Studying waters of the Volgo-Don canal for the purpose of irrigation

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Abstract. The data on the quality of water for irrigation and measures to improve the uniformity of distribution of artificial rain along the water pipeline of the sprinkler in order to increase the quality of irrigation are given. It has been established that the uniformity of irrigation is affected by the quality of water, in particular the presence of small particles and impurities in it, which clog the sprinklers, leading to the cessation of water supply to the irrigated area. Plants do not get enough moisture, resulting in lower yields. Studies on the uniformity of the distribution of the rain layer when irrigating with the Don-K sprinkler showed that after the installation of a water purification system in front of the water pipeline input, a more uniform distribution of rain was observed along the water-conducting belt of the farm. The content of undissolved impurities decreased by a factor of 10, and the irrigation rate increased by 15%.

1. Introduction

The development of land reclamation in the Russian Federation contributes to the creation of new modernized domestic sprinkler equipment, with higher technical-operational, economic and environmental parameters, contributing to the realization of the fertility of the main wealth of our country - the land [1–4]. A prerequisite for the use of reclaimed land is not only obtaining high and sustainable crop yields, but also respect for the land as the main means of agricultural production. Significant areas of irrigated land are located in the steppe and dry steppe zones of Russia. The flow of irrigation water to the soil surface during sprinkling differ from the processes occurring in nature. With natural precipitation, the characteristics of rain (droplet size, intensity) are the same over the entire area of rain capture. Natural precipitation simultaneously covers large areas, while when sprinkling, the rain characteristics vary along the length of the machine, along the radius of the stream, in the overlap zone (that is, over the area covered by rain), sprinklers cover a small area [5–9].

Irrigation water can come from different sources and be of different quality. The quality of water from surface sources differs significantly in composition from water from artesian wells. Usually, natural water used for irrigation must undergo preliminary purification before being supplied for irrigation; otherwise, without preliminary water treatment, it may lead to breakdown of the irrigation equipment, disable valves, nozzles of the irrigation system, pumping equipment [10–12]. When irrigating large industrial areas, water from surface water bodies is mainly used, but it is considered the most polluted and must pass through mechanical filters [13–17].
It is necessary to select equipment for water purification during irrigation in accordance with the purposes of its use. In some cases, it is necessary to purify the water from bacteria, hardness salts, iron, that is, a deeper water treatment is needed, in others, it is enough to filter the water from solid particles.

The water potential of the Volgograd region is relatively large, including about 190 rivers of various sizes, lakes, ponds, reservoirs, which are sources of water for various purposes, including irrigation.

The purpose of our research is to analyze the quality of water used for irrigation and to develop measures to improve the uniformity of distribution of artificial rain along the water pipe of the sprinkler machine, in order to increase the quality of irrigation.

2. Materials and methods
During the research, the volume of irrigation water and atmospheric precipitation was determined in relation to the irrigated agricultural landscape, the dynamics of water quality in irrigation sources, as well as the possibility of dusting, salinization and other negative processes in the soil due to the input with irrigation water. The object of the research is the Don-K circular sprinkler. Water intake for irrigation of agricultural crops is carried out by a pumping station of the first rise from the Varvarov reservoir.

3. Results and discussions
When using water resources from surface sources, canals, reservoirs, where water quickly warms up in summer, creating conditions for the development of various bacteria, mucus, blue-green and other algae, which, having got into the distribution pipeline network, can disable irrigation equipment.

The water temperature in the reservoir increases during the irrigation period, which leads to a manifold increase in the phytoplankton concentration. According to the All-Russian Research Institute of Irrigated Agriculture, the species composition of microalgae showed an increase in their number, so the content of blue-green algae during the irrigation period increased 30 times, green algae - 10 times, diatoms - 40 times (Fig. 1) [8].

![Figure 1. Seasonal dynamics of phytoplankton of the Varvarov reservoir (biomass of algae, mg / dm³)](image)

Analysis of the quality of irrigation water at the Varvarov reservoir showed a decrease in the content of undissolved impurities by 90% on average (Figure 2).
Figure 2. Content of undissolved impurities in irrigation water from the «Varvarov» reservoir (%)

The sprinkler system consists of four main elements: a water source, a pumping station, a water supply pipeline and a sprinkler installation. Introducing a device for cleaning irrigation water into this scheme, as the fifth element

Studies on the operation of the Don-K sprinkler showed that the uniformity of irrigation is affected by the quality of water, and in particular the presence of small particles and impurities, which, getting into the water supply of the machine, clog the sprinklers, leading to the cessation of water supply to the irrigated area. Plants do not get enough moisture, resulting in lower yields.

Studies on the uniformity of the distribution of the rain layer during irrigation with the Don-K sprinkler showed that after three irrigations, the uniformity of precipitation distribution decreased due to clogging of the sprinklers, especially at the end of the machine pipeline, and after installation in front of the water supply pipeline of the water purification system (Figure 3) there was a uniform distribution of rain along the water-carrying belt of the farm, the irrigation rate increased by 15% (Figure 4).

Figure 3. Scheme of the main elements of sprinkler irrigation with a filter (1- water source; 2- suction pipeline; 3- pumping station; filter; 5-dirt receptacle; 6- sprinkler; 7 - suction valve)
The sprinkler operator has to clean the clogged nozzles. This operation is rather laborious. During operation, it is necessary to constantly monitor the operation of valves and control structures, the uniformity of the flow rates of all outlets. The installed filters of the head structures must be washed as they become dirty, by flushing the filter element itself with a small stream of water. After connecting the suction and discharge pipelines, the pump and the engine are prepared for start-up. Before the first watering, the unit is tested with water and the central rotary ring and pipes of the lower belt are washed with the end devices removed. To prevent the ingress of debris, the intake structure is equipped with a trash screen, which is usually cleaned manually. We recommend equipping the end sections of the irrigation pipeline with self-cleaning sedimentation tanks, which automatically flush the pipeline and remove accumulated sludge, as a result of which the uniformity of rain distribution will increase.

4. Conclusions
When preparing for irrigation, it is necessary to assess the quality of irrigation water and, if necessary, select the optimal options for bringing it to the required concentrations. Cleaning sprinklers is a rather laborious process, both in terms of labor resources and in time. The use of self-cleaning sedimentation tanks contributes to an increase in the quality of irrigation, a decrease in labor resources and, as a result, an increase in productivity.

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