CONTROL AND PREVENTION METHODS OF THE DEGRADED SOIL OWING TO THE HUMIDITY TRANSGRESSION

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ABSTRACT: In this work are presented generalities regarding the humidity transgression and the main causes of the humidity transgression. There are also described the control and prevention methods, as well as the hydrotechnic scheme for the surface drainage.

KEY WORDS: prevention, control, humidity transgression, soil

1. INTRODUCTION

The humidity transgression represents the moment when the soil has not the restraint capacity of the water anymore.

In order to define the humidity transgression it uses more indicators, the most important referring at the water volume which exceeds the field capacity of the soil for the water and at the minimum air volume necessary to ensure the normal conditions of breathing of the plant roots and of the aerobe microorganisms.

To fulfil these conditions, in soil there must be an air volume of minimum 10-15% of the total volume of the soil. The water quantity which reduces the air volume below minimum limit, represents the humidity transgression (fig. 1.).

2. THE EFFECTS OF THE HUMIDITY TRANSGRESSION

The humidity transgression causes in the soil complex and multiple physical, chemical and biological processes, which have negative effects against it and against the plants.The excessive damping causes in the soil the pseudoglaze, glaze and amphiglaze processes, and when they appear in excess, there is a high content of soluble salts, causing processes of salinization and alkalizing.

The glaze process is due to the ground-water layer, when this is at the surface. The pseudoglaze process is due to the presence in soil of an humidity transgression resulted from the atmospheric precipitations. This process is produced in the piemountain areas, on the terraces or on the bottom of the depressions. The amphiglaze process implies the existance in soil of an humidity transgression and it appears at the bottom of the slopes from the hill-plateau area or at the junction between the depressions and the higher surrounding units.

These processes cause some unfavourable aerohydric conditions in the soil, the lack of ventilation restraining the activity of the aerobe microorganisms which assures the decomposition of the organic material in simple compounds, soluble in water and assimilable by the plants.

The humidity transgression influences the thermic conditions of the soils, these become colder and warm harder. The excessive humidity predisposes the soil at the hard frost on large depths, especially in the snowless winters and in the case of late spring

frosts, the gase exchanges between soil and air work out hard, because the water in excess does not allow the replacement of the carbon dioxide educed by the organisms, with the atmospheric oxygen. The structure of the soil is also, affected, because the binders, which unite the soil particles in structural aggregates, are dissolvents, the soil becoming bulky. The soils with humidity transgression are heavier, plastic, adhesive and have a high cohesion, being hard-worked.

The humidity transgression determines an unfavourable aerohydric, thermic, biological and nutritive regime, with negative consequences against soil fertility.

Figure 1. Humidity transgression

2. THE CAUSES OF THE HUMIDITY TRANSGRESSION

The main causes of the humidity transgression are: the precipitations, the groundwater, the infiltrations under the dike, the irrigations, the floods.

The precipitations – consist the main cause of the humidity transgression. Part of the precipitations is retained by the vegetation, the rest being divided between the infiltrations in the soil and the leakage at the surface, depending on the relation between the instant pluviometer of infiltration of the water from the soil.

The groundwater – is the second main cause of the humidity transgression, depending on its position given by the soil quote. It is considered that, if the phreatic level is found at depths between 1-3 m, by capillarity, the groundwater could reach the soil surface.

In the areas where the groundwater is found at depths bigger than 3-5 m, it participates at the water balance in soil, but it is not a cause of the humidity transgression anymore.

The infiltrations – as a rule, the dikes are calculated in order to include the infiltration curve inside them.

The infiltration under the dike is produced in the case of existance in its foundation of some permeable layers.

The infiltration is produced due to the growing of the hydrostatic pressure of the groundwater caused by the high quotes of the embanked water. The infiltrations behind the dike through the foundation are produced at a distance of 200-300 m of the dike.

The irrigations – are a cause of humidity transgression due to the leakages produced with the occasion of watering applyings and through the infiltrations from the channels with the occasion of water transportation.(fig.2.)

Figure 2. The irrigations – cause of humidity transgression

Figure 3. Floods

The floods – in the case of embanked flows the procedure of floods is caused by a complex of factors: the production of abundant precipitations on a field with high humidity which makes that the volume of leakage from the hydrographic reservoir to be big; the overlap of the rainy periods with the melting period of snows; the existance in the bed of embanked flows of some filling points of the total section by exploitation works of the ballast and of the sand; building material depots for regularizations.(fig.3.)

3. CONTROL AND PREVENTION METHODS OF HUMIDITY TRANSGRESSION

On the steppe areas, the irrigations together with the other agrophitotechnical measures can double or triple the production of the agricultural crops, and on the podzolic soils this matter can be made by the bailing out the excess of water from the soil, combined with the ameliorative measures and with those agrophitotechnical.

A large part of surfaces of podzolite and podzolic soils sown with crop, keeps up to the end of spring, sometimes and in the summer or during the autumn, a pronounced humidity transgression, with noxious effects. The water excess collects in microdepressions, and on the plane fields, the water swamps at the surface. The humidity transgression burdens a lot the performing of the mechanical works at the best time, and their quality leaves much to be desired.

To obtain good crops on the podzolite and podzolic soils, simultaneous with the correction measures of the chemical features, are necessaries the elimination measures of the humidity transgression, too. This can be done:

- by leaking of the surface waters;
- through the internal drainage of the soils.

The leakage of the surface waters and the bailing out of the water excess from the soil, can be made just together, by taking the same measures, which are in a close interdependence:

- the performance of a draining channel web;
- the increasing of the soil permeability;
- the increasing of the organic matter content;
- the performance of the underground drains;
- the modeling of the soil in some cases.

By removing the humidity transgression of the soil surface and from the soil profile using draining-drainage works, the airing of the soil is improved, which has the effect of the ameliorating of the thermic regime, the biochemical processes of oxidation are promoted and there are created normal conditions for the activity of the microorganisms from the soil.

To remove the humidity transgression the following works are made:

a) The draining – represents an aggregate of hydrotechnical works and agropedoameliorative measures which has the goal the removing of the water excess from the soil surface or from the soil profile, creating normal conditions to develop the plants and to carry on the production processes.

The hydrotechnical works of draining include the channel and the collecting and evacuation drain web, the pumping stations,

the hydrotechnical constructions of the channel and drain web, the installations for measuring the levels and the leaked water discharges, the installations of communication and automation, etc.

Draining methods:

- the evacuation of the water in excess by leaking at the land surface.
- the drainage of the water in excess from the root level of the plants.
- the evacuation of the water by leaking at the land surface and the drainage of the root level.
- the biological drainage.
- the silting – is the process where the land quote is raised due to the naturally or artificially alluvial of it.
- frontal drainages – consists of depth longitudinal raws or drains, made using different technical solutions which collect the infiltrate waters.

In the wet climate conditions, the draining-drainage must cause the production in the active level of the soil, of an optimum ratio between the water and the air. The drainage presents two subdivisions:

- Drainage at the surface: it is occupied with the evacuation of the water excess from the land surface and from the superficial layer of the soil, using open channels. For this category of works, in the romanian technology it is used the term of draining.
- Underground drainage: consists of works which have the goal to control the groundwater level or the water excess from the soil profile, using buried perforated tubes, called drains.

The drainage has the following objectives:

- on the lands with normal hydrological regime, to prevent the production of the humidity transgression, caused by the irrigations and floods;
- on the lands with surplus hydrological regime, to ensure the collecting and the evacuation of the excessive humidity from the soil and that land to be used with a maximum agricultural productivity;
- on the nonproductivity lands from the low areas, to collect the humidity stagnated at the soil surface and in soil, making thus the introduction of the land in the agricultural circulation.

Beside the hydroameliorative part, the drainage works have an ecological part, too, by protecting the soils quality against pollution by salinization or by secondary swamping. The goal of these interventions is strictly economic and thus the works must be applied with judgement in order to combine their favourable economic effect with the preserving of typical or rare ecosystems.

b) ***The deep breaking up*** – is made with the soil broken up machine.

c) ***The leveling in slope***

d) ***The modelling of the land in strips with ridges***. In the first stage the gutter between ridges is leaked and then during this, up to the collecting web.

It is distinguished between the soil drainage and the land drainage.

The soil drainage represents the leakage of the water through its profile. The land drainage represents the (underground) soil drainage, the speed and the leakage at the land surface.(fig. 4.)

In the conditions of humidity transgression is produced the leaching of the colloidal particles and their storage in a accumulation horizont, that leading to the modifying of the porosity. This influences the infiltration capacity and the restraint capacity for the soil water. If the permeable layer presents a bigger thickness, it can reach at the flood of the soil profile then when due to some abundant precipitations the whole profile is filled with water.

4. THE HYDROTECHNICAL SCHEME FOR THE SURFACE DRAINAGE

During the main drainage works it could be distinguished the following categories of works:

- surface drainage
- underground horizontal drainage
- vertical drainage

The surface drainage represents the totality of the hydroameliorative works whose goal are the control and the prevention of the humidity transgression produced at the land

surface and in the superficial layer of the soil. The surface drainage web consists of the following elements:

Figure 4. The land drainage

- *collector channels of the water* (CC) in excess, which delimit between them land surfaces called lots
- *interception channels of the external waters*, which leak from the high lands, limitrophe to the arrangd land (belt channels, CCC) or of infiltration from the embanked flows (infiltration channels CCI)
- *evacuation channels*, (CE) which receive the water of the collecting or interception channels and lead it to the emissary.

These can be differentiated in:

- secundary evacuation channels (CES)
- main evacuation channels (CEP)

The tracing of the channel web

The surface drainage channels trace on the lower lands of the arranged surface, where the water has the tendency to concentrate naturally, respecting the organisation requirements of the territory, the mechanization requirements of the agricultural works, the arranged requirements for the irrigations, control of the soil erosion, etc.

The collector channels (CC) have the role to collect the waters from the land surface, which stagnate or present a slow leakage. With that end in view, they are traced on the general direction of the level curves (perpendicular on the slope direction) assuring them a slope of minimum 0,5%.

When the collector channels will be traced, it will be taken the following principles into consideration:

- to pass through, as far as possible, the depression areas of the relief, especially those with the level differences bigger than the surrounding land.
- If, respecting a certain distance between the channels, on the space between them there are depressions, it will be ensured the unloading of them in the nearest channel using gutters (temporary channels, fords) with slopes (1/3,1/4) in order to be pass through by the agricultural machines
- it will follow the assurance of some lots with a regular geometrical shape (rectangular, trapezium, parallelogram) with long sides – built from the channels - parallel
- as far as possible, the surfaces delimited by the channels (lots) must be equal between them in order to ensure an efficient structure of the agricultural work processes. The surface of a lot is between 20- 90 ha.

Depending on the relief and the microrelief of the land, on the pedological and hydrological conditions which condition the water circulation at the land surface, in soil and underground, it could be made systematic webs or desultory webs.

In case of systematic webs, the distance between channels can be calculated with one of the following relations:

$$d = \frac{24T\sqrt{I}}{n} x \frac{(K_s H)^{2/3}}{(K_s H)^{2/3} - I} (\text{m}) \quad \textbf{(1)}$$

where:

T – time of water evacuation from the draining surface, hours;
I – the medium slope of the land, m/m
n – rugosity coefficient of the land, (after Kutter), with the values:

- n= 0,030 – grazing fields and hayfields with short grass
- n= 0,035 – grazing fields and hayfields with high grass
- n= 0,040 – maturity agricultural cultures
- n= 0,050 – rare bush, with weeds

K_s – leaking coefficient characteristic of the low lands

H – the water layer in the moment of ceasing rain, mm: H = 0,65 x I t_p

I – the rain intensity (mm/hour)

t_p – the rain duration (hours)

d – distance between channels (m)

$$d = \frac{78}{\gamma} \eta i T^2 I \text{ (m)} \qquad \textbf{(2)}$$

where:

i – intensity of the calculation rain, mm/hour, usually i = 1-3 mm/hour;

I – medium slope of the land, %

γ – coefficient of leaking: (0,3-0,5)

η – coefficient with the value of: (3-5)

T – duration of water evacuation, hours

The length of the collector channels has values of 800-1500 m with the tendency to reach high values, up to 200 m.

The length is established depending on the slope and on the land microrelief, following that the maximum deep to ensure the collecting of the water from the gutters and drains.

The evacuation channels are traced on the lowest quotes of the served land, following the thalweg of the vallyes and of the main depressions. If the land allows, the evacuation channels could have bilateral action, in that case it could be traced at the big distances: 1600-3000 m in the case of secondary evacuation channels. In the case of the unilateral action, the secondary evacuation channels are placed at distances of 800-1500 m. Their length could reach at 1500-3000 m thus, with a minimum length is ensured the serving of the interested area.

The collector channels of interception (CCI) are traced at the limit of the draining surface and, as far as possible, perpendicular on the direction of the external water inflow. They will follow the lowest places of the land from that area, as well as the general slope of the field.

The belt collector channels (CCC) collect waters which leak from the high lands, limitrophe to the arranged area preventing the flood of the land. The maximum length of the belt channels do not pass beyond 1500 m.

The belt channel, is usually made, in the shape of a channel with the width bigger than the depth, with small longitudinal slope (i‹0,5%), with the slopes inclination differentiated; the upstream slope – 1/2; the downstream slope – 1/1,5-1/2.

The infiltration collector channel (CCI) are placed parallel with the dike at 30-50 m of the internal slope foot of it.

If the land of the dike area presents a big permeability, the channels will have depths up to 2 m, in order to collect all the infiltrate flow. If the land has a weak permeability or is impermeable, there are used low depth channels, as gutter type. The collected flow will be dischrged in the nearest draining channels of dike; these channels must have a minimum depth of 1,5 m.

5. CONCLUSIONS

The main causes of the humidity transgression are: the precipitations, the groundwater, the infiltrations under the dike, the irrigations, the floods.

- To remove the humidity transgression are made the following works: the draining-drainage, the deep breaking up, the leveling in slope, the modelling of the land in strips with ridges.

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