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METHODS OF PURIFICATION OF DRINKING WATER WITH COAGULANTS

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ABSTRACT:
This article is mainly about the technology of treatment of source water (rivers, canals, basins) and wastewater from treatment plants.

Keywords: coagulation, water, purification

INTRODUCTION:

Demand for clean drinking water is growing worldwide as a result of global warming, environmental problems, and global population growth. This, in turn, creates the need for scientists to implement modern, affordable and, most importantly, environmentally friendly drinking water technologies to solve existing and potential problems. Today, most of the drinking and wastewater treatment plants in the country use the same, ie the following methods of treatment: coagulation (+ flocculation), sedimentation, filtration and disinfection. This is the most common scheme of wastewater and drinking water treatment used since the beginning of the twentieth century. The task of the water treatment process involves the removal of various mechanical impurities, colloids and organic matter from surface and groundwater. The method of water purification by coagulation helps to increase the efficiency of water purification. Coagulation provides better sedimentation of mixtures, thereby accelerating subsequent sedimentation and filtration. Coagulants are used to treat source water that contains contaminants in the form of finely dispersed suspensions and colloids. Coagulation with chemical reagents often uses reagents as hydrolysed salts formed from multiplied charged cations of weak bases and anions of strong acids. Coagulation (Coagulatio - coagulation, thickening, enlargement) is simply the addition of small particles to larger particles. Coagulation results in the accumulation of the smallest suspended solids and their deposition in the form of flocculent sediments.

Reagents used for coagulation are called coagulants. Aluminium sulphate and aluminium or iron salts such as ferrous sulphate or chloride are commonly used for coagulation.

The main feature of coagulants is that their particles have a positive charge. Dissolved and suspended mixtures are negatively charged. Therefore, as a result of the interaction of coagulants and suspensions, they stick to each other and form larger formations.

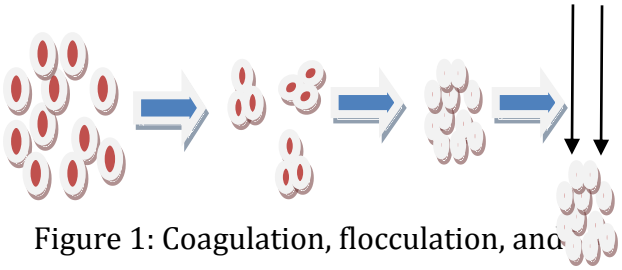

Figure 1: Coagulation, flocculation, and sedimentation1-Particles causing turbidity, 2-coagulation, 3- floccular formation, 4-sedimentation

Sometimes a flocculent is added after the coagulant. A flocculent is a polymer-based component that binds coagulated suspensions together. As a result, the removed mixtures

accumulate in large flocks (floccules), which are easier to filter or collect in the sediment. The larger and heavier the particle, the faster it settles or is stored in the filter material.

The following table shows how the settling time of pollutants in water depends on their volume.

Particle diameter	Contaminants in water	Drowning time in a layer of water 1 meter high
10 mm	Mud (small stone particles)	1 sek
1 mm	Sand	10 sek
0,1 mm	Fine sand	2 min

The coagulation time and the quality of the coagulant mix with water are also important in the coagulation process. The coagulant is added to the water, where it mixes quickly and circulates more throughout the system. After treatment with the reagent, the water can be delivered directly to the next purification stage according to the technology, for example:

- For mechanical filters (sand, gravel);
- The pit where the flocks sink to the bottom under the influence of gravity;
- To the flotation (wastewater treatment method), where the suspended mixtures are removed by foam flotation;
- For micro or ultrafiltration devices.

Coagulants are used to purify source water that contains contaminants in the form of finely dispersed suspensions and colloids. In the method of coagulation with chemical reagents, hydrolysable salts formed from multiplied charged cations of weak bases and anions of strong acids are often used as reagents.

What compounds are released when water is treated by the coagulation method?

The coagulation method effectively removes the following contaminants from the water:

- Dissolved natural organic substances and organic compounds, including
- Suspended particles, including inorganic substances (such as iron),

High organic content in water can lead to unpleasant tastes or odors or brown water. However, even if coagulation is stopped and some of the dissolved particles are removed, viruses and bacteria can remain in the water.

An international study published in 1998 showed that coagulation and sedimentation kill 27-84% of viruses and 32-87% of bacteria. But usually pathogenic microorganisms are removed from the water because the dissolved particles to which they are attached are removed from there. [1]

In the picture below, a coagulant is added to the water and the suspended substance sticks together and begins to sink.

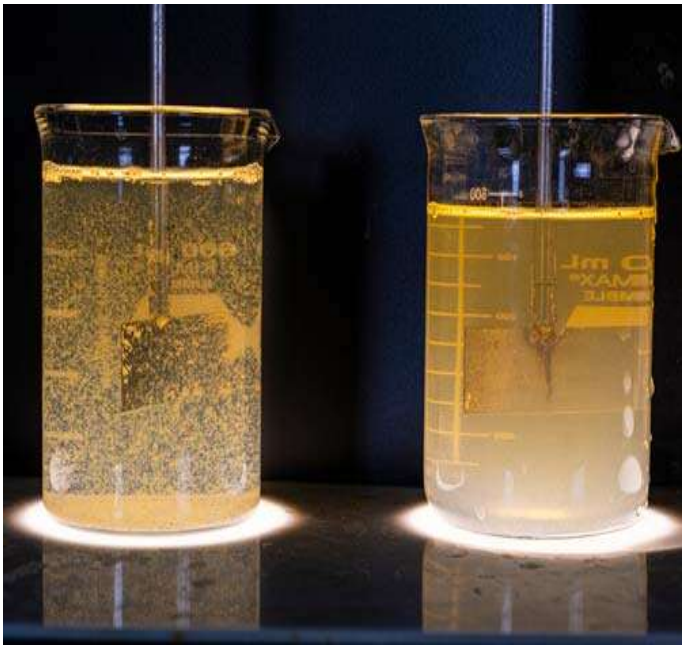

Figure 2: Results of laboratory testing of coagulant in water treatment plant

Although coagulation cannot capture all the smallest organisms and viruses, it is an

important primary cleaning element because it allows the removal of dissolved organic compounds by sedimentation, which makes subsequent disinfection difficult. In this case, after coagulation, a small amount of chlorine-containing substances are required to completely disinfect the water. [2,3].

This will reduce the cost of the process for water intake and treatment facilities as well as municipal wastewater treatment plants as less chlorine-containing components are used. In this case, the quality of the water will be higher because the amount of trihalomethanes formed as a by-product during the reaction of chlorine-containing compounds with organic compounds is reduced.Safety precautions should be taken to reduce the amount of harmful substances in clean water and not to overdose the disinfectant components, as additional compounds and by-products will be formed during the reaction. Their composition depends on the reagent used. [4,5]

Examples of coagulants and formed compounds:

Coagulant	Obtained elements
Ferrous sulfate	Sulfates, Fe
Iron chloride	Chlorides, Fe
Aluminum sulfate	Sulfates, Al

At present, almost all water intake and irrigation facilities and municipal sewage treatment plants in the country use aluminum sulfate as a coagulant. Dosage is usually calculated so that all impurities are released along with the sediment. [6]

However, it is assumed that purified water with the addition of aluminum-based coagulants may contain aluminum.

Thus, coagulants and flocculants are used to accelerate the precipitation and filtration processes.

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