed drain spacing in slightly permeable soils varies from 6 to 15-17 m; this value varies from 20-25 to 50 m and more in well permeable soils. For example, the drain spacing in silty clay soils of Poland equals 8 m; it varies from 6 to 18 m in Germany, from 8 to 15 m in Austria and Switzerland, and averages 25 m in England.

The efficiency of heavy soil drainage is also achieved through regulation of the depth of drain laying.
The depth of drain laying in heavy soils of the Russian Federation is assumed to be 1.0-1.2 m.
The depth may be increased to 1.5-2.0 m under the condition of intense feeding with pressure water. In slightly permeable soils, when the line of seepage is not formed in subsoil layers, the depth of drain laying is decreased to 0.7-0.9 m and drain filling with filtering material is provided.
As for the foreign experience, the following depth of drain laying is practiced in different countries depending on soil and climatic conditions:
0.8-1.6 m in arable lands and 0.7-1.3 m in grasslands of Austria, 1.2 m in Finland; at the rate of drainage equaling 0.6-0.9 m,
0.75 - 1.37 m in the USA;
0.9 - 1.3 m in UK and
from 0.9 to 1.5 m in Poland.

Perennial grass on drained lands (2-yields) Agro landscape of VNIIMZ

Productivity 4,5 th.tone. from 1 ha

Construction practice

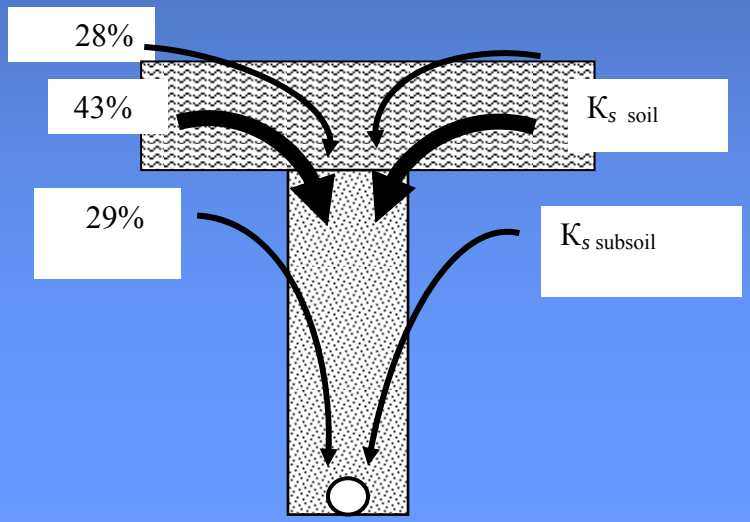
The efficiency of closed drainage operation depends not only on its parameters but also on constructional features of drainage pipes.

Over a long period of time, drains for closed drainage systems were made of tile pipes in Russia. Beginning in 1975, corrugated PVC and polyethylene pipes 50 and 63 mm in diameter are used. Roll synthetic non woven materials are used as filtering materials. Drains in moderately and slightly permeable soils are also covered with local bulk filtering material (sand, wood chips, slag, etc.) and then backfill of trenches with excavated earth is performed.

In draining lands of heavy mineralogical composition, the use is made of granulated material of high permeability (sand, gravel, ash and slag wastes, etc.) for filling trenches.

Pic3. Water flow to drain in heavy soils

$K_{s\ soil} > 5\ K_{s\ subsoil}$



Long-term functioning of drainage systems

- To ensure long-term functioning and more efficient operation of drainage systems with the use of tile and other type of drainage the following measures are necessary:
- regular cleaning of drainage systems (particularly, outlets of discharge collecting drains) from sediments with application of up-to-date methods and use of drain-flushing machines;
- reconstruction, repair, and cleaning of canals from vegetation and sediments. This will need considerable enlargement of the fleet of excavators, cutters, and other special machines in water management organizations..

Conclusions

Considerable volumes of work related to reconstruction and rehabilitation of drainage systems have to be fulfilled in accordance with the approved Federal Goal-Oriented Programme “Maintaining and Restoration of Soil Fertility of Agricultural Lands and Agro landscapes as the National Wealth of Russia over the Period of 2006-2010 and up to 2012”.

During the period of 2006-2012, it is planned to reconstruct drainage systems covering the area of 140 000 ha, to implement a large volume of other works aimed at improving drained land areas, soil fertility and enhancing the efficiency of drained land use.


Thank you