Research Journal of Agricultural Science, 58 (2), 2026; ISSN: 2668-926X;

http://doi.org/10.59463/RJAS.2026.2.03

SOME METHODS FOR PREVENTING AND FIGHTING AGAINST THE CLOGGING OF DRAINAGE PIPES WITH FERRUGINOUS SEDIMENTS

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Abstract. *Drainage works are hydro-ameliorative measures intended to lower the groundwater table in the soil and to remove excess saline water resulting from soil leaching conditions, which are necessary for soil improvement. The depth to which the groundwater table is lowered relative to the ground surface (called the drainage norm) depends on the pedoclimatic zone, the agricultural crops, and the soil layer subjected to leaching. The conditions required by plants are called drainage criteria and have been relatively little studied; more attention has been given to the groundwater level and its variation regime, as well as to soil salinity in the root zone. The decrease in agricultural yield is caused, at high groundwater levels, by a lack of air in the soil, and at low levels, by a lack of water in the soil. In clay soils, in order to achieve good agricultural production, the groundwater level must be maintained at a lower depth. Through this paper, we aim to ensure the prerequisites for the proper and long-term functioning of drainage pipes used in drainage and land reclamation systems. In another study, we analyzed the process of formation and deposition of iron and manganese compounds in drainage pipes. In the present paper, we further examine and propose certain preventive measures to avoid and combat the clogging of drainage pipes with mineral deposits, especially those of iron and manganese compounds. At the same time, we provide recommendations regarding the design, construction, and operation of drainage networks.*

Keywords*: soil, excess moisture, drainage, sediments, agriculture*

INTRODUCTION

A modern drainage system includes a systematic network of drainage canals and a subsurface drainage network, together with the associated hydraulic structures, equipment, and installations. Drainage networks are designed to regulate the groundwater level within the area between drainage canals.

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The decrease in agricultural yield is caused at high groundwater levels by a lack of air in the soil and at low levels by a lack of water in the soil. In clay soils, in order to achieve good agricultural production, the groundwater level must be maintained at a lower depth.

Experimental studies carried out in our country on agricultural drainage fields, for different pedoclimatic zones, have shown that in some areas (such as the Danube Floodplain) the drainage norm values are Z = 1–2 m for crops like wheat and sugar beet. The design

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drainage discharge (q = 7–15 mm/day) is determined in experimental drainage fields, depending on pedoclimatic conditions, the infiltration capacity of precipitation water through the unsaturated soil zone, and then the movement of water through the saturated zone toward the drains. The drains must have a collection capacity greater than the design drainage discharge (q). The collection capacity of drains is determined based on the degree of clogging of the filtering material and of the drain itself, in contact with the soil in the area to be drained.

MATERIAL AND METHODS

Techniques and methods for fighting against the process of clogging

The techniques used for fighting against the clogging of the drainage pipes with ferruginous compounds can be prophylactic methods and they are used for preventing the accumulation of the sediments in the drainage pipes, or they can be methods of exploitation, which are used for removing the accumulated sediments.

The authors suggest the following prophylactic methods, which are more efficient:

1. Fighting against the entering of iron protoxide in the draining pipes

The elimination of the iron protoxide from the underground waters before there are entering into the draining pipes, is possible if we are introducing some inhibitory substances in the soil used for filling up the ditches of the drains, inhibitory substances which form with the iron protoxide some insoluble sediments. The introduction of the lime in the drainage ditches (the lime is laying on the bottom of the ditch in the soil used for filling up the ditches) in order to protect the draining pipes against the process of clogging with ferruginous sediments.

This method proved to be a very efficient method and it is used over 50 years in Denmark and Finland and more recently in Germany.

The researches made until present time made evident the fact that very good results are obtained from using 2 kg/m.l. burnt lime. In this case, the technology of creating the draining system with absorbing pipes made from ceramics, foresee the following logical succession of the works that need to be done (Figure 1):

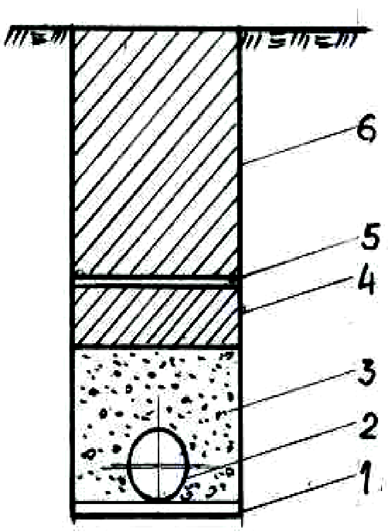

Figure 1. Cross-section of the drainage system (proposed by the authors)

Depositing a lime ledge (1) on the bottom of the ditch, taking photograph of the draining pipes (2) and of the filterable material (3) , covering with a terrestrial ledge combined with humus (4) (made between 7 and 10 cm thickness) , depositing a lime ledge (5) and covering the rest of the ditch with soil (6).

The necessary quantity of lime can be calculated after the environment acidity (pH) and after the capacity of free Ionian of CO_2 in the water, in the same way as it is calculated for purifying the water in the network of providing drinkable water.

But, as inhibitory other materials can be used, as well. In U.S.A. the slag furnaces with phosphorus content are used in order to protect the pipes against clogging with chemical sediments.

The iron phosphate that is formed due to the contact between the iron protoxide and the slag remains in the soil used for covering the pipes in the ditches and it does not enter in the drains.

The danger of clogging the pipes is considerably decreasing with lime treating of the soils. Thus, at a superficial treating with 300-500 kg/ha of lime, with an ulterior burying under the furrow at a depth of 30-40 cm, the possibility of depositing the ferruginous sediments is very much reduced.

A greater effect is obtained in case of introducing the lime in heavy soils at a depth of 0.7-1.0 m .In case of breaking up deeply the soil is ascertained that the process of clogging is constantly decreased.

2. Fighting the oxidation of the ferrous salt in the drainage pipes.

As the researchers point out (Reeve, Luthin, Donnan,1987), the drainage systems which have the evacuation mouths of the collectors flooded are less clogged than the collector systems photographed over the water from the channels. Based on these ascertain facts, it is proposed that in order to limit the oxygen change in the drains, the mouths of evacuation should be drowned (Figure 2).

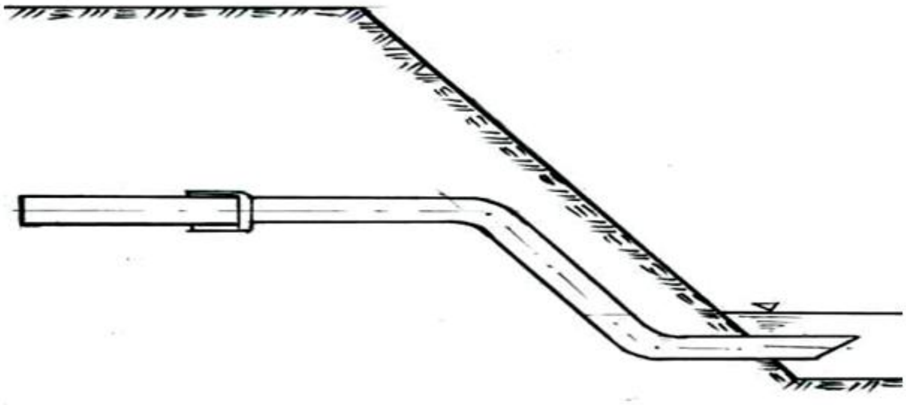

Figure. 2. Longitudinal section of the drainage system (proposed by the authors)

Thus, the condition of permanent drowning of the mouth is assured by the construction of an evacuation mouth in the collector channel, formed by a plastic pipe, bent downside and descending to 0.2-0.3 m under water.

Positive effects were obtained in Denmark and Sweden by using lines of drains with mouths of evacuation drowned without flooding the drains.

Choosing this constructive solution presents the advantage that the slope of the channel remains free until the level of the water, having the evacuation mouth flooded. Thus, it is permitted the utilization of mechanical methods for mowing the vegetation or for readjustment the section of the channel.

Another constructive measure, which is recommended, is increasing the diameters of the drainage pipes so that the sediments should be retained, without their complete clogging. Thus, in U.S.A., the minimum diameter in the mineral soils is of 100 mm; in Cehia the technical conditions recommend the minimum diameters to be 65-80 mm; in England the

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ceramic pipes have minimum 75 mm diameter. Another advantage of this measure is the increasing of the capacity of collecting of the drains.

3. Fighting the accumulation of the sediments in the drains.

The most radical prophylactic method of fighting the accumulation of the ferruginous compounds in the drains is hobbling the stagnation of the water. The speed of the movement of the water must pass the minimum admissible values from the clogging conditions point of view (0.3-0.4 m/s). Assuring such a speed means that the slope of the drainage pipes should be increased.

The technical indications for projecting the draining network establish the minimum slope in the drains from ferruginous soils to be at 0.004.

The researches made in Germany showed that with a slope greater than 0.005 the process of clogging is tiny.

Increasing the slope of the drains and of the collectors is not possible many times, because this involves a greater depth of the evacuation mouths. Yet, if there is possible, it is necessary to increase the slope of the drains in order to avoid great accumulation of the ferruginous compounds.

The iron sediments in the soil around the drains decrease the impermeability of those mentioned before, which must be taken into account during the process of establishment of the distance between the drains.

In Germany, when the danger of clogging was noticed, the distance between the drains were recommended to be between 5 and 10 times smaller than the distance between the drains in the regular soils. (KUNTZE, 1978). In Cehia the distances are increased with 1.2 m in case the iron content is higher than 8 mg/l.

The material of the filters and the type of the drainage pipes also influence the intensity of the process of clogging.

The researches made in Germany pointed out that the ceramic pipes are clogged between 17 and 29 times less than the plastic pipes (SCHAFFER and SCHMITZ,1970). A greater clogging of the plastic pipes is explained by electrostatic phenomenon, which is manifested in case of using such materials.

The ferruginous compounds are accumulated not only on the bottom of the draining pipes, but also in the combining parts of the pipes and in the orifices, fact that determines pulling out the entire drain. For preventing the clogging of the orifices it is recommended that the parts between drains and the orifices of the pipes should not have a diameter smaller than 1.5 mm.

The specialists do not share the same opinion concerning a rational construction of the filters in the presence of iron in the underground waters.

The researches made in Germany (KUNTZE, 1978), pointed out that using the glass cotton wool and different synthetic materials determines a greater clogging of the drains with ferruginous compounds. Instead of using such materials, it is recommended using the broken stones and the slag.

In Holland the specialists gave up almost completely at using the linen of glass and in Austria were found the fact that in the alluvial soils with great content of iron, the linen of glass is completely clogged with ferruginous compounds after a period of 4 years of exploitation.

RESULTS AND DISCUSSIONS

These measures of fighting against the accumulation of iron are reduced to the mechanical cleaning of the draining pipes through hydraulic washing and to the chemical cleaning of the drains through acidic washing. Hydraulic washing is the most well spread measure used and it is recommended being done annually or twice a year in order that ferruginous sediments should not solidify. For doing that we recommend pipe and sewer cleaning nozzle. The pipe cleaning nozzle is a specialized accessory used together with a pressure washer, designed for unclogging and maintaining sewer, drainage, or industrial piping systems. It converts the energy of pressurized water into strategically directed jets capable of removing stubborn deposits. Operating principle is based on converting water pressure (typically between 100–250 bar, depending on the equipment) into high-velocity jets:

- Front jet (0°) → breaks solid blockages (compacted mud, roots, ice)
- Rear jets (15°–45°) → create the pulling force that propels the nozzle inside the pipe, washes and dislodges deposits from the pipe walls

This mechanism eliminates the need for direct mechanical intervention in many cases. It may be used different types of nozzles and there are several design variants adapted to different types of deposits, standard (universal) nozzle for general maintenance and light deposits, rotary nozzle - jets rotate → uniform 360° cleaning even the stubborn deposits (grease, lime scale), root cutter nozzle equipped with a rotating head or chains that cuts roots infiltrated into pipes, penetrator nozzle powerful front jet for severe blockages, etc.

Main design features and characteristics includes precisely calibrated orifices typical number 3–8 rear jets optimized for hydraulic efficiency, spray angles rear: 15°–45°, front: 0° (direct), compact and aerodynamic geometry allows movement in narrow and curved pipes, hydrodynamic balance reduces vibrations and hose wear.

Nozzles are built for harsh environments stainless steel corrosion and abrasion resistance, heat-treated steel for heavy-duty applications, ceramic inserts (premium models) extend the lifespan of the orifices, resistance to chemicals, sand and abrasive particles. With an easy connection and compatibility, standard connector (1/4 inch quick connect) and other options (1/8", 3/8" for harder applications), compatible with most pressure washers and specialized sewer hoses (more flexible and durable)

It has to take into account important technical parameters because an unsuitable nozzle can reduce efficiency or even damage the system. The following parameters should be considered when selecting a nozzle: maximum pressure (bar), water flow rate, pipe diameter, orifice size (nozzle size), number and orientation of jets, etc.

Table 1.

Sewer cleaning nozzle application on hydraulic washing used in agriculture drainage system maintenance

Advantages	Limitations and Precautions
• Efficient cleaning without dismantling pipes • Access to hard-to-reach areas • Fast maintenance with reduced costs • Reduces the use of chemicals	• Requires appropriate pressure equipment • Risk of injury (very powerful jets) • Not ideal for very fragile or damaged pipes • May require experience for effective use

In U.S.A, also a chemical method is successfully used in order to clean the drains and it implies using a solution of bisulphate of sodium sulphate biocide. Chemical treatments may also be applied in some cases to inhibit oxidation or dissolve early-stage deposits, although these must be used cautiously due to environmental considerations. Periodic maintenance, such as flushing the system with high-pressure water or mechanical cleaning, can help remove accumulated sediments before they become problematic.

In conclusion, the integration of chemical, biological, and engineering knowledge has significantly improved the ability to prevent and manage clogging in drainage systems. By addressing the root causes of iron and manganese sediment formation, it is possible to extend the lifespan and efficiency of drainage infrastructure while reducing maintenance costs and environmental impact.

CONCLUSIONS

Summing up what was mentioned before, it must be pointed out the fact that the main prophylactic measures for fighting the clogging of drains with ferruginous sediments are:

- Introducing the lime in the ditches of the drains;
- Using inhibitors for protecting the drains;
- Executing the mouth of evacuation drowned;
- Increasing the slope of the draining pipes;
- Increasing the diameter of the draining pipes;
- Using adequate materials for drainage;
- Improving the quality of the construction works in the draining network.

The efficiency of applying these recommended measures for different types of soils is not sufficiently studied. Thus, using unique recommendations differentiated on the type of soil is not possible yet.

There are missing safe criteria in order to appreciate the degree of danger concerning the clogging of the drains with ferruginous compounds in different types of soils, criteria that should be used in researching and projecting the drainage systems.

All the determinations presented, represent just some researches regarding the studied process but is also required some future extensions researches in this domain.

Also, it is necessary a farther research for the next scientists generations regarding the exploitation measures, periodically cleaning measures of draining pipes in the exploitation period, permanently finding of new and modern technology including the machines and installations with superior working criteria confront the existing technology.

BIBLIOGRAPHY

DUMITRU M., BORZA I., SIMOTA C., TARAU D.,- Evaluarea impactului ecologic, Editura Eurobit, Timisoara 2008

HALBAC, -COTOARA, ZAMFIR R. - Studii de drenaj eficiente tehnico-economic pentru terenurile cu exces de umiditate, Editura Politehnica – Timişoara, 2010

HILER E.A. – Quantitative evaluation of drainage requirement of crops – A.S.A.E. Chicago 1971

KOROTKOV P.A. – Shema I constructia drenaja na orasaemih zemleah – Ghidrotehnika I melioratia – nr. 3. – 1971

KUNTZE H. – Materialoperzifisches Haften von Eisenocke, Z. Kulturtechnik, feuerberein nr. 6, 1988

LUTHER B, ARNOLD J – Restoring subsurface drain performance. Jurnal of the Irrigation and Drainage Division – U.S.A. – nr. 1 / 1972

MASLOV B.S. – Zakuporka drenajei ghidratom okisijeleza I meri borbisnei. Vodnoe hoziastvo nr. 3, 1975

MUNTEANU I., MUNTEANU RODICA – Monografie, Editura Mirton, Timisoara 2002

REEVE R.C, LUTHIN J.N., DONNAN W.W. – Drainage Investigation Methods – Drainage of agricultural lands A.S.A.E. – 1987

ROGOBETE G., - Stiinta solului, Editura Mirton, Timisoara 1993
SCHAFFER E., SCHMITZ R. – Richtlinie furdie Projektiererung den Bann und fur die Instandhaltang von Dransystemen auf verockerungsgefahrdeten Standarden , Berlin 1970
TARAU D., ROGOBETE G., GROZAV ADIA, DICU D., - Solurile din Sud Vestul Romaniei, Editura Eurobit, Timisoara 2018
TARAU D., ROGOBETE G., DICU D.D., NITA L.D. – Pamanturi si locuri dintre Dunare-Varful Gugu-Crisul Negru, Editura EUROBIT, 2019
*** Date tehnice oportunistice din arhivele OSPA Timis
*** Date tehnice oportunistice din arhivele ANIF RA, sucursala Timis