SOLUTIONS TO ECOLOGICAL RECONSTRUCTION OF SALT LANDS

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Abstract
The paper presents improvement solutions for the ecological reconstruction of salt land according to the characteristics of their natural conditions. Agroameliorative, agrobiological, agrochemical and hydroameliorative methods may be used. Effectiveness of ecological restoration increases by applying complex ameliorative works. The main role of such an undreground drainage facility is to collect the salt-loaded, leaching water. Drain distance is calculated for non-permanent flow conditions, establishing a distance L that allows the lowering grounwater level from its highest hydraulic load to its best value, h_t, withing a given time length. The sewer canals should have a depth of min. 1.2 if the land is not equipped with underground drains, and between 1.5 and 1.6 if underground drainage exists.The distance between the antenna and the sewer canal should be about 200 m or the length of the watering installation. Vertical drainage consists in the use of wells with a depth of 25 m, equipped with selected gravel filter (Ø 2-7 mm) and a decanter (1.5 m in length).

Keywords: ecological reconstruction, salt soils, external drainage, electrical conductance, leaching standard

1. INTRODUCTION

The concern for improving salt soil started in the 20th century, resulting from extending secondary salinization of irrigated lands and in particular the need to preserve usable arable land.

The main ameliorative solutions that can be applied are [2]:

- agroameliorative methods aiming to increase soil permeability for water: deep loosening at 0.40–1.50 m, subsoiling, application of some mineral materials for amelioration purposes (sand, power station ash, etc);
- agrobiological methods that increase the soil content in organic substances and improve its physical features (green or bacterial fertilizers);
- agrochemical methods that correct the unfavourable soil features (gypsum amendments, calcium carbonate, etc);
- hydroameliorative methods that provide salt removal from soil by mixed drainage-irrigation facilities.

The application of complex hydro and agroameliorative works for a time period of 5-8 leads to a better quality of salt soil that can be agriculturally used through a variety of agricultural crops more tolerant to salinity, according to a specific agricultural technology. In time, soil quality is improving, comparable to the normal practices allowing a wider range of crops and obtaining proper profit.

2. MATERIAL AND METHOD

Stages in aplying hydroameliorative solutions. Ameliorative solutions to salt soils should be classified according to their complex natural conditions and be applied in several stages [1].

Thus, in **stage I** the hydrotechnical scheme must be designed to regularize the system of surface water and aducțiunea of leaching salts. During this stage, 3-5 sub-stages can be differentiated according to different objectives: to improve land reclamation from the existing facilities; to improve small isolated areas, unevenly placed within the area, by using agroameliorative measures; to improve soil salt outside the existing land improvement facilities by agroameliorative works, etc.

Stage II includes the lands located outside the hydroamelioratively-planned areas and are provided with drainage and salt leaching works, as well as appropriate agroameliorative measures.

Stage III consists in the application of some final ameliorative works that were not highlighted in the previous stage.

The following solutions can be applied for the hydroameliorative works within the above-mentioned stages:

- salt land leaching, no drainage network. The work is preventive and applies to secondary salt soils with good internal drainage, formed on permeable deposits, with the ground water at great depth;
- salt land leaching, after the drainage of surface or underground water, with a preventive role. The work is recommended for the existing irrigation facilities, in order to maintain the salt tolerance threshold of crops;
- drainage facilities based on salt leaching by rainfalls. It can be applied to areas where annual rainfalls exceed 550 mm, or as salt leaching stage where washing water collection requires uneconomical investments.
- drainage facility based on intermittent, rice-type flood leaching. It is recommended for average or high salt lands situted in areas favourable to growing rice crops;
- drainage facility based on intermittent spray flooding. It is the most highly applicable solution resulting from its economic and ameliorative advantages;
- mixed drainage facilities, horizontal and vertical, based on spray leaching. The solution is limited by hydrogeographic and ecological conditions;
- drainage facility based on intermittent or continuous leaching by surface runoff on bands or furrows.

The first land reclamation work to be applied in the salt-land amelioration facilities is drainage. The purpose of the facility is the evacuation of the waters stagnating on the surface and the leaching waters land by maintaining the groundwater level at a certain hydraulic load.

The natural conditions imposing certain planning solutions are the following:

- Soils with unfavourable external drainage, permeability over 5 m / day and ground water depths over 1.5 m, can be equipped with a systematic or unsystematic canal network for surface drainage;
- For layered soils with slight permeability in the top layer over 8.6 m in thickness, low permeability and transmissivity <50 m^2/day in the bottom layer, horizontal underground drainage works are recommended, either systematic or unsystematic.
- For layered soils with top layer thickness below 6 m, transmissivity > 50 m^2/day and groundwater quality that can be either potable (<3 g / l salts, etc.) or used for irrigation purposes, self-pumping vertical drains can be used.
- For layered soils with lower layer water under pressure and a degree of mineralization over 3 g / l, flow rate under 8 l / s, self-pumping vertical drains can be used if the coating is less than 6 m in thickness;
- For layered soils of high hydraulic resistance and groundwater under pressures, a tiered drainage facility can be used, based on vertical drains discarging into horizontal tubular drains, (fig.1.).

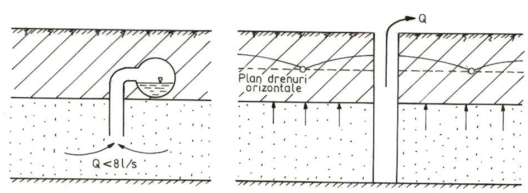

Fig. 1. Schematic presentation of tiered drainage conditions

3. RESULTS AND DISCUSSION

The main role of such an undreground drainage facility is to collect the salt-loaded, leaching water. Considering that salt lands are situated in dry areas, where the danger of secondary salinization is obvious, the depth of drain positioning should maintain underground water below the critical salinization depth.

The same condition should be provided in the case of surface drainage channels whose depth should maintain their water under the critical salinization depth.

Therefore, the channels and drains should be placed at lower depths than the drainage standard by 0.5-0.8 m. Orientatively, recommendations include the following positioning depths (channel depths):

- 1.5 – 1.8 m on light-textured soils
- 1.8 – 2.0 m on meadium-textured soils
- 2.0 – 2.5 m on heavy-textured soils

A tiered drainage network can be arranged on heavy soils by using some shallow drains (0.6 - 1.0 m) at long distances (50-70 m); the drains are demolished after soil desalination.

The hydrotechnical scheme of the drainage facility is based on the same principles as the collection and disposal of excess water, as it often performs this role even after soil desalination is over.

The distance between the sewer canals correlates with the distance between the last permanent elements of the irrigation water network, typically included within a range of 200-300 m.

It is necessary to adopt a unified concept for the compaction of the two hydrotechnical schemes (drainage and irrigation) so that it does not interfere with the use of the agricultural land.

The following drainage criteria should be known when designing the underground horizontal drainage system:

- for the non-permanent flow:
- hydraulic load of groundwater, h_o, at/2 L, at the initial time, after reloading
- hydraulic load of groundwater, h_t , after the recovery time (t)
- recovery time (t)
- for the permanent flow:
- hydraulic load of groundwater compared with the slight permeable layer, h
- drainage-evacuated flow, resulted from (q):

$$q = (1-\eta)\frac{m}{t} \quad \text{(mm/day)}$$

where:

η - watering efficiency,
m - watering standard, mm/ha
t - watering time length, days

- water application corresponds [3] to the leaching requirement and is determined by the following:

$$R = (ETP - P)\frac{CEi}{f\,(2CEd - ECi)} \quad \text{(mm/month)}$$

where:

ETP - potentialevapotranspiration, (mm/ month)
P - actual rainfall, (mm/month)
CEi - electrical conductance of irrigation water, d S
Ced - electrical conductance of drainage water, d S
f - factor of soil leaching efficiency (0.2 – 0.3 sandy texture; 0.5 – 0.6 sandy-loamy texture)

The leaching requirement can be calculated for the whole growing season, which has the advantage that it may require leaching. If the irrigation application leads to water losses exceeding the leaching requirement, the latter is no longer necessary, as salt balance is provided by the water lost during the application.

Drain distance is calculated for non-permanent flow conditions, establishing a distance L that allows the lowering grounwater level from its highest hydraulic load to its best value, h_t, withing a given time length. This can be solved by applying the following calculation hypotheses:

- modified Glover Dumm:

$$L = \pi\left(\frac{Kdt}{Pa}\right)^{1/2}\left(\ln\cdot 1{,}16\frac{h_o}{ht}\right)^{-1/2}$$

- Kraijenhoff van de Leur and Maasland

$$h = \frac{qL^2}{8KD}$$

4. CONCLUSIONS AND RECOMMENDATIONS

Land planning for salt leaching purposes can be achieved through several solutions depending on the method of salt soil amelioration, land use in the current situation and after amelioration, as well as economic opportunities.

- Facilities based on surface drainage canals and leaching by surface leakage. Leaching water distribution on the field is made through the irrigation furrows whose downstream flow is collected by a ditch discharging into a sewer canal. The latter is sized for about 50% of the flow channels plus the calculated rainfall-produced flow (highest rainfall in 24 hours, to ensure maximum 5%). The sewer canal depth should be at least 1.1 to 1.2 m.

- Facilities based on surface drainage channels and spray leaching. Site planning involves linking the two hydrotechnical schemes. Thus, the distance between the sewer canals must determine the length of the irrigation facility while their depth should take into consideration the possibility to introduce underground horizontal drainage.

The sewer canals should have a depth of min. 1.2 if the land is not equipped with underground drains, and between 1.5 and 1.6 if underground drainage exists.

The distance between the antenna and the sewer canal should be about 200 m or the length of the watering installation.

- Distribution scheme of the surface drainage channels, vertical pumping drains, horizontal drainage, and spray leaching. This solution is possible if the land has a low coating thickness (1.5 to 4.0 m) and the permeable layer has high transmissivity and a flow over 8-10 l / s while the level of water mineralization is suitable for irrigation.

- Vertical drainage consists in the use of wells with a depth of 25 m, equipped with selected gravel filter (Ø 2-7 mm) and a decanter (1.5 m in length). Vertical drains are located in the 800 x 432 m scheme according to the requirements included in the irrigation plan. The average flow of a well is 25 l / s.

5. REFERENCES

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